4. *Supplier Documentation*

Description	Page Number
LED Edison Screw light bulbs	2 of 759
LV DC CFL Edison Screw Light bulbs	3 of 759
IP66 DC Bathroom light	4 of 759
FIAMM SMG/F Industrial Batteries	6 of 759
Lead Acid Battery - Material Safety Data Sheet	8 of 759
MainsPro Mains Decoupling Relay	12 of 759
MainsPro Mains Decoupling Relay installation and operation guide	14 of 759
Bilion BIPAC 7800GZ modem/router	56 of 759
Communication Topology Notes	59 of 759
Siemens Simatic Net Router	60 of 759
Data sheets SoLa BRISTOL Power cables	201 of 759
Data sheets SoLa BRISTOL Communication cables	202 of 759
Siemens Simeas P Power meter	203 of 759
Siemens Simeas P Power Meter manual	290 of 759
Siemens TM 1703 ACP data sheet	424 of 759
Sicam 1703 TM1703 emic system description	498 of 759
Xtender Four Quadrant Inverter	642 of 759
Studer 4Q Inverter User Manual	690 of 759
Technical Specification - Xtender Serial Protocal	714 of 759
Xcom-232i user manual	740 of 759

HORIZONSTAR Clean and Green Energy Solutions www.horizonstarenergy.com		1205, Silicon Tower 88 Larch Street, Kowloon, Hong Kong E: sales@horizonstarenergy.com T: +85227300518 F: +85223936055
	**E273X1PWW-L**	**Power consumption** – 3 Watt **Colour temp:** Warm white - 2800-3200K natural white - 4000-4500K pure white - 6000-6500K **Voltage :** AC/DC 12V/24V **Base:** E27/ E14 **Material:** Aluminum 6063 **CRI:** >70 **Luminous:** 200-250LM **Size:** Φ50*H100mm **Net weight:** 88g **Amp Draw**-12V- 300mA (+/- 10%) **Amp Draw**-24V- 150mA (+/- 10%)
	**E276X1PCW-L**	**Power consumption** – 6 Watt **Colour temp:** Warm white - 2800-3200K natural white - 4000-4500K pure white - 6000-6500K **Voltage :** AC/DC 12V/24V **Base:** E27/ E14 **Material:** Aluminum 6063 **CRI:** >70 **Luminous:** 500-550LM **Size:** Φ60*H110mm **Net weight:** 142g **Amp Draw-**12V- 580mA (+/- 10%) **Amp Draw-**24V- 300mA (+/- 10%)

Low Voltage CFL Light Bulbs

ES Screw fit (12v & 24v models)

These energy saving 12v & 24v DC CFL bulbs produce a high quality flicker-free light and are available in warm white or bright white colour temperatures.

Low voltage lighting is ideal for solar and wind powered systems. They can be used in a number of applications such as off-grid buildings, boats, caravans, vehicles and a wide variety of other remote lighting applications.

Product Features:

- New circuit design provides an extremely high number of switching cycles.
- Wide operational voltage range: 10.5v to 15v (12v) 21v to 29v (24v).
- Sophisticated pre-heat starting for long life.
- Reverse polarity & overcurrent protected.
- Manufactured in an ISO9001 facility.
- Approximate life 10,000 hrs.
- Bulb fitting : Edison Screw, ES/E27.
- Warm White : 2700k or Bright White : 6400k
- Certified to comply with CE and RoHS standards.

Specifications

Model	Rated Watts	Average Lumens (lm)	Length x Dia. (mm)
SDC-M 5W	5 W	250	112xØ44
SDC-M 7W	7 W	350	125xØ44
SDC-M 9W	9 W	510	135xØ44
SDC-M 11W	11 W	670	145xØ44
SDC-M 15W	15 W	1200	145xØ80

Available From:

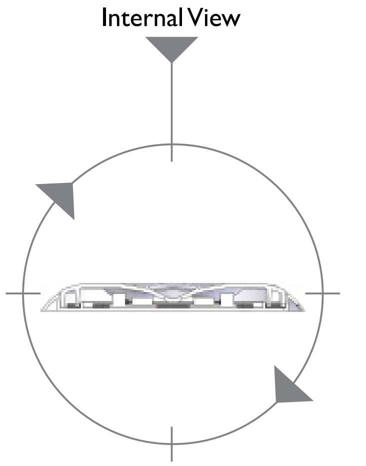
Energy Development Co-operative Limited

Solar Panels ● Wind Generators ● Charge Regulators ● Batteries ● Inverters ● Accessories

www.solar-wind.co.uk

MEGALUX (PD1)

- High output CREE LEDs
- Very low profile design
- 85% less energy than halogen
- 90 000 hours life
- Waterproof to IP66

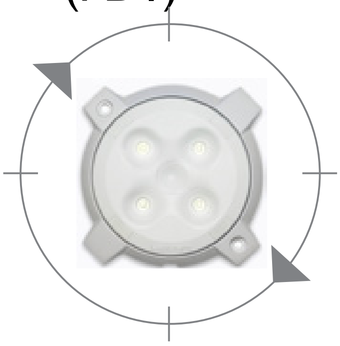


See technical specs overleaf >>>

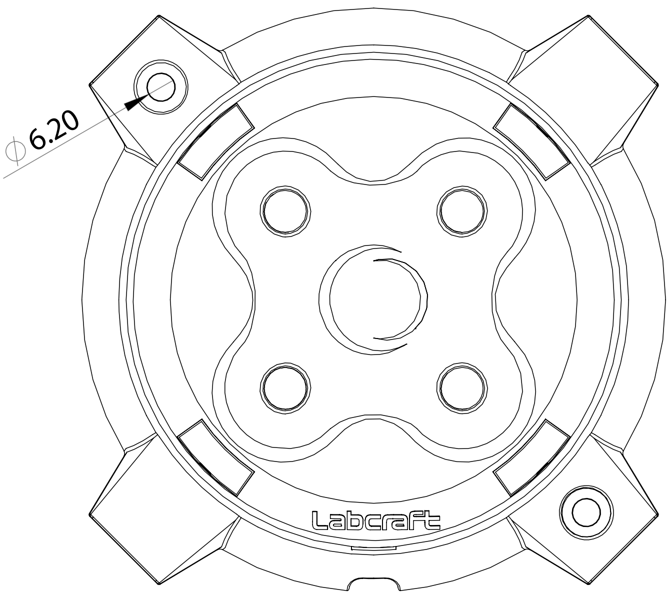
REV 0

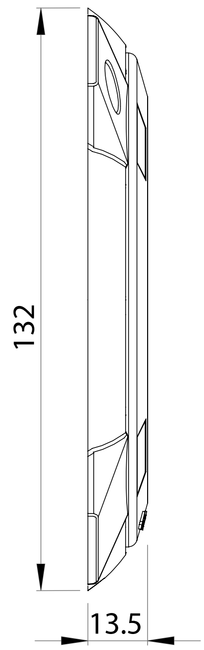
Made in the UK

MEGALUX (PD1)



- High output CREE LEDs - LED technology produces a clean white light and creates a safe working environment.
- Very low profile design - At just 14mm deep, this light can be fitted in a multitude of applications.
- 85% less energy than halogen - The Megalux uses only 10W of power to produce 850 lumens, providing a bright light for longer.
- 90 000 hours life - Designed to manage heat effectively and last more than 90 times longer than halogen bulbs, the Megalux saves money and improves safety.
- Waterproof to IP66 - The unit is completely sealed and protected, making it suitable for tough working conditions.





Specification

ALL DIMENSIONS HAVE A TOLERANCE OF +/-1mm

		PD1_4-1 MV	PD1_4-3 MV
Voltage Range	VDC	10-32V	10-32V
Average Current	A	0.42	0.84
Light Output	lm	488	850
LED Power	W	4 x 1.25W	4 X 2.5W
Weight	kg	0.15	0.15
Temp. Range	°C	-30 to +40	-30 to +40

MEGALUX (PD1)

REV 0

E & OE

FIAMM
Industrial Batteries

ENDURLITE

SMG/F

Applications and Key Benefits

- Designed for front terminal Telecom application ideal for:
  - off-grid and hybrid TLC installations
  - use in areas with unreliable power supply
  - front terminal compact battery layout
- Tubular positive plates
- Electrolyte immobilized in gel
- Excellent cycling performance, also at elevated temperature
- Deep discharge proof
- 15 years design life
- Front terminal design reduces installation time and facilitates maintenance
- For 23 inch power racks / cabinets
- Minimal gassing and fit for remote venting
- Non-spillable maintenance free without topping-up
- Non-hazardous for air/sea/rail/ road transportation
- 100% Recyclable

Applicable Standards

- DIN 43539T5 - deep discharge
- IEC 60896 Part 21 - VRLA methods of testing
- IEC 60896 Part 22 - VRLA requirements
- Eurobat “Long Life” - 12 years and longer

FIAMM Manufacturing

- ISO 9001 Quality Management System
- ISO 14001 Environmental Management System
- OHSAS 18001 - Workplace Safety & Health

Technical Features

- Tubular positive plates, pressure cast from high tin / low calcium alloy
- Electrolyte immobilized in gel structure
- Highly porous gauntlets retain the active material
- Pasted negative plates designed to have service lives consistent with the positive plates
- Separators with extremely high porosity and low internal resistance
- ABS IEC 707 FV0 and UL 94 V0 flame retardant plastics (LOI greater than 28%)
- Container and lid designed for unsurpassed mechanical strength made of thick walled plastics
- Threaded female M8 terminal posts guarantee highest conductivity, maximum torque retention and easy installation
- Front terminals for reduced headspace, higher energy density and compact battery layout
- High integrity post seal design to prevent electrolyte leakage and terminal corrosion
- Flame arrestors prevent sparks or flames from entering the battery
- Cells equipped with one-way safety valves that open at 5 PSI and close at 3 PSI to allow excess gas to escape when overcharging
- < 2% self-discharge per month at 20°C allows 6 months shelf life
- Supplied with rigid inter-cell connectors and connector cover
- Remote venting system available for applications which require limited gassing to be vented externally

ENDURLITE

SMG/F

FIAMM SMG/F range

BATTERY TYPE	NOMINAL VOLTAGE (V)	CAPACITY (AH) Ah at 20°C	SHORT CIRCUIT CURRENT (A)	INTERNAL RESISTANCE (mohm)	DIMENSIONS (mm)			WEIGHT (kg)	TERMINAL TYPE
		10 hrs to 1.80 VPC	IEC 60896-21	IEC 60896-21	Width	Length	Height		
12SMG100/F	12	100	1500	7.8	126	560	270	44	Female M8

Note: dimensions may have a natural tolerance of ± 2mm

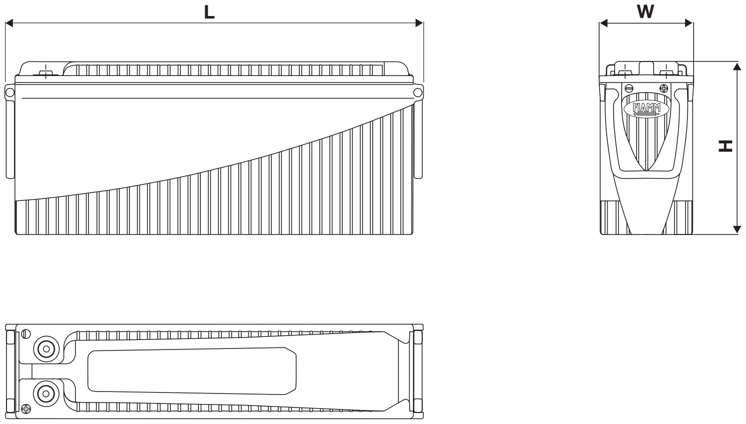
Discharge data at 20°C

BATTERY TYPE	NOMINAL CAPACITY 1.80 VPC 10 hours, 20°C	DISCHARGE TIME (hours) end voltage (V)									
		1 1.65 VPC		2 1.70 VPC		3 1.75 VPC		5 1.80 VPC		10 1.80 VPC	
		W/cell	A	W/cell	A	W/cell	A	W/cell	A	W/cell	A
12SMG100/F	100	111	61.4	65.7	35.7	47.2	25.3	31.2	16.5	19.1	10.0

Electrical Characteristics

- FLOAT VOLTAGE CHARGE AT 20°C: 13.5 V/bloc (2.25 V/cell)
- BOOST RECHARGE VOLTAGE: 14.1V/bloc (2.35V/cell) with maximum charge current: 0.25 x C_{10} (A)
- FLOAT VOLTAGE TEMPERATURE COMPENSATION: -2.5 mV/°C/cell

Dimensions



FIAMM S.p.A.
Industrial Batteries
www.fiamm.com
email:info.standby@fiamm.com

FIAMM
Industrial Batteries

Title : **LEAD ACID BATTERY**

1. PRODUCT AND COMPANY IDENTIFICATION

Product Name & Use: Lead acid battery for stationary applications, free electrolyte.

Company Identification:

FIAMM S.p.A.
Viale Europa, 63 I - 36075 Montecchio Maggiore (Vicenza)
Telephone (I)-0444-709311; Telex 480295 FIAMM Fax (I)-0444-699237

Production Plant:

FIAMM S.p.A.
Via Dovaro, 8 I - 36045 Almisano di Lonigo (Vicenza)
Telephone (I)-0444-725511 Fax (I)-0444-833996

2. COMPOSITION / INFORMATION ON INGREDIENTS

Component	% Weight	EINECS# - CAS#	Danger - Symbol	R/S Phrases	EU Limits
Metallic lead and lead compounds	60-70	Lead 231-100-4/7439-92-1 Lead Monoxide 215-267-0/1317-36-8	Toxic - T	R20/22 R33 R61 R62 R50/53 S53 S45 S60 S61	Lead in Air: 0,15 mg/m^3 Lead in Blood: 60 µg/dl (Italy) 70 µg/dl (EU)
Sulphuric Acid solution	20-30	231-639-5 7664-93-9	Corrosive - C	R35 S2 S26 S30 S45	
Thermoplastic Polymer	6-9				

3. HAZARDS IDENTIFICATION

Danger of Explosion
A mixture of explosive gases, containing hydrogen, can be produced inside the battery during charging. Naked flames, lit cigarettes, sparks or incandescent materials must be avoided in the immediate vicinity of the battery. Avoid short circuits between the terminals. Use antistatic materials when cleaning. Do not store the product in sealed container; maintain a fresh, well-ventilated environment protected from direct sunlight and away from heat sources.

Contact Danger
The dilute sulphuric acid solution, density 1.21 - 1.30 kg/l contained in the battery is corrosive and irritant to the eyes and skin.

Health Risks
Under normal conditions of use there is no danger, however, inside the battery are lead parts that could be harmful if ingested or breathed-in.

4. FIRST AID MEASURES

The first aid measures described below are concerned with sulphuric acid exposure; the other components are solid and do not present substantial risk under normal conditions of use.

a) inhalation
Inhalation is not considered to be likely for this product. Remove the patient from the contaminated zone, to an area of fresh air. In the case of breathing difficulties seek medical advice.

b) Skin contact
Wash the effected zone immediately with copious amounts of water. Remove contaminated clothing. If the irritation persists seek medical advice.

c) Eye Contact
Wash with copious amount of water, while keeping the eyelid open. Seek medical advice immediately

d) Swallowing
Rinse the mouth with water. Give water to drink. Do not induce vomiting. Seek medical advice immediately.

■ First aid resources for specific treatment to keep available: Eye wash bottles or emergency eye wash fountains, Shower.

5. FIRE FIGHTING MEASURES PREVENTION

The lead batteries are weakly combustible due to their construction that includes polymeric thermoplastic comprising 6-9% of the total weight. In instances of fire wear adequate means of respiratory protection.

a) APPROPRIATE EXTINGUISHING MEDIA.
Use dry powder, foam extinguisher, CO2.

b) INAPPROPRIATE EXTINGUISHING MEDIA
Water, which in contact with acid can develop heat.

6. ACCIDENTAL RELEASE MEASURES

a) Personal Precautions
In the case of electrolyte leak prevent contact with skin and eyes by wearing appropriate protective equipment. Rubber gloves, rubber boots, safety goggles/face shield and acid resistant clothing.

b) Environmental precautions
Keep the electrolyte and possible lead powder away from drains or surface water.

c) Procedure for containment and collection
Neutralise with Caustic Soda or Calcium Carbonate
Contain the spill with sand, earth or other absorbent material.
Do not use Water (sulphuric acid solution can react exothermically with water).

7. HANDLING AND STORAGE

Keep away from heat sources, sparks and open flames.
Do not store the product in sealed containers; maintain a in a well ventilated area away from direct sunlight and well away from sources of heat.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

With the exception of safety shoes, the other means of personal protection are all related to preventing contact with electrolyte. The solid components do not represent an appreciable risk factor (apart from voluntary or accidental ingestion of lead components).
Personal Protection:
Rubber gloves resistant to sulphuric acid. Safety Glasses (mask or visor), acid resistant clothing, rubber boots.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance: Solid state prismatic type

Electrolyte: Sulphuric Acid in aqueous Solution
Corrosive
Density 1.21 - 1.30 kg/l
Odourless
Non-flammable.

10. STABILITY AND REACTIVITY

The product is normally stable and inert.
A minute quantity of hydrogen and oxygen gas are produced when the units are left in a stable environment, avoid open flame sources and sparks in the proximity of the product.

11. TOXICOLOGICAL INFORMATION

Inapplicable to the finished product 'lead acid battery', applicable to its constituents:
Sulphuric Acid:
Acute toxicity data:

- LD50(oral, rat) 2140 mg/Kg
- LC50 (inhalation, rat) 510 mg/mc/2h

Acts intensely corrosive on skin and mucous membranes. The inhalation of mists may cause damage to the respiratory tract.
Lead and its inorganic compounds:
Exposure to lead and its compounds may cause damage to blood, nerves (central nervous system) and kidneys. Lead compounds are considered hazardous to reproduction (pregnant women should be protected from excessive exposure).

12. ECOLOGICAL INFORMATION

The electrolyte solution reacts with water and organic substances causing damage to flora and fauna. The Batteries also contain soluble components of lead than can be toxic to aquatic environments.

13. DISPOSAL CONSIDERATIONS

Lead batteries are classified "dangerous waste" and the user is obliged by law to arrange for their disposal or recycling. It is prohibited to abandon this type of refuse to the environment.
For additional information and to locate your nearest collection centre contact the local consortium for the disposal of used and scrap lead containing batteries. FIAMM Batteries are 100% recyclable.

14. TRANSPORT INFORMATION

Land Transport (ADR/RID, U.S. DOT)

UN N°:	UN2794
Classification ADR/RID:	Class 8
Proper Shipping Name:	BATTERIES, WET, FILLED WITH ACID electric storage
Packing Group ADR:	not assigned
Label required:	Corrosive

ADR/RID: New batteries are excepted from all ADR/RID (special provision 598 ADR).

Sea Transport (IMDG Code)

Classification:	Class 8
UN N°:	UN2794
Proper Shipping Name:	BATTERIES, WET, FILLED WITH ACID electric storage
Packing Group:	III
EmS-FIRE & SPILL:	F-A, S-B
Label required:	Corrosive

Air Transport (IATA-DGR)

Classification:	Class 8
UN N°:	UN2794
Proper Shipping Name:	BATTERIES, WET, FILLED WITH ACID electric storage
Packing Group:	n.a.
Label required:	Corrosive

15. REGULATORY INFORMATION

Symbols

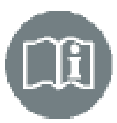
Explosive Gas

16. OTHER INFORMATION

R/S Phrases (indicative since this is not directly applicable to the product, but the electrolyte contained therein which represents the major risk of the product):

R35 Can produce severe chemical burns.
S2 Keep out of reach of Children.
S16 Keep away from sparks or naked flame - No smoking.
S26 In case of contact with eyes wash immediately with abundant quantity of water and seek medical advice.
S30 Do not put water on the product.
S45 In case of accident or if you feel unwell, seek medical advice immediately.

Read the instructions for use contained in the guarantee/warrantee certificate.



The information contained herein is accurate to the best of our knowledge as of the date of writing given above. The references refer only to the product indicated and do not constitute a guarantee of quality. The user is held responsible and must ensure the maintenance and completeness of such information with respect to the products specific final application.

MainsPro

ComAp

MAINS DECOUPLING RELAY

MEETS STANDARDS: G59 and the new G59/2 • IEC 60255

Are you generating power in parallel to the mains?

You will need 'loss of mains' protection.

Essential to avoid supplying your electricity into an islanded grid, leading to possible equipment damage or safety issues.

The solution is MainsPro, the new microprocessor based mains decoupling relay from ComAp, which offers unequalled mains protection for a wide range of mains connected applications. These include generator sets and renewable energy sources such as photovoltaic plants, wind turbine and other forms of micro cogeneration.

With MainsPro, no special knowledge is needed for installation and no additional units are required, making the ideal solution for both untrained personnel and professionals alike. The unit is designed to fully comply with Utilities' connexion requirements and statutory codes, offering a high level of protection and safety when working in parallel to the mains.

Reduces your costs for installation and commissioning workload expenses.

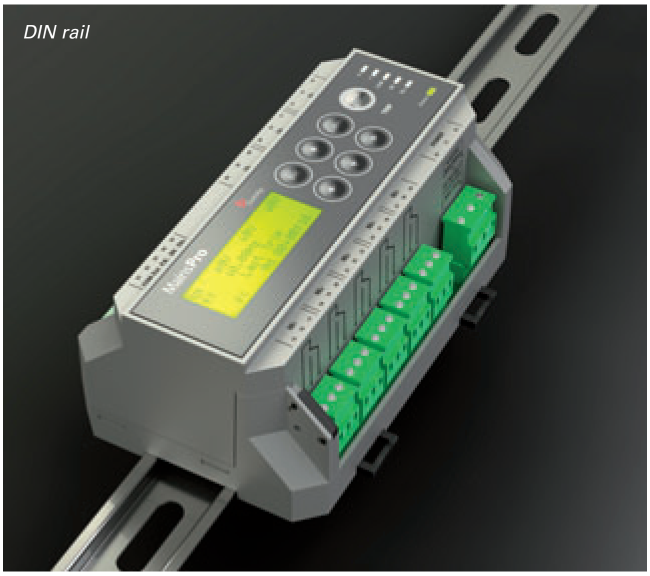
Efficient installation:

- Flexible supply voltage and measurement range
- Suitable for standard DIN rail installation or panel-mount (optional)
- Friendly interface with easy setting of values
- Compact design allows installation into restricted spaces
- Simple wiring with detachable connectors
- Increased efficiency of commissioning tests
- Integrated mechanical lock to secure your setting

ComAp is a member of AMPS (The Association of Manufacturers of Power generating Systems).

ComAp products meet the highest standards, with every stage of production undertaken in accordance with the ISO certification obtained in 1998.

ANSI	Protective functionality
27	Undervoltage
59	Overvoltage
81H	Overfrequency
81L	Underfrequency
78	Vector shift
81R	Rate of change of frequency + ROCOF filter
47	Voltage asymmetry
	Positive sequence undervoltage
	Negative sequence overvoltage
	Phase sequence supervision
	Binary switches: Ext. trip, Fault reset, Activate/ de-activate, Alternative parameters


DIN rail

Technical information:

- **True RMS** measurement for increased accuracy, reliable evaluation of failures
- **Vector Shift** and **Rate of change of frequency** (**ROCOF)** protections available in one unit to choose the best fit to secure your site
- Symmetrical components for better detection of **voltage asymmetry** failures
- **Two stage settings** of voltage and frequency protections to cover short term as well as long term disturbances with appropriate priority
- Free assignment of **5 relay outputs** allows wide range of signaling and trip methods
- **4 binary switches** to remotely change operation of the unit
- Adjustable time delay of **Automatic fault reset** to avoid necessity of on-site personnel
- **Universal power supply** 8-40 VDC, 85-265 VAC, 110-370 VDC
- Selectable voltage range 120/230/400 VAC with over-range to 156/290/520 VAC makes the unit **independent on application**
- Supports **3-phase and 1-phase** applications
- **Last trip recorded** in order to provide the evidence of cause of trip

Door mount

ComAp

MANUFACTURER:

ComAp, spol. s r. o.
Czech Republic
Phone: + 420 246 012 111
Fax: + 420 266 316 647
E-mail: info@comap.cz
www.comap.cz
www.comap.cz/protections

LOCAL DISTRIBUTOR / PARTNER:

www.comap.cz/distributors

Customer satisfaction is our mission. We continuously develop the best people to succeed in our mission.

Mains**Pro**

Mains Decoupling Protection Relay

Comprehensive Guide - rev. 2

SW version 1.0, September 2010

ComAp

Installation and Operation Guide
Application Guide
Reference Guide

Written by Tomas Jelen
Prague, Czech Republic

ComAp, spol. s r.o.
Kundratka 2359/17, 180 00 Praha 8, Czech Republic
Tel: +420 246 012 111, Fax: +420 246 316 647
E-mail: info@comap.cz, www.comap.cz

ISO 9001 CERTIFIED
ComAp, spol. s r.o. Quality Management

Purpose of the MainsPro manuals

Installation and Operation Guide

The Installation and Operation Guide serves for the personnel, providing installation of the MainsPro unit. It contains wiring and setting instructions, needed for service and commissioning of the unit. It also contains introduction of the user interface and necessary procedures to perform setting and operating of the unit. Though MainsPro is very simple and intuitive for the operating personnel, we recommend to keep one copy of this manual available permanently at the installation site, where MainsPro unit is installed, to facilitate the necessary service and operation tasks.

Application Guide

The Application Guide serves for the designers and engineers, who process the necessary documentation and implementation procedures on the installation site, where MainsPro is installed. It contains detailed description of MainsPro functionalities and practical application of MainsPro functionalities.

Reference Guide

The Reference Guide contains library of setpoints, inputs and outputs functionalities and technical data for the purpose of detailed technical information. This information is referenced in the Installation and Operation Guide and Application Guide.

MainsPro

Mains Decoupling Protection Relay

Installation and Operation Guide - rev. 2

SW version 1.0, September 2010

Installation and Operation Guide

Written by Tomas Jelen
Prague, Czech Republic

ComAp, spol. s r.o.
Kundratka 2359/17, 180 00 Praha 8, Czech Republic
Tel: +420 246 012 111, Fax: +420 246 316 647
E-mail: info@comap.cz, www.comap.cz

Table of contents

Table of contents 2
Introduction 3
Purpose of this manual 3
Conformity declaration 3
Warnings 3
Installation data 5
Dimensions 5
List of terminals 5
Wiring 6
“Wye” connection 6
“Delta” connection: 6
Connection with voltage transformers 7
Single-phase connection 7
Power supply 7
Relay outputs connection 8
Binary switches connection 9
Measurement range 9
User interface 10
Control and navigation Pushbuttons - basic operation 10
Setpoints change: 10
Reset trip counters 11
TEST mode activation 11
Factory default 11
Mechanical sealing 12
Signalization LEDs 12
Measurement screens 13
Alarm messages 15

Introduction

Congratulations to your purchase of ComAp MainsPro unit! MainsPro is a microprocessor-based protective relay, providing a comprehensive set of protective and supplementary functionalities. The basic protective functions are:

- Voltage
- Frequency
- Loss of mains

This covers the basic requirements for mains-decoupling (inter-tie, „G59/2“) protection, but allows also usage in many applications where benefits of the unit’s unique functionality is needed.

Purpose of this manual

The Installation and Operation Guide serves for the personnel, providing installation of the MainsPro unit. It contains wiring and setting instructions, needed for service and commissioning of the unit. It also contains introduction of the user interface and necessary procedures to perform setting and operating of the unit. Though MainsPro is very simple and intuitive for the operating personnel, we recommend keeping one copy of this manual available permanently at the installation site, where MainsPro unit is installed, to facilitate the necessary service and operation tasks.

Conformity declaration

Following described machine complies with the appropriate basic safety and health requirement of the EC Low Voltage Directive No: 73/23 / EEC and EC Electromagnetic Compatibility Directive 89/336 / EEC based on its design and type, as brought into circulation by us.

Warnings

Be aware that the relay outputs can change state during and after the unit setting (before the unit is used again ensure that the proper setting is done)!!!

Be aware that the devices connected to binary outputs of the unit may operate upon disconnection of power supply, measurement inputs and/or binary inputs!!!

If the device is used in other way then stated by the manufacturer, the protection provided by the device may be corupted.

!!! CAUTION !!!

Dangerous voltage

In no case touch the terminals of voltage measurement!

Adjust set points

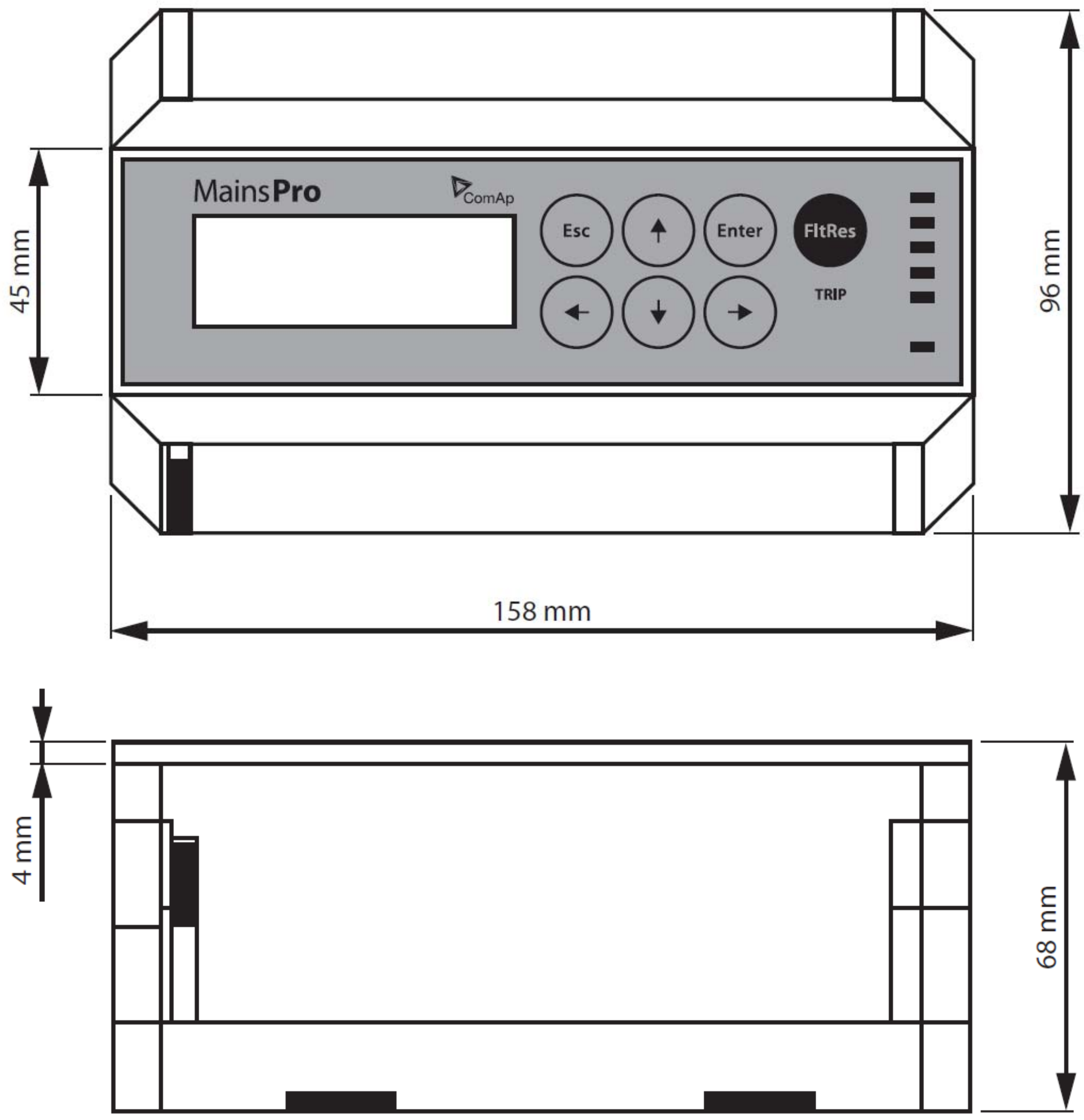
All setpoints are pre-adjusted to their typical values. Before putting into operation, the setpoints must be checked and/or adjusted to the required values.

Installation may be done by qualified personnel only.
To avoid personal injury do not perform any action not specified in this guide!!!

Note:
ComAp believes that all information provided herein is correct and reliable and reserves the right to update at any time. ComAp does not assume any responsibility for its use unless otherwise expressly undertaken.

Installation data

Dimensions



List of terminals

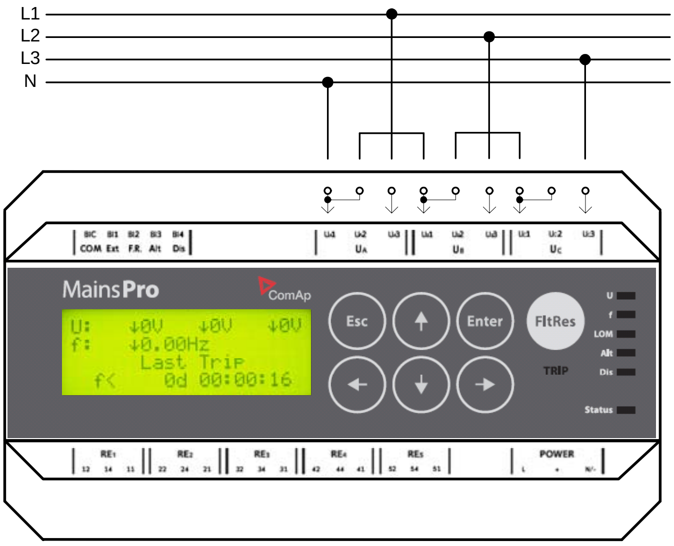
BIC	Binary switches – COM terminal
BI1	External trip binary switch
BI2	Remote Fault reset binary switch
BI3	Alternative settings binary switch
BI4	Disable binary switch
UA1 to 3	First set of voltage measurement terminals (Ua). Terminals UA1 and UA2 are internally interconnected

UB1 to 3	Second set of voltage measurement terminals (Ub). Terminals UB1 and UB2 are internally interconnected
UC1 to 3	Third set of voltage measurement terminals (Uc). Terminals UC1 and UC2 are internally interconnected
11, 21, 31, 41, 51	RE1-5 relay contact – common
12, 22, 32, 42, 52	RE1-5 relay contact – normally closed (during fault-free conditions maintained in open position)
14, 24, 34, 44, 54	RE1-5 relay contact – normally open (during fault-free conditions maintained in closed position)
L/+	Power supply – high range 85-265 VAC / 110 – 370 VDC.
+	Power supply – low range 8 – 40 VDC. Connect + pole to this terminal.
N/-	Common terminal for power supply. In case of DC supply, connect – pole to this terminal.

Wiring

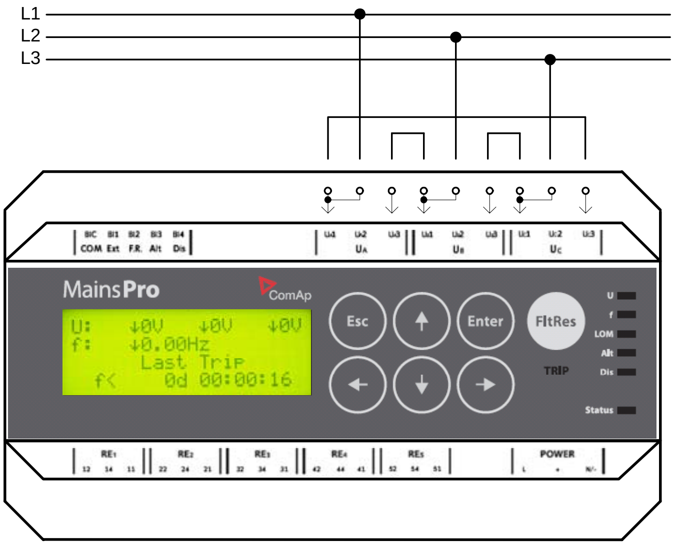
"Wye" connection

If used for rated voltage 230 VAC ph-ground, set the setpoint Basic: Uin is to **230/**400V, for systems with rated voltage 120VAC ph-ground, set the setpoint Basic: Uin is to **120V**. No additional setting is necessary for indication of "Wye" connection - MainsPro provides automatic detection of phase-ground voltage measurement. MainsPro provides over-range to 130% of the rated voltage, i.e. 300 VAC for 230 V system and 156 V for 120 V system with no change of measurement accuracy.



"Delta" connection:

In this arrangement, MainsPro is rated for 400 VAC ph-ph with over-range to 130% = 520 VAC with no change of measurement accuracy. Setpoint Basic: Uin is to be set to **230/400V**, no additional setting is necessary for indication of "Delta" connection. MainsPro provides automatic detection of phase-phase voltage measurement.

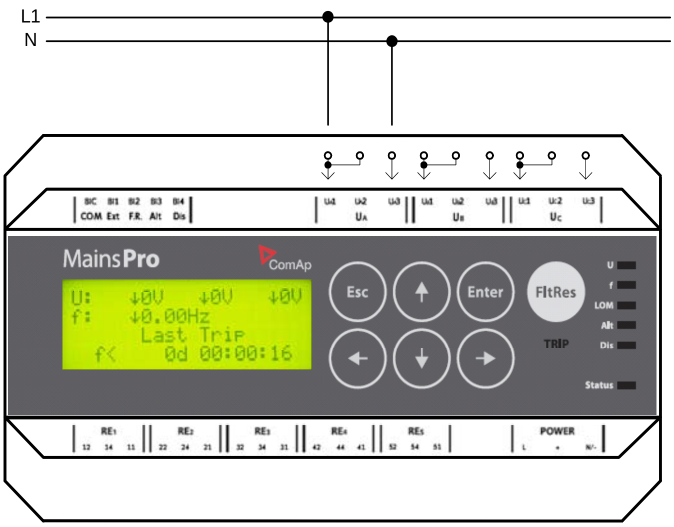


Connection with voltage transformers

MainsPro allows to connect HV or other measurement transformers with secondary rated voltage 100V. Provide the "Wye" or "Delta" arrangement on the primary windings of the transformers and connect the secondary 100 V to the MainsPro measurement inputs. Setpoint Basic: Uin is to be set to **120V**. This setting provides the guaranteed measurement accuracy for the 100V inputs with over-range to 120V * 130% = 156 VAC.

Single-phase connection

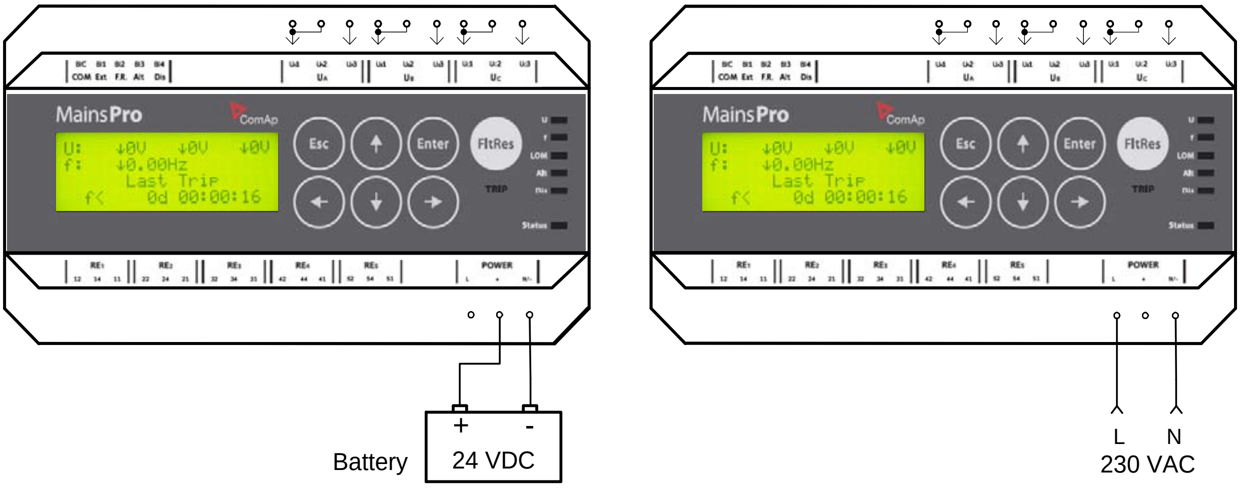
MainsPro provides support for single-phase applications. Use the U_A terminals to connect the measured voltage to the unit and set the setpoint Basic: System to **1ph**. Use the same setting of rated voltage selection as mentioned above.



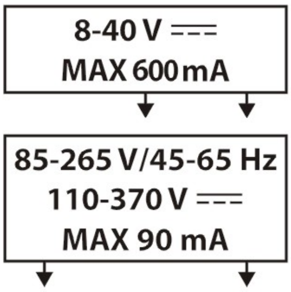
Power supply

MainsPro provides set of 3 terminals for the purpose of dual power supply range:

- 8 - 40 VDC: use the terminals + and N/-
- 85 - 265 VAC / 110-370 VDC: use the terminals L/+and N/-



For proper connection of the power supply, see also the printed sign on the MainsPro unit:



Requirements for power supply connections:
The unit is suitable for permanent connection to the power supply. The power supply circuits must have sufficient current withstand, corresponding to the appropriate power supply range and comply to the standards, relevant for the installation.

Requirements for power supply disconnecting device:
In case of power supply from AC voltage, the unit must be equipped by circuit breaker or contactor, marked as disconnecting device in accordnace with the EN 61010-1 standard.

Note:
The power supply circuit 8-40 VDC is internally interconnected with the supply circuit 85-265 VAC. In case of operation with both power supply terminals connected, keep in mind, that a failure of insulation in the AC power supply may cause propagation of AC voltage into the circuits of low safe DC voltage, due to galvanic interconnection of both circuits!

Relay outputs connection

For safety purposes, all MainsPro relay outputs use the inverse logic for failures trips and signaling. This means that in case of fault-free state all contacts are kept in energized position. In trip or out-of-range signaling state, the contacts de-energize. In case of power-supply fail, the unit automatically moves to fault-signaling by de-energizing the output relays, assuring safety disconnection of the controlled devices.
Relay outputs in MainsPro are freely assignable by the setpoints f(RE).

- In default configuration, RE1 serves as the permanently energized common trip output contact (ComTrpPer). Use this contact to operate the connector devices with permanently energized inputs.
- In default configuration, RE2 serves as an impulse common trip contact (Com Trp Imp). Use this contact to operate e.g. opening or UV coil of circuit breakers.
- Remaining 3 relay outputs serve for signaling of any sensed failure.

- The arrangement of RE1 to 4 outputs in default configuration corresponds to the functionality of the previous NPU-FUV unit outputs.

Binary switches connection

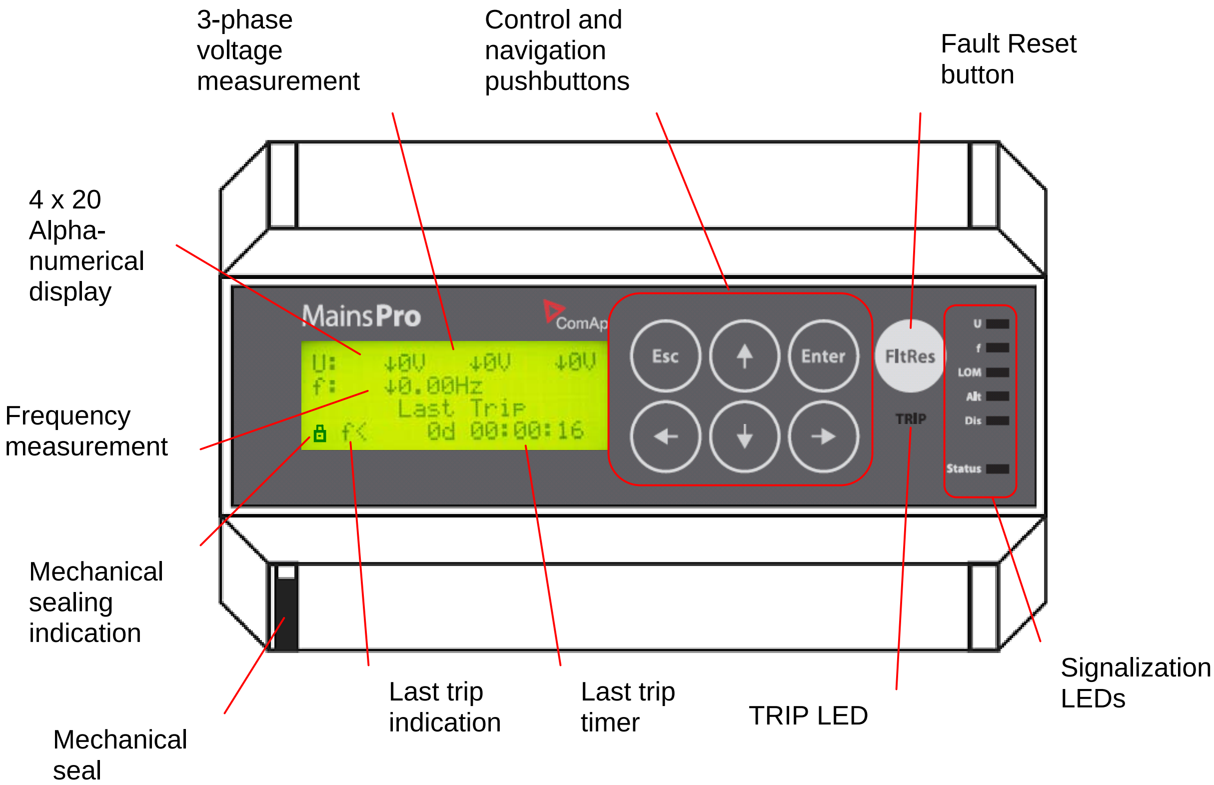
MainsPro provides 4 galvanically isolated binary switches with fixed functionality. These inputs allow connection of any voltage free contact between the common terminal BI0 and the appropriate functional contact.

Measurement range

MainsPro allows using multiple voltage ranges on the measurement inputs with unchanged measurement accuracy. The following ranges are applicable:

- 230 V - this range applies in case of "star" connection of the 3-phase system using nominal 230V phase to neutral. It may be also used for single-phase applications 230V phase to neutral. Overshoot by 30% up to 290V is possible for this measurement range. For this case, set the setpoint Basic: Uin to 230/400V. MainsPro will adjust automatically the measurement method, to assure the defined accuracy for the measured voltage 230 V.
- 400 V - this range applies in case of "delta" connection of the 3-phase system using nominal 400V phase to phase. Overshoot by 30% up to 520V is possible for this measurement range. For this case, set the setpoint Basic: Uin to 230/400V. MainsPro will adjust automatically the measurement method, to assure the defined accuracy for the measured voltage 400 V.
- 120 V - this range is applicable in countries using 120 V nominal voltage phase to neutral. Another application is for the high-voltage and other applications, using voltage transformers from rated voltage to 100 V. The guaranteed accuracy applies to both ranges 100 and 120 V. Overshoot by 30% up to 156V is possible for this measurement range. For this case, set the setpoint Basic: Uin to 120V.

User interface



Control and navigation Pushbuttons - basic operation

- In the measurement screens, use the and arrow buttons to browse through the measured values as displayed on the 4x20 alphanumerical display. See the chapter Measurement screens to get the basic orientation.
- To enter the setpoints menu, Push the button. For setpoints change, see the following chapter.
- To enter the init screen, perform factory default reset, reset statistics or enter the Test mode, push the and at the same time. Together with the init screen display, the nit performs lamp test by simultaneous cycling of all LEDs through all indication colors.
- For confirmation of any value change or query, use the button.
- For leaving any value change or query screen without change, use button.
- From any screen, press and fold the button for 2 seconds to return back to the main measurement screen (homepage).

Setpoints change:

1. Push the button to open the setpoints menu.
2. By buttons and browse through the menu. The setpoint groups are displayed in the cycling order, i.e. from the last setpoint group by button , the cursor moves to the first group and vice versa.

3. By button or , enter the setpoint group, by button , move one level up in the setpoint tree. The setpoints are displayed in the cycling order, i.e. from the last setpoint by button , the cursor moves to the first one and vice versa.
4. If standing on a setpoint, the setpoint change screen opens by pressing or . In the screen, see the setpoint limits at the lowest row of the screen.
5. The change is done by orders, starting form the least important digit. Use the buttons and to move between the digits. Use the buttons and to edit the digit. Please note, that the value is not limited by the parameters limits during editing, but if an out-of-limits value is set-up, it will not be allowed to store in the unit memory (the change may not be confirmed).
6. After the setpoint change is done, press to confirm the set value, or to leave the setpoint change screen without saving the changes.
7. **Please note**: the unit allows mechanical sealing of the setpoints by the black switch in left-bottom corner of the unit. If locked, the icon of closed padlock will appear on the position of setpoint change and the setpoints may not be changed. Also, the padlock icon will be seen on the “homepage” measurement screen. Once the setpoint change screen is entered and afterwards the sealing position is changed, the padlock indication is not changed, but the internal lock is applied immediately.

Reset trip counters

1. Enter the init screen, by pushing the and at the same time.
2. Press to enter the Clear Statistics dialog screen:

```
Clear statistics?

YES  →NO←
```

3. Using and do your selection. By selecting YES, all trip counters will be reset. Press to confirm your selection.
4. By selecting NO and pressing or by pressing , return to the measurement screens with no change.

TEST mode activation

1. Enter the init screen, by pushing the and at the same time.
2. Press and to enter the Test mode activation screen:

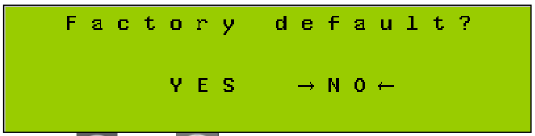
```
Test mode?

YES  →NO←
```

3. Using and do your selection. By selecting YES, you will activate the TEST mode - see the chapter TEST mode in Application Guide. Press to confirm your selection.
4. By selecting NO and pressing or by pressing , return to the measurement screens with no change.

Factory default

MainsPro contains a default set of all setpoints, which corresponds to the typical requirement of distribution network operator in some countries.

1. Enter the init screen, by pushing the and at the same time.
2. Press and to enter the Factory default activation screen:



3. Using and do your selection. By selecting YES, you will return all previously done setting to the default values. **Please note that by this selection, you will loose all setting done prior to this operation!** Press to confirm your selection.
4. By selecting NO and pressing or by pressing , return to the measurement screens with no change.

Mechanical sealing

MainsPro allows to mechanically prevent the setting changes by securing the mechanical seal in locked position by sealing wire. The locked position is indicated at the MainsPro side-print and on the alphanumerical display.

Signalization LEDs

- There are 7 LEDs for indication of MainsPro status with the meaning indicated in the table below:
- In case of signaling different statuses by one LED, the following priorities apply, i.e. the higher priority signal is provided by the LED:
    1. Red flashing
    2. Red
    3. Orange flashing
    4. Orange
    5. Green
- **Please note:** the U and f signalization is immediate at detection of fault conditions, regardless of the set delay for the unit trip. After the conditions get back to the fault-free state, the LEDs may move back to green color, regardless of whether the unit is currently in TRIP status.
- Indication of LED LOM is immediate at detection of the particular protection stage (Vector shift or ROCOF) and fault indication remains active for the period of time, set by the setpoint Basic: Imp Len Del.
- TRIP signalization is delayed according to the particular delay of the appropriate protective stage.

Meaning of signaling LEDs

LED	Color	Meaning
TRIP	Red	The unit has the appropriate outputs in TRIP position and the unit is sensing a fault situation
	Red flashing	The unit has the appropriate outputs in TRIP position, but the unit is sensing fault-free situation. Fault reset is possible.
	Nothing	The unit has no output in TRIP position
U	Red flashing	Voltage of any phase is above threshold for 1st or 2nd stage overvoltage
	Red	Voltage of any phase is under threshold for 1st or 2nd stage undervoltage
	Orange flashing	Voltage unbalance (amplitude) is indicated.
		If activated together with LED f and LOM, indicates incorrect phase rotation
	Orange	Negative sequence overvoltage or Positive sequence undervoltage is indicated.

Meaning of signaling LEDs		
LED	**Color**	**Meaning**
		If activated together with LED f and LOM, indicates incorrect polarity of one phase
	Green	All voltages are in fault-free state
	Nothing	Over/under voltage protections are not enabled by setpoint and no other voltage failure is sensed
f	Red flashing	Frequency as sensed on terminals Ua is above threshold for 1st or 2nd stage overfrequency
	Red	Frequency as sensed on terminals Ua is under threshold for 1st or 2nd stage underfrequency
	Orange flashing	Together with LED U and LOM, indicates incorrect phase rotation
	Orange	Together with LED U and LOM, indicates incorrect polarity of one phase
	Green	Frequency, rotation and phases polarity are in fault-free state
	Nothing	Over/under frequency is protections are not enabled by setpoint and no other indicated failure is sensed
LOM	Red	Vector shift or ROCOF protection was indicated and Fault reset was not yet done
	Orange flashing	Together with LED U and f, indicates incorrect phase rotation
	Orange	Together with LED U and f, indicates incorrect polarity of one phase
	Nothing	None of Vector shift or ROCOF failure is detected or neither Vector shift nor ROCOF protections are not enabled by setpoint and no other indicated failure is sensed
Status	Red flashing	Indication of severe internal failure. Contact ComAp technical support!
	Orange flashing	Indication of internal failure. Contact ComAp technical support!
	Orange	Indication of internal failure. Contact ComAp technical support!
	Green	The unit is in operation with no internal problems.
	Nothing	The unit is not in operation
Alt	Orange	The function Alternative setting is activated by means of binary switch Alt setting.
	Nothing	The function Alternative setting is not activated
Dis	Orange	The unit is disabled by means of binary switch Disable
	Nothing	The unit is not disabled by means of binary switch Disable

Measurement screens

Following are the examples of the measurement screens, showing values measured and evaluated by the unit:

Main measurement screen (homepage), 3-phase application:	- U: measured voltages on terminal sets Ua, Ub and Uc. If overvoltage or undervoltage is detected on a particular phase, arrow symbol is displayed left of the particular voltage value. - f: measured frequency on terminal set Ua. If overfrequency or underfrequency is detected, arrow

U: ↓0V ↓0V ↓0V f: 0.00Hz Last Trip --- ---d --:--:--	symbol is displayed left of the frequency value. - Last Trip: indication of the latest event, which caused trip by the MainsPro unit. See the following chapter for trip messages explanation.
Main measurement screen (homepage), 1-phase application (setpoint System set to 1ph): U: ↓0V f: 0.00Hz Last Trip --- ---d --:--:--	- U: measured voltage on terminal set Ua. If overvoltage or undervoltage is detected, arrow symbol is displayed left of the voltage value. - f: measured frequency on terminal set Ua. If overfrequency or underfrequency is detected, arrow symbol is displayed left of the frequency value. - Last trip: indication of the latest event, that caused trip by the MainsPro unit
Loss of mains (LOM) measurement screen: Max Vs 0.0° Act RCF 0.00Hz/s Max RCF 0.00Hz/s	- Max Vs: maximum value of measured Vector shift since unit power-up or since the last reset Vector shift trip. - Act RCF: actual measured value of ROCOF protection - Max RCF: maximum value of measured ROCOF protection since unit power-up or since the last reset ROCOF trip.
Voltage asymmetry measurement screen: V asymetry 0V V negative 0V V positive 0V	- V asymmetry: actual value of asymmetry of effective values measured on terminals Ua, Ub, Uc - V negative: actual value of negative sequence voltage - V positive: actual value of positive sequence voltage *Negative sequence overvoltage and positive sequence undervoltage are methods of evaluation of angle asymmetry of the 3-phase voltage system. See more in the chapter Voltage unballance and angle asymmetry*
Binary switches status screen: External trip 0 Fault reset I Alt settings (I) Disable 0	Status of the 4 MainsPro binary switches. If any of the switches is not enabled by the appropriate setpoint, its status is not internally processed and it is displayed in brackets on the display screen.
Relay outputs 1-4 status screen: RE1(CommTrpPer) 0 RE2(CommTrpImp) I RE3(CommSigImp) I RE4(CommSigDel) 0	Status of the first 4 MainsPro relay outputs. Name in parenthesis marks the function assigned by the setpoints in group f(RE).
Relay output 5 status screen: RE5(U Sig) 0	Status of the 5th MainsPro relay output. Name in parenthesis marks the function assigned by the setpoints in group f(RE).
Trip counters and indication screen: Last Trip : - TripCnt : 0 U : 0 LOM: 0 f : 0 Otr: 0	- Last Trip: indication of the latest event, which caused trip by the MainsPro unit. See the following chapter for trip messages explanation. - TripCnt: total counter of MainsPro trips since the MainsPro unit counters reset - U: counter of overvoltage and undervoltage -related trips - f: counter of overfrequency and underfrequency -related trips - LOM: counter of Loss-of-Mains - related trips (Vector shift and ROCOF) - Otr: counter of trips with other reason then the above mentioned: External trip, voltage asymmetry, phase sequence or inverse phase polarity

Time measurement screen:
`PowerUp Time`
`0d 00:00:00`
`Last Trip Time`
`---d --:--:--`
	- PowerUp Time: time from MainsPro unit power-up.
	- Last Trip Time: time from the latest trip by the MainsPro unit.
	Please note that the time information on the MainsPro unit is not measured by a calibrated RTC device and may serve for orientation purposes only. Find more in Technical data chapter.

Alarm messages

One of these indications appears on the homepage screen in case of the unit trip. It indicates the first protective stage, which issued the trip event:

f>	Overfrequency, 1st stage
f>>	Overfrequency, 2nd stage
f<	Underfrequency, 1st stage
f<<	Underfrequency, 2nd stage
U>	Overvoltage, 1st stage
U>>	Overvoltage, 2nd stage
U<	Undervoltage, 1st stage
U<<	Undervoltage, 2nd stage
Vs	Vector shift
RCF	ROCOF
Vunb	Voltage (amplitude) unbalance
Vneg	Negative sequence overvoltage
Vpos	Positive sequence undervoltage
Rot	Wrong phase rotation
Pol	Wrong polarity of one phase
Ext	External trip

MainsPro

Mains Decoupling Protection Relay

Application Guide - rev. 2

SW version 1.0, September 2010

Application Guide

Written by Tomas Jelen
Prague, Czech Republic

ComAp, spol. s r.o.
Kundratka 2359/17, 180 00 Praha 8, Czech Republic
Tel: +420 246 012 111, Fax: +420 246 316 647
E-mail: info@comap.cz, www.comap.cz

ISO 9001 CERTIFIED Quality Management ComAp, spol. s r. o.

Table of contents

Table of contents 2
Purpose of this manual 3
MainsPro typical usage 3
Typical applications of MainsPro protection relay 3
Important Steps of MainsPro utilization 4
TRIP and Fault Reset description 4
TRIP and Fault Reset description 5
TRIP 5
Fault reset 5
Protective features 5
59 Overvoltage, 27 Undervoltage 5
81H Overfrequency, 81L Underfrequency 6
47 Voltage unbalance and angle asymmetry 6
78 Vector shift 7
81R Rate Of Change Of Frequency (ROCOF) 8
Phase rotation, incorrect phase polarity 8
Application tips 8
Auto Fault reset 8
Binary switches application 9
Counters 9
Timer 10
TEST mode 10

Purpose of this manual

The Application Guide serves for the designers and engineers, who process the necessary documentation and implementation procedures on the installation site, where MainsPro is installed. It contains detailed description of MainsPro functionalities and practical application of MainsPro functionalities.

MainsPro typical usage

MainsPro is a mains protective relay protecting operation of parallel-to mains generators or other electrical resources of distributed generation of electricity. The main purpose is to prevent unwanted interaction between the generator and mains in case of its abnormal state (e.g. mains failure):

- Specific situations may occur, causing e.g. the utility network to momentarily disconnect part of the network and connect it back by automatic-recloser. During this fault-clearing period, the generators may move away from synchronism and their eventual re-connection may cause severe damage to the property of the generator operator, or to the utility equipment.
- The sole operation of a generator into an unintentionally islanded part of electricity network provides potentially dangerous situation. The load of the area may exceed the generator capacity and cause instability of the voltage, delivered to the consumers connected in the islanded area.
- Severe hazards may occur to the working personnel on the grid equipment in the area, where the mains is presumed as failed, but there are still generators delivering power into this area without central control of their operation.

These are some of the situations, leading the utilities to strictly require that any parallel connection to the mains is approved and protection devices with required protective features are installed.

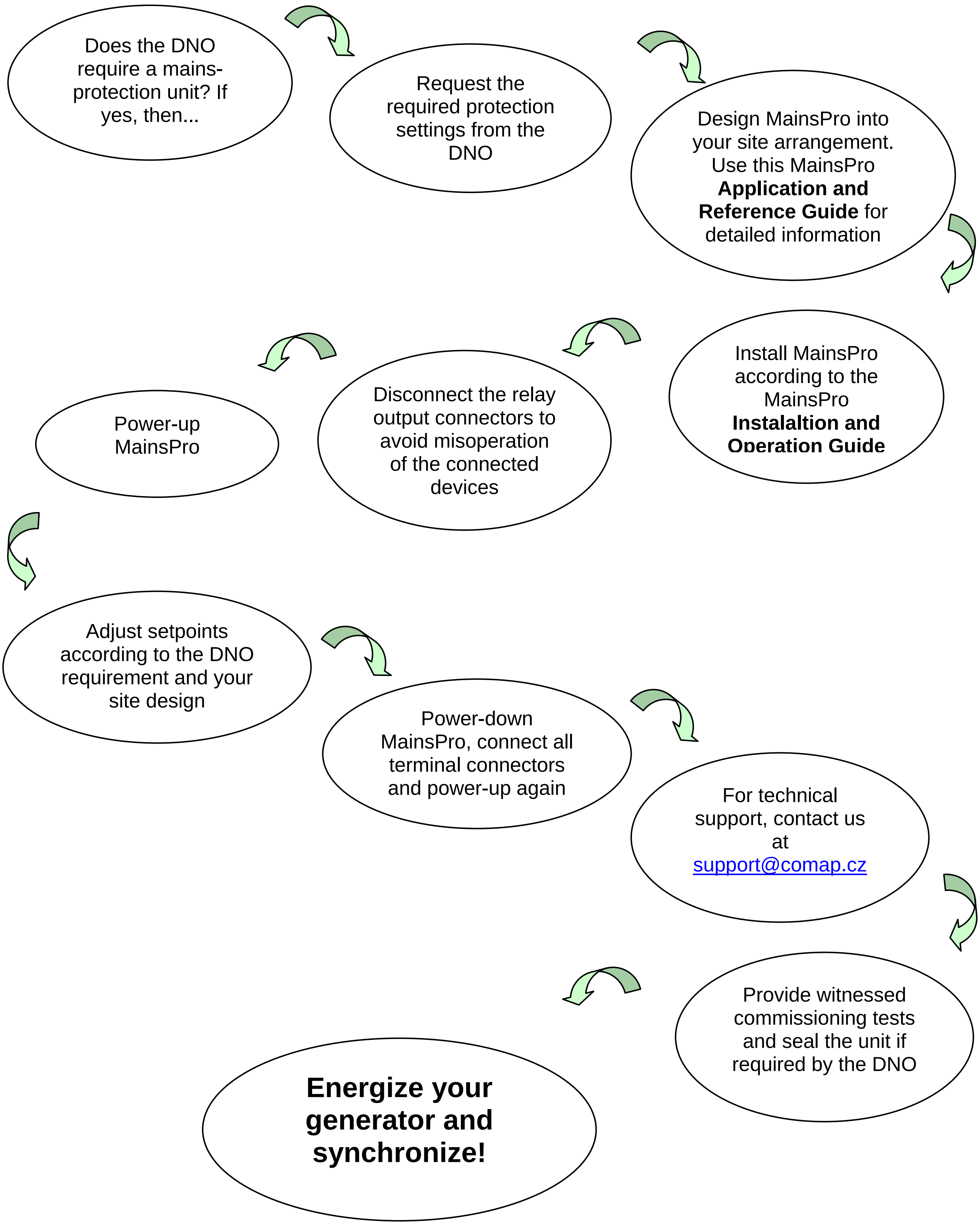
Typical applications of MainsPro protection relay

These are installations of any sources of electrical energy. For example:

- Cogeneration
- Peak-lopping power stations
- Stand-by generators with soft return/short-time parallel operation with mains
- Microturbines
- Small hydro power-plant
- Photovoltaic power plant
- Windmills

Important Steps of MainsPro utilization

This process describes a typical decisions and technical steps to follow in case of MainsPro utilization, if required by the distribution network operator (DNO).



TRIP and Fault Reset description

TRIP

TRIP may be considered as event or status of the unit:

TRIP event:

- Starts in the moment of terminating the count-down of any protective function with delay, or in the moment of activation of any immediate protective function.
- As a result of the trip event, are e.g. the following consequences:
  - Immediate deactivation of outputs CommTrpPer and CommTrpImp
  - LED TRIP goes to red
  - The appropriate counter in the statistics screen increments
  - The Last Trip Time timer starts to count time and the last trip indication is set

TRIP status:

- Starts at the moment of TRIP event
- During this status, the CommTrpPer output keeps in the fault position
- During this status, it is not possible to perform Fault reset
- TRIP status is active until a successful Fault reset. This may not be done before all measured and evaluated values are within preset limits.
- If during the TRIP status, caused by some value, another value overreached its limits for TRIP evaluation, this second overreach is not considered as TRIP. It does not cause a second TRIP event. However, as a consequence of this, the TRIP duration may be prolonged until the moment when both (all) values are within limits.

Fault reset

Fault reset is an event, caused by either of the following reasons:

- FltRes button is pressed
- Binary switch Fault reset is activated
- Automatic fault reset timer set by setpoint Basic: Auto FR Del, has count down. The counter is started in the moment when all evaluated values are back within their limits. If during the count-down another fault status appears, the timer is reset and started no sooner than after all evaluated values are back within limits again.
- By activation and following deactivation of binary switch Disable.

The abovementioned reasons are a trigger to provide Fault reset, however, it is successfully done only in case that the TRIP status is activated and all evaluated values have returned back into limits. If the TRIP status is not activated, or it is activated, but any of the values is still out of limits, Fault reset is not done and any of the mentioned triggers is forgotten. I.e., the unit may not be „provisionally“ fault-reset.
By a successful Fault reset, the TRIP status is terminated.

Protective features

The following protective functionalities, referred also by their ANSI number, are available in MainsPro unit:

59 Overvoltage, 27 Undervoltage

The RMS value of measured voltage is compared with the preset limit of overvoltage or undervoltage. When any of the preset limits is over/underreached, the appropriate LED signal is issued by LED U and the output U Sig moves to fault-indicating position immediately. If voltage of in the given phase keeps out of limits for the delay of the appropriate stage, TRIP is issued. As the voltage returns back within limits in all measured phases, the LED and U Sig output stop to signal the fault state immediately, regardless of whether TRIP was issued or not or Fault reset was performed or not.
Both overvoltage and undervoltage protective stages provide possibility of setting 2 levels with independent delay assigned to each level.

81H Overfrequency, 81L Underfrequency

The frequency value measured on phase L1 is compared with the preset limit of overfrequency or underfrequency. When any of the preset limits is over/underreached, the appropriate LED signal is issued by LED f and the output f Sig moves to fault-indicating position immediately. If the frequency keeps out of limits for the delay of the appropriate stage, TRIP is issued. As the frequency returns back within limits, the LED and f Sig output stop to signal the fault state immediately, regardless of whether TRIP was issued or not or Fault reset was performed or not.
Both overfrequency and underfrequency protective stages provide possibility of setting 2 levels with independent delay assigned to each level.

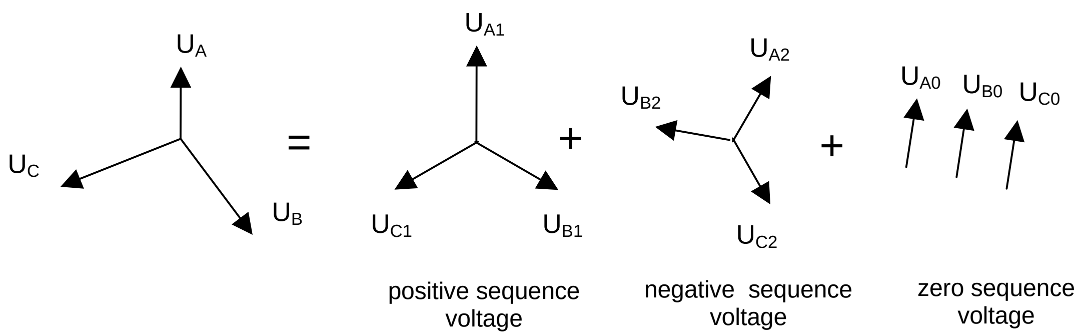
47 Voltage unbalance and angle asymmetry

MainsPro provides 3 independent methods for evaluation of voltage symmetry failures. All of these protections are only active in case that 3-phase system is selected by the setpoint Basic: System.

Voltage unbalance
In further text, this term refers to the state, when amplitude difference between any 2 phases overreaches the preset limit dU: V unb. I.e., it refers to the amplitude unbalance of the measured voltage.

Positive sequence undervoltage, Negative sequence overvoltage
These two methods provide very good sensitivity also to angle asymmetry of the measured voltages. The evaluation is based on the mathematical principle of evaluation of the symmetrical components of measured voltage. Any 3-phase system in any asymmetrical arrangement may be decomposed to 3 perfectly symmetrical components:

- positive sequence - system of 3 phases with 120° phase-shift between the system vectors and the same phase-order as the original system.
- negative sequence - system of 3 phases with 120° phase-shift between the system vectors and opposite phase-order as the original system.
- zero sequence - system of 3 conphase vectors (with 0° phase-shift between the phases).



Picture 2: decomposition of a generic 3-phase voltage to symmetrical components

MainsPro provides positive and negative sequence voltage evaluation and compares the measured values with V> neg and V< pos thresholds. In the perfectly symmetrical arrangement, negative sequence voltage is zero and positive sequence voltage equals to the measured voltage. If the asymmetry situation occurs, non-zero negative sequence voltage is calculated and positive sequence voltage drops. When any of the preset limits is over/underreached, the appropriate LED signal is issued by LED U and the output dU Sig moves to fault-indicating position immediately. If the calculated values keep out of limits for the delay dU del, TRIP is issued. As the calculated values of voltage asymmetry return back within limits, the LED and dU Sig output stop to signal the fault state immediately, regardless of whether TRIP was issued or not or Fault reset was performed or not.
Some utilities strictly require in their regulations that symmetrical components are evaluated in the mains-decupling relay and appropriate trip is provided. However, the method may also be used in the areas, where no such requirement is in place, to minimize non-detection zones of detection of 1-phase mains failures. In case that the generator, connected to the mains is operated close to equity-state, i.e. power delivered to the mains is close to zero, it may be difficult to sense loss of one phase further in

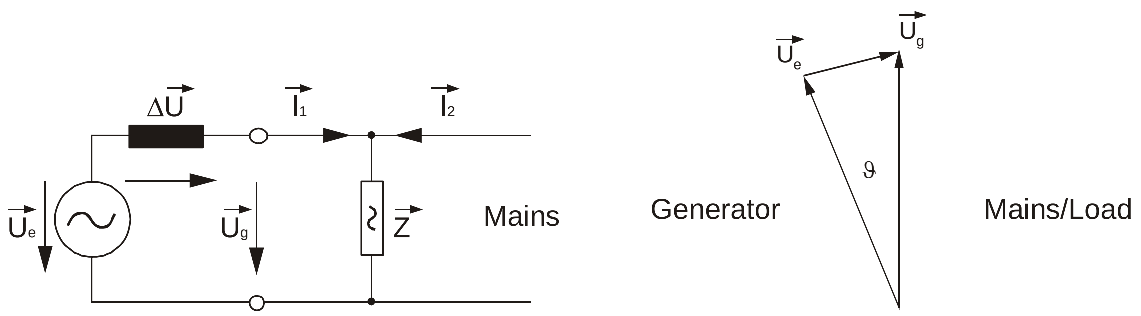
the system. The only change seen in such situation may be movement of the failed phase by a certain angle with small or no voltage drop in the absolute values. This may not be detected by undervoltage or unbalance protection stage. Symmetrical components provide very good and sensitive method to detect such a situation and trip the generator in case of this situation.
Typical setting of the V< pos vary from 0,65 to 0,85 of the rate voltage value. The exact values are delivered by the mains operator or may be set-up during commissioning after experimental verification of the protection stage sensitivity to the single-phase failures in equity state of the generator (e.g. by opening one fuse on the mains transformer).

78 Vector shift

The vector shift is one of the fast "Loss of Mains" protection stages. The principle is based on the fact that if a generator works into an islanded area of the electricity network, its voltage and frequency depend strongly on the load size, remaining in the islanded area. Decrease of the generator speed due to overload may not be fast enough to assure e.g. trip by underfrequency stage. The mains may be equipped with auto-reclosing mechanisms and in case that the generator is not disconnected within the auto-reclosing delay, the area may be reconnected back to the grid by this mechanism. This reconnection may meet the generator in asynchronous state, imposing severe risk of damage to the generator, its feeder equipment as well as equipment of the mains operator. Vector shift provides fast protective function for this situation.

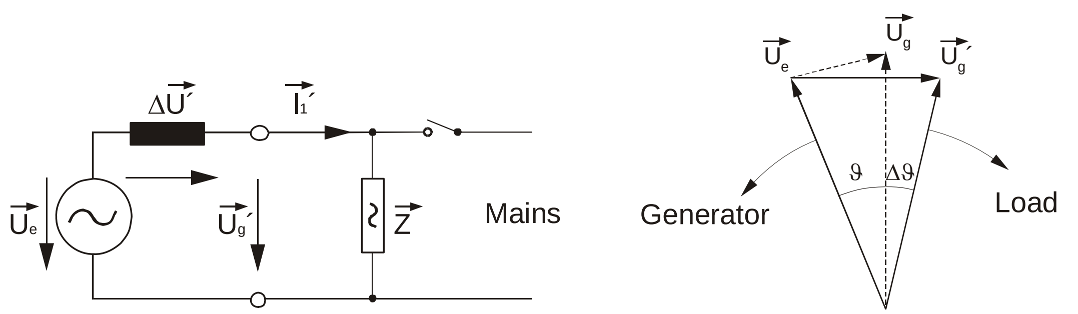
Measuring principle

When synchronous alternator is loaded, the rotor displacement angle ϑ is build between the terminal voltage (mains voltage) $\vec{\mathbf{U}}$g and the synchronous electromotive force $\vec{\mathbf{U}}$e. Therefore a voltage difference Δ**U** is built between $\vec{\mathbf{U}}$e and $\vec{\mathbf{U}}$g. The rotor displacement angle ϑ between stator and rotor is depending on mechanical moving torque of the generator shaft. The mechanical shaft power is balanced with the electrical feeder mains power and therefore the synchronous speed keeps constant.



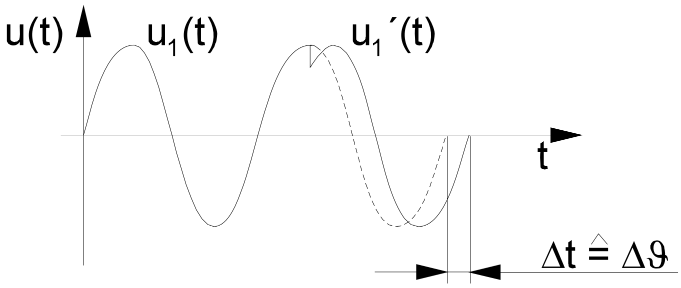
In parallel with the mains

In case of mains failure or auto reclosing the generator suddenly feeds a very high consumer load. The rotor displacement angle is decreased repeatedly and the voltage vector $\vec{\mathbf{U}}$g changes its direction to $\vec{\mathbf{U}}$g’.



At mains failure

As shown in the timing diagram the voltage jumps to another value and the phase position changes. This procedure is called phase or vector surge. MainsPro continuously measures the cycles, starting each zero up ward slope. The time cycle is internally compared to the reference time. In case of vector surge the zero up ward is delayed and the device trips instantaneously. The trip angle $\Delta\vartheta$ and consequently the sensitivity of the vector surge detection is adjustable by the setpoint LOM: Vs lim.



Proper setting of Vector shift limit has to be examined at the field tests, especially at very low setting of the protection limit (under 3°). Vector shift is very fast method and may be sensitive to disturbances, naturally present in the electricity grid.
Note:
Due to high sensitivity, Vector shift protection is not evaluated in the transient states, e.g. when Alt settings functionality is turned on or off, fault reset is performed or Vector shift limit is being set. Functionality is blocked in the sine wave period, when such an event occurs.

81R Rate Of Change Of Frequency (ROCOF)

ROCOF is another fast "Loss of Mains" protection stages provided in MainsPro. It is based on the similar principle as Vector shift, i.e. dependence of the generator speed and voltage on the load size. The variations of frequency delivered by the gen-set depend on the load fluctuations and speed of the compensated fuel inlet. In case of operation in parallel with large network, these changes are absorbed in the network and frequency is stable. When the connected area disconnects from the mains into island operation, the frequency becomes instable. MainsPro ROCOF stage provides fast evaluation of the frequency instability and TRIPS immediately in case of fast frequency changes. The threshold is set by the setpoint LOM: ROCOF. As the ROCOF stage provides very sensitive protection, software filter may be set using the LOM: ROCOF filt setpoint. By appropriate setting of those two setpoints, perfect ratio between sensitivity and speed of reaction of ROCOF protection may be established at the field tests.

Phase rotation, incorrect phase polarity

MainsPro provides check of the phase sequence and polarity. The correct connection is indicated in the wiring instructions e.g. on MainsPro box or in Wiring chapter, where clockwise rotation system is expected on the mains side. It may happen, that e.g. by redesign in the mains or generator site installation, the phase rotation changes. MainsPro ensures in such case, that this state is indicated and it prevents incorrect closing of the circuit breaker by its standard protective functionality. To allow phase sequence or incorrect phase polarity check, the phase angle between the 3 voltage vectors is expected in range 120° +/- 30°. If wrong phase arrangement is detected, TRIP is issued and the appropriate LED signalization is given. The reconnection of measurement terminals is necessary to ensure further proper functionality of the unit.

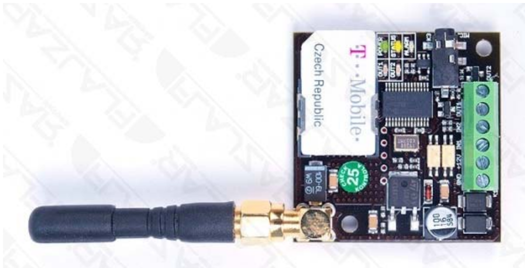
Application tips

Auto Fault reset

Appropriate setting of automatic fault reset by setpoint Basic: Auto FR Del timer allows setting the waiting time reserved for mains parameters to settle in their fault-free conditions after a TRIP. This state is indicated by flashing red signal of the TRIP LED. If during this time any measured value reaches out of the preset limits, MainsPro terminates the automatic fault reset count-down and goes back into fault indication state. The automatic fault reset is reset and started again in the moment when all measured values are back in limits again. After automatic fault reset is count down to zero, the unit performs automatic fault reset and terminates the TRIP status.

Binary switches application

MainsPro allows basic remote operation by means of binary signals wired from an external logic to MainsPro binary switches. The signals may be also provided remotely, e.g. through radio or GSM communicator devices. As an example for the many similar devices on the market, see the uGATE communicator below. Ask for more information about this product at protections@comap.cz.



This way, MainsPro functionality may be simply controlled by a mobile telephone commands. All four binary switches may be enabled or disabled by the appropriate setpoints in the group Basic.

External trip

- In case that a specific protective function is requested and this function is not supported in MainsPro, it may be provided in an external device. Wire the output of this device to Ext binary switch to allow tripping by this external device.
- Use the External trip also for forced disconnection of the generator if such command is for example evaluated in a superior system or transmitted through remote communication device.
- External trip functionality may be also used for intertripping method of protection system topology. This method is required by the mains operator for bigger generators.

Fault reset

- Use this switch in case that complex conditions are to be evaluated before the generator is connected back to mains. These conditions may be processed in an external system and the result may be sent to this switch.
- External fault reset may be also provided in case that locked button is used for performing the fault reset operation by authorized personnel only. In this case, MainsPro is to be secured inside of the locked switchboard and external fault reset only made possible.
- Remote fault reset via GSM communicator may also be a useful feature for the remote sites.

Alternative settings

- Alt settings binary switch may be used in case that a specific setting of the protection relay is required by the mains operator when exceptional conditions occur. After deactivation, the unit immediately switches to the default groups of setpoints.

Disable

- The Disable switch may be used for blocking the MainsPro protective functions, e.g. in case that the generator is not running in parallel operation with mains, or any other blocking conditions are fulfilled.

Counters

Keeping a track of the most frequent trips may provide valuable information for the generator as well as distribution network operator. Use the counters indication on the MainsPro screen for keeping track of the most frequent failures detected in the point of your connection. For example, in case that the MainsPro counters show significantly higher rate of a certain failure types (e.g. overvoltage or Vector shift), it may be a good signal to perform a detailed evaluation of the voltage quality in the point of connection or start discussions with the DNO to allow for wider limits of the protection setting to minimize down-times of the generator.

Timer

MainsPro provides two time counters: since the unit power-up and since the last TRIP. Use these timers for investigation of failures that were detected by MainsPro unit. Please note that MainsPro does not provide RTC clock and after each power-up of the unit, the time and date is lost. For this reason only indication of days / hh : mm : ss is used. The accuracy of the time measurement may also not be fully guaranteed. During internal tests, the measurement error of 4 seconds per 24 hours was recorded.

TEST mode

MainsPro provides the TEST mode, in which phase-by-phase testing of 3-phase protective features by single-phase power source is supported.

- The test mode may be activated by entering the init screen (entered by pressing the Enter and Esc at the same time). Follow by ← button and then ↑ button. This will open the Test mode activation screen.
- Select Y to enter the TEST mode.
- The voltage asymmetry protections are deactivated.
- The following functions are fix-assigned to the appropriate relay outputs, regardless of their actual assignment:
    - Comm Trp Per to RE3
    - f Sig to RE4
    - U Sig to RE5
- In TEST mode, the setpoint group TEST becomes visible. This group contains only one setpoint Phase - by setting this setpoint to the appropriate measurement input (U_A, U_B or U_C). Use this setting to assign, to which input is the 1-phase measurement voltage source connected.
- All relevant protections are evaluated only in that phase, which is selected:
    - If TEST/Phase = Ua, the following protective functions are evaluated:
        - Overvoltage and undervoltage on the U_A terminals, with dual stage setting, including the Alt parameters possibility
        - Overfrequency and underfrequency on the U_A terminals, with dual stage setting, including the Alt parameters possibility
        - Loss OF Mains protections on the U_A terminals, with the Alt parameters possibility
    - If TEST/Phase = Ub or Uc, the following protective functions are evaluated:
        - Overvoltage and undervoltage on the appropriate terminals, with dual stage setting, including the Alt parameters possibility
        - **Please note: When testing on the terminals Ub and Uc, it is always necessary, that the same measurement voltage as applied on terminals Ub or Uc is also present at the terminals Ua. It is not used for testing purposes, but serves for the internal synchronization of the measurement process of the unit.**
- On the first measurement screen (homepage), the sign !!!TEST!!! is displayed in the bottom line instead of the last trip information.
- If any TRIP is performed during the TEST mode, no counters are incremented and the last trip indication and timer is not affected.
- In the TEST mode, it is possible to change setpoints, but some functionality, which is disabled in the TEST mode (e.g. voltage asymmetry setting or assignment of f(RE)) is not applicable.
- After return from the TEST mode, the unit goes back to its original setting including the outputs assignment and the setpoint group TEST is hidden.

To return from the TEST mode:

- Go to Test mode activation screen and select NO, or
- Turn the unit off and on again, or
- The unit goes back to the standard operation after 10 minutes from the last keyboard activity.

MainsPro

Mains Decoupling Protection Relay

Application and Reference guide - rev. 2

SW version 1.0, September 2010

Reference Guide

Written by Tomas Jelen
Prague, Czech Republic

ComAp, spol. s r.o.
Kundratka 2359/17, 180 00 Praha 8, Czech Republic
Tel: +420 246 012 111, Fax: +420 246 316 647
E-mail: info@comap.cz, www.comap.cz

Table of contents

Table of contents ... 2
Purpose of this manual ... 3
Library of setpoints ... 4
Basic ... 4
Uin ... 4
System ... 4
DispT [min] ... 4
Auto FR del [s] ... 4
Start Trip ... 4
Imp Len [s] ... 4
Ext ... 5
F.R. ... 5
Alt ... 5
Disable ... 5
V <>, A.V <> ... 5
V>, V>>, V<, V<<, A.V>, A.V>>, A.V<, A.V<< [V] ... 5
V> del, V>> del, V< del, V<< del [s] ... 5
dU, A.dU ... 5
V unb, A.V unb [V] ... 5
V< pos, A.V< pos [V] ... 6
V> neg, A.V> neg [V] ... 6
dU del, A.dU del [s] ... 6
f <>, A.f <> ... 6
f>, f>>, f<, f<<, A.f>, A.f>>, A.f<, A.f<< [Hz] ... 6
f> del, f>> del, f< del, f<< del, A.f> del, A.f>> del, A.f< del, A.f<< del [s] ... 6
LOM, A.LOM ... 6
VS lim, A.VS lim [°] ... 6
ROCOF, A.ROCOF [Hz/s] ... 6
ROCOF filt, A.ROCOF filt [-] ... 7
LOM Init Del, A. LOM Init Del [s] ... 7
LOM Trip Del, A.LOM Trip Del [s] ... 7
f(RE) ... 7
f(RE1-5) ... 7
Library of binary switches ... 8
Ext Trip ... 8
Fault Reset ... 8
Alt Settings ... 8
Disable ... 8
Library of relay outputs ... 9
CommTrpPer ... 9
CommTrpImp ... 9
CommSigImp ... 9
CommSigDel ... 9
U Sig ... 9
f Sig ... 9
LOM Sig ... 10
dU Sig ... 10
Other Sig ... 10
Technical data ... 11
Accuracies and reaction times ... 11
Operating area ... 11
Voltage measurement ... 12
Frequency measurement ... 12
Time delays accuracy ... 12
Loss of Mains reaction times ... 12
Technical parameters ... 12
Endurance to the power supply voltage fails ... 13

Purpose of this manual

The Reference Guide contains library of setpoints, inputs and outputs functionalities and technical data for the purpose of detailed technical information. This information is referenced in the Installation and Operation Guide and Application Guide.

Library of setpoints

MainsPro provides the possibility of dual setting of the protection functions setpoints. This setting may be used in case that the installation is running in exceptional conditions with different requirements for protections setting. Some groups of setpoints have their alternative setpoints identified by the same name, but with latter “A.” at the beginning (e.g. V<>, A.V<> etc.). By activating the binary switch Alt settings, the unit is immediately switched to the setting, done in the “A.xx” group. See more in the chapter Library of binary switches.

Basic

Uin

Selection of the measurement range in order to adjust the HW for maximum accuracy.

230/400V	the unit measures 230 VAC phase-ground or 400V phase-phase with max over-range 130% (300/520 VAC)
120V	the unit measures 120 VAC phase-ground or on the secondary winding of the VT with max over-range 130% (156 VAC)

Default setting: 230/400V

System

Selection of single phase or 3-phase application. In case of single phase setting, the voltage on last two phases and voltage asymmetry are not measured.

3ph	the unit measures 3-phase system
1ph	the unit measures single-phase system

Default setting: 3ph

DispT [min]

Setting of display backlight timeout since the last button activity.

Range: 1..60 min
0 min = OFF, display is set to permanent backlight

Default setting: 10 min

Auto FR del [s]

Automatic fault reset delay. The timer starts to count in the moment when TRIP is detected, but the fault conditions are cleared. After the Auto FR del time, the Fault reset is done automatically to allow automatic reconnection.

Range: 1..6000 s
0 = OFF, automatic fault reset function is disabled

Default setting: 0 s

Start Trip

Start of the unit into the TRIP state.

ENABLED	after power-up, the unit goes immediately into the TRIP state and only after successfull fault reset its outputs are set to the fault-free state
DISABLED	after power-up, all values are evaluated on the measurement inputs and depending on the measured values, the unit goes either into fault-free or TRIP state.

Default setting: DIASABLED

Imp Len [s]

Impulse length in case of activation of various impulse outputs of the protection. The setpoint is reverenced in the appropriate outputs description.

Range: 0..60 s
Default setting: 1 s

Ext
Enabled or disables the functionality of the External trip binary switch.

ENABLED the binary switch is enabled
DISABLED the binary switch is disabled

Default setting: ENABLED

F.R.
Enabled or disables the functionality of the Fault reset binary switch.

ENABLED the binary switch is enabled
DISABLED the binary switch is disabled

Default setting: ENABLED

Alt
Enabled or disables the functionality of the Alternative settings binary switch.

ENABLED the binary switch is enabled
DISABLED the binary switch is disabled

Default setting: ENABLED

Disable
Enabled or disables the functionality of the Disable binary switch.

ENABLED the binary switch is enabled
DISABLED the binary switch is disabled

Default setting: ENABLED

V <>, A.V <>

V>, V>>, V<, V<<, A.V>, A.V>>, A.V<, A.V<< [V]
Threshold of 1st and 2nd stage overvoltage and 1st and 2nd stage undervoltage protection respectively.

Range: 1..999 V
0 = OFF, the appropriate stage of voltage protection is not enabled

Default setting:

- V>, V>> 253 V
- V<, V<< 196 V

V> del, V>> del, V< del, V<< del [s]
Delay of the appropriate stage of the voltage protection.

Range: 0,00..600,00 s

Default setting: 2,50 s

dU, A.dU

V unb, A.V unb [V]
Threshold of the voltage unbalance (amplitude asymmetry). The value corresponds to the maximum difference between highest and lowest RMS phase voltage of the 3-phase system.

Range: 0..999 V
0 = OFF, the amplitude asymmetry is disabled

Default setting: 15 V

V< pos, A.V< pos[V]
Threshold of the positive sequence undervoltage (angle asymmetry method).

Range: 0..999 V
0 = OFF, the positive sequence undervoltage is disabled

Default setting: 0 V

V> neg, A.V> neg[V]
Threshold of the negative sequence overvoltage (angle asymmetry method).

Range: 0..999 V
0 = OFF, the negative sequence overvoltage is disabled

Default setting: 0 V

dU del, A.dU del [s]
Delay of the voltage unbalance (amplitude asymmetry) protection.

Range: 0,00..600,00 s

Default setting: 2,5 s

f <>, A.f <>

f>, f>>, f<, f<<, A.f>, A.f>>, A.f<, A.f<< [Hz]
Threshold of 1st and 2nd stage overfrequency and 1st and 2nd stage underfrequency protection respectively.

Range: 45..65 Hz
0 = OFF, the appropriate stage of frequency protection is not enabled

Default setting:

- f>, f>> 52 Hz
- f<, f<< 48 Hz

f> del, f>> del, f< del, f<< del, A.f> del, A.f>> del, A.f< del, A.f<< del [s]
Delay of the appropriate stage of the frequency protection.

Range: 0,00..600,00 s

Default setting: 2,50 s

LOM, A.LOM

VS lim, A.VS lim [°]
Threshold at which the Vector shift protection is activated.

Range: 1..50°
0 = OFF, the Vector shift protection is not enabled

Default setting: 20°

ROCOF, A.ROCOF [Hz/s]
Threshold at which the Rate of change of frequency (ROCOF) protection is activated.

Range: 0,1..10,0 Hz/s
0 = OFF, the ROCOF protection is not enabled

Default setting: 0 Hz/s

ROCOF filt, A.ROCOF filt [-]

Number of periods considered for evaluating ROCOF protection. Higher number means lower sensitivity and longer evaluation time. Lower number means increased sensitivity and shorter evaluation time.

Range: 1..100

Default setting: 5 Hz/s

LOM Init Del, A. LOM Init Del [s]

Delay for what the Loss of Mains (LOM, i.e. Vector shift and ROCOF) protection is disabled after sensing the valid voltage on measurement terminals (stepping into the operational area of voltage and frequency).

Range: 0..600

Default setting: 3 s

LOM Trip Del, A.LOM Trip Del [s]

Duration of Loss of Mains (LOM, i.e. Vector shift and ROCOF) protection trip. After this delay, the fault is considered as terminated and Fault reset is possible. In case of automatic fault reset, the timer is started.

Range: 0..3600

Default setting: 3 s

f(RE)

f(RE1-5)

Function, assigned to the appropriate relay output 1 to 5. For description, see chapter „Relay outputs“.

CommTrpPer
CommTrpImp
CommSigImp
CommSigDel
U Sig
f Sig
LOM Sig
dU Sig
Other Sig

Default setting:

- RE1: CommTrpPer
- RE2: CommTrpImp
- RE3: CommSigImp
- RE4: CommSigDel
- RE5: U Sig

Library of binary switches

Ext Trip

Activation of this input causes immediate trip of the protection. The trip conditions are active throughout the activation of this input.

Fault Reset

Activation of this switch causes fault reset. The input has the same effect as pushing the button FltRes. If permanently activated, every 100ms an impulse to fault reset the unit is done internally.

Alt Settings

Activation of this switch causes immediate switching to the setting, done in the setpoint groups marked as „A.xx. In case that the switchover comes in the moment when a delay of some of the protection stage is being count-down (the unit is about to trip), the timer setting is kept as before the switch. However, if the trip conditions change during the delay run (e.g. by changing the protection threshold), the trip is not performed.

Disable

Activation of this switch disables immediately all protective features of the unit. The switch may be used e.g. in case that the generator is not yet in parallel-to-mains operation, and so the mains parameters do not have to be evaluated. In this case, the unit does not trip on any fault conditions.

Library of relay outputs

The standard logic of MainsPro corresponds to the standard of protective relays. I.e. the relay contacts are used, with fault-free position maintained in energized state. This is for safety reasons – in case of power supply fail, the unit goes to “fault” indication position. For this reason, any signaling or trip activation is described in this manual as “the output relay deactivates”, what means, it goes to “fault indication” position.

CommTrpPer

Common trip permanent relay. The relay opens at any failure with delay given by appropriate parameter. Relay opens immediately in case of LOM protection (Vector shift or ROCOF), External trip, incorrect phase rotation or wrong phase polarity. Relay closes in fault free state after a successful fault reset. In case of LOM protection, the delay LOM: LOM Trip Del is timed out and after this time it is possible to perform Fault reset.

CommTrpImp

Common trip impulse relay. The relay opens at any failure with delay given by appropriate parameter. Relay opens immediately in case of LOM protection (Vector shift or ROCOF), External trip, incorrect phase rotation or wrong phase polarity. Relay closes after Basic: Imp Len has timed out, his closing however does not mean end of trip state! Trip is terminated in fault free state after a successful fault reset. In case of LOM protection, the delay LOM: LOM Trip Del is timed out and after this time it is possible to perform Fault reset. During trip status, the relay does not react on any new failure.

CommSigImp

Impulse signaling relay – immediate. Relay opens immediately at any failure. Relay closes after Basic: Imp Len since its opening. Any other detected fault-state during run of this timer has no effect. Fault reset has no influence on this output.

CommSigDel

Impulse signaling relay delayed. Relay opens at any failure with delay given by appropriate parameter. Relay opens immediately in case of LOM protection (Vector shift or ROCOF), External trip, incorrect phase rotation or wrong phase polarity. Relay closes after Basic: Imp Len since its opening. Any other detected fault-state during run of this timer causes a new activation of this relay or extends timing of Basic: Imp Len by the new impulse length from the moment of the failure detection. Fault reset has no influence on this output

U Sig

Immediate signaling relay – voltage. Relay opens immediately in case of voltage failure (over or under voltage). Relay closes in case that all parameters are back within limits, but no sooner than after Basic: Imp Len from its activation. If the relay is open during trip activation, it closes no sooner than Basic: Imp Len since trip status activation. Fault reset has no influence on this output. If any voltage protection is disabled by setpoint (limit set to 0), the output does not signal activation of this protection stage.

f Sig

Immediate signaling relay – frequency. Relay opens immediately in case of frequency failure (over or under frequency). Relay closes in case that all parameters are back within limits, but no sooner than after Basic: Imp Len from its activation. If the relay is open during trip activation, it closes no sooner than Basic: Imp Len since trip status activation. Fault reset has no influence on this output. If any frequency protection is disabled by setpoint (limit set to 0), the output does not signal activation of this protection stage.

LOM Sig

Immediate signaling relay – loss of mains. Relay opens immediately in case of loss of mains failure (Vector shift or ROCOF). Relay closes after LOM: LOM Trip Del since the last LOM protection activation. Fault reset has no influence on this output. If any LOM protection is disabled by setpoint (limit set to 0), the output does not signal activation of this protection stage.

dU Sig

Immediate signaling relay – asymmetry. Relay opens immediately in case of voltage (amplitude) unbalance, positive sequence undervoltage or negative sequence overvoltage. failure (over or under frequency). Relay closes in case that all three methods of voltage asymmetry are in fail-free state, but no sooner than after Basic: Imp Len from its activation. If the relay is open during trip activation, it closes no sooner than Basic: Imp Len since trip status activation. Fault reset has no influence on this output. If any asymmetry protection is disabled by setpoint (limit set to 0), the output does not signal activation of this protection stage.

Other Sig

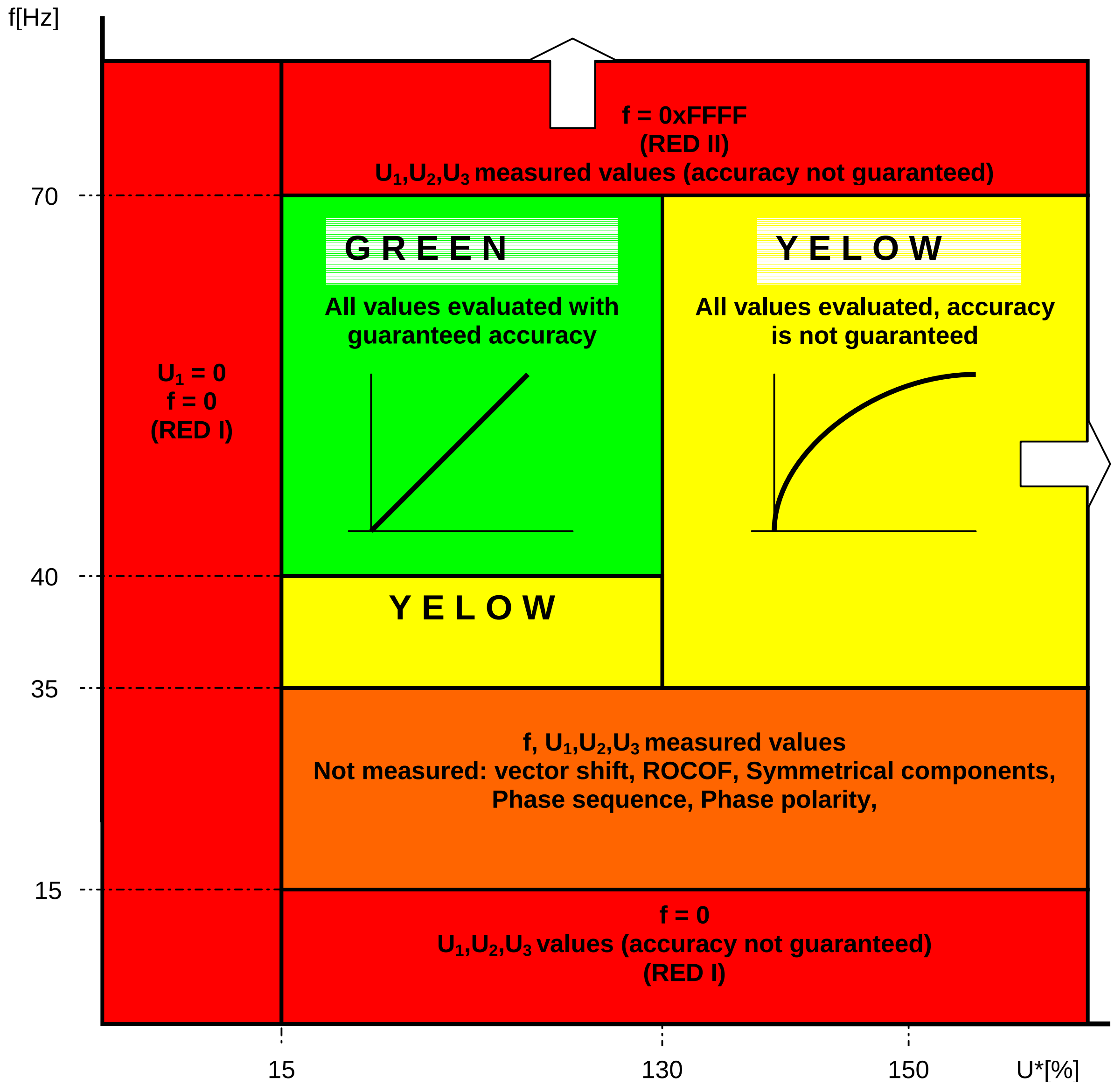
Immediate signaling relay – other failures. Relay opens immediately in case of incorrect phase rotation, wrong polarity of one phase or External trip. Relay closes in case that all observed failures are not active, but no sooner than after Basic: Imp Len from its activation. If the relay is open during trip activation, it closes no sooner than Basic: Imp Len since trip status activation. Fault reset has no influence on this output.

Technical data

Accuracies and reaction times

Operating area

MainsPro provides the below mentioned accuracies and reaction times in case that the measured voltage is within the green area on the picture below. Outside of the green area, MainsPro provides the expected performance (i.e. trips in case of voltage overreaching the green area border), but the behavior, accuracies and reaction times may not be guaranteed.



* of the range (120V or 230/400V).

Voltage measurement

- Voltage measurement accuracy is 1% of the nominal value at frequency 50 Hz ± 10% and temperature 25°C.
- The accuracy is 1,5% within the complete temperature range and in the green operational area. See the Operating area.
- Maximum reaction time for voltage failures (in case of the delay set to 0,00 s) is 2 periods of measured voltage + 15 ms. This is valid at nominal frequencies 50 Hz ± 10% and 60 Hz ± 10%.

Frequency measurement

- Frequency measurement is 0,1 Hz in the complete green operating area.
- Maximum reaction time for frequency failures (in case of the delay set to 0,00 s) is 75 ms. This is valid in complete green operating area.

Time delays accuracy

- The unit allows to set the time delays with step 10 ms.
- Accuracy of the unit timing is ± 1%.

Loss of Mains reaction times

- Reaction time of Vector shift protection is 1,5 period of measured signal + 15 ms

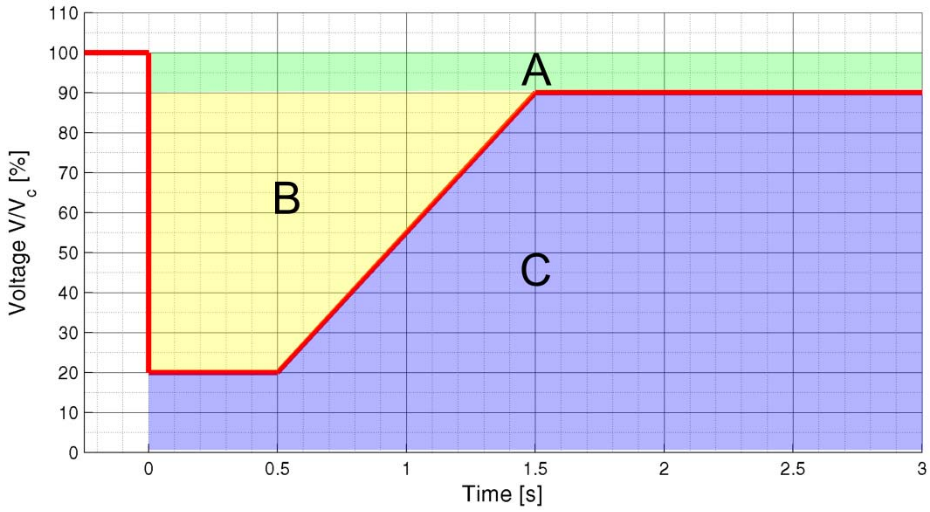
Technical parameters

Power supply:	
8 - 40 V ⎓	Maximum consumption 600 mA **Not galvanically separated from power supply 85 - 265 VAC!**
85 - 265 V/45-65 Hz, 110 - 370 V ⎓	Maximum consumption 90 mA
Operating temperature range	-20°C TO +70°C
Dimensions	158 x 96 x 68 mm
Protection	IP20
Rated voltage	120 V / 230 V ph-n / 400 V ph-ph
Maximal voltage range	Rated + 30%
Rated frequency of measured voltage	50 Hz,60 Hz (indicated accuracy is guaranteed on frequency range 40-70 Hz)
Signal relay contacts:	
Max switched voltage/current	250 V / 4A
Max switched power	resistive load: 1000 VA AC, 200 W DC
	inductive load: 50 VA AC, 25 W DC
Rated voltage/current	resistive load: 250 V / 4 A AC
	200 V / 0,1 A DC, 24 V / 4A DC
	inductive load: 250 V / 2 A AC
	200 V / 0,1 A DC, 24 V 3A DC
Minimum load	1 W / 1VA at U_{min} > 10 V
Lifetime	1 x 10^5 cycles
Terminal tightening torque	0,4 Nm
Measurement category	III (EN 61010-1)
Appliance class	II, double insulation ⧈, the device has no protective earthing terminal (IEC 61140)
Recommended fuse of the unit power supply and measurement circuits	fuse 1A

The unit is intended for use on a DIN rail inside a switchboard with prevention of access of non-qualified personnel. In case of access of non-qualified personnel, it is necessary to cover the terminals by means corresponding to the environment of the unit operation. It is possible to make the user interface accessible to the operation staff.

Endurance to the power supply voltage fails

MainsPro unit withstands the power supply voltages failures of 100 ms lengths in the full range of power supply voltage on the 85 - 265 VAC / 110 - 370 VDC terminals and at the voltage .18 - 40 VDC connected to the 8 - 40 VDC terminals. The construction of the power supply allows that the unit withstands the voltage drop down to min 40 VAC in case that the unit was started from the AC voltage within the allowed range 85 - 265 VAC. Such a drop of the voltage for unlimited time does not influence the unit operation. This construction allows safe operation at the voltage, corresponding to the following picture (Un = 230V):



Statement of the factory default setting of MainsPro unit

Setting	Setpoint group	Setpoint name	Value	Step	Unit
Overfrequency limit 1	f<>	f>	52	0,1	[Hz]
Overfrequency delay 1	f<>	f> Del	2,50	0,01	[s]
Overfrequency limit 2	f<>	f>>	52	0,1	[Hz]
Overfrequency delay 2	f<>	f>> Del	2,50	0,01	[s]
Underfrequency limit 1	f<>	f<	48	0,1	[Hz]
Underfrequency delay 1	f<>	f< Del	2,50	0,01	[s]
Underfrequency limit 2	f<>	f<<	48	0,1	[Hz]
Underfrequency delay 2	f<>	f<< Del	2,50	0,01	[s]
Overvoltage limit 1	V<>	V>	253	1	[V]
Overvoltage delay 1	V<>	V> Del	2,50	0,01	[s]
Overvoltage limit 2	V<>	V>>	253	1	[V]
Overvoltage delay 2	V<>	V>> Del	2,50	0,01	[s]
Undervoltage limit 1	V<>	V<	196	1	[V]
Undervoltage delay 1	V<>	V< Del	2,50	0,01	[s]
Undervoltage limit 2	V<>	V<<	196	1	[V]
Undervoltage delay 2	V<>	V<< Del	2,50	0,01	[s]
Voltage asymmetry limit	dU	V unb	15	1	[V]
Negative sequence overvoltage limit	dU	V> neg	0 (vypnuto)	1	[V]
Positive sequence undervoltage limit	dU	V< pos	0 (vypnuto)	1	[V]
Common delay of all voltage asymmetry protections	dU	dU Del	2,50	0,01	[s]
Vector shift limit	LOM	Vs Lim	20	1	[°]
ROCOF limit	LOM	ROCOF	0 (vypnuto)	0,01	[Hz/s]
ROCOF filter	LOM	ROCOF Filt	5	1	[-]
Delay of Vector shift and ROCOF evaluation after measured voltage connection	LOM	LOM Init Del	3	1	[s]

Setting	Setpoint group	Setpoint name	Value	Step	Unit
Vector shift and ROCOF signalization time (TRIP duration)	LOM	LOM Trip Del	3	1	[s]
Measurement range	Basic	Uin	230/400V	-	-
Measured system	Basic	System	3ph	-	-
Display timeout	Basic	DispT	10	1	[min]
Automatic Fault Reset	Basic	Auto FR Del	0 (vypnuto)	1	[s]
TRIP at the unit startup	Basic	Start Trip	DISABLED	-	-
Common impulse length	Basic	Imp Len	1	1	[s]
Enabling the external trip binary switch	Basic	Ext	DISABLED	-	-
Enabling the fault Reset binary switch	Basic	F.R.	ENABLED	-	-
Enabling the Alt settings binary switch	Basic	Alt	DISABLED	-	-
Enabling the blocking binary switch	Basic	Dis	DISABLED	-	-
Function of 1st relay output	f(RE)	f(RE1)	CommTrpPer	-	-
Function of 2nd relay output	f(RE)	f(RE2)	CommTrpImp	-	-
Function of 3rd relay output	f(RE)	f(RE3)	CommSigImp	-	-
Function of 4th relay output	f(RE)	f(RE4)	CommSigDel	-	-
Function of 5th relay output	f(RE)	f(RE5)	U Sig	-	-

ComAp states that the mentioned setting is guarranteed for all MainsPro units, SW version 1.0, upon shipment of a new unit, if no other setting is explicitly requested. In case of need, the mentioned settings can be provided by the following procedure:

1. Enter the init screen, by pushing the Enter and Esc at the same time.
2. Press ← and ↓ to enter the Factory default activation screen:

```
Factory default?

  YES    →NO←
```

3. Using ← and → do your selection. By selecting YES, you will return all previously done setting to the default values. **Please note that by this selection, you will loose all setting done prior to this operation!** Press Enter to confirm your selection.
4. By selecting NO and pressing Enter or by pressing Esc, return to the measurement screens with no change.

BILLION BIPAC 7800GZ

A unique 3G embedded wireless 'G' modem/router that features a Dual WAN interface with one ADSL2/2+ port and a built-in SIM-card slot for rock-solid 3G/HSPA connectivity. In addition one of the 4 Ethernet ports can be configured as a second fixed WAN port for cable/fibre/2nd ADSL2/2+ connectivity allowing autofailover to be configured to operate between any 2 of the 3 WAN interfaces available. External 3G antennas help to boost performance in low signal areas and 3G usage control feature allows monitoring and control of your 3G bandwidth.

Overview

The 7800GZ also incorporates a business-class firewall, supports IPSec VPN capability and in fixed line mode offers fast Internet access via your ADSL line, with download speeds up to 24 Mbps with ADSL2+ and higher upload speeds with Annex M. Billion's renowned built-in Quality of Service (QoS) feature for bandwidth management and traffic prioritization makes this an ideal model for the SOHO or small business user who is serious about security and high-performance.

- Product Description - Billion BIPAC 7800GZ - wireless router - DSL / cellular mdm - 802.11b/g - desktop
- Features - DMZ port, DHCP support, NAT support, auto-uplink (auto MDI/MDI-X), IGMP snooping, Syslog support, Stateful Packet Inspection (SPI), DoS attack prevention, packet filtering, dynamic DNS server, DiffServ support, MAC address filtering, VPN passthrough, Wireless Distribution System (WDS) support, URL filtering, firmware upgradable, SNTP support, Quality of Service (QoS), virtual server support, Wi-Fi Protected Setup (WPS)
- Dimensions (WxDxH) - 23 cm x 15.5 cm x 4.3 cm
- Device Type - Wireless router - DSL modem / wireless cellular modem - 4-port switch (integrated)
- Enclosure Type - Desktop
- Data Transfer Rate - 54 Mbps
- Compliant Standards - ANSI T1.413, IEEE 802.11b, IEEE 802.11g, IEEE 802.1x, Wi-Fi Protected Setup, UPnP
- Data Link Protocol - Ethernet, Fast Ethernet, IEEE 802.11b, IEEE 802.11g
- Network / Transport Protocol - PPPoE, PPPoA, AAL5, DHCP, DNS
- Remote Management Protocol - Telnet, HTTP
- Digital Signaling Protocol - ADSL, ADSL2, ADSL2+
- Routing Protocol - RIP-1, RIP-2, static IP routing
- Frequency Band - 2.4 GHz
- Cellular Protocol - GSM, GPRS, UMTS, EDGE, HSPA

Specification

General

- Features : DMZ port, DHCP support, NAT support, auto -uplink (auto MDI/MDI -X), IGMP snooping, Syslog support, Stateful Packet Inspect ion (SPI), DoS attack prevention, packet filtering, dynamic DNS server, DiffServ support, MAC address filtering, VPN passthrough, Wireless Distribution System (WDS) support, URL filtering, firmware upgradable, SNTP support, Qualit y of Service (QoS), virtual server support, Wi -Fi Protected Setup (WPS)
- Connectivity Technology : Wireless, wired
- Data Link Protocol : Ethernet, Fast Ethernet, IEEE 802.11b, IEEE 802.11g
- Network / Transport Protocol : PPPoE, PPPoA, AAL5, DHCP, DNS
- Compliant Standards : ANSI T1.413, IEEE 802.11b, IEEE 802.11g, IEEE 802.1x, Wi -Fi Protected Setup, UPnP
- Device Type : Wireless router - 4-port switch (integrated)
- Enclosure Type : Desktop
- Data Transfer Rate : 54 Mbps
- Status Indicators : Link activity, power
- Remote Management Protoc ol : Telnet, HTTP
- Encryption Algorithm : DES, Triple DES, AES, 128 -bit WEP, 64 -bit WEP, IKE, WPA -PSK, WPA2 -PSK
- Routing Protocol : RIP -1, RIP -2, static IP routing
- Frequency Band : 2.4 GHz

Expansion / Connectivity

- Interfaces : 3 x 10Base -T/100Base -TX - RJ-45
  WAN : 1 x ADSL2+ - RJ-11
  WAN / LAN : 1 x 10Base -T/100Base -TX - RJ-45
- Expansion Slot(s) : 1 (total) / 1 (free) x SIM card

Miscellaneous

- Width : 23 cm
- Depth : 15.5 cm
- Height : 4.3 cm
- Cables I ncluded : 1 x phone cable
  1 x network cable

Power

- Power Device : Power adapter - external

Software / System Requirements

- Software Included : Drivers & Utilities

Environmental Parameters

- Min Operating Temperature : 0 °C
- Max Operating Temperature : 40 °C
- Humidity Range Operating : 20 - 95%

Communications

- Type : DSL modem / wireless cellular modem
- Max Transfer Rate : 24 Mbps
- Protocols & Specifications : ITU G.992.1 (G.DMT), ITU G.992.2 (G.Lite), ITU G.994.1 (G.hs), ITU G.992.3 (G.DMT.bis), ITU G.9 92.5
- Digital Signaling Protocol : ADSL, ADSL2, ADSL2+

- Cellular Protocol : GSM, GPRS, UMTS, EDGE, HSPA

Aerial

- Antenna Qty : 3
- Aerial : External detachable

Line Properties

- Framing Format : ANSI T1.413

Notes

- Due to inherent limitation in the available routers the following restrictions apply
    - A Billion router can't be used at the university site as it is restricted to 4 VPNs
    - A Sinaut Router can't be used at the university site as it is restricted to 10 VPNs
    - As up to 20 VPN's need to be terminated a suitable router needs to be selected
        - A CISCO 800 series 880G or 890 would be suitable for the test
- The Test Topology would not scale well above 100 VPN Installations
    - Migration to Dynamic Multipoint Virtual Private Network (DMVPN) capable routers would enhance future scalability
    - This would require all routers from House to Control Centre to be DMVPN capable
        - Neither Billion or Sinaut support DMVPN
- Quality of Service should be enabled on the house routers to preserve uplink capacity for the eMIC
- Separate VLANs will be enabled, if supported by the router, to segregate WLAN and LAN traffic
- Firewall rules will be defined to only allow traffic to flow to known devices
- DHCP will be used to provide IP addresses to House devices connected by WLAN
- SSH will be configured to allow remote monitoring and configuration of the routers
    - Only the Dta Concentrator and the Siemens Remote devices will be granted access
- Structured IP addressing will be used in the trial but will not be practical in the scaled system
    - IEC-104 Addressing will follow the IP Addressing scheme
- Private Shared Keys will be a randomized 16 character string appended by a device ID
    - This is indicated in the Topology Diagrams by the tag <>D-xx
        - <> marks the 16 character tag
        - D marks the following types
            - H = House, E = School, S = Substation, U = University
        - xx marks the instance
        - For example
            - g8cS2_Rv b9e@Ve#bH-08 is the PSK between the House 8 and its Substation
            - g8cS2_Rv b9e@Ve#bS-08 is the PSK between the Substation 8 and the University
            - g8cS2_Rv b9e@Ve#bU-08 is the PSK between the University and Siemens Remote
- University and Siemens devices have fixed IP addresses (or allocated from a known pool)
- Dynamic DNS services will be used to resolve 3G allocated dynamic IP addresses
    - The domain is bristolsmartgrid.co.uk
    - Host follow the naming convention illustrated above
        - h01. bristolsmartgrid.co.uk is House 1 router
        - s08.bristolsmartgrid.co.uk is Substation 8 router
        - u01. bristolsmartgrid.co.uk is the University router
- Due to limitation in the Billion routers DynDNS updates do not occur on change but on a fixed period which is currently set to 15 minutes. This will not be acceptable on scaling up. Only dynamic updating by the routers would be acceptable.
- AES-128 Encryption in the VPN was selected above 3DES. If latency becomes too much for the Billion software driven encryption routers with a hardware encryption module should be selected.
- SHA-1 was selected due to known weaknesses in MD5
- Perfect Forward Secrecy is not supported in the Billion Router else it would have been enabled.
- House wireless will use WPA2-PSK encryption
    - The PSK will be derived in the same manner as the VPN keys but with a shorter 8 character key
        - The key will only use numbers and digits to maximise compatibility
        - The tag H-xx will be appended to the above root.

SIEMENS

SIMATIC NET

EGPRS/GPRS-Router SINAUT MD741-1

System manual

Preface, Contents

Applications and functions **1**

Setup **2**

Configuration **3**

Local interface **4**

External interface **5**

Security functions **6**

VPN connection **7**

Remote access **8**

Status, log and diagnosis **9**

Additional functions **10**

Technical Data **11**

Applied Standards and Approvals **12**

Glossary

C79000-G8976-C236-04

Release 02/2011

Legal information

Warning notice system

This manual contains notices you have to observe in order to ensure your personal safety, as well as to prevent damage to property. The notices referring to your personal safety are highlighted in the manual by a safety alert symbol, notices referring only to property damage have no safety alert symbol. These notices shown below are graded according to the degree of danger.

Danger

indicates that death or severe personal injury **will** result if proper precautions are not taken

Warning

indicates that death or severe personal injury **may** result if proper precautions are not taken.

Caution

with a safety alert symbol, indicates that minor personal injury can result if proper precautions are not taken..

Caution

without a safety alert symbol, indicates that property damage can result if proper precautions are not taken.

Notice

indicates that an unintended result or situation can occur if the corresponding information is not taken into account.

If more than one degree of danger is present, the warning notice representing the highest degree of danger will be used. A notice warning of injury to persons with a safety alert symbol may also include a warning relating to property damage.

Qualified Personnel

The product/system described in this documentation may be operated only by **personnel qualified** for the specific task in accordance with the relevant documentation for the specific task, in particular its warning notices and safety instructions. Qualified personnel are those who, based on their training and experience, are capable of identifying risks and avoiding potential hazards when working with these products/systems.

Prescribed Usage

Note the following:

Warning

Siemens products may only be used for the applications described in the catalog and in the relevant technical documentation. If products and components from other manufacturers are used, these must be recommended or approved by Siemens. Proper transport, storage, installation, assembly, commissioning, operation and maintenance are required to ensure that the products operate safely and without any problems. The permissible ambient conditions must be adhered to. The information in the relevant documentation must be observed.

Trademarks

All names identified by ® are registered trademarks of the Siemens AG. The remaining trademarks in this publication may be trademarks whose use by third parties for their own purposes could violate the rights of the owner.

Disclaimer of Liability

We have reviewed the contents of this publication to ensure consistency with the hardware and software described. Since variance cannot be precluded entirely, we cannot guarantee full consistency. However, the information in this publication is reviewed regularly and any necessary corrections are included in subsequent editions.

Siemens AG
Automation and Drives
Postfach 48 48
90437 NÜRNBERG
GERMANY

Order No.: C79000-G8976-C236-04
Release 02/2011

External power supply

Use only an external power supply which also complies with EN60950. The output voltage of the external power supply must not exceed 30V DC. The output of the external power supply must be short-circuit proof.

Warning

The power supply unit to supply the SINAUT MD741-1 must comply with the requirements for a Limited Power Source according to IEC/EN 60950-1

The power supply unit to supply the SINAUT MD741-1 must comply with NEC Class 2 circuits as outlined in the National Electrical Code ® (ANSI/NFPA 70) only.

Please pay regard to section 2.7 of the system manual, as well as the installation and utilisation regulations of the respective manufacturers of the power supply, the battery or the accumulator.

SIM card

To install the SIM card the device must be opened. Before opening the device, disconnect it from the supply voltage. Static charges can damage the device when it is open. Discharge the electric static of your body before opening the device. To do so, touch an earthed surface, e.g. the metal casing of the switch cabinet. Please pay regard to section 2.7 of this system manual.

Handling cables

Never pull a cable connector out of a socket by its cable, but pull on the connector itself. Cable connectors with screw fasteners (D-Sub) must always be screwed on tightly. Do not lay the cable over sharp corners and edges without edge protection. If necessary, provide sufficient strain relief for the cables.

For safety reasons, make sure that the bending radius of the cables is observed.

Failure to observe the bending radius of the antenna cable results in the deterioration of the system's transmission and reception properties. The minimum bending radius static must not fall below 5 times the cable diameter and dynamic below 15 times the cable diameter.

Radio device

Warning

Never use the device in places where the operation of radio devices is prohibited. The device contains a radio transmitter which could in certain circumstances impair the functionality of electronic medical devices such as hearing aids or pacemakers. You can obtain advice from your physician or the manufacturer of such devices. To prevent data carriers from being demagnetised, do not keep disks, credit cards or other magnetic data carriers near the device.

Installing antennas

Warning

The emission limits as recommended by the German Commission on Radiological Protection (13/14 September 2001; www.ssk.de) must be observed.

Installing an external antenna

Caution

When installing an antenna outdoors it is essential that the antenna is fitted correctly by a qualified person.

When the antenna is installed outdoors it must be earthed for lightning protection. The outdoor antennas shield must be reliable connective to protective earth.

The installation shall be done according the national installation codes

For US this is the National Electric Code NFPA 70, article 810.

For Germany, observe the current version of the Lightning Protection Standard VDE 0185 (DIN EN 62305) Sections 1 to 4 for buildings with lightning protection, or the standard VDE 0855 (DIN EN 60728-11) in case there is no lightning protection.

This work must be carried out by qualified personnel only.

Requirements for compliance to Safety, Telecom, EMC and other standards

Caution

Observe the regulations listed in chapter 12 before putting the SINAUT MD741-1 into operation.

Operating costs

Notice

Note that data packets exchanged for sign up connections, reconnecting, connect attempts (e.g. Server switched off, wrong destination address, etc.) as well as keeping the connection alive are also subject to charge.

Firmware with Open Source GPL/LGPL

The firmware of the SINAUT MD741-1 includes open Source Software under terms of GPL/LGPL. According to section 3b of GPL and of section 6b of LGPL we provide you the source code. Please write to

s_opsource@gmx.net
s_opsource@gmx.de

Please enter 'Open Source MD741' as subject of your e-mail, that we can filter your e-mail easier.

Firmware with OpenBSD

The firmware of SINAUT MD741-1 contains sections from the OpenBSD software. The use of OpenBSD software is subject to the following copyright notice

Preface

Purpose of this documentation

This documentation will support you on your way to successful application of GSM/GPRS modem SINAUT MD741-1. It will introduce you to the topic in clear and straightforward steps and provide you with an overview of the hardware of the SINAUT MD741-1 GSM/GPRS modem. This documentation will help you during installation and commissioning of SINAUT GSM/GPRS modem and explains the diagnostics and service options available.

Validity of the documentation

This manual relates to the following product versions

- GPRS/GSM modem MD741-1 hardware release 2.x

  Order number 6NH9741-1AA00

  Hardware product version 2.x

Intended purpose: (E-)GPRS-VPN-Router for industrial application

Online Support

In addition to our product documentation, the comprehensive online information platform supports you in all aspects of our Service & Support at any time and from any location in the world. You will find this on the Internet at the following address:
www.siemens.com/automation/service&support

Here, you will find the following information:

- Support news, newsletter
- Product information, Product Support, Applications & Tools
- Technical Forum
- Access to other features of our Service & Support offer:
  - Technical Consulting
  - Engineering Support
  - Field Service

    Phone: +49 911 895 7444
  - Spare parts and repairs

    Phone: +49 911 895 7448
  - Optimization and modernization

– Technical Support

  Expert advice on technical questions with a wide range of demand-optimized services for all our products and systems.

  Phone: +49 911 895 7222
  www.siemens.de/automation/support-request

You will find contact addresses on the Internet at the following address:

www.automation.siemens.com/partner

SITRAIN

With over 300 different courses, SITRAIN covers the entire Siemens product and system spectrum in the field of automation and drive technology. Advanced training tailored to your needs is also available. In addition to our classic range of courses, we also offer a combination of various training media and sequences. You can, for example, use self-study programs on CD-ROM or on the Internet as preparation or to consolidate training.

You will find detailed information on our training curriculum and how to contact our customer consultants at the following Internet address:

www.siemens.com/sitrain

Siemens documentation

- You will find the order numbers for the relevant Siemens documentation in the following catalogs:
  – SIMATIC NET Industrial Communication, catalog IK PI
  – SIMATIC Products for Totally Integrated Automation and Micro Automation, catalog ST 70

  You can request these catalogs and additional information from your Siemens representative.

- You will find many SIMATIC NET manuals on the Internet pages of Siemens Customer Support for automation:

  Link to Customer Support:
  http://support.automation.siemens.com/WW/view/en

  Enter the ID of the relevant manual as the search item. The ID is listed below some of the reference entries in brackets.

  → You will find the latest version of this documentation under the entry ID 22550242.

- Alternatively you will find the SIMATIC NET manuals on the Internet pages of Siemens Customer Support for automation:

  http://support.automation.siemens.com/WW/view/en/10805878

  Browse to the designated product group and set the following filter settings:

  "Entry list" → Entry type "Manuals"

Contents

1 **Applications and functions** **11**

2 **Setup** **14**

2.1 Important notes on using the device 14
2.2 Step by step 15
2.3 Preconditions for operation 16
2.4 Device front 17
2.5 Service button (SET) 17
2.6 Operating state indicators 18
2.7 Connections 19
2.8 Inserting the SIM card 21
2.9 Top rail mounting 22

3 **Configuration** **23**

3.1 TCP/IP configuration of the network adapter in Windows XP 24
3.2 Allowed characters for user name, passwords and other inputs 25
3.3 Establishing a configuration connection 26
3.4 Start page of the Web user interface 29
3.5 Language selection 31
3.6 Configuration procedure 32
3.7 Configuration Profiles 33
3.8 Changing the password 34
3.9 Reboot 35
3.10 Load factory settings 37

4 **Local interface** **38**

4.1 IP addresses of the local interface 38
4.2 DHCP server to local network 40
4.3 DNS to local network 42
4.4 Local hostname 44
4.5 System Time/NTP 45
4.6 Additional Internal Routes 47

5 **External interface** **48**

5.1 Access parameters to EGPRS/GPRS 48
5.2 EGPRS/GPRS Connection Monitoring 52
5.3 Hostname via DynDNS 54
5.4 SRS – Siemens Remote Service 56

6 **Security functions** **58**

6.1 Packet Filter 58
6.2 Port Forwarding 63
6.3 Advanced security functions 65

	6.4	Firewall Log	67
7	**VPN connection**		**68**
	7.1	VPN Roadwarrior Mode	70
	7.2	IPsec VPN Standard Mode	77
	7.3	Loading VPN certificates	85
	7.4	Firewall rules for VPN tunnel	87
	7.5	Supervision of VPN connections	88
	7.6	Advanced settings for VPN connections	91
	7.7	Status of the VPN connections	93
8	**Remote access**		**94**
	8.1	HTTPS remote access	94
	8.2	SSH remote access	96
	8.3	Remote access via dial-in connection	98
9	**Status, log and diagnosis**		**101**
	9.1	System status display	101
	9.2	Log	105
	9.3	Remote logging	107
	9.4	Snapshot	109
	9.5	Hardware information	111
	9.6	Software information	111
10	**Additional functions**		**112**
	10.1	Service Center	112
	10.2	Alarm SMS	112
	10.3	SMS - Messaging from the local network	114
	10.4	Software Update	117
11	**Technical Data**		**119**
12	**Applied Standards and Approvals**		**122**
	12.1	EU Declaration of Conformance	122
	12.2	Compliance to FM, UL and CSA	125
	12.3	Compliance to FCC	126
13	**Glossary**		**128**

Applications and functions 1

The SINAUT MD741-1 provides a wireless connection to the Internet or to a private network. The SINAUT MD741-1 can provide this connection in any location where a GSM network (Global System for Mobile Communication = mobile phone network) is available which provides the services EGPRS (Enhanced General Packet Radio Service = EDGE) or GPRS (General Packet Radio Service). A precondition for this is a SIM card of a GSM network operator with the appropriate services activated.

The SINAUT MD741-1 thus links a locally connected application or entire networks to the Internet via wireless IP connections. It is also possible to connect directly to an intranet, to which in turn the external remote stations are connected.

The SINAUT MD741-1 can establish a VPN (Virtual Private Network) between a locally connected application / a network and an external network, and can protect this connection against access by third parties through the use of IPsec (Internet Protocol Security).

In order to perform these tasks in the scenarios described, the device combines the following functions:

- EDGE modem for flexible data communication via EGPRS or GPRS
- Firewall for protection against unauthorized access. The dynamic packet filter examines data packets based on their source and destination addresses (stateful inspection firewall) and blocks undesirable data traffic (anti-spoofing)
- The SINAUT MD741-1 can establish via the wireless IP connections a VPN Virtual Private Network) between the locally connected application or network and en external network and can protect this connection by IPsec (Internet Protocol Security) against unwanted access by third parties.

Application examples of the SINAUT MD741-1

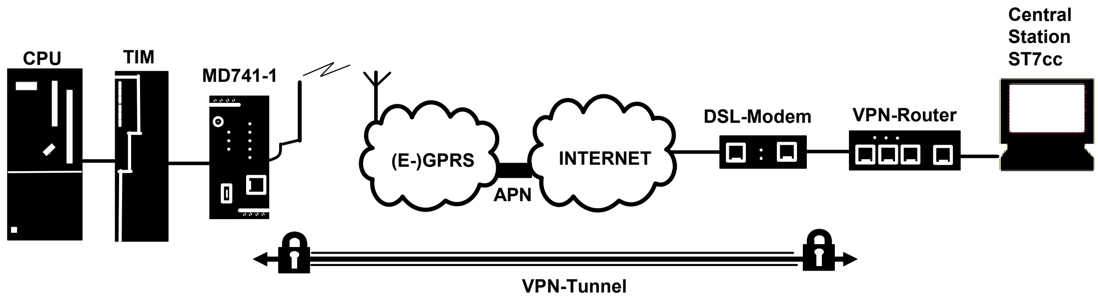


Figure 1-1 Connection between CPU and Central Station

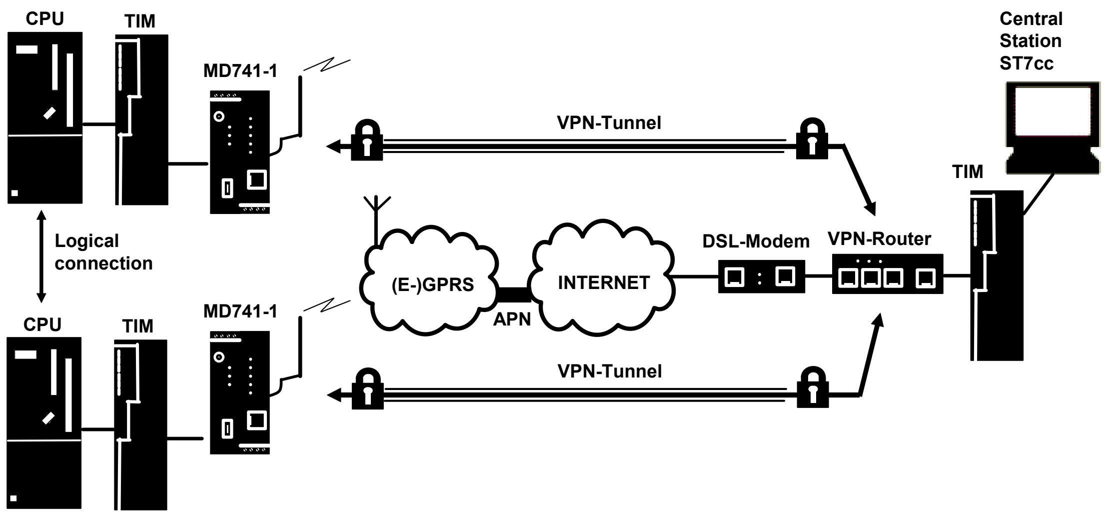


Figure 1-2 Connection between two CPU

Configuration

The device can be configured via a Web user interface that can simply be displayed using a Web browser. It can be accessed by means of the following:

- the local interface
- EGPRS/GPRS
- CSD (Circuit Switched Data = dial-in data connection) of the GSM

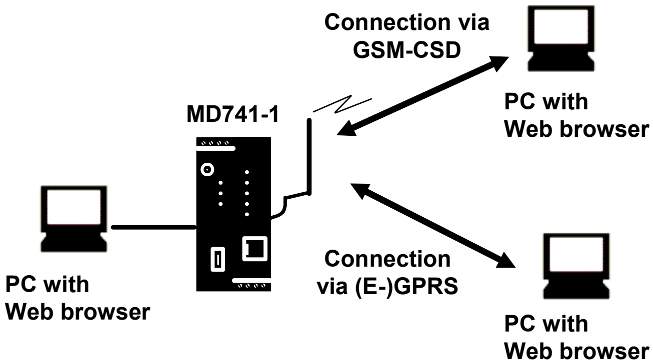


Figure 1-3 Configuration

Firewall functions

The SINAUT MD741-1 provides the following firewall functions in order to protect the local network and itself from external attacks:

- Stateful inspection firewall
- Anti-spoofing
- Port forwarding
- NAT

Additional functions

The SINAUT MD741-1 provides the following additional functions:

- DNS cache
- DHCP server
- NTP
- Remote logging
- In Port
- Web user interface for configuration
- Sending alarm SMS
- SSH console for configuration
- DynDNS client
- Dial-in data connection for maintenance and remote configuration

Setup 2

2.1 Important notes on using the device

Safety notices on the use of the device

The following safety notices must be adhered to when setting up and operating the device and during all work relating to it such as installation, connecting up, replacing devices or opening the device.

General notices on use in hazardous areas

Warning

Risk of explosion when connecting or disconnecting the device

EXPLOSION HAZARD

DO NOT CONNECT OR DISCONNECT EQUIPMENT WHEN A FLAMMABLE OR COMBUSTIBLE ATMOSPHERE IS PRESENT.

Warning

Replacing components

EXPLOSION HAZARD

SUBSTITUTION OF COMPONENTS MAY IMPAIR SUITABILITY FOR CLASS I, DIVISION 2 OR ZONE 2.

General notices on use in hazardous areas according to ATEX

Warning

Requirements for the cabinet/enclosure

When used in hazardous environments corresponding to Class I, Division 2 or Class I, Zone 2, the device must be installed in a cabinet or a suitable enclosure.

To comply with EU Directive 94/9 (ATEX95), this enclosure must meet the requirements of at least IP54 in compliance with EN 60529.

Warning

Suitable cables for temperatures in excess of 70 °C

If the cable or conduit entry point exceeds 70 °C or the branching point of conductors exceeds 80 °C, special precautions must be taken. If the equipment is operated in an air ambient in excess of 50 °C, only use cables with admitted maximum operating temperature of at least 80 °C.

Warning

Protection against transient voltage surges

Provisions shall be made to prevent the rated voltage from being exceeded by transient voltage surges of more than 40 %. This criterion is fulfilled, if supplies are derived from SELV (Safety Extra-Low Voltage) only.

2.2 Step by step

Set up the SINAUT MD741-1 in the following steps:

Step		Chapter
1.	First familiarise yourself with the preconditions for operation of the SINAUT MD741-1.	2.3
2.	Read the safety instructions and other instructions at the beginning of this document very carefully, and be sure to follow them.	
3.	Familiarise yourself with the control elements, connections and operating state indicators of the SINAUT MD741-1.	2.4 -2.7
4.	Connect a PC with a Web browser (Admin PC) to the local interface (X2) of the SINAUT MD741-1.	3
5.	Using the Web user interface of the SINAUT MD741-1, enter the PIN (Personal Identification Number) of the SIM card.	5.1
6.	Disconnect the SINAUT MD741-1 from the power supply.	2.7
7.	Insert the SIM card in the device.	2.8
8.	Connect the antenna.	2.7
9.	Connect the SINAUT MD741-1 to the power supply.	2.7
10.	Set the SINAUT MD741-1 up in accordance with your requirements.	3 - 10
11.	Connect your local application.	2.7

2.3 Preconditions for operation

In order to operate the SINAUT MD741-1, the following information must be on hand and the following preconditions must be fulfilled:

Antenna

An antenna, adapted to the frequency bands of the GSM network operator you have chosen: 850 MHz, 900 MHz, 1800 MHz or 1900 MHz. Use only antennas from the accessories for the SINAUT MD741-1.

See Chapter 2.7.

Power supply

A power supply with a voltage between 12 VDC and 30 VDC that can provide sufficient current.

See Chapter 2.7.

SIM card

A SIM card from the chosen GSM network operator.

PIN

The PIN for the SIM card.

EGPRS / GPRS activation

The SIM card must be activated by your GSM network operator for the services EGPRS or GPRS.

The EGPRS / GPRS access data must be known:

- Access Point Name (APN)
- User name
- Password

CSD 9600 bit/s activation

The SIM card must be activated by your GSM network operator for the CSD service if you wish to use remote configuration via a dial-in data connection, see Chapter 8.3.

2.4 Device front

Here are definitions of terms frequently used in this manual:

Figure 2-1 Operating elements

1) Connection terminals for the power supply
2) Set button
3) Antenna jack type SMA
4) Operating state indicators S, Q,
5) X1 (Service; USB) – without function
6) 10/100 Base-T - RJ45 jack for connecting the local network
7) Operating state indicators Power, LAN, VPN

2.5 Service button (SET)

On the front side of the SINAUT MD741-1 there is a small hole (see B) which is SET marked and has a button behind it. Use a pointed object, e.g. a straightened-out paperclip, to press this button.

- If you press the button for longer than 5 seconds, the SINAUT MD741-1 reboots and loads the factory settings.

2.6 Operating state indicators

The SINAUT MD741-1 has 7 indicator lamps (LEDs) to indicate the operating state.

The 3 indicator lamps on the left-hand side of the device indicate the state of the EGPRS wireless modem:

LED	State	Meaning
***S** (Status)*	Flashing slowly	PIN transfer
	Flashing quickly	PIN error / SIM error
	ON	PIN transfer successful
***Q** (Quality)*	OFF	Not logged into GSM network
	Flashing briefly	Poor signal strength (CSQ < 6)
	Flashing slowly	Medium signal strength (CSQ= 6..10)
	ON, with brief interruptions	Good signal strength (CSQ=11-18)
	ON	Very good signal strength (CSQ > 18)
***C** (Connect)*	OFF	No connection
	Flashing quickly	Service call via CSD active
	ON with brief interruptions	GPRS connection active
	ON	EGPRS connection active
S, Q, C together	Light up in sequence quickly	Booting
	Light up in sequence slowly	Update
	Flashing quickly in unison	Error

The 3 indicator lamps on the right-hand side of the device indicate the state of additional device functions:

LED	State	Meaning
DC5V	ON	Device switched on, operating voltage present
	OFF	Device switched off, operating voltage not present
LINK	ON	Ethernet connection established to the local application / the local network
	OFF	No Ethernet connection to the local application / the local network
	ON with brief interruptions	Data transfer via the Ethernet connection
VPN	ON	VPN connection active
	OFF	VPN connection active

2.7 Connections

X2 (10/100 Base-T)

The local network is connected to the local applications at the 10/100 Base-T connection, e.g. a programmable controller, a machine with an Ethernet interface for remote monitoring, or a notebook or desktop PC.

To set up the SINAUT MD741-1, connect the Admin PC with Web browser here.

The interface supports autonegotiation. It is thus detected automatically whether a transmission speed of 10 Mbit/s or 100 Mbit/s is used on the Ethernet.

A connecting cable with a RJ45 plug must be used. It can be a cross-over cable or a patch cable.

X1 (USB; Service)

In the SINAUT MD741-1 this interface has no function and is reserved for later applications. Do not connect any devices here. Doing so could interfere with the SINAUT MD741-1's operation.

SMA antenna jack

The SINAUT MD741-1 has an antenna jack of the type SMA for connecting the antenna.

The antenna that is used should have an impedance of about 50 ohms. It must be matched for GSM 900MHz and DCS 1800MHz or GSM 850 MHz and PCS 1900 MHz, depending on which frequency bands your GSM network operator uses. In Europe and China GSM 900MHz and DCS 1800MHz are used, in the USA GSM 850 MHz and PCS 1900 MHz are used. Obtain this information from your network operator.

The match (VSWR) of the antenna must be 1:2.5 or better.

Caution:

Use only antennas from the accessories line for the SINAUT MD741-1. Other antennas could interfere with product characteristics or even lead to defects.

When installing the antenna, a sufficiently good signal quality must be ensured (CSQ > 11). Use the indicator lamps of the SINAUT MD741-1 which show the signal quality. Make sure that there are no large metal objects (e.g. reinforced concrete) close to the antenna.

Observe the installation and user instructions for the antenna being used.

Warning:

When the antenna is installed outdoors it must be earthed for lightning protection. The outdoor antennas shield must be reliable connective to protective earth. The installation shall be done according the national installation codes (For US this is the National Electric Code NFPA 70, article 810).

This work must be carried out by qualified personnel only.

Screw terminals for power supply

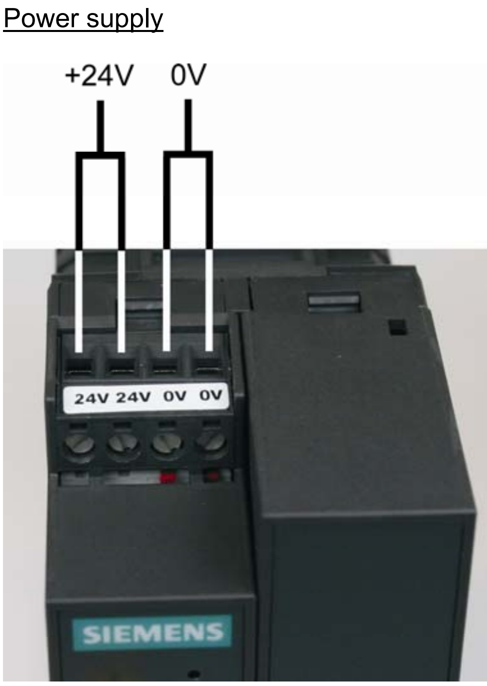


Figure 2-2 Screw terminals

The SINAUT MD741-1 operates with direct current of from DC 12-30 V, nominally DC 24 V. This power supply is connected at the screw terminals on the left-hand side of the device.

Connect the positive supply voltage to one or both screw terminals marked 24V and the negative supply voltage to one or both screw terminals marked 0V.

The rated current consumption is about 510 mA at 12 V and 230 mA at 30 V.

Warning:

The power supply unit of the SINAUT MD741-1 is not electrically isolated. Observe the safety instructions at the beginning of this manual.

Field wiring instructions

Use copper wires only.

Solid wire:	0,5...3 mm^2 (AWG 20...18)
Strained wire:	0,5...2,5 mm^2
Torque of screw clamps:	0,6...0,8 Nm

2.8 Inserting the SIM card

Caution:
Before inserting the SIM card, enter the PIN of the SIM card in the SINAUT MD741-1 via the Web user interface. See Chapter 5.1.

Figure 2-3 Inserting the SIM card

1. After you have entered the PIN of the SIM card, disconnect the SINAUT MD741-1 completely from the power supply.
2. The drawer for the SIM card is located on the back of the device. Right next to the drawer for the SIM card in the housing aperture there is a small yellow button. Press on this button with a pointed object, for example a pencil.

   When the button is pressed the SIM card drawer comes out of the housing.
3. Place the SIM card in the drawer so that its gold-plated contacts remain visible.
4. Then push the drawer with the SIM card completely into the housing.

Caution:
Do not under any circumstances insert or remove the SIM card during operation. Doing so could damage the SIM card and the SINAUT MD741-1.

2.9 Top rail mounting

The SINAUT MD741-1 is suitable for top-hat rail mounting on DIN EN 50022 rails. A corresponding bracket can be found at the rear of the device.

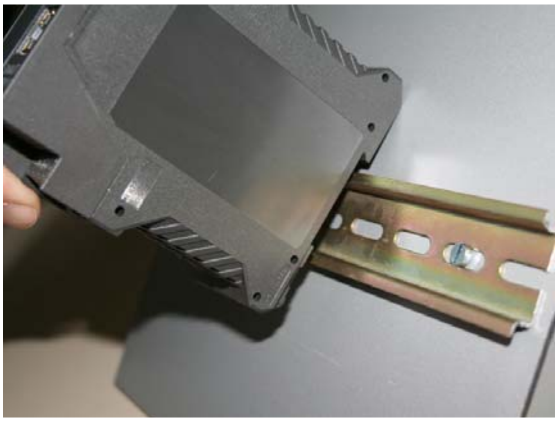


Figure 2-4 Top rail mounting

Configuration

3

Configuration of the router and firewall functions is carried out locally or remotely via the Web-based administration interface of the SINAUT MD741-1.

Remote configuration

Remote configuration via HTTPS or CSD access is only possible if the SINAUT MD741-1 is configured for remote access. In this case proceed exactly as described in Chapter 8.

Configuration via the local interface

The preconditions for configuration via the local interface are:

- The computer (Admin PC) that you use to carry out configuration must be either connected directly to the Ethernet jack of the SINAUT MD741-1 via a network cable or it must have direct access to the SINAUT MD741-1 via the local network.

- The network adapter of the computer (Admin PC) that you use to carry out configuration must have the following TCP/IP configuration:

  IP address: **192.168.1.2**

  Subnet mask: **255.255.255.0**

  Instead of the IP address **192.168.1.2** you can also use other IP addresses from the **range 192.169.1.x**.

- If you also wish to use the Admin PC to access the external network via the SINAUT MD741-1, the following additional settings are necessary:

  Standard gateway: **192.168.1.1**

  Preferred DNS server: **Address of the domain name server**

3.1 TCP/IP configuration of the network adapter in Windows XP

Configure the LAN connection

Click on *Start, Connect To ..., Show All Connections…*

Then click on *LAN Connection*. In the dialog box Properties of *LAN Connection*, click on the General tab and select there the entry I*nternet Protocol (TCP/IP)*. Open *Properties* by clicking on the corresponding button.

The window Properties of Internet Protocol (TCP/IP) appears (see illustration below).

Note:
The path leading to the dialog box *Properties of LAN Connection* depends on your Windows settings. If you are not able to find this dialog box, search in the Windows Help function for *LAN Connection* or *Properties of Internet Protocol (TCP/IP)*.

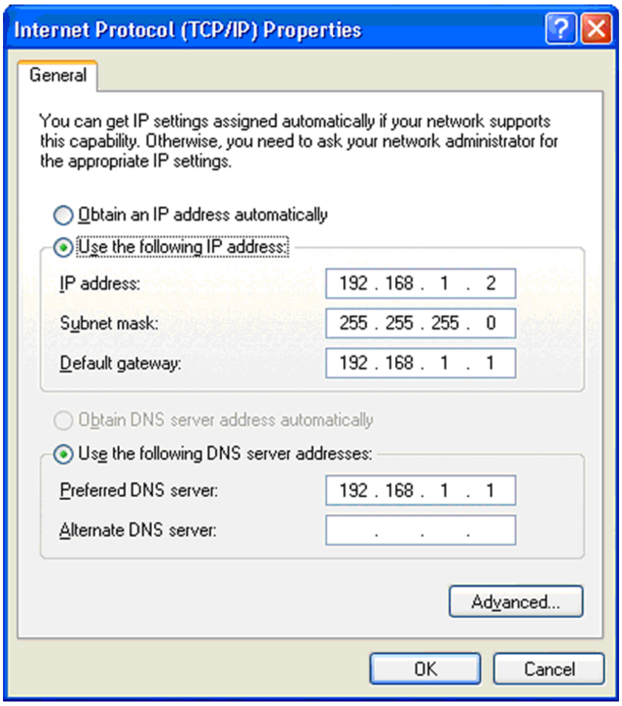


Figure 3-1 Properties of Windows Internet Protocol

Enter the following values in order to get to the Web user interface of the SINAUT MD741-1:

IP address: **192.168.1.2**

Subnet mask: **255.255.255.0**

In addition, enter the following values if you want to use the Admin PC to access the external network via the SINAUT MD741-1:

Standard gateway: **192.168.1.1**

Preferred DNS server: **192.168.1.1**

Preferred DNS server

If you call up addresses via a domain name (e.g. www.neuhaus.de), then you must refer to a domain name server (DNS) to find out what IP address is behind the name. You can define the following as the domain name server:

- The DNS address of the network operator,

  or

- The local IP address of the SINAUT MD741-1, as long as it is configured for breaking out host names into IP addresses
  (see Chapter 4.3; **Factory setting**).

To define the domain name server in the TCP/IP configuration of your network adapter, proceed as described above.

3.2 Allowed characters for user name, passwords and other inputs

For user names, passwords, host names, APN and PIN the following ASCII chracters may be used:

User names, passwords and PIN

a b c d e f g h I j k l m n o p q r s t u v w x y z A B C D E F G H I J K L M N O P Q R S T U V W X Y Z 0 1 2 3 4 5 6 7 8 9 ! $ % & ' ( ) * + , . / : ; < = > ? @ [\ ] ^ _ ` { | }

Host names and APN

a b c d e f g h I j k l m n o p q r s t u v w x y z A B C D E F G H I J K L M N O P Q R S T U V W X Y Z 0 1 2 3 4 5 6 7 8 9 . -

3.3 Establishing a configuration connection

Setting up a Web browser

Proceed as follows:

1. Launch a Web browser.

   (e.g. MS Internet Explorer Version 7 or later or Mozilla Firefox Version 2 or later; the Web browser must support SSL (i.e. HTTPS).)

2. Make sure that the browser does not automatically dial a connection when it is launched.

   In MS Internet Explorer, make this setting as follows: Menu *Tools, Internet Options...*, tab *Connections*: Under *Dial-up and VPN Settings*, make sure that *Never dial a connection* is activated.

Calling up the start page of the SINAUT MD741-1

3. In the address line of the browser, enter the address of the SINAUT MD741-1 in full. In the factory settings this is:

   https://192.168.1.1

   Result: A security message appears. In Internet Explorer 7, for example, this one:

Figure 3-2 Confirming the security message

4. Acknowledge the corresponding safety message with "Continue loading this page …"

Note

Because the device can only be administered via encrypted access, it is delivered with a self-signed certificate. In the case of certificates with signatures that the operating system does not know, a security message is generated. You can display the certificate.
It must be clear from the certificate that it was issued for SIEMENS AG. The Web user interface is addressed via an IP address and not using a name, which is why the name specified in the security certificate, is not the same as the one in the certificate.

Entering the user name and password

5. You will be asked to enter the user name and the password:

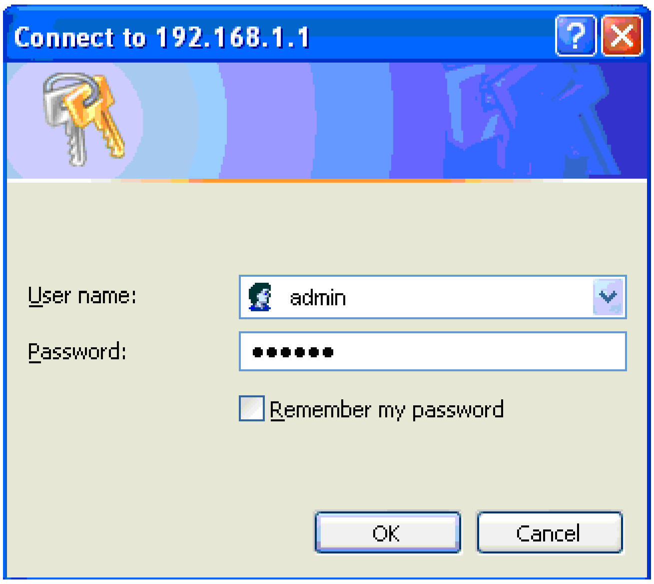


Figure 3-3 Enter user name and password

The factory setting is:

User name: **admin**

Password: **sinaut**

Note

You should change the password in any event. The factory setting is general knowledge and does not provide sufficient protection. Chapter 3.8 contains a description of how to change the password.

The start page is displayed

After the user name and password are entered, the start page of the SINAUT MD741-1 appears in the Web browser with an overview of the operating state, see Chapter 3.4.

The start page is not displayed

If after several tries the browser still reports that the page cannot be displayed, try the following:

- Check the hardware connection. On a Windows computer, go to the DOS prompt (Menu *Start, Programs, Accessories, Command Prompt*) and enter the following command:

  ping 192.168.1.1

  If a return receipt message for the 4 packets that were sent out does not appear within the specified time period, check the cable, the connections and the network card.

- Make sure that the browser does not use a proxy server. In MS Internet Explorer (Version 7.0), make this setting as follows: Menu *Tools, Internet* Options*...*, tab *Connections*: Under *LAN Settings*, click on the *Settings...* button, then in the dialog box *Settings for local network (LAN)*, make sure that under *Proxy Server* the entry *Use proxy server for LAN* is not activated.

- If other LAN connections are active on the computer, deactivate them for the duration of the configuration process.
  Under the Windows menu *Start, Connect To ..., Show All Connections…* , under LAN or High-Speed Internet right-click on the connection concerned and select *Deactivate* in the pop-up menu.

- Enter the address of the SINAUT MD741-1 with a slash:

  https://192.168.1.1/

3.4 Start page of the Web user interface

After the Web user interface of the SINAUT MD741-1 is called up and the user name and password are entered, an overview of the current operating state of the SINAUT MD741-1 appears.

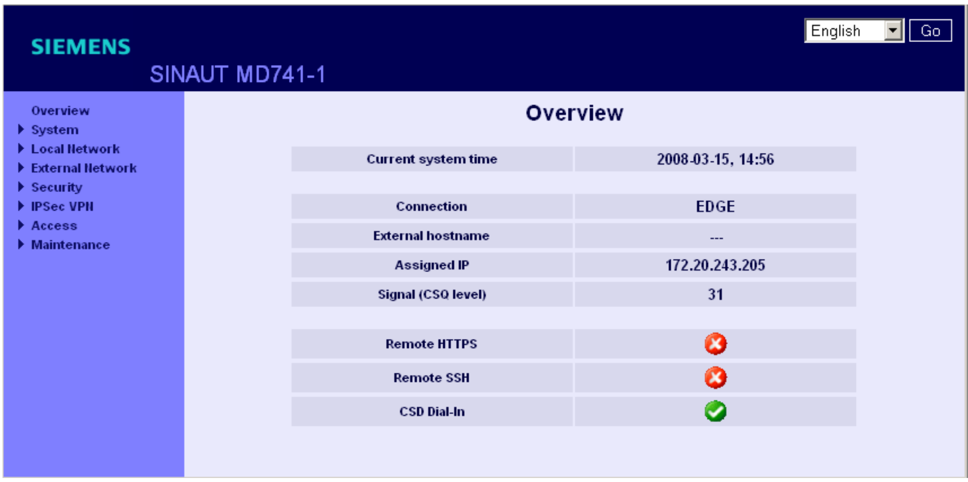


Figure 3-4 Overview

Note

Use the *Refresh* function of the Web browser to update the displayed values.

Current system time

Shows the current system time of the SINAUT MD741-1 in the format:

Year – Month – Day, Hours – Minutes

Connection

Shows if a wireless connection exists, and which one:

- EDGE connection (IP connection via EGPRS)
- GPRS connection (IP connection via GPRS)
- CSD connection (service connection via CSD)

External hostname

Shows the hostname (e.g. md741.mydns.org) of the SINAUT MD741-1, if a DynDNS service is being used.

Signal (CSQ level)

Indicates the strength of the GSM signal as a CSQ value.

- CSQ < 6: Poor signal strength
- CSQ= 6..10: Medium signal strength
- CSQ=11-18: Good field strength
- CSQ > 18: Very good field strength
- CSQ = 99: No connection to the GSM network

Assigned IP address

Shoes the IP address at which the SINAUT MD741-1 can be reached in EGPRS or GPRS. This IP address is assigned to the SINAUT MD741-1 by EGPRS or GPRS.

Note

It may occur that an EDGE (EGPRS) or GPRS connection and an assigned IP address are both shown, but the connection quality is still not good enough to transmit data. For this reason we recommend using the active connection monitoring (see Chapter 5.2).

Remote HTTPS

Shows whether remote access to the Web user interface of the SINAUT MD741-1 via EGPRS, GPRS or CSD is permitted (see Chapter 8.1).

- White check mark at green dot: Access is allowed.
- White cross at red dot: Access is not allowed.

Remote SSH

Shows whether remote access to the SSH console of the SINAUT MD741-1 via EGPRS, GPRS or CSD is permitted (see Chapter 8.2).

- White check mark at green dot: Access is allowed.
- White cross at red dot: Access is not allowed.

CSD Dial-In

Shows whether remote CSD service calls are allowed (see Chapter 8.3).

- White check mark at green dot: Access is allowed.
- White cross at red dot: Access is not allowed.

3.5 Language selection

The Web user interface of the SINAUT MD741-1 supports English and German language.

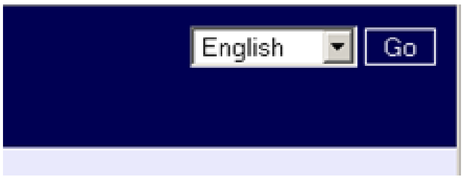


Figure 3-5 Language selection

Automatic

The SINAUT MD741-1 selects the language of the Web user interface in accordance to the selected language of the used Web browser:

- German, if the Web browser uses the German language,
- English, in all other cases.

Deutsch

The SINAUT MD741-1 uses the German language, irrespective of the Web browser setting.

English

The SINAUT MD741-1 uses the English language, irrespective of the Web browser setting.

Click the *GO* and refresh your Web browser to change the language.

3.6 Configuration procedure

The procedure for configuration is as follows:

Carrying out configuration

1. Use the menu to call up the desired settings area
2. Make the desired entries on the page concerned or use Reset to delete the current entry which has not been saved.
3. Use Save to confirm the entries so that they are accepted by the device.

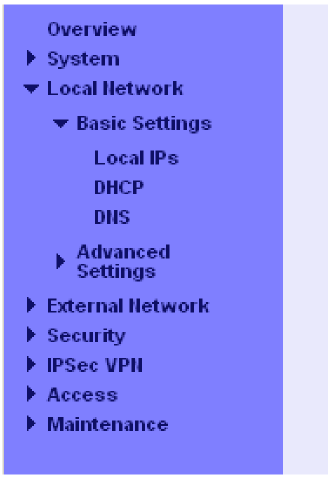


Figure 3-6 Configuration

Note

Depending on how you configure the SINAUT MD741-1, you may then have to adapt the network interface of the locally connected computer or network accordingly.

When entering IP addresses, always enter the IP address component numbers without leading zeros, e.g.: 192.168.0.8.

Invalid entries

The SINAUT MD741-1 checks your entries. Obvious errors are detected during saving and the input box in question is marked.

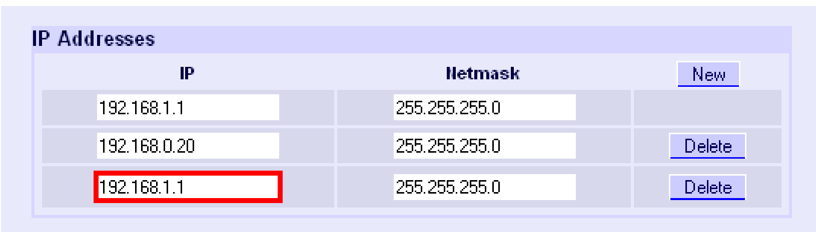


Figure 3-7 Indication of invalid entries

3.7 Configuration Profiles

The settings of the SINAUT MD741-1 can be saved in configuration profiles (files) and re-loaded at any time.

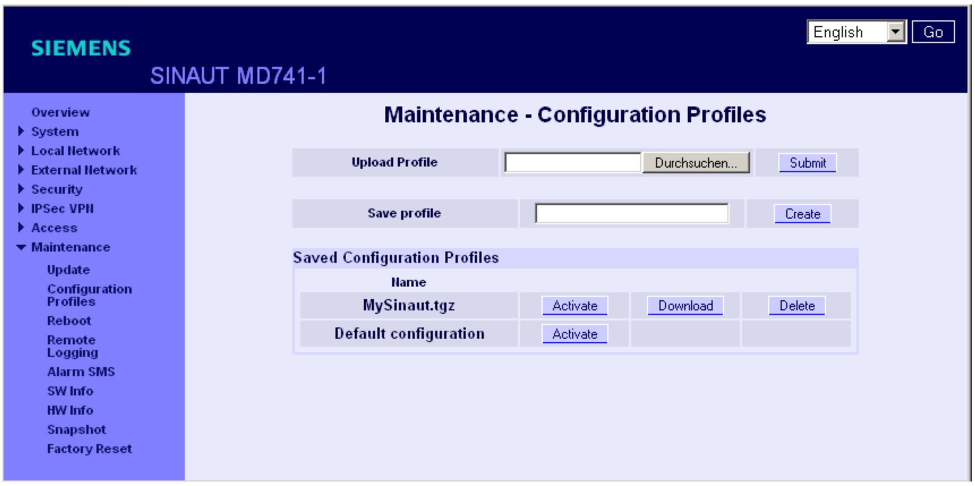


Figure 3-8 Maintenance > Configurations Profiles

Upload Profile

Loads to the SINAUT MD741-1 a configuration profile that was created before and saved on the Admin PC. Files with configuration profiles have the file extension *.epr.

Browse can be used to search the Admin PC for configuration profiles,

Submit loads the configuration profile to the SINAUT MD741-1.

It will then be shown in the table of saved configuration profiles.

Create profile

Saves the current settings of the SINAUT MD741-1 in a configuration profile.

First enter a name for the profile in the input box. *Create* saves the settings in a profile with this names and then displays them in the table of saved configuration profiles.

Saved Configuration Profiles

The table of saved configuration profiles shows all of the profiles that are saved in the SINAUT MD741-1.

Download

Loads the profile to the Admin PC.

Activate

The SINAUT MD741-1 accepts the settings from the selected configuration profile and continues to work using them.

Delete

The configuration profile is deleted.

The profile *Default configuration* contains the factory settings, and cannot be deleted.

3.8 Changing the password

Access to the SINAUT MD741-1 is protected by an access password. This access password protects access both via the

- local interface to the Web user interface, and
- via the local interface to the SSH console,

and also access via

- EGPRS or GPRS by https to the Web user interface, and
- EGPRS or GPRS to the SSH console

Figure 3-9 Access > Password

Access password (factory setting)

The factory setting for the SINAUT MD741-1 is:

- User name: **admin** *(*cannot be changed)
- Password: **sinaut**

Note

Change the password immediately after initial start-up. The factory setting is general knowledge and does not provide sufficient protection.

Note

The user name for the SSH access is different from the user name for the Web-Interface.

User name: **root** (cannot be changed)

The password for the SSH access is the same as for the Web-Interface.

New access password (with confirmation)

To change the password, enter the new password you have selected in *New access password* and confirm the entry in *Retype new access password.*

Reset can be used to discard any entries that have not yet been saved. *Save* accepts the new password.

3.9 Reboot

Although the SINAUT MD741-1 is designed for continuous operation, in such a complex system faults may occur, often triggered by external influences. A reboot can rectify these faults.

The reboot resets the functions of the SINAUT MD741-1. Current settings according to the configuration profile do not change. The SINAUT MD741-1 continues to work using these settings after the reboot.

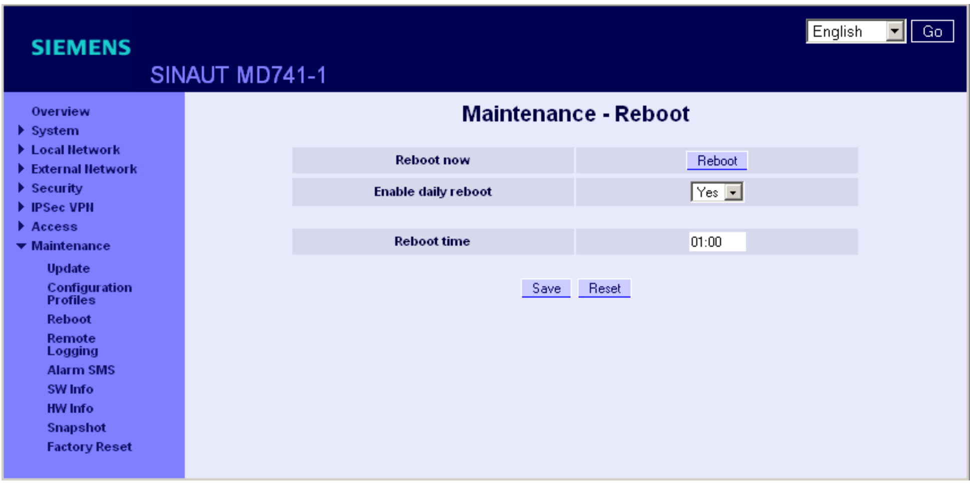


Figure 3-10 Maintenance > Reboot

Reboot now

A reboot will be executed immediately, if you press the *Reboot* button

Enable daily reboot

The reboot is carried out automatically once a day if you switch the function on with *Yes*.

Specify the *Time of the daily reboot*. The reboot will be carried out at the specified system time. Existing connections will be interrupted.

Factory setting

Enable daily reboot:	**No**
Time of the daily reboot:	**01:00**

3.10 Load factory settings

The factory settings of the SINAUT MD741-1 can be restored by the following means:

Figure 3-11 Maintenance > Factory Reset

Reset to factory settings

A click on the push button *Reset* loads the factory settings, resets the passwords and deletes the stored certificates, the configuration profiles and the archived log files.

Service button (SET)

The load of the factory settings can also be activated by pushing the service button (see chapter 2.5).

Default configuration

If just the factory settings shall be loaded, without to delete the certificates, configuration profiles and the archived log files, just activate the default configuration as being described in chapter 3.7.

4 Local interface

The local interface is the interface of the SINAUT MD741-1 for connecting the local network. The interface is labeled X2 on the device. This is an Ethernet interface with a data rate of 10Mbit/s or 100Mbit/s.

The Local network is the Network connected to the local interface of the SINAUT MD741-1. The local network contains at least one local application.

Local applications are network components in the local network, for example a programmable controller, a machine with an Ethernet interface for remote monitoring, or a notebook or desktop PC or the Admin PC.

Configure the local interface and the related functions according to the your requirements and the advices in this chapter.

4.1 IP addresses of the local interface

This is where the IP addresses and the netmasks at which the SINAUT MD741-1 can be reached by local applications are set.

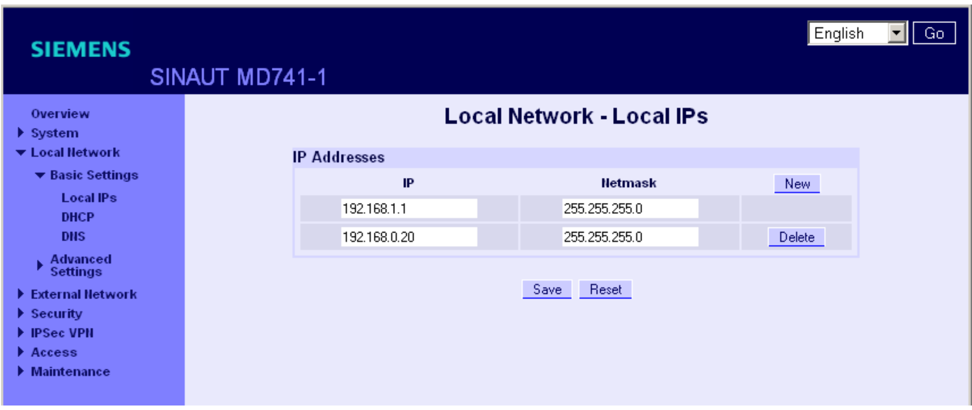


Figure 4-1 Local Network > Basic Settings > Local IPs

The factory settings for the SINAUT MD741-1 are as follows:

IP **192.168.1.1**

Netmask **255.255.255.0**

These factory-set IP addresses and netmasks can be changed freely, but should follow the applicable recommendations (RFC 1918).

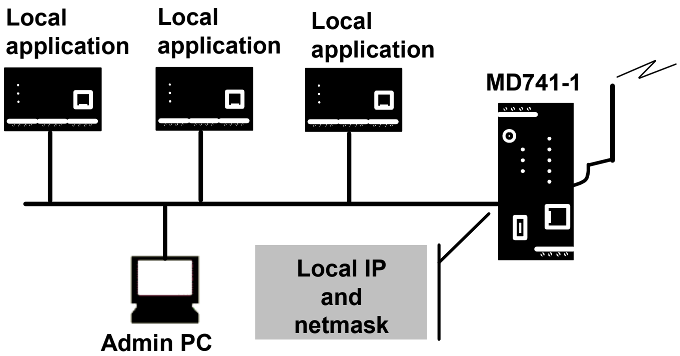


Figure 4-2 Local interface

You can define additional addresses at which the SINAUT MD741-1 can be reached by local applications. This is useful, for example, when the local network is subdivided into subnetworks. Then multiple local applications from different subnetworks can reach the SINAUT MD741-1 under various addresses.

New

Adds additional IP addresses and netmasks, which you can then modify in turn.

Delete

Removes the respective IP address and netmask. The first entry cannot be deleted.

4.2 DHCP server to local network

The SINAUT MD741-1 contains a DHCP server (DHCP = Dynamic Host Configuration Protocol). If the DHCP server is switched on, it automatically assigns to the applications that are connected to the local interface of the SINAUT MD741-1 the IP addresses, netmasks, the gateway and the DNS server. This is only possible the setting for obtaining the IP address and the configuration parameter automatically via DHCP is activated for the local applications.

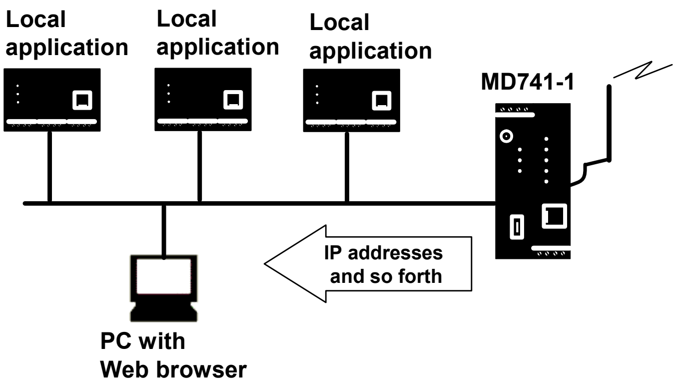


Figure 4-3 DHCP function on local interface

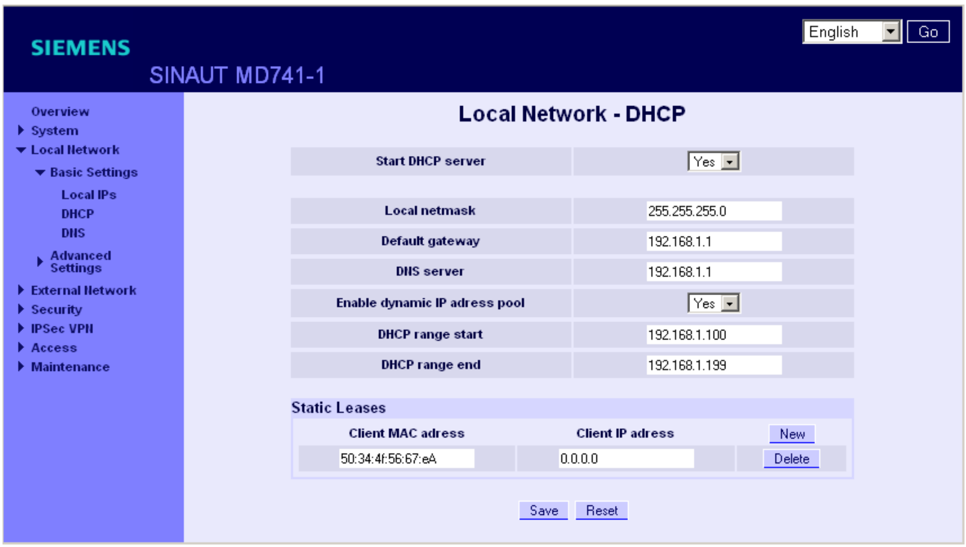


Figure 4-4 Local Network > Basic Settings > Local IPs

Start DHCP server

Start DHCP server – *Yes* switches on the DHCP server of the SINAUT MD741-1; *No* switches it off.

Local netmask

Here enter the local netmask that should be assigned to the local applications.

Default gateway

Here enter the default gateway that should be assigned to the local applications.

DNS server

Here enter the DNS server that should be assigned to the local applications.

Enable dynamic IP address pool

With *Yes* the IO addresses that the DHCP server of the SINAUT MD741-1 assigns are drawn from a dynamic address pool.

With *No* the IP addresses must be assigned to the MAC addresses of the local application under *Static Leases*.

DHCP range start

Specifies the first address of the dynamic address pool.

DHCP range end

Specifies the last address of the dynamic address pool.

Static Leases

In Static Leases of the IP addresses you can assign corresponding IP addresses to the MAC addresses of local applications.

If a local application requests assignment of an IP address via DHCP, the application communicates its MAC address with the DHCP query. If an IP address is statically assigned to this MAC address the SINAUT MD741-1 assigns the corresponding IP address to the application.

MAC address of the client – MAC address of the querying local application

IP address of the client – assigned IP address

Factory setting

The factory settings for the SINAUT MD741-1 are as follows:

Start DHCP server	**No**
Local netmask	**255.255.255.0**
Default gateway	**192.168.1.1**
DNS server	**192.168.1.1**
Enable dynamic IP address pool	**No**
DHCP range start	**192.168.1.100**
DHCP range end	**192.168.1.199**

4.3 DNS to local network

The SINAUT MD741-1 provides a domain name server (DNS) to the local network.

If you enter the IP address of the SINAUT MD741-1 in your local application as the domain name server (DNS), then the SINAUT MD741-1 answers the DNS queries from its cache. If it does not know the corresponding IP address for a domain address, then the SINAUT MD741-1 forwards the query to an external domain name server (DNS).

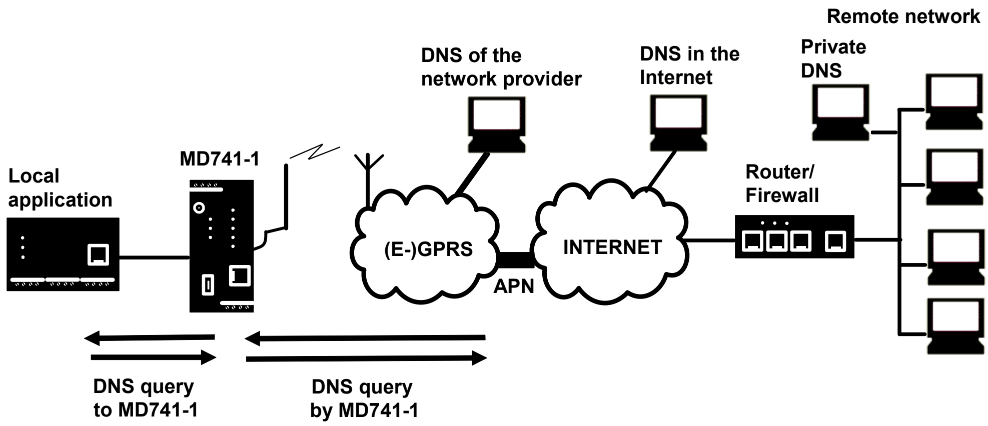


Figure 4-5 DNS function on local interface

The time period for which the SINAUT MD741-1 holds a domain address in the cache depends on the host being addressed. In addition to the IP address, a DNS query to an external domain name server also supplies the life span of this information.

The external domain name server (DNS) used can be a server of the network operator, a server on the Internet, or a server in a private external network.

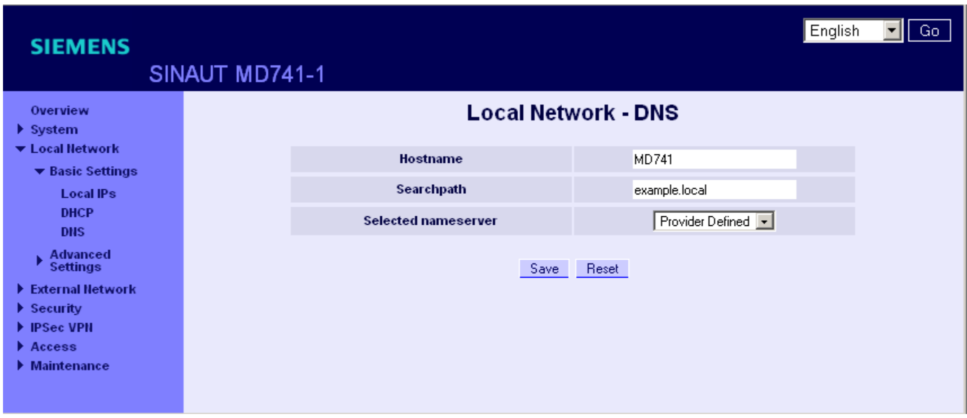


Figure 4-6 Local Network > Basic Settings > DNS

Selected nameserver

Select which domain name server (DNS) the SINAUT MD741-1 should query.

Provider Defined

When a connection is established to EGPRS or GPRS the network operator automatically communicates one or more DNS addresses. These are then used.

User Defined

As the user you select your preferred DNS. The DNSes can be connected to the Internet, or it can be a private DNS in your network.

User defined nameserver

If you have selected the option *User Defined* then enter the IP address of the selected DNS as the *Server IP Address*.

New can be used to add additional DNSes.

Factory setting

The factory settings for the SINAUT MD741-1 are as follows:

Selected nameserver	**Provider Defined**
User defined nameserver	**-**
for new entry	**0.0.0.0**

4.4 Local hostname

The SINAUT MD741-1 can also be addressed from the local network using a host name. To do this, define a host name, e.g. *MD741*.

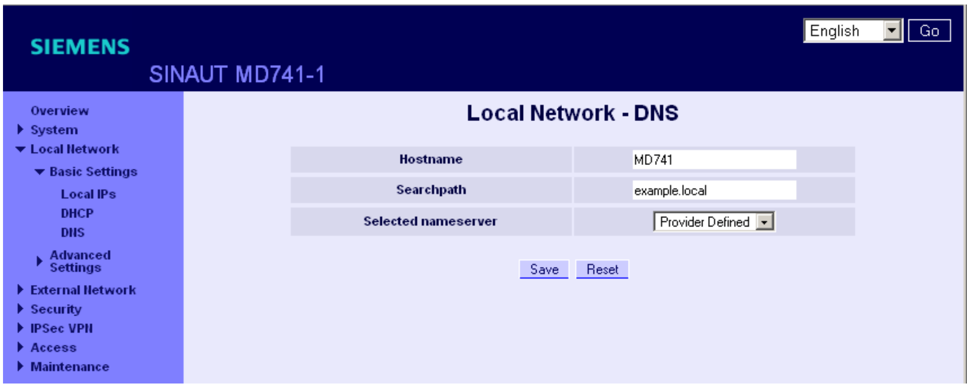


Figure 4-7 Local Network > Basic Settings > DNS

The SINAUT MD741-1 can then be called up, for example from a Web browser as *MD741*.

Note

The security concept of the SINAUT MD741-1 requires the creation of an outgoing firewall rule for each local application that is to use this hostname function. See Chapter 6.1.

If you do not use DHCP (see Chapter 4.2), then identical search paths have to be entered manually in the SINAUT MD741-1 and in the local applications. If you do use DHCP, the local applications received the search path entered in the SINAUT MD741-1 via DHCP.

Factory setting

The factory settings for the SINAUT MD741-1 are as follows:

Searchpath	**example.local**
Hostname	**SINAUT**

4.5 System Time/NTP

This is where you set the system time for the SINAUT MD741-1. This system time is:

- used as a time stamp for all log entries, and
- serves as a time basis for all time-controlled functions.

Select the year, month, day, hour and minute.

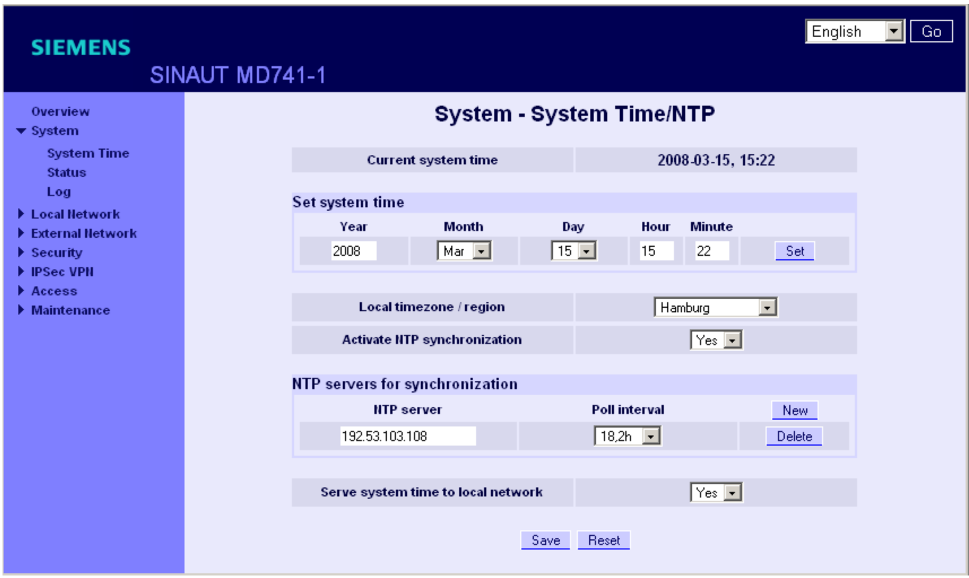


Figure 4-8 System > System Time/NTP

Activate NTP synchronization

The SINAUT MD741-1 can also obtain the system time from a time server via NTP (= *Network Time Protocol*). There are a number of time servers on the Internet that can be used to obtain the current time very precisely via NTP.

Local timezone / region

The NTP time servers communicate the UTC (= *Universal Time Coordinated*). To specify the time zone, select a city near the location near where the SINAUT MD741-1 will be operating. The time in this time zone will then be used as the system time.

NTP server

Click on *New* to add an NTP server, and enter the IP address of such an NTP server, or use the NTP server preset at the factory. You can specify multiple NTP servers at the same time.

It is not possible to enter the NTP address as a hostname (e.g. timeserver.org).

Poll interval

The time synchronization is carried out cyclically. The interval at which synchronization is performed is determined by the SINAUT MD741-1 automatically. A new synchronization will be carried out at least once every 36 hours. The poll interval defines the minimum period that the SINAUT MD741-1 waits until the next synchronization.

Notice

Synchronization of the system time via NTP creates additional data traffic on the EGPRS or GPRS interfaces. This may result in additional costs, depending on your user agreement with the GSM network operator.

Serve system time to local network

The SINAUT MD741-1 can serve itself as an NTP time server for the applications that are connected to its local network interface. To activate this function select *Yes*.

The NTP time server in the SINAUT MD741-1 can be reached via the local IP address set for the SINAUT MD741-1, see Chapter 4.1.

Factory setting

The factory settings for the SINAUT MD741-1 are as follows:

Local timezone	**UTC**
Activate NTP synchronization	**No**
NTP server	**192.53.103.108**
Poll interval	**1.1 hours**
Serve system time to local network	**No**

4.6 Additional Internal Routes

If the local network is subdivided into subnetworks, you can define additional routes.

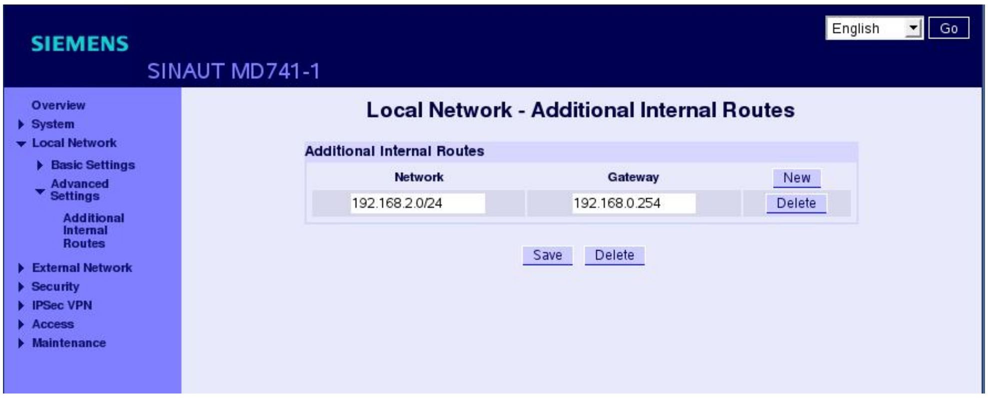


Figure 4-9 Local Networks - Additional Internal Rotes

See also the Glossary.

To define an additional route to a subnetwork, click on *New*.

Specify the following:

- the IP address of the subnetwork (network), and also
- the IP address of the gateway via which the subnet is connected.

You can define any desired number of internal routes.

To delete an internal route, click on *Delete*.

Factory setting

The factory settings for the SINAUT MD741-1 are as follows:

Additional Internal Routes	**-**
Default for new routes:	**No**
Network:	**192.168.2.0/24**
Gateway:	**192.168.0.254**

External interface 5

The external interface of the SINAUT MD741-1 connects the SINAUT MD741-1 to the external network. EGPRS, GPRS or GSM are used for the communication at this interface.

External networks are the Internet or a private intranet.

External remote stations are network components in an external network, e.g. Web servers on the Internet, routers on an intranet, a central company server, an Admin PC, and much more.

Configure the external interface and the related functions according to the your requirements and the advices in this chapter.

5.1 Access parameters to EGPRS/GPRS

The SINAUT MD741-1 uses EGPRS or GPRS for communication with the external network. For access to the services EGPRS and GPRS and to the underlying GSM wireless network, access parameters are necessary, which you will receive from your GSM network operator.

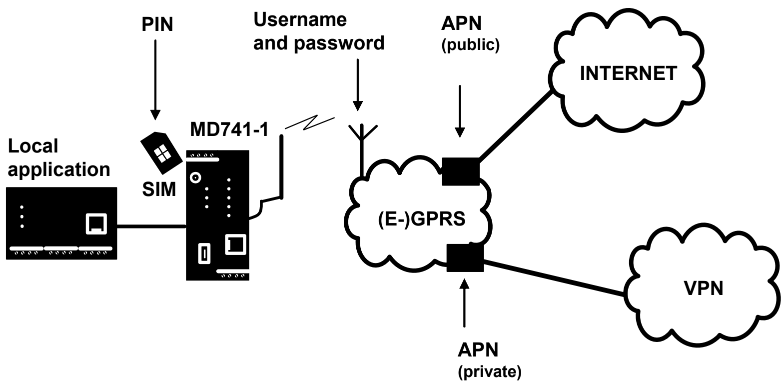


Figure 5-1 Access parameters to EGPRS/GPRS

The PIN protects the SIM card against unauthorised use. The user name and password protect the access to EGPRS and GPRS and the APN (Access Point Name) defines the transition from EGPRS or GPRS to additional connected IP networks, for example a public APN to the Internet or a private APN to a virtual private network (VPN).

Provider selection mode - manual

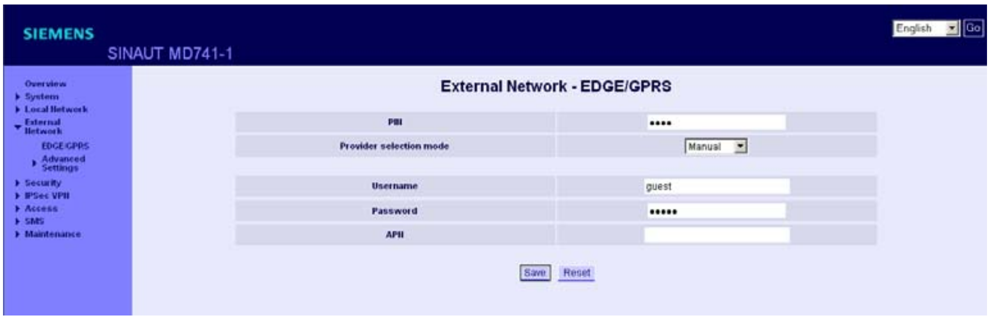


Figure 5-2 External Network > EDGE/GPRS - Provider selection mode - manual

If you select *Manual* as the provider selection mode, enter the user name, password and APN for the GPRS service manually.

Provider selection mode - Automatic

Figure 5-3 External Network > EDGE/GPRS - Provider selection mode - Automatic

If you select *Automatic* as the provider selection mode, the access data for the GPRS service is selected automatically from the list of providers based on the Net ID of the SIM card. You can create several entries in the list.

Note

Only the standard APNs of the providers are entered automatically!

With *New*, you add a new entry. With *Delete*, you remove the entries.

PIN

Enter the PIN for your SIM card here. You will receive the PIN from your network operator.

The SINAUT MD741-1 also works with SIM cards that have no PIN; in this case enter ***NONE***. In this case the input box is left empty.

Note

If no entry is made, the input box for the PIN is shown with a red outline after saving.

Provider (only for the provider selection *Automatic*)

Here, you can enter any text of your choice to name the GPRS service, such as the name of the provider (for example Vodafone, Eplus, my GPRS access).

Net-ID (only for the provider selection *Automatic*)

Here, enter the identification number (Net-ID) of the network provider. Each GSM/GPRS network provider has an assigned identification number that is unique worldwide known as the Public Land Mobile Network (PLMN). PLMN is made up of (MCC) and (MNC). You will find the Net-ID in the documentation provided by your GSM/GPRS network provider or on the provider's Internet pages.

The Net-ID is stored on the SIM card. The SINAUT MD741-1 reads the Net-ID from the SIM card and selects the corresponding GPRS access data from the list of providers.

User name

Enter the user name for EGPRS and GPRS here. Some GSM/GPRS network operators do not use access control with user names and/or passwords. In this case enter *guest* in the corresponding box.

Password

Enter the password for EGPRS and GPRS here. Some GSM/GPRS network operators do not use access control with user names and/or passwords. In this case enter *guest* in the corresponding box.

APN

Enter the name of the transition from EGPRS and GPRS to other networks here.

You can find the APN in your GSM/GPRS network operator's documentation, on your operator's Website, or ask your operator's hotline.

Factory settings

The factory settings of the SINAUT MD741-1 are as follows:

Provider selection mode	**Manual**
Provider selection mode - manual	
PIN	**NONE**
User name	**guest**
Password	**guest**
APN	**NONE**
Provider selection mode - Automatic	
1st provider	**T-Mobile**
Net-ID	**26201**
User name	**guest**
Password	**guest**
APN	**internet.t-mobile**
2nd provider	**Vodafone**
Net-ID	**26202**
User name	**guest**
Password	**guest**
APN	**web.vodafone.de**
3rd provider	**Eplus**
Net-ID	**26203**
User name	**guest**
Password	**guest**
APN	**internet.eplus.de**
4th provider	**O2**
Net-ID	**26207**
User name	**guest**
Password	**guest**
APN	**internal**

nth provider	**O2**
Net-ID	**NONE**
User name	**NONE**
Password	**NONE**
APN	**NONE**

5.2 EGPRS/GPRS Connection Monitoring

With the function *Connection Check* the SINAUT MD741-1 checks its connection to EGPRS or GPRS and to the connected external networks, such as the Internet or an intranet. To do this, the SINAUT MD741-1 sends ping packets (ICMPs) to up to four remote stations (target hosts) at regular intervals. This takes place independently of the user data connections. If after such a ping the SINAUT MD741-1 receives a response from at least one of the remote stations addressed, then the SINAUT MD741-1 is still connected with the EGPRS or GPRS and ready for operation.

Some *network operators* interrupt connections when they are inactive. This is likewise prevented by the *Connection Check* function.

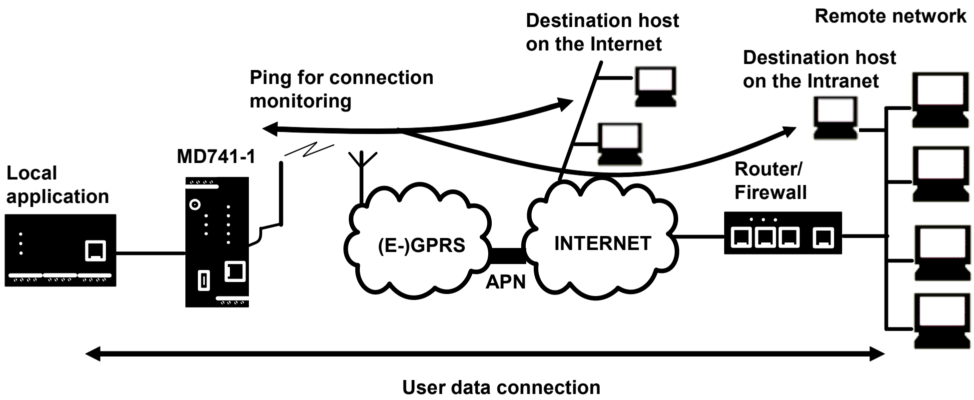


Figure 5-4 Connection Monitoring

Notice

Sending ping packets (ICMPs) increases the amount of data sent and received via EGPRS or GPRS. This can lead to increased costs.

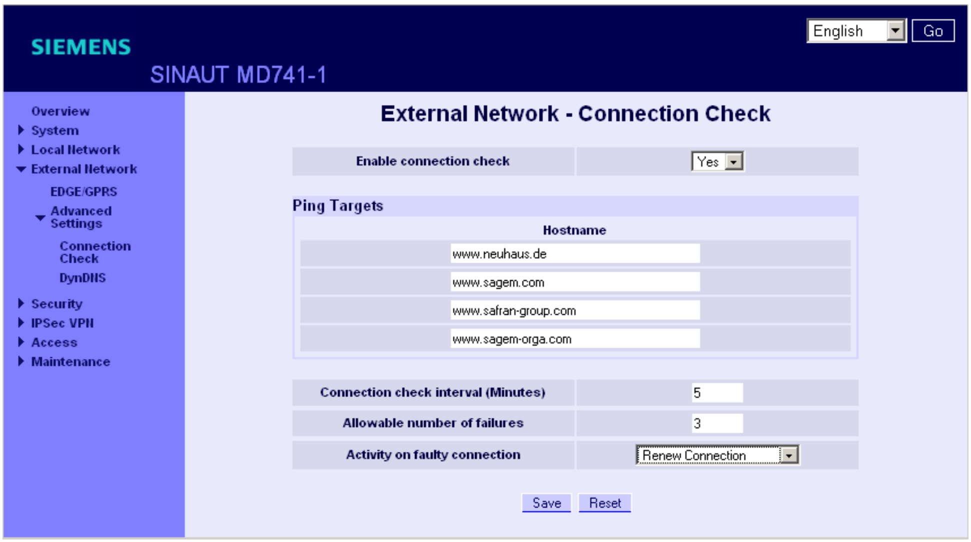


Figure 5-5 External Network > Connection Check

Enable connection check

Yes activates the function.

Ping Targets – Hostname

Select up to four remote stations that the SINAUT MD741-1 can ping. The remote stations must be available continuously and must answer pings.

Note

Make sure that the selected remote stations will not be disturbed.

Connection check interval (minutes)

Specifies the interval at which the connection check ping packets are sent by the SINAUT MD741-1. This is specified in minutes.

Allowable number of failures

Specifies how many times it is allowed for all ping packets of an interval not to receive an answer, i.e. for none of four pinged remote stations to answer, before the specified action is carried out.

Activity on faulty connection

Renew Connection

The SINAUT MD741-1 re-establishes the connection to EGPRS or GPRS if the ping packets sent were not answered.

Reboot MD741-1

The SINAUT MD741-1 carries out a reboot if the ping packets sent were not answered.

Factory setting

The factory settings for the SINAUT MD741-1 are as follows:

Enable connection check	**No (switched off)**
Hostname	**-**
Connection check interval	**5 (minutes)**
Allowable number of failures	**3 (failed attempts)**
Activity on faulty connection	**Renew Connection**

5.3 Hostname via DynDNS

Dynamic domain name servers (DynDNS) make it possible for applications to be accessible on the Internet under a hostname (e.g. myHost.org), even if these applications do not have a fixed IP address and the hostname is not registered. If you log the SINAUT MD741-1 on to a DynDNS service, you also can reach the SINAUT MD741-1 from external network under a hostname, e.g. mySINAUT.dyndns.org.

For more information on DynDNS see the Glossary.

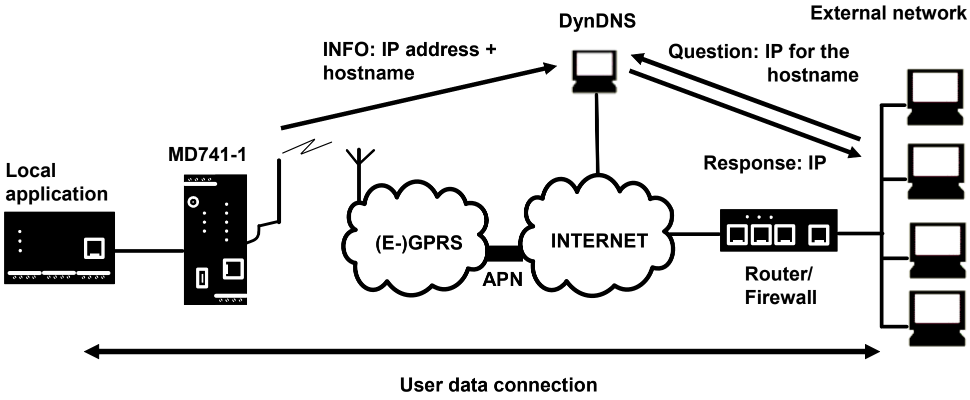


Figure 5-6 DynDNS Function

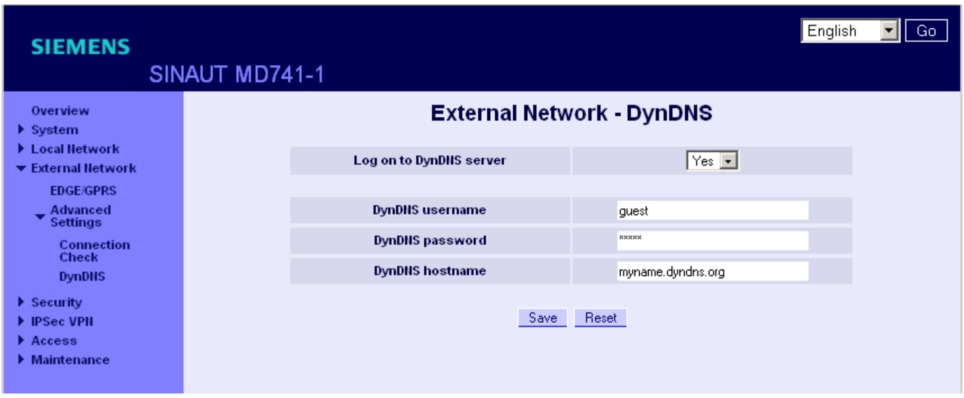


Figure 5-7 External Network > DynDNS

Log this SINAUT MD741-1 on to a DynDNS server

Select *Yes* if you want to use a DynDNS service.

DynDNS provider

The SINAUT MD741-1 is compatible to dyndns.org.

DynDNS username / password

Enter here the username and the password that authorise you to use the DynDNS service. Your DynDNS provider will give you this information.

DynDNS hostname

Here enter the hostname that you have agreed with your DynDNS provider for the SINAUT MD741-1, e.g. myMD741.dyndns.org.

Factory setting

The factory settings for the SINAUT MD741-1 are as follows:

Log the MD741-1 on to DynDNS server	**No (switched off)**
DynDNS username	**guest**
DynDNS password	**guest**
DynDNS hostname	**myname.dyndns.org**

5.4 SRS – Siemens Remote Service

Note

Using the services provided by the "SIMATIC Remote Support Services", remote access to machines and plants is available.

To use the services, additional service agreements are necessary and certain constraints must be kept to. If you are interested in the Siemens Remote Service, speak to your local Siemens contact.

If the Siemens Remote Service is activated, the SINAUT MD741-1 transfers its external IP address assigned by the EDGE/GPRS service to a selectable destination server. This transfer is made using the secure HTTPS protocol.

The procedure is comparable with the DynDNS service and requires suitable access to the server.

Figure 5-8 External Network > Advanced Settings > DynDNS

With *New*, you add a new destination server. With *Delete*, you remove existing entries.

Use Siemens Remote Service

Select *Yes* if you want to use Siemens Remote Service.

If you do not want to use the Siemens Remote Service, select *No*.

Refresh interval

Enter the interval in seconds at which the assigned IP address of the SINAUT MD741-1 is transferred to the selected destination server.

Siemens Remote Service Accounts

Here, enter the destination address and access data of one or more destination servers:

Remote host

Enter the IP address of the destination server.

Group

Enter the group name.

Username

Enter the user name for access to the destination server.

Password

Enter the password for access to the destination server.

Factory settings

The factory settings of the SINAUT MD741-1 are as follows:

Use Siemens Remote Service	**No** (turned off)
Refresh interval	**900 seconds**
Destination address	**0.0.0.0**
Group	**group**
Username	**user**
Password	**pass**

Security functions 6

6.1 Packet Filter

The SINAUT MD741-1 contains a stateful inspection firewall.

A stateful inspection firewall is a packet filtering method. Packet filters only let IP packets through if this has been defined previously using firewall rules. The following is defined in the firewall rules:

- which protocol (TCP, UDP, ICMP) can go through,
- the permitted source of the IP packets (From IP / From port)
- the permitted destination of the IP packets (To IP / To port)

It is likewise defined here what will be done with IP packets that are not allowed through (discard, reject).

For a simple packet filter it is always necessary to create two firewall rules for a connection:

- One rule for the query direction from the source to the destination, and
- a second rule for the query direction from the destination to the source.

It is different for a SINAUT MD741-1 with a stateful inspection firewall. Here a firewall rule is only created for the query direction from the source to the destination. The firewall rule for the response direction from the destination to the source results from analysis of the data previously sent. The firewall rule for the responses is closed again after the responses are received or after a short time period has elapsed. Thus responses can only go through if there was a previous query. This means that the response rule cannot be used for unauthorised access. What is more, special procedures make it possible for UDP and ICMP data to also go through, even though these data were not requested before.

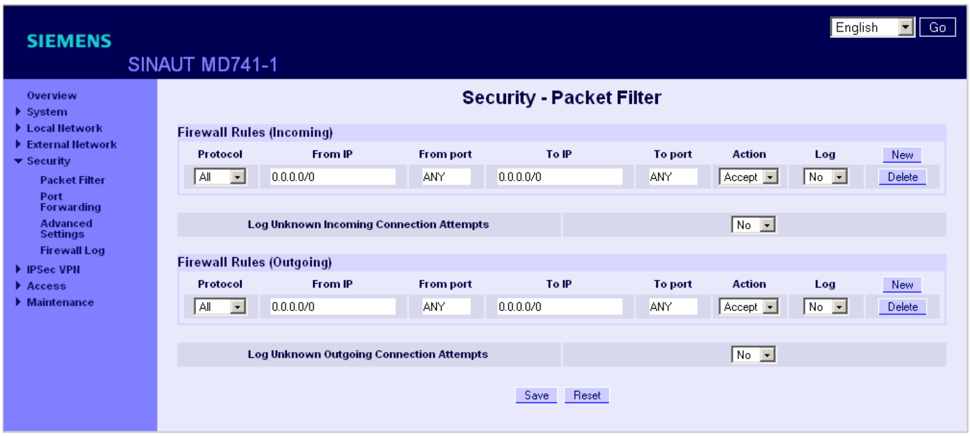


Figure 6-1 Security > Packet Filter

Firewall Rules (Incoming)

The Firewall Rules (Incoming) are used to define how to handle IP packets that are received from external networks (e.g. the Internet) via EGPRS or GPRS. The source is the sender of this IP packet. The destination is the local applications on the SINAUT MD741-1.

In the factory setting, no incoming firewall rule is set initially, i.e. no IP packets can go through.

New

Adds an additional firewall rule that you can then fill out.

Delete

Removes firewall rules that have been created.

Protocol

Select the protocol for which this rule will be valid. The following selections are available: *TCP, UDP, ICMP*. If you select *All*, the rule is valid for all three protocols.

From IP

Enter the IP address of the external remote station that is allowed to send IP packets to the local network. Do this by specifying the IP address or an IP range for the remote station. ***0.0.0.0/0*** means all addresses.

To specify a range, use the CIDR notation - see the Glossary.

From port

Enter the port from which the external remote station is allowed to send IP packets. (is only evaluated for the protocols TCP and UDP)

To IP

Enter the IP address in the local network to which IP packets may be sent. Do this by specifying the IP address or an IP range of the application in the local network. ***0.0.0.0/0*** means all addresses.

To specify a range, use the CIDR notation - see the Glossary.

To port

Enter the port to which the external remote station is allowed to send IP packets.

Action

Select how incoming IP packets are to be handled:

Accept – The data packets can go through,

Reject – The data packets are rejected, and the sender receives a corresponding message.

Drop – The data packets are discarded without any feedback to the sender.

Firewall Rules (Outgoing)

The Firewall Rules (Outgoing) are used to define how to handle IP packets that are received from the local network. The source is an application in the local network. The destination is an external remote station, e.g. on the Internet or in a private network.

In the factory setting, no outgoing firewall rule is set initially, i.e. no IP packets can go through.

New

Adds an additional firewall rule that you can then fill out.

Protocol

Select the protocol for which this rule will be valid. The following selections are available: *TCP, UDP, ICMP*. If you select *All*, the rule is valid for all three protocols.

From IP

Enter the IP address of the local application that is allowed to send IP packets to the external network. Do this by specifying the IP address or an IP range for the local application. ***0.0.0.0/0*** means all addresses.

To specify a range, use the CIDR notation - see the Glossary.

From port

Enter the port from which the local network is allowed to send IP packets. Do this by specifying the port number.
(is only evaluated for the protocols TCP and UDP)

To IP

Enter the IP address in the external network to which IP packets may be sent. Do this by specifying the IP address or an IP range of the application in the network. ***0.0.0.0/0*** means all addresses.

To specify a range, use the CIDR notation - see the Glossary.

To port

Enter the port to which the external remote station is allowed to send IP packets. Do this by specifying the port number.
(is only evaluated for the protocols TCP and UDP)

Action

Select how outgoing IP packets are to be handled:

Accept – The data packets can go through,

Reject – The data packets are rejected, and the sender receives a corresponding message.

Drop – The data packets are discarded without any feedback to the sender.

Firewall Rules Incoming / Outgoing

Log

For each individual firewall rule you can define whether the event should be

- logged when the rule takes effect - set Log to Yes
- or not - set Log to No (factory setting)

The log is kept in the firewall log, see Chapter 6.4.

Log Unknown Connection Attempts

This logs all connection attempts that are not covered by the defined rules.

Factory setting

The factory settings for the SINAUT MD741-1 are as follows:

Incoming firewall

Firewall Rules (Incoming)	**- (Everything blocked)**
Protocol	**All**
From IP	**0.0.0.0/0**
From port	**Any**
To IP	**0.0.0.0/0**
To port	**Any**
Action	**Accept**
Log	**No (switched off)**
Log Unknown Connection Attempts	**No (switched off)**

Outgoing firewall

Firewall Rules (Outgoing)	**- (Everything blocked)**
Protocol	**All**
From IP	**0.0.0.0/0**
From port	**Any**
To IP	**0.0.0.0/0**
To port	**Any**
Action	**Accept**
Log	**No (switched off)**
Log Unknown Connection Attempts	**No (switched off)**

6.2 Port Forwarding

If a rule has been created for port forwarding, then data packets received at a defined IP port of the SINAUT MD741-1 from the external network will be forwarded. The incoming data packets are then forwarded to a specified IP address and port number in the local network. The port forwarding can be configured for TCP or UDP.

In port forwarding the following occurs: The header of incoming data packets from the external network that are addressed to the external IP address of the SINAUT MD741-1 and to a specific port are adapted so that they are forwarded to the internal network to a specific computer and to a specific port of that computer. This means that the IP address and port number in the header of incoming data packets are modified.

This process is also called Destination NAT or Port Forwarding.

Note

In order for incoming data packets to be forwarded to the defined IP address in the local network, a corresponding incoming firewall rule must be set up for this IP address in the packet filter. See Chapter 6.1.

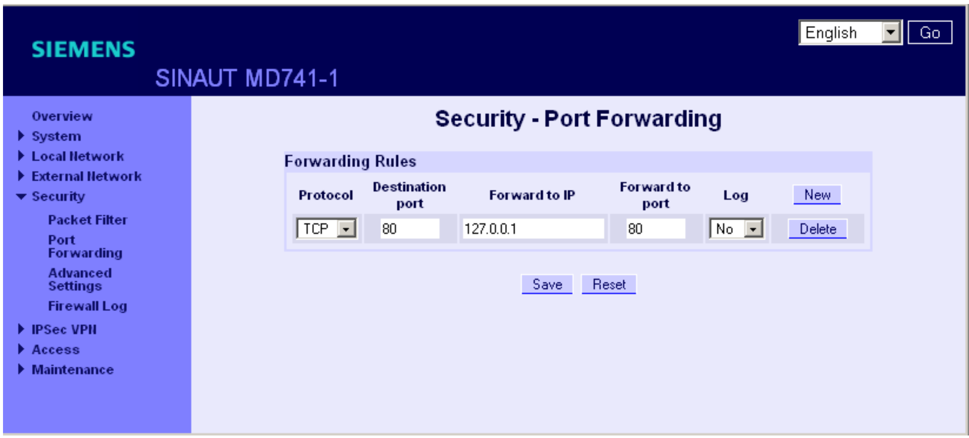


Figure 6-2 Security > Port Forwarding

New

Adds a new forwarding rule that you can then fill out.

Delete

Removes forwarding rules that have been created.

Protocol

Specify here the protocol (TCP or UDP) to which the rule should refer.

Destination port

Specify here the port number (e.g. 80) at which the data packets which are to be forwarded arrive from the external network.

Forward to IP

Specify here the IP address in the local network to which the incoming data packets should be forwarded.

Forward to port

Specify here the port number (e.g.) for the IP address in the local network to which the incoming data packets should be forwarded.

Log

For each port forwarding rule you can define whether the event should be

- logged when the rule takes effect - set Log to Yes
- or not - set Log to No (factory setting)

The log is kept in the firewall log, see Chapter 6.4.

Factory setting

The factory settings for the SINAUT MD741-1 are as follows:

Forwarding Rules	**-**
Protocol	**All**
Destination port	**80**
Forward to IP	**127.0.0.1**
Forward to port	**80**
Log	**No (switched off)**

6.3 Advanced security functions

The advanced security functions serve to protect the SINAUT MD741-1 and the local applications against attacks. For protective purposes it is assumed that only a certain number of connections or received PING packets are permissible and desirable in normal operation, and that a sudden burst represents an attack.

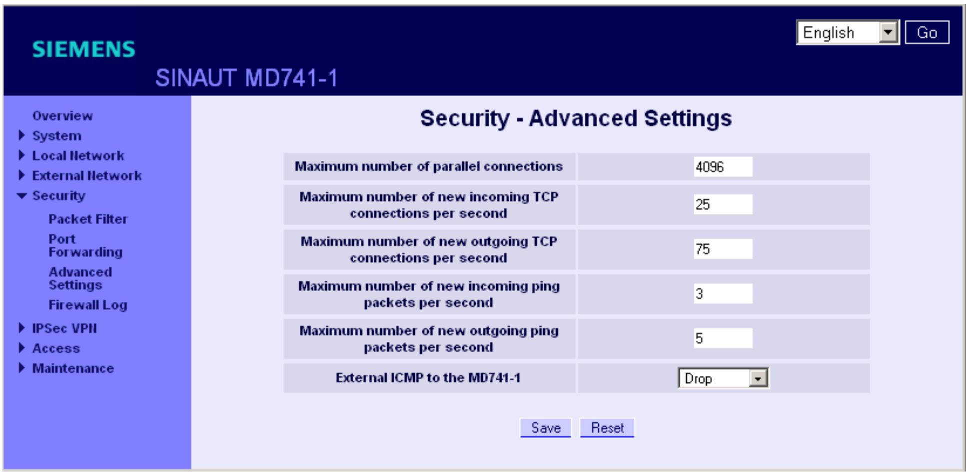


Figure 6-3 Security > Advanced Settings

Maximum number …

The entries

- Maximum number of parallel connections
- Maximum number of new incoming TCP connections per second
- Maximum number of new outgoing TCP connections per second
- Maximum number of new incoming ping packets per second
- Maximum number of new outgoing ping packets per second

set the upper limits. The settings (see illustration) have been selected so that they will in practice never be reached in normal use. In the event of an attack, however, they can be reached very easily, which means that the limitations constitute additional protection. If your operating environment contains special requirements, then you can change the values accordingly.

External ICMP to the SINAUT MD741-1

You can use this option to affect the response when ICMP packets are received that are sent from the external network in the direction of the SINAUT MD741-1. You have the following options:

- *Drop*: All ICMP packets to the SINAUT MD741-1 are discarded.

- *Allow Ping:* Only ping packets (ICMP type 8) to the SINAUT MD741-1 are accepted.
- *Accept*: All types of ICMP packets to the SINAUT MD741-1 are accepted.

Factory setting

The factory settings for the SINAUT MD741-1 are as follows:

Maximum number of parallel connections	**4096**
Maximum number of new incoming TCP connections per second	**25**
Maximum number of new outgoing TCP connections per second	**75**
Maximum number of new incoming ping packets per second	**3**
Maximum number of new outgoing ping packets per second	**5**
External ICMP to the MD741-1	**Drop**

6.4 Firewall Log

The application of individual firewall rules is recorded in the firewall log. To do this, the LOG function must be activated for the various firewall functions.

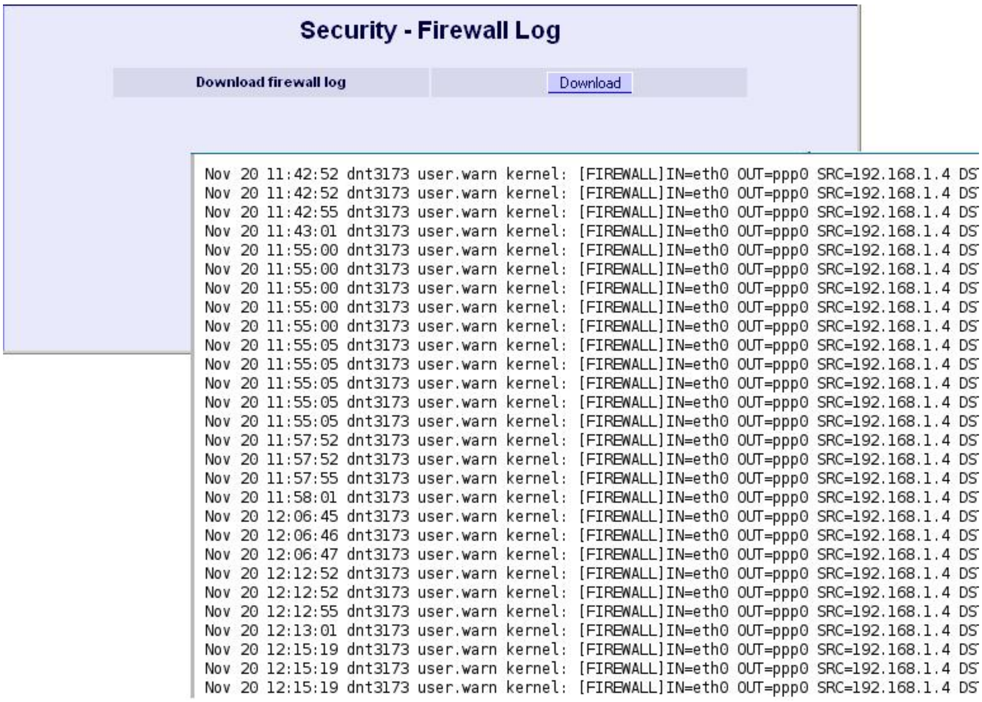


Figure 6-4 Security > Firewall Log

Caution

The firewall log is lost in the event of a reboot.

VPN connection 7

The SINAUT MD741-1 can connect the local network to a friendly remote network via a VPN tunnel. The IP data packets that are exchanged between the two networks are encrypted, and are protected against unauthorised tampering by the VPN tunnel. This means that even unprotected public networks like the Internet can be used to transfer data without endangering the confidentiality or integrity of the data.

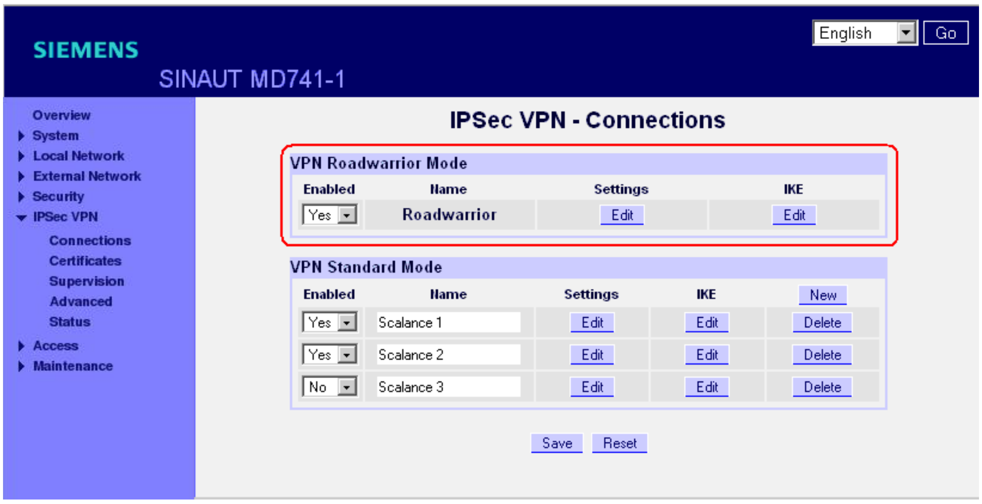


Figure 7-1 IPsec VPN > Connections

For the SINAUT MD741-1 to establish a VPN tunnel, the remote network must have a VPN gateway as the remote station for the SINAUT MD741-1.

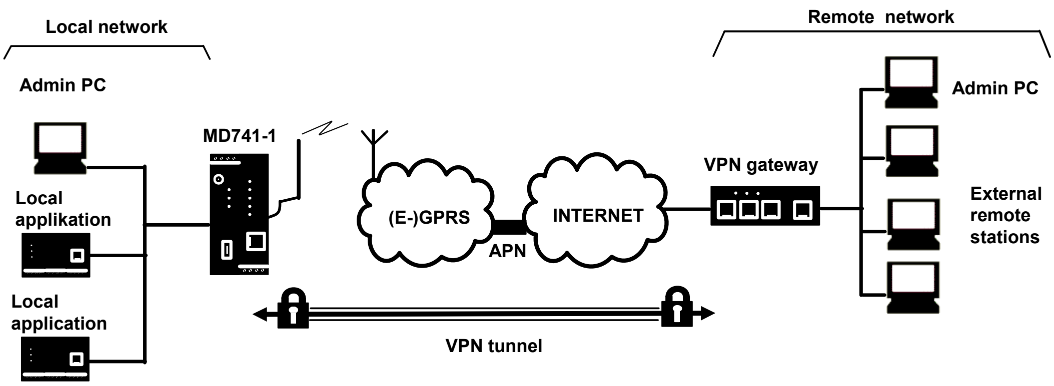


Figure 7-2 IPsec VPN - Connections

For the VPN tunnel, the SINAUT MD741-1 uses the IPsec method in tunnel mode. In this method the IP data packets to be transmitted are completely encrypted and provided with a new header before they are sent to the remote station's VPN gateway. There the data packets are received, decrypted, and used to reconstruct the original data packets. These are then forwarded to their destination in the remote network.

Differences between two VPN connection modes:

- In VPN Roadwarrior Mode the SINAUT MD741-1 VPN can accept connections from remote stations with an unknown address. These can be, for example, remote stations in mobile use that obtain their IP address dynamically.
  The VPN connection must be established by the remote station. Only one VPN connection is possible in Roadwarrior Mode. VPN connections in Standard Mode can be used at the same time.

- In VPN Standard Mode the address (IP address or hostname) of the remote station's VPN gateway must be known for the VPN connection to be established. The VPN connection can be established either by the SINAUT MD741-1 or by the remote station's VPN gateway as desired.

Establishment of the VPN connection is subdivided into two phases: First in Phase 1 (ISAKMP = Internet Security Association and Key Management Protocol) the Security Association (SA) for the key exchange between the SINAUT MD741-1 and the VPN gateway of the remote station is established.

After that in Phase 2 (IPsec = Internet Protocol Security) the Security Association (SA) for the actual IPsec connection between the SINAUT MD741-1 and the remote station's VPN gateway is established.

Requirements for the remote network's VPN gateway

In order to successfully establish an IPsec connection, the VPN remote station must support IPsec with the following configuration:

- Authentication via X.509 certificates, CA certificates or pre-shared key (PSK)
- ESP
- Diffie-Hellman group 1, 2 or 5
- 3DES or AES encryption
- MD5 or SHA-1 hash algorithms
- Tunnel Mode
- Quick Mode
- Main Mode
- SA Lifetime (1 second to 24 hours)

If the remote station is a computer running under Windows 2000, then the Microsoft Windows 2000 High Encryption Pack or at least Service Pack 2 must also be installed.

If the remote station is on the other side of a NAT router, then the remote station must support NAT-T. Or else the NAT router must know the IPsec protocol (IPsec/VPN passthrough).

7.1 VPN Roadwarrior Mode

The Roadwarrior Mode makes it possible for the SINAUT MD741-1 to accept a VPN connection initiated by a remote station with an unknown IP address. The remote station must authenticate itself properly; in this VPN connection there is no identification of the remote station based on the IP address or the hostname of the remote station.

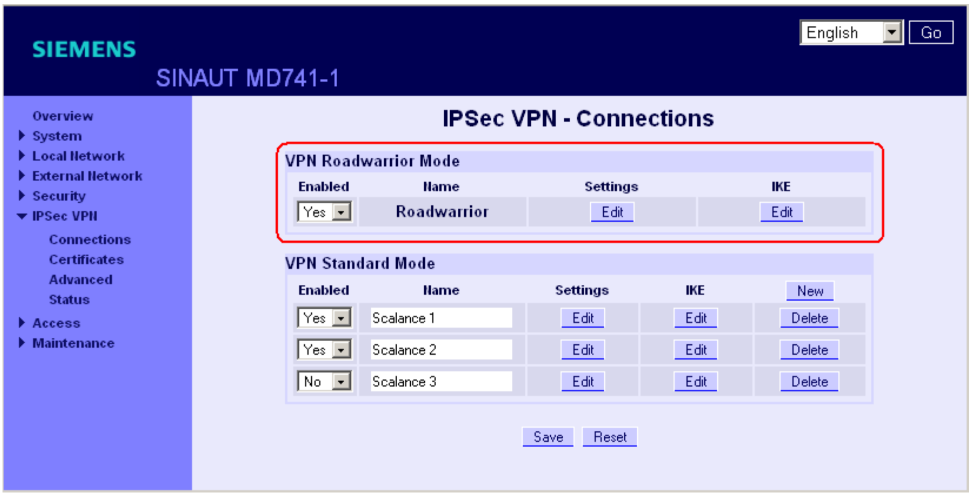


Figure 7-3 IPsec VPN > Connections

Set the SINAUT MD741-1 up in accordance with what has been agreed with the system administrator of the remote station.

Roadwarrior Mode Edit Settings

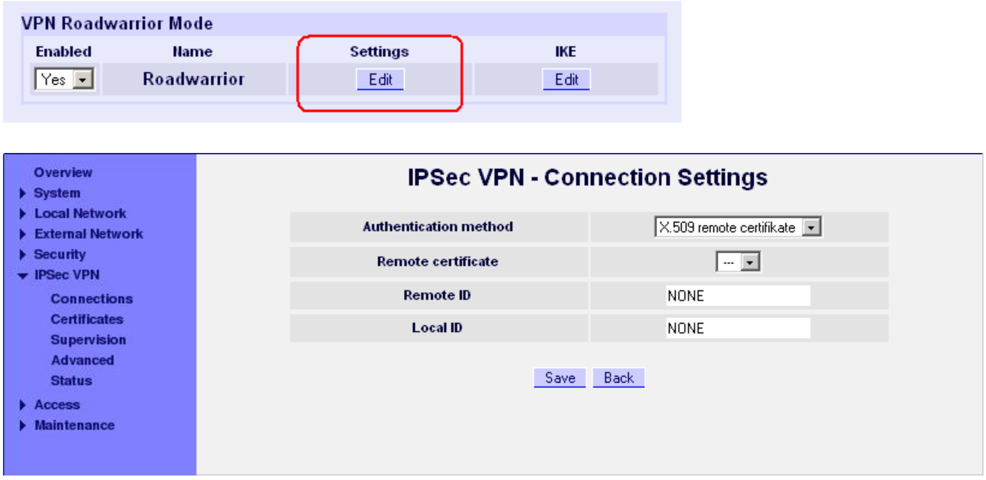


Figure 7-4 IPsec VPN > Connection Settings

Authentication method

Select the authentication method in accordance with what you have agreed with the system administrator of the remote station.

The SINAUT MD741-1 supports three methods:

- X.509 certificate
- CA certificate
- Pre-shared key

X.509 certificate, CA certificate

In the authentication methods X.509 certificate and CA certificate, the keys used for authentication have first been signed by a Certification Authority (CA). This method is considered especially secure. A CA can be a service provider, but also, for example, the system administrator for your project, provided that he has the necessary software tools.

The CA creates a certificate file (PKCS12) with the file extension *p12 for each of the two remote stations. This certificate file contains the public and private keys for the own station, the signed certificate from the CA, and the public key of the CA. For the authentication method X.509 there is additionally a key file (*.pem, *cer or *.crt) for each of the two remote stations with the public key of the own station.

X.509 certificate

The public keys (files with extension *.pem, *cer or *.crt) are exchanged between the SINAUT MD741-1 and the remote station's VPN gateway takes place manually, for example on a CD-ROM or vie e-mail. To load the certificate, proceed as described in Chapter 7.3.

CA certificate

The public keys are exchanged between the SINAUT MD741-1 and the remote station's VPN gateway via the data connection when the VPN connection is established. Manual exchange of the key files is not necessary.

Pre-shared secret key (PSK)

This method is primarily supported by older IPsec implementations. Here authentication is performed with a character string agreed on beforehand. In order to obtain high security, the character string should consist of about randomly-selected 30 lower-case and upper-case letters and numerals.

Remote certificate

If you have selected X.509 certificate as the authentication method, then a list of the remote certificates that you have already loaded into the SINAUT MD741-1 is displayed here. Select the certificate for the VPN connection.

Remote ID, Local ID

The Local ID and the Remote ID are used by IPsec to identify the remote stations uniquely when establishing the VPN connection. The own Local ID constitutes the Remote ID of the remote station and vice versa.

For authentication with X.509 certificate or CA certificate:

- If you keep the factory setting *NONE*, then the Distinguished Names from the own certificate and from the certificate communicated by the remote station are automatically used as the Local ID and Remote ID.
- If you manually change the entry for the Local ID or the Remote ID, then the corresponding entries must be adapted at the remote station. The manual entry for Local or Remote ID must be made in the ASN.1 format, e.g. "C=XY/O=XY Org/CN=xy.org.org"

For authentication with pre-shared secret key (PSK):

- In Roadwarrior Mode the Remote ID must be entered manually. The Remote ID must have the format of a hostname (e.g. RemoteStation.de) or the format of an e-mail address (remote@station.de), and must be the same as the Local ID of the remote station.
  The Local ID can be left on *NONE*. In this case the IP address is used as the local IP address. If you enter a Local ID; then it must have the format of a hostname (e.g. RemoteStation.de) or the format of an e-mail address (remote@station.de), and must be the same as the Local ID of the remote station.

Roadwarrior Mode Edit IKE

Here you can define the properties of the VPN connection according to your requirements and what you have agreed with the system administrator of the remote station.

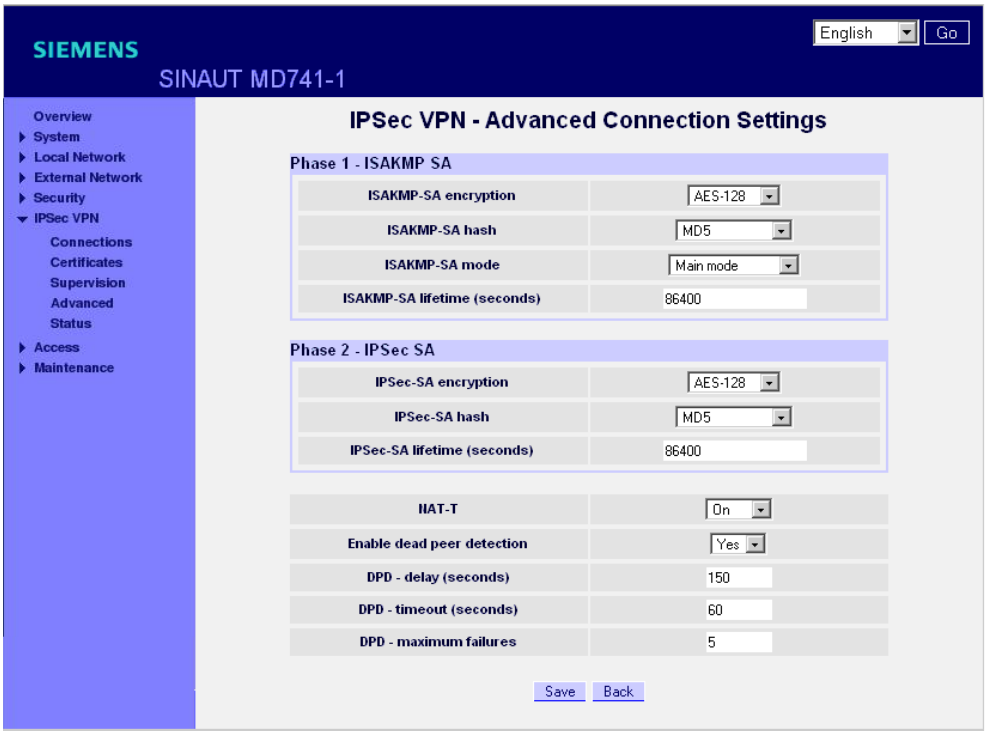


Figure 7-5 IPsec VPN > Edit IKE

ISAKMP-SA encryption, IPsec-SA encryption

Agree with the administrator of the remote station which encryption method will be used for the ISAKMP-SA and the IPsec-SA. The SINAUT MD741-1 supports the following methods:

- 3DES-168
- AES-128
- AES-192
- AES-256

3DES-168 is a commonly used method and is therefore set as the default.

The method can be defined differently for ISAKMP-SA and IPsec-SA.

Note:

The more bits in the encryption algorithm - indicated by the appended number - the more secure it is. The method AES-256 is therefore considered the most secure. However, the longer the key, the more time the encryption process takes and the more computing power is required.

ISAKMP-SA hash, IPsec-SA hash

Agree with the administrator of the remote station which method will be used for computing checksums/hashes during the ISAKMP phase and the IPsec phase. The following selections are available:

- MD5 or SHA-1 (automatic detection)
- MD5
- SHA-1

The method can be defined differently for ISAKMP-SA and IPsec-SA.

ISAKMP-SA mode

Agree with the administrator of the remote station which method will be used for negotiating the ISAKMP-SA. The following selections are available:

- Main mode
- Aggressive mode

Note:

When the authentication method Pre-Shared Key is used, Aggressive mode must be set in Roadwarrior mode.

ISAKMP-SA lifetime, IPsec-SA lifetime

The keys for an IPsec connection are renewed at certain intervals in order to increase the effort required to attack an IPsec connection.

Specify the lifetime (in seconds) of the keys agreed on for the ISAKMP-SA and IPsec-SA.

The lifetime can be defined differently for ISAKMP-SA and IPsec-SA.

NAT-T

There may be a NAT router between the SINAUT MD741-1 and the VPN gateway of the remote network. Not all NAT routers allow IPsec data packets to go through. It may therefore be necessary to encapsulate the IPsec data packets in UDP packets so that they can go through the NAT router.

On:

If the SINAUT MD741-1 detects a NAT router that does not let the IPsec data packets through, then UDP encapsulation is started automatically.

Force:

During negotiation of the connection parameters for the VPN connection, encapsulated transmission of the data packets during the connection is insisted upon.

Off:

The NAT-T function is switched off.

Enable dead peer detection

If the remote station supports the dead peer detection (DPD) protocol, then the partner in question can detect whether the IPsec connection is still valid or not, meaning that it may have to be re-established. Without DPD, depending on the configuration it may be necessary to wait until the SA lifetime elapses or the connection has to be re-initiated manually. To check whether the IPsec connection is still valid, the dead peer detection sends DPD requests to the remote station itself. If there is no answer, then after the permitted number of failed attempts the IPsec connection is considered to be interrupted.

Notice

Sending DPD requests increases the amount of data sent and received via EGPRS or GPRS. This can lead to increased costs.

Yes

Dead peer detection is switched on. Independently of the transmission of user data, the SINAUT MD741-1 detects if the connection is lost, in which case it waits for the connection to be re-established by the remote stations.

No

Dead peer detection is switched off.

DPD - delay (seconds)

Time period in seconds after which DPD requests will be sent. These requests test whether the remote station is still available.

DPD - timeout (seconds)

Time period in seconds after which the connection to the remote station will be declared dead if no response has been made to the DPD requests.

DPD - maximum failures

Number of failed attempts permitted before the IPsec connection is considered to be interrupted.

Factory setting

The factory settings for the SINAUT MD741-1 are as follows:

Name	**Any**
Enabled	**No (switched off)**
Authentication method	**CA certificate**
Remote ID	**NONE**
Local ID	**NONE**
Remote certificate	**-**
ISAKMP-SA encryption	**3DES-168**
IPsec-SA encryption	**3DES-168**
ISAKMP-SA hash	**MD5**
IPsec-SA hash	**MD5**
ISAKMP-SA mode	**Main**
ISAKMP-SA lifetime (seconds)	**86400**
IPsec-SA lifetime (seconds)	**86400**
NAT-T	**On**
Enable dead peer detection	**Yes**
DPD - delay (seconds)	**150**
DPD – timeout (seconds)	**60**
DPD – maximum failures	**5**

7.2 IPsec VPN Standard Mode

The VPN connections already created are shown. You can enable (Enabled = *Yes*) or disable (Enabled = *No*) each individual connection. You can use *New* to add additional VPN connections, *Edit Settings* and *Advanced Settings* to set them up, and *Delete* to remove a connection.

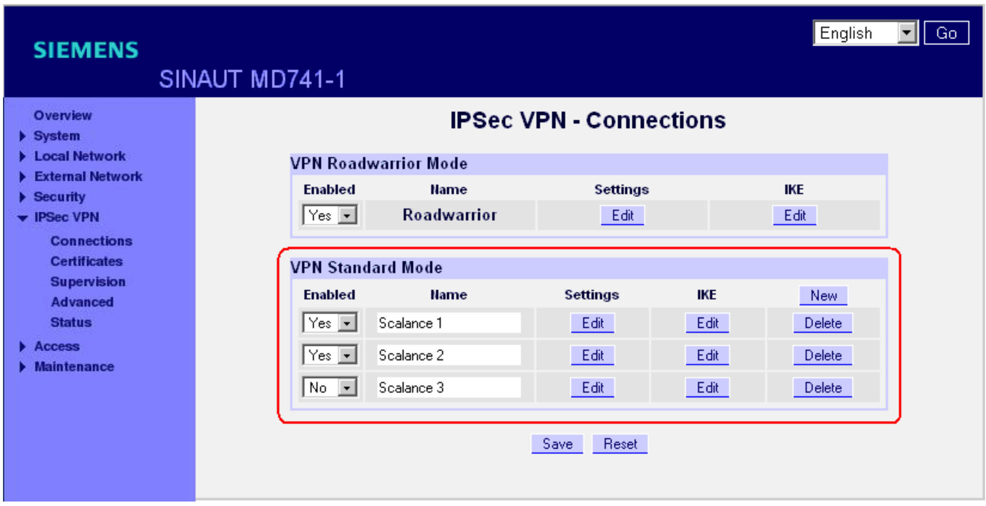


Figure 7-6 IPsec VPN > Connections

VPN Standard Mode - Edit Settings

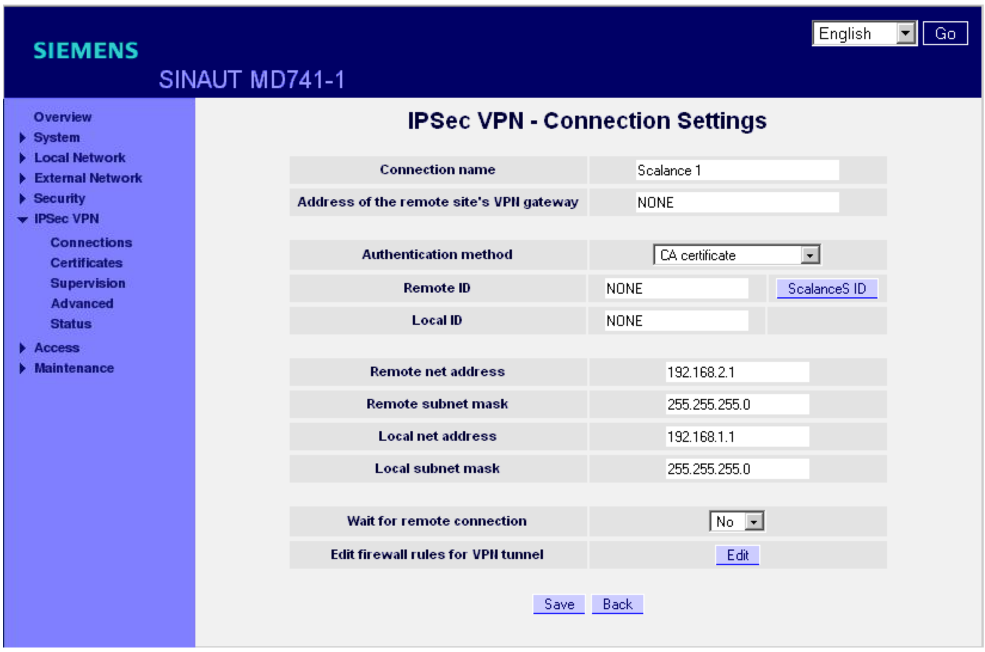


Figure 7-7 IPsec VPN > Connection Settings

Connection name

Give the new connection a connection name here.

Remote host

Specify the address of the remote station here, either as a hostname (e.g. myadress.com) or as an IP address.

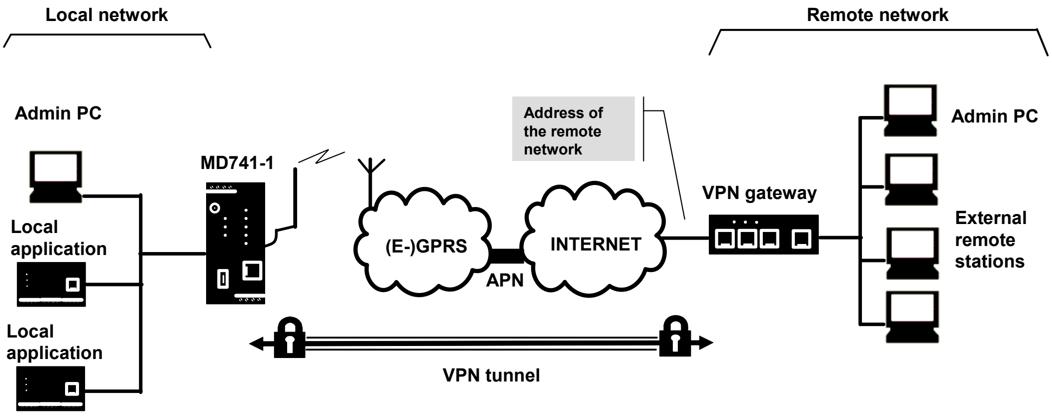


Figure 7-8 Address of the remote host

X.509 certificate, CA certificate

In the authentication methods X.509 certificate and CA certificate, the keys used for authentication have first been signed by a Certification Authority (CA). This method is considered especially secure. A CA can be a service provider, but also, for example, the system administrator for your project, provided that he has the necessary software tools. The CA creates a certificate file (PKCS12) with the file extension *p12 for each of the two remote stations. This certificate file contains the public and private keys for the own station, the signed certificate from the CA, and the public key of the CA. For the authentication method X.509 there is additionally a key file (*.pem, *cer or *.crt) for each of the two remote stations with the public key of the own station.

X.509 certificate

The public keys (files with extension *.pem, *cer or *.crt) are exchanged between the SINAUT MD741-1 and the remote station's VPN gateway takes place manually, for example on a CD-ROM or vie e-mail. To load the certificate, proceed as described in Chapter 7.3.

CA certificate

The public keys are exchanged between the SINAUT MD741-1 and the remote station's VPN gateway via the data connection when the VPN connection is established. Manual exchange of the key files is not necessary.

Pre-shared key (PSK)

This method is primarily supported by older IPsec implementations. Here authentication is performed with a character string agreed on beforehand. In order to obtain high security, the character string should consist of about randomly-selected 30 lower-case and upper-case letters and numerals.

Remote ID, Local ID

The Local ID and the Remote ID are used by IPsec to identify the remote stations uniquely when establishing the VPN connection.

For authentication with X.509 certificate or CA certificate:

- If you keep the factory setting NONE, then the Distinguished Names from the own certificate and from the certificate communicated by the remote station are automatically applied and used as the Local ID and Remote ID.
- If you manually change the entry for the Local ID or the Remote ID, then the corresponding entries must be adapted at the remote station. The own Local ID must be the same as the Remote ID of the remote station and vice versa. The entries for Local or Remote IDs must be made in the ASN.1 format, e.g. "C=XY/O=XY Org/CN=xy.org.org"

For authentication with pre-shared secret key (PSK):

- If you keep the factory setting NONE, then the own IP address is automatically used as the Local ID, and the IP address of the remote station is used as the Remote ID:
- If you manually change the entry for the Local ID or for the Remote ID, then the entries must have the format of a hostname (e.g. RemoteStation.de) or the format of an e-mail address (remote@station.de). The own Local ID must be the same as the Remote ID of the remote station and vice versa.

Note:

If with pre-shared secret key (PSK) the IP address is not used as the Remote ID, then the Aggressive Mode has to be set as the ISAKMP-SA mode.

Scalance S ID

If you have loaded a Scalance S certificate, by clicking the Scalance S button, you can load the Remote ID from the certificate.

Wait for remote connection

Yes

The SINAUT MD741-1 waits for the VPN gateway of the remote network to initiate establishment of the VPN connection.

No

The SINAUT MD741-1 initiates establishment of the connection.

Remote net address

Here enter the IP address (e.g. 123.123.123.123) of the remote network. The remote network can also be only a single computer.

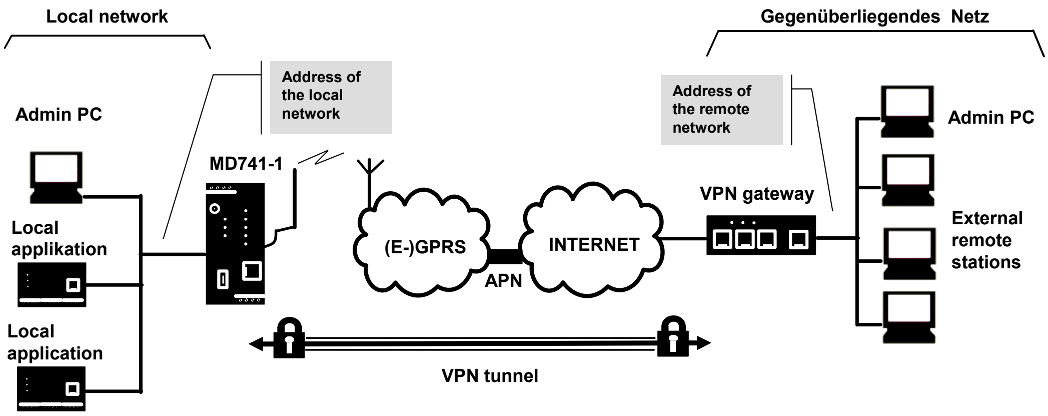


Figure 7-9 Remote net address

Remote subnet mask

Here enter the subnet mask (e.g. 255.255.255.0) of the remote network. The remote network can also be only a single computer.

Local net address

Here enter the IP address (e.g. 123.123.123.123) of the local network. The local network can also be only a single computer.

Local subnet subnet mask

Here enter the subnet mask (e.g. 255.255.255.0) of the local network. The local network can also be only a single computer.

Firewall rules for VPN tunnel

See Chapter 7.4

VPN Standard Mode - Edit IKE

Here you can define the properties of the VPN connection according to your requirements and what you have agreed with the system administrator of the remote station.

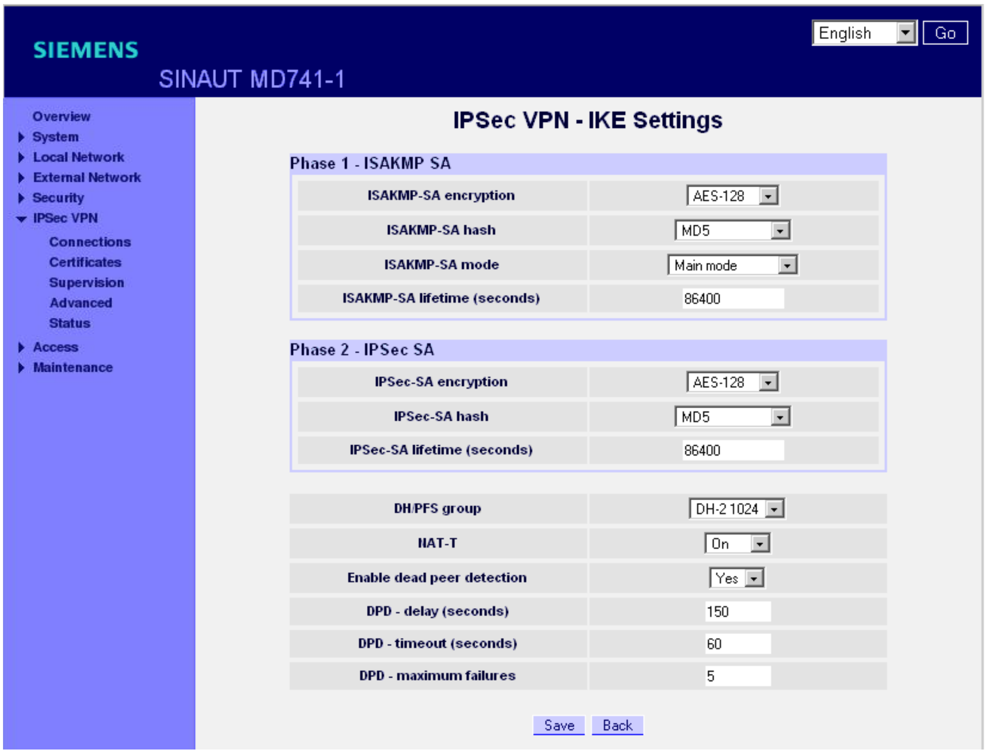


Figure 7-10 IPsec > IKE Settings

ISAKMP-SA encryption, IPsec-SA encryption

Agree with the administrator of the remote station which encryption method will be used for the ISAKMP-SA and the IPsec-SA. The SINAUT MD741-1 supports the following methods:

- 3DES-168
- AES-128
- AES-192
- AES-256

3DES-168 is a commonly used, and is therefore set as the default. The method can be defined differently for ISAKMP-SA and IPsec-SA.

Note:

The more bits in the encryption algorithm - indicated by the appended number - the more secure it is. The method AES-256 is therefore considered the most secure. However, the longer the key, the more time the encryption process takes and the more computing power is required.

ISAKMP-SA hash, IPsec-SA hash

Agree with the administrator of the remote station which method will be used for computing checksums/hashes during the ISAKMP phase and the IPsec phase. The following selections are available:

- MD5 or SHA-1 (automatic detection)
- MD5
- SHA-1

The method can be defined differently for ISAKMP-SA and IPsec-SA.

ISAKMP-SA mode

Agree with the administrator of the remote station which method will be used for negotiating the ISAKMP-SA. The following selections are available:

- Main mode
- Aggressive mode

DH/PFS group

Agree with the administrator of the remote station the DH group for the key exchange.

ISAKMP-SA lifetime, IPsec-SA lifetime

The keys for an IPsec connection are renewed at certain intervals in order to increase the effort required to attack an IPsec connection.

Specify the lifetime (in seconds) of the keys agreed on for the ISAKMP-SA and IPsec-SA.

The lifetime can be defined differently for ISAKMP-SA and IPsec-SA.

NAT-T

There may be a NAT router between the SINAUT MD741-1 and the VPN gateway of the remote network. Not all NAT routers allow IPsec data packets to go through. It may therefore be necessary to encapsulate the IPsec data packets in UDP packets so that they can go through the NAT router.

On:

If the SINAUT MD741-1 detects a NAT router that does not let the IPsec data packets through, then UDP encapsulation is started automatically.

Force:

During negotiation of the connection parameters for the VPN connection, encapsulated transmission of the data packets during the connection is insisted upon.

Off:

The NAT-T function is switched off.

Enable dead peer detection

If the remote station supports the dead peer detection (DPD) protocol, then the partner in question can detect whether the IPsec connection is still valid or not, meaning that it may have to be re-established. Without DPD, depending on the configuration it may be necessary to wait until the SA lifetime elapses or the connection has to be re-initiated manually. To check whether the IPsec connection is still valid, the dead peer detection sends DPD requests to the remote station itself. If there is no answer, then after the permitted number of failed attempts the IPsec connection is considered to be interrupted.

Notice

Sending DPD requests increases the amount of data sent and received via EGPRS or GPRS. This can lead to increased costs.

Yes

Dead peer detection is switched on. Attempts are made to re-establish the IPsec connection if it has been declared dead, independently of the transmission of user data.

No

Dead peer detection is switched off.

DPD - delay (seconds)

Time period in seconds after which DPD requests will be sent. These requests test whether the remote station is still available.

DPD - timeout (seconds)

Time period in seconds after which the connection to the remote station will be declared dead if no response has been made to the DPD requests.

DPD – maximum failures

Number of failed attempts permitted before the IPsec connection is considered to be interrupted.

Factory setting

The factory settings for the SINAUT MD741-1 are as follows:

Name	**NewConnection**
Enabled	**No (switched off)**
Authentication method	**CA certificate**
Remote ID	**NONE**
Local ID	**NONE**
Remote certificate	**-**
Wait for remote connection	**No**
Remote net address	**192.168.2.1**
Remote subnet mask	**255.255.255.0**
Local net address	**192.168.1.1**
Local subnet subnet mask	**255.255.255.0**
ISAKMP-SA encryption	**3DES-168**
IPsec-SA encryption	**3DES-168**
ISAKMP-SA hash	**MD5**
IPsec-SA hash	**MD5**
DH/PFS group	**DH-2 1024**
ISAKMP-SA mode	**Main**

ISAKMP-SA lifetime (seconds)	**86400**
IPsec-SA lifetime (seconds)	**86400**
NAT-T	**On**
Enable dead peer detection	**Yes**
DPD - delay (seconds)	**150**
DPD – timeout (seconds)	**60**
DPD – maximum failures	**5**

7.3 Loading VPN certificates

Loading and administering certificates and keys.

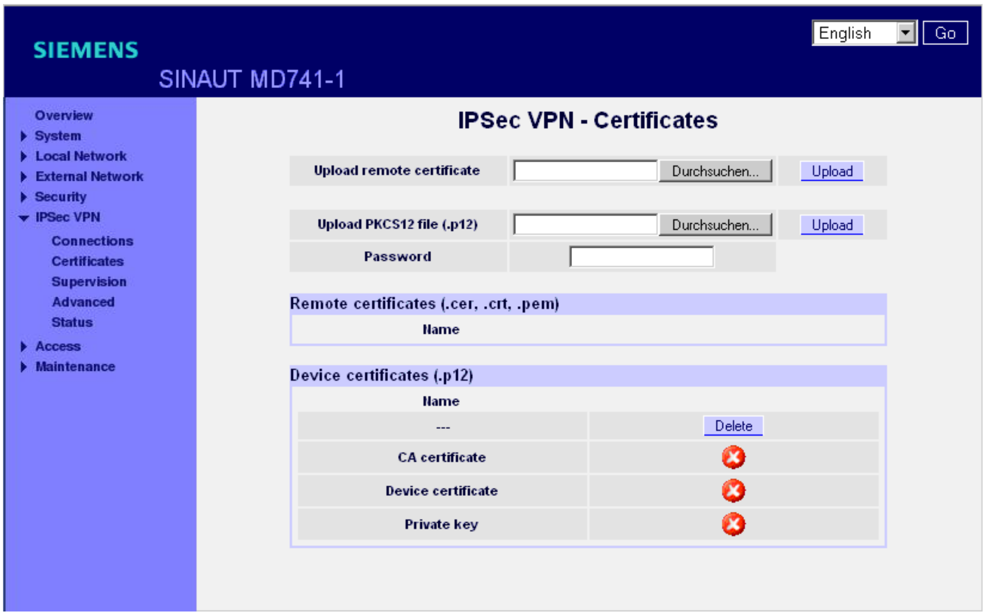


Figure 7-11 IPsec > Certificates

Upload remote certificate

Here load key files (*.pem, *.cer or *.crt) with remote certificates and public key from remote stations into the SINAUT MD741-1. To do this, the files must be saved on the Admin PC. A remote certificate is only required for the authentication method with X.509 certificate.

Upload PKCS12 file (.p12)

Here load the certificate file (PKCS12 file) with the file extension .p12 into the SINAUT MD741-1. To do this, the certificate file must be saved on the Admin PC.

Caution

If there is already a certificate file in the device, then it must be deleted before loading a new file.

Password

The certificate file (PKCS12 file) is password-protected. Here enter the password that you received with the certificate file.

Remote certificates (*.pem, *cer, .crt,)

A list with all of the loaded remote certificates is shown here. You can use *Delete* to remove a remote certificates that is no longer needed.

Device certificates (.p12)

The name and status of the loaded certificate file (PKCS12 file) is shown here. A white check mark on a green dot indicates that the corresponding component of the certificate file is present, a white cross on a red dot indicates that the corresponding component is missing or that the wrong password was entered.

7.4 Firewall rules for VPN tunnel

The user interface for setting up the firewall rules for VPN tunnels can be found under IPsec VPN > Connections:

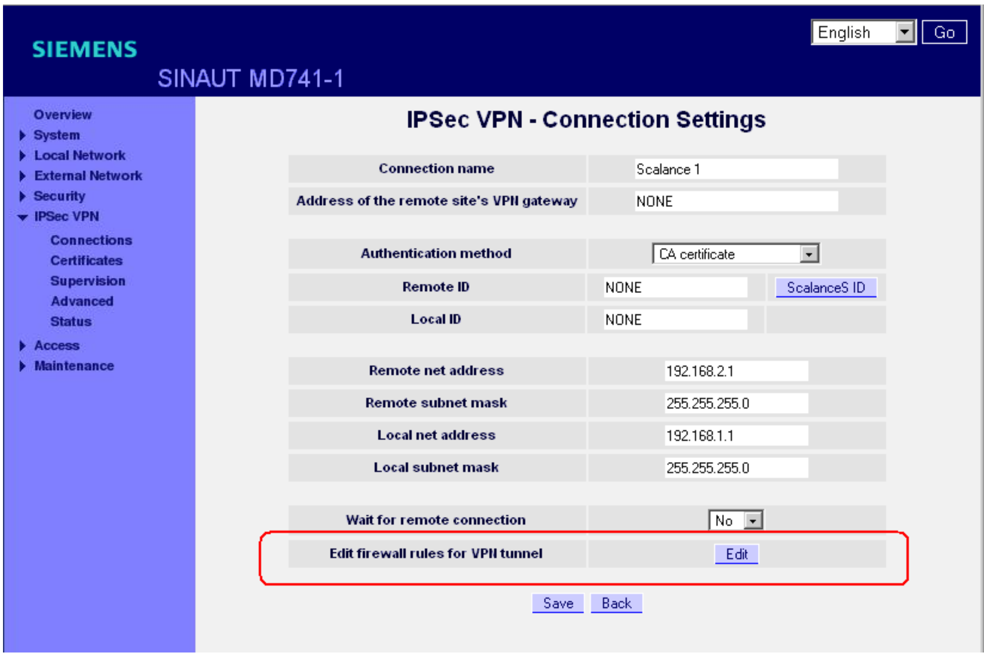


Figure 7-12 IPsec > Connection Settings

IPsec VPN – Edit Firewall Rules

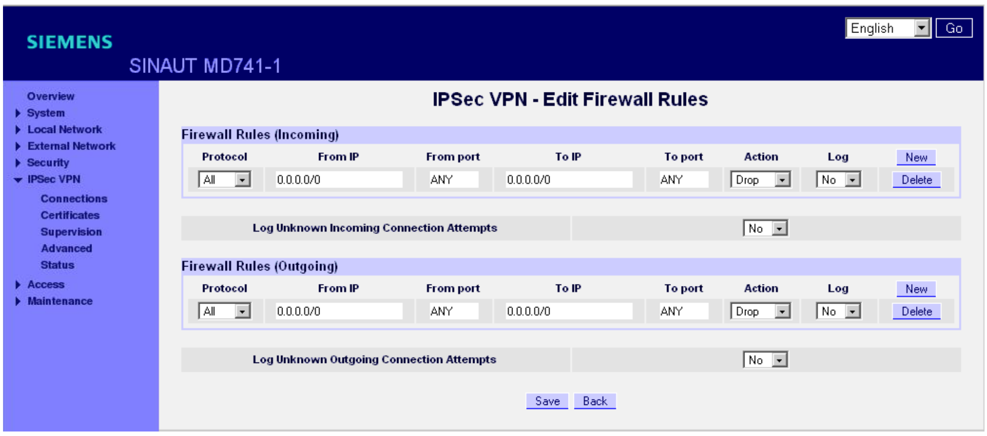


Figure 7-13 IPsec > Edit Firewall Rules

Function

The IPsec VPN connection is viewed as fundamentally secure. Thus data traffic over this connection is not limited by default. It is possible, however, to create firewall rules for the VPN connection

To set up firewall rules for the VPN connection, proceed in the same way as for setting up the packet filter function of the general firewall (see Chapter 6.1). However, the rules defined here apply only to the specific VPN connection.

Factory setting

The factory settings for the SINAUT MD741-1 are as follows:

Firewall rules for VPN tunnel	**No limitations**

7.5 Supervision of VPN connections

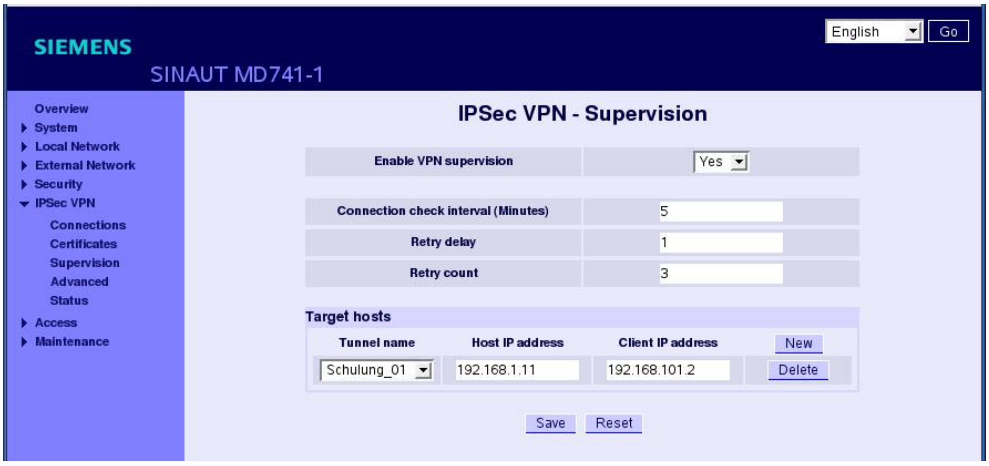


Figure 7-14 IPsec > Supervision

Function

With the supervision of VPN connections the SINAUT MD741-1 checks the condition of configured VPN connections. To check the VPN connection status the SINAUT MD741-1 sends periodically ping packets (ICMP) via the VPN connection to one or several remote stations (target hosts). This is made independently from payload data. For each VPN connection an own supervision can be configured.

If the SINAUT MD741-1 receives the answer for the ping packet from at least one addressed remote station, the VPN connection is still operational.

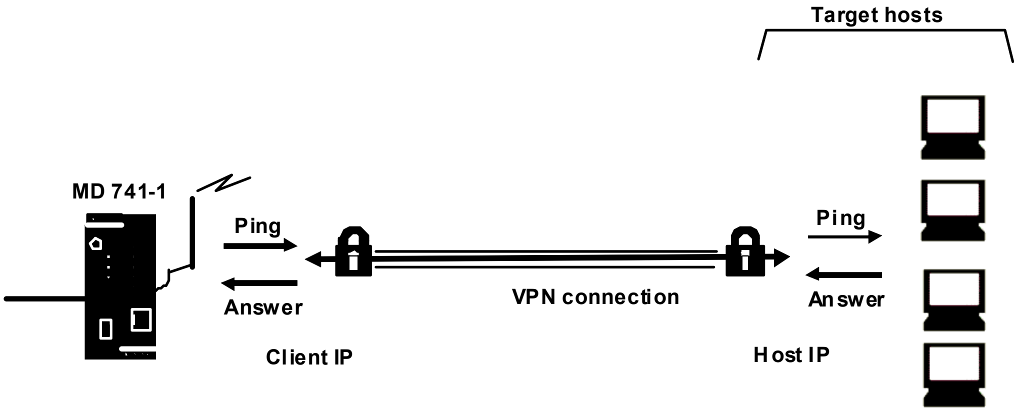


Figure 7-15 VPN connection supervision

Note

Do not ping a host downstream from the VPN Gateway! Here, the tunnel monitoring responds if a host can no longer be reached, for example due to ShutDown.

Ping the internal IP interface of the VPN Gateway!

If no remote station answers the ping packet the transmission of the ping packet will be repeated several times after a delay which can be configured. If all repetitions end without success, the VPN client in the SINAUT MD741-1 are will be restarted. This causes a reconnection of all existing VPN connections.

Notice

Sending ping packets (ICMPs) increases the amount of data sent and received via EGPRS or GPRS. This can lead to increased costs.

Enable VPN supervision

Yes

VPN supervision on.

No

VPN supervision off

Connection check interval

This parameter determines the time interval to send ping packets through the supervised VPN connection (VPN tunnel).

The value shall be given in minutes.

Retry delay

This parameter determines the delay a ping packet is repeated after a failed ping check (ping packet not answered).

The value shall be given in minutes.

Retry count

This parameter determines the number of allowed failed ping transmission retries before the VPN client inside the SINAUT MD741-1 are will be restarted.

Target hosts

Tunnel name

Determine, which VPN connection (VPN tunnel) shall be supervised. Add a VPN connection by clicking the *New* button, delete a VPN connection by clicking the *Delete* button.

Host IP address

Enter the IP address of the remote station (target host) here.

Client IP address

Enter here any unused IP address of the local network related to the VPN connection.

Factory setting

The factory settings for the SINAUT MD741-1 are as follows:

Enable VPN supervision	**Nein**
Connection check interval (minutes)	**5**
Retry delay (minutes)	**1**
Retry count	**3**
DynDNS tracking interval (minutes)	5

7.6 Advanced settings for VPN connections

Setting special timeouts and intervals for VPN connections.

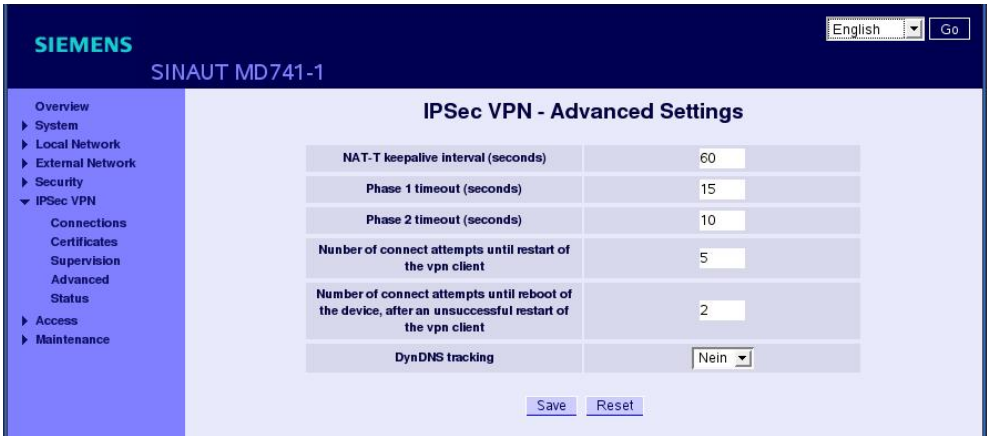


Figure 7-16 IPsec > Advanced Settings

NAT-T keepalive interval (seconds)

If NAT-T is enabled (cf. Chapter 7.2), then keepalive data packets will be sent periodically by the SINAUT MD741-1 through the VPN connection. The purpose of this is to prevent a NAT router between the SINAUT MD741-1 and the remote station from interrupting the connection during idle periods without data traffic.

Here you can change the interval between the keepalive data packets.

Phase 1 timeout (seconds)

The Phase 1 timeout determines how long the SINAUT MD741-1 waits for completion of an authentication process of the ISAKMP-SA. If the set timeout is exceeded, the authentication will be aborted and restarted.

Here you change the timeout.

Phase 2 timeout (seconds)

The Phase 2 timeout determines how long the SINAUT MD741-1 waits for completion of an authentication process of the IPsec-SA. If the set timeout is exceeded, the authentication will be aborted and restarted.

Here you change the timeout.

Number of connects attempts until restart of the VPN client

If the establishment of a VPN connection fails, the connection setup will be retried by the SINAUT MD741-1. Enter the number of unsuccessfull retries, being performed before the SINAUT MD741-1 restart its VPN client before trying again the connection setup.

Number of connect attempts until reboot of the device, after an unsuccessful restart of the VPN client

If the establishment of a VPN connection fails, the connection setup will be retried by the SINAUT MD741-1. Enter the number of unsuccessfull retries, being performed before the SINAUT MD741-1reboots and tries again the connection setup.

DynDNS tracking

If the VPN gateway of the remote stations uses a DynDNS service to get an IP address and no Dead Peer Detection is used, the SINAUT MD741-1 should periodically check, if the remote VPN gateway is still reachable. The DynDNS tracking function provides this function. *Yes* activates this function, *No* deactivate this function.

DynDNS tracking interval (minutes)

Configure here the interval it shall be checked, if the remote station is still reachable.

Number of connects attempts until restart of the VPN client	**5**
Number of connect attempts until reboot of the device, after an unsuccessful restart of the VPN client	**2**

Factory setting

The factory settings for the SINAUT MD741-1 are as follows:

NAT-T keepalive interval (seconds)	**60**
Phase 1 timeout (seconds)	**15**
Phase 2 timeout (seconds)	**10**
Number of connect attempts until restart of the VPN client	**5**

Number of connect attempts until reboot of the device, after an unsuccessful restart of the VPN client	**2**
DynDNS tracking	**Yes**
DynDNS tracking interval (minutes)	**5**

7.7 Status of the VPN connections

Indicates the status of the enabled VPN connections and the option for loading a protocol file to the Admin PC.

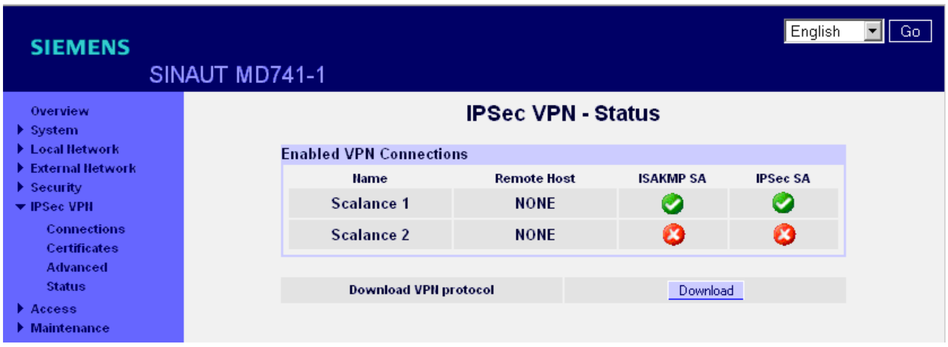


Figure 7-17 IPsec > Status

Enabled VPN Connections

A white check mark on a green dot indicates that the specific Security Association (SA) has been successfully established- A white cross on a red dot indicates that the Security Association does not exist.

Download VPN protocol

This function can be used to download the VPN protocol file to the Admin PC.

Remote access 8

8.1 HTTPS remote access

The HTTPS remote access (= *HyperText Transfer Protocol Secure*) allows secure access to the Web user interface of the SINAUT MD741-1 from an external network via EGPRS, GPRS or CSD.

Configuration of the SINAUT MD741-1 via the HTTPS remote access then takes place exactly like configuration via a Web browser via the local interface (see chapter 3).

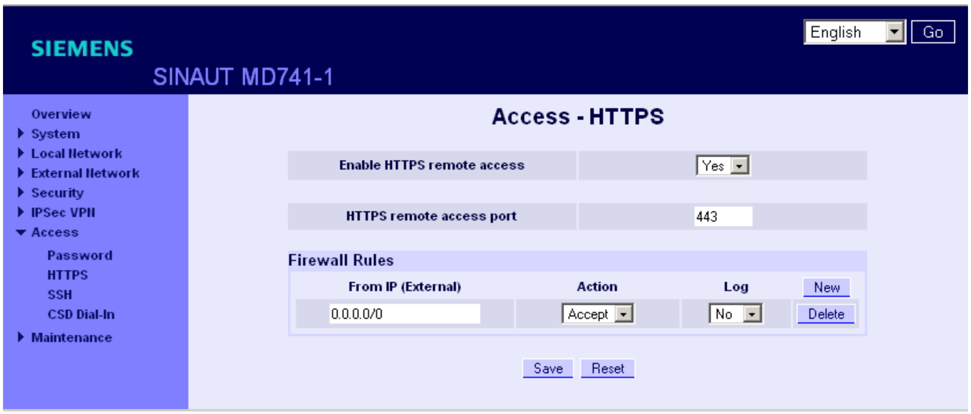


Figure 8-1 Access > HTTPS remote access

Enable HTTPS remote access

Yes

Access to the Web user interface of the SINAUT MD741-1 from the external network via HTTPS is allowed.

No

Access via HTTPS is not allowed.

HTTPS remote access port

Default: 443 (factory setting)

You can define a different port. However, if you have defined a different port, then the external remote station conducting the remote access must specify the port number after the IP address when specifying the address.

Example:
If this SINAUT MD741-1 can be accessed via the Internet using the address 192.144.112.5, and if port number 442 has been defined for the remote access, then the following must be specified in the Web browser at the external remote station:
https://192.144.112.5:442

Firewall rules for HTTPS remote access

New

Adds a new firewall rule for HTTPS remote access that you can then fill out.

Delete

Removes a firewall rule for HTTPS remote access that has been created.

From IP (External)

Specify here the address(es) of the computer(s) for which remote access is allowed. You have the following options:

IP address or address range: **0.0.0.0/0** means all addresses. To specify a range, use the CIDR notation - see the Glossary.

Action

Define how access to the specified HTTPS port will be handled:

Accept means that the data packets can go through.

Reject means that the data packets are rejected, and the sender receives a message about the rejection.

Drop means that the data packets are not allowed through. They are discarded without the sender receiving any information about where they went.

Log

For each individual firewall rule you can define whether the event should be logged when the rule takes effect - set *Log* to*Yes*, or not - set *Log* to *No* (factory setting).

The log is kept in the firewall log, see Chapter 6.4.

Factory setting

The factory settings for the SINAUT MD741-1 are as follows:

Enable HTTPS remote access	**No (switched off)**
HTTPS remote access port	**443**
Default for new rules:	
From IP (External)	**0.0.0.0/0**
Action	**Accept**
Log	**No (switched off)**

8.2 SSH remote access

The SSH remote access (= Secured SHell) allows secure access to the file system of the SINAUT MD741-1 from an external network via EGPRS, GPRS or CSD.

To do this, a connection must be established using an SSH-capable program from the external remote station to the SINAUT MD741-1.

Use the SSH remote access only if you are familiar with the LINUX file system.

In the factory setting this option is deactivated.

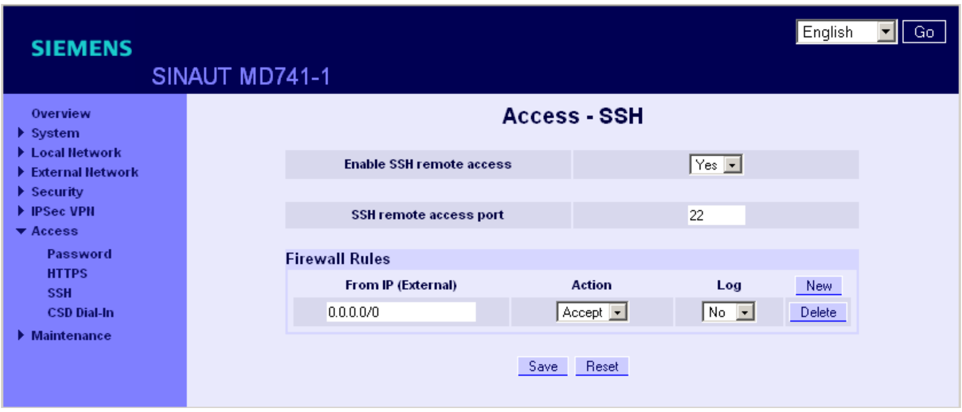


Figure 8-2 Access >SSH remote access

Warning

Via SSH remote access it is possible to derange the configuration of the device in such a way that it will have to be sent in for servicing. In this case contact your dealer or distributor.

Enable SSH remote access

Yes

Access to the file system of the SINAUT MD741-1 from the external network via SSH is allowed.

No

Access via SSH is not allowed.

SSH remote access port

Default: 22 (factory setting)

You can define a different port. However, if you have defined a different port, then the external remote station conducting the remote access must specify the port number defined here in front of the IP address when specifying the address.

Example:
If this SINAUT MD741-1 can be accessed from the external network using the address 192.144.112.5, and if port 22222 has been defined for the remote access, then this port number must be specified in the SSH client (e.g. PUTTY) at the external remote station:

ssh -p 22222 192.144.112.5

Firewall rules for SSH remote access

New

Adds a new firewall rule for SSH remote access that you can then fill out.

Delete

Removes a firewall rule for SSH remote access that has been created.

From IP (External)

Specify here the address(es) of the computer(s) for which remote access is allowed. You have the following options:

IP address or address range: **0.0.0.0/0** means all addresses. To specify a range, use the CIDR notation - see the Glossary.

Action

Define how access to the specified SSH port will be handled:

Accept means that the data packets can go through.

Reject means that the data packets are rejected, and the sender receives a message about the rejection.

Drop means that the data packets are not allowed through. They are discarded without the sender receiving any information about where they went.

Log

For each individual firewall rule you can define whether the event should be logged when the rule takes effect - set Log to Yes, or not - set Log to No (factory setting).

The log is kept in the firewall log, see Chapter 6.4.

Factory setting

The factory settings for the SINAUT MD741-1 are as follows:

Enable SSH remote access	**No (switched off)**
HTTPS remote access port	**22**
Default for new rules:	
From IP (External)	**0.0.0.0/0**
Action	**Accept**
Log	**No (switched off)**

8.3 Remote access via dial-in connection

The CSD dial-in access makes it possible to access the Web user interface of the SINAUT MD741-1 via a dial-in data connection (CSD = Circuit Switched Data). To do this, call the SINAUT MD741-1 at the data call number using an analogue modem, or at the voice or data call number of its SIM card using a GSM modem. The SINAUT MD741-1 accepts the call if:

- the call number of the telephone connection that you call from is saved in the list of permitted numbers in SINAUT MD741-1, and
- the call number is transmitted by the telephone network (CLIP function)

Dialling must be performed by a PPP client, for example via a Windows dial-up connection. In Windows, use the *New Connection Wizard*, and under *Connect to the network at my workplace* set up a *Dial-up connection*.

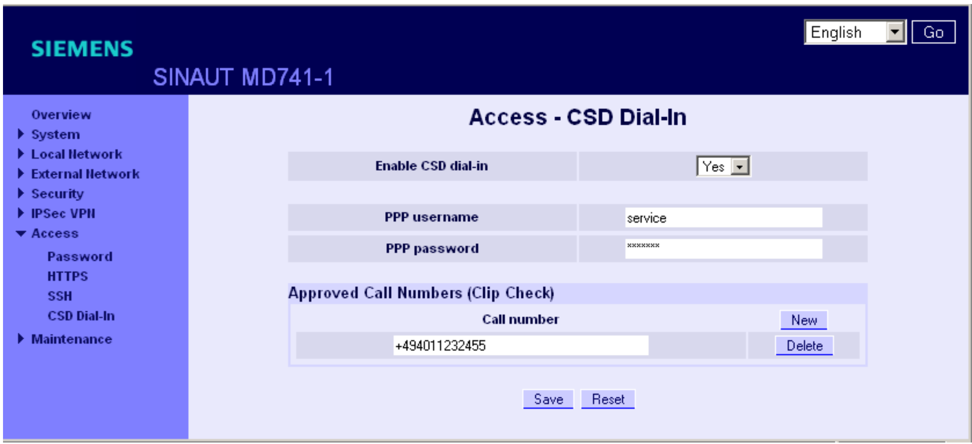


Figure 8-3 Access > CSD Dial-In

Enable CSD dial-in

Yes

Access to the Web user interface of the SINAUT MD741-1 from a dial-in data connection is allowed.

No

Access via dial-in data connection is not allowed.

PPP username / password

Select a username and a password that must be used by a PPP client (e.g. a Windows dial-up connection) to log on to the SINAUT MD741-1. The same username and the same password must be entered in the PPP client.

Approved Call Numbers

Specify the call number of the telephone connection from which the dial-in data connection is established. The telephone connection must support Calling Line Identification Presentation (CLIP), and this function must be activated.

The call number entered in the SINAUT MD741-1 must be exactly the same as the call number reported, any may also have to include the country code and prefix, e.g. +494012345678.

If multiple call numbers of a private branch exchange are to have access authorisation, you can use the "*" symbol as a wildcard, e.g. +49401234*. Then all call numbers that begin with +49401234 will be accepted.

Note

Firewall rules entered for HTTPS and SSH access also apply for CSD access. The source IP address (*"From IP"*) for CSD access is defined as 10.99.99.2.

New

Adds a new approved call number for CSD remote access that you can then fill out.

Delete

Removes a firewall rule for CSD remote access.

Factory setting

The factory settings for the SINAUT MD741-1 are as follows:

Enable CSD dial-in	**No (switched off)**
PPP username	**service**
PPP password	**service**
Approved Call Numbers	*

9 Status, log and diagnosis

9.1 System status display

The System-Status gives an overview about the current operating status of the SINAUT MD741-1.

Figure 9-1 System > Status

Note

Use the *Refresh* function of the Web browser to update the displayed values.

Current system time

Shows the current system time of the SINAUT MD741-1 in the format:

Year – Month – Day, Hours – Minutes

Connection

Shows if a wireless connection exists, and which one:

- EDGE connection (IP connection via EGPRS)
- GPRS connection (IP connection via GPRS)
- CSD connection (service connection via CSD)

Note

It may occur that an EDGE (EGPRS) or GPRS connection and an assigned IP address are both shown, but the connection quality is still not good enough to transmit data. For this reason we recommend using the active connection monitoring (see Chapter 5.2).

Connected since

Shows how long the current connection to EGPRS or GPRS has existed.

Used APN

Shows the APN (= Access Point Name) of the EGPRS or GPRS that is being used.

External hostname

Shows the hostname (e.g. md741-1.mydns.org) of the SINAUT MD741-1, if a DynDNS service is being used.

DynDNS

Shows if a DynDNS service is activated.

- White check mark at green dot: DynDNS service activated.
- White cross at red dot: DynDNS service not activated

Assigned IP address

Shoes the IP address at which the SINAUT MD741-1 can be reached in EGPRS or GPRS. This IP address is assigned to the SINAUT MD741-1 by the EGPRS or GPRS service.

Signal (CSQ level)

Indicates the strength of the GSM signal as a CSQ value.

- CSQ < 6: Poor signal strength
- CSQ= 6..10: Medium signal strength
- CSQ=11-18: Good field strength
- CSQ > 18: Very good field strength
- CSQ = 99: No connection to the GSM network

IMSI

Shows the subscriber identity that is saved on the SIM card being used.

The IMSI (= International Mobile Subscriber Identity) is used by the GSM network operator to detect the authorisations and agreed services for the SIM card.

IMEI

Shows the serial number of the SINAUT MD741-1 as a GSM wireless device. The IMEI (= International Mobile Equipment Identity) is assign uniquely worldwide.

Bytes sent / Bytes received

Shows the number of bytes that have been sent or received during the existing connection to GPRS. The counter is reset when a new connection is established.

Note

These figures serve only as a general indication of the data volume, and can differ significantly from the GSM network operator's accounting.

Bytes sent / Bytes received since initial operation

Shows the number of bytes that have been sent via GPRS or received since the last time the factory settings were loaded. The counter is reset when the factory settings are loaded.

Remote HTTPS

Shows whether remote access to the Web user interface of the SINAUT MD741-1 via EGPRS or GPRS is permitted.

- White check mark at green dot: Access is allowed.
- White cross at red dot: Access is not allowed.

Remote SSH

Shows whether remote access to the SSH console of the SINAUT MD741-1 via EGPRS or GPRS is permitted.

- White check mark at green dot: Access is allowed.
- White cross at red dot: Access is not allowed.

CSD Dial-In

Shows whether remote CSD service calls are allowed.

- White check mark at green dot: CSD service calls are possible.
- White cross at red dot: CSD service calls are not possible.

Number of active firewall rules

Shows how many firewall rules are active.

Current system version

Shows the version number of the SINAUT MD741-1's software.

9.2 Log

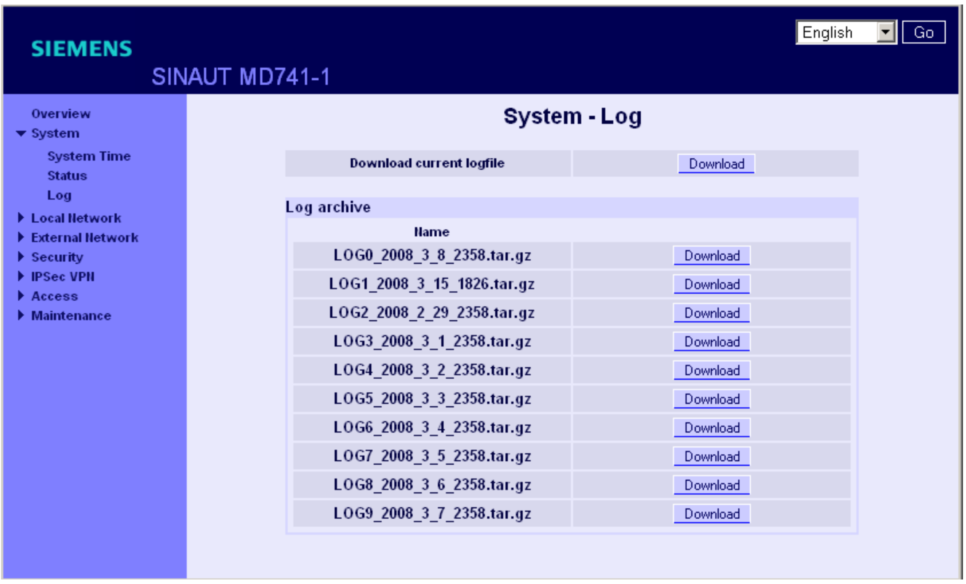


Figure 9-2 System > Log

Logfile

Important events in the operation of the SINAUT MD741-1 are saved in the log.

- Reboot
- Changes to the configuration
- Establishing of connections
- Interruption of connections
- Signal strength
- and operating messages

The log is saved to the log archive of the SINAUT MD741-1 when a file size 1 MByte, is reached, but after 24 hours at the latest.

Download current logfile

Download - the current log is loaded to the Admin PC. You can select the directory to save the file to, and can view the file there.

Log archive

Download - The archived log files are loaded to the Admin PC. You can select the directory to save the files to, and can view the files there.

Example:

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
13.12.2007 11:04	3173XX	(null)	(null)	(null)	SERVICE_MASK=0	4	UH	41	CURRENT SYSTEM VERSION	1.014					
13.12.2007 19:46	3173XX	(null)	(null)	(null)	SERVICE_MASK=0	4	UH	41	CURRENT SYSTEM VERSION	1.014					
13.12.2007 19:46	3173XX	CSQ=---	STAT=---	COPS=---	SERVICE_MASK=495591	4	APL	0	SYSTEM STARTING	Success					
13.12.2007 19:47	3173XX	CSQ=---	STAT=---	COPS=---	(null)	0	APL	5	CONNECTION ERROR	Missing or incorrect GSM parameter					
13.12.2007 20:03	3173XX	CSQ=8	STAT=1	COPS=26201	SERVICE_MASK=495591	4	APL	34	SYSTEM RUNNING SUCCESSFUL	CellID:4389	Version:1.014	TXS:	RXS:	TX:0	RX:0;
13.12.2007 20:19	3173XX	CSQ=8	STAT=1	COPS=26201	SERVICE_MASK=495591	4	APL	34	SYSTEM RUNNING SUCCESSFUL	CellID:4389	Version:1.014	TXS:	RXS:	TX:0	RX:0;
13.12.2007 20:36	3173XX	CSQ=8	STAT=1	COPS=26201	SERVICE_MASK=495591	4	APL	34	SYSTEM RUNNING SUCCESSFUL	CellID:4389	Version:1.014	TXS:	RXS:	TX:0	RX:0;
13.12.2007 20:52	3173XX	CSQ=8	STAT=1	COPS=26201	SERVICE_MASK=495591	4	APL	34	SYSTEM RUNNING SUCCESSFUL	CellID:4389	Version:1.014	TXS:	RXS:	TX:0	RX:0;
13.12.2007 21:09	3173XX	CSQ=8	STAT=1	COPS=26201	SERVICE_MASK=495591	4	APL	34	SYSTEM RUNNING SUCCESSFUL	CellID:4389	Version:1.014	TXS:	RXS:	TX:0	RX:0;
13.12.2007 21:25	3173XX	CSQ=8	STAT=1	COPS=26201	SERVICE_MASK=495591	4	APL	34	SYSTEM RUNNING SUCCESSFUL	CellID:4389	Version:1.014	TXS:	RXS:	TX:0	RX:0;
14.12.2007 12:15	3173XX	(null)	(null)	(null)	SERVICE_MASK=0	4	UH	41	CURRENT SYSTEM VERSION	1.014					
14.12.2007 12:16	3173XX	CSQ=---	STAT=---	COPS=---	SERVICE_MASK=495591	4	APL	0	SYSTEM STARTING	Success					
14.12.2007 12:16	3173XX	CSQ=---	STAT=---	COPS=---	SERVICE_MASK=495591	0	APL	5	CONNECTION ERROR	Missing or incorrect GSM parameter					
14.12.2007 12:16	3173XX	CSQ=---	STAT=---	COPS=---	SERVICE_MASK=495591	4	CH	9	CONFIGURATION FILE ACCESS	(write values)					
14.12.2007 12:16	3173XX	CSQ=---	STAT=---	COPS=---	SERVICE_MASK=495591	4	CH	9	CONFIGURATION FILE ACCESS	InternalIPs.InternalIP_0.IP:192.168.1.1					
14.12.2007 12:16	3173XX	CSQ=---	STAT=---	COPS=---	SERVICE_MASK=495591	4	CH	9	CONFIGURATION FILE ACCESS	InternalIPs.InternalIP_0.NetMask:255.255.255.0					
14.12.2007 12:16	3173XX	CSQ=---	STAT=---	COPS=---	(null)	4	CH	9	CONFIGURATION FILE ACCESS	InternalIPs.InternalIP_1.IP:192.168.0.20					
14.12.2007 12:16	3173XX	CSQ=---	STAT=---	COPS=---	(null)	4	CH	9	CONFIGURATION FILE ACCESS	InternalIPs.InternalIP_1.NetMask:255.255.255.0					
14.12.2007 23:05	3173XX	(null)	(null)	(null)	SERVICE_MASK=0	4	UH	41	CURRENT SYSTEM VERSION	1.014					
14.12.2007 23:05	3173XX	CSQ=---	STAT=---	COPS=---	SERVICE_MASK=495591	4	APL	0	SYSTEM STARTING	Success					
14.12.2007 23:05	3173XX	CSQ=---	STAT=---	COPS=---	(null)	0	APL	5	CONNECTION ERROR	Missing or incorrect GSM parameter					
14.12.2007 23:08	3173XX	CSQ=8	STAT=1	COPS=26201	SERVICE_MASK=495591	4	CH	9	CONFIGURATION FILE ACCESS	(write values)					
14.12.2007 23:09	3173XX	CSQ=8	STAT=1	COPS=26201	SERVICE_MASK=495591	4	CH	9	CONFIGURATION FILE ACCESS	(write values)					
14.12.2007 23:09	3173XX	CSQ=8	STAT=1	COPS=26201	SERVICE_MASK=495591	4	APL	3	GPRS CONNECTION ESTABLISHED	GPRS connect					
14.12.2007 23:10	3173XX	CSQ=8	STAT=1	COPS=26201	SERVICE_MASK=495591	4	APL	8	IP ASSIGNED	172.25.105.9					
14.12.2007 23:11	3173XX	CSQ=8	STAT=1	COPS=26201	SERVICE_MASK=495591	4	CH	9	CONFIGURATION FILE ACCESS	(write values)					
14.12.2007 23:11	3173XX	CSQ=8	STAT=1	COPS=26201	SERVICE_MASK=495591	4	CH	9	CONFIGURATION FILE ACCESS	ICMPCheck.Enabled:true					
14.12.2007 23:11	3173XX	CSQ=8	STAT=1	COPS=26201	SERVICE_MASK=495615	4	CH	9	CONFIGURATION FILE ACCESS	(write values)					
14.12.2007 23:11	3173XX	CSQ=8	STAT=1	COPS=26201	SERVICE_MASK=495615	4	CH	9	CONFIGURATION FILE ACCESS	ICMPCheck.Enabled:true					
14.12.2007 23:12	3173XX	CSQ=8	STAT=1	COPS=26201	SERVICE_MASK=495615	4	CH	9	CONFIGURATION FILE ACCESS	(write values)					
14.12.2007 23:12	3173XX	CSQ=8	STAT=1	COPS=26201	SERVICE_MASK=495615	4	CH	9	CONFIGURATION FILE ACCESS	ICMPCheck.Enabled:true					
14.12.2007 23:13	3173XX	CSQ=8	STAT=1	COPS=26201	SERVICE_MASK=495615	4	CH	9	CONFIGURATION FILE ACCESS	(write values)					
14.12.2007 23:13	3173XX	CSQ=8	STAT=1	COPS=26201	SERVICE_MASK=495615	4	CH	9	CONFIGURATION FILE ACCESS	NTP.Enabled:true					
14.12.2007 22:24	3173XX	CSQ=8	STAT=1	COPS=26201	SERVICE_MASK=499711	4	APL	34	SYSTEM RUNNING SUCCESSFUL	CellID:4389	Version:1.014	TXS:449	RXS:358	TX:1078	RX:358;
14.12.2007 22:40	3173XX	CSQ=8	STAT=1	COPS=26201	SERVICE_MASK=499711	4	APL	34	SYSTEM RUNNING SUCCESSFUL	CellID:4389	Version:1.014	TXS:449	RXS:358	TX:1078	RX:358;
14.12.2007 22:57	3173XX	CSQ=8	STAT=1	COPS=26201	SERVICE_MASK=499711	4	APL	34	SYSTEM RUNNING SUCCESSFUL	CellID:4389	Version:1.014	TXS:449	RXS:358	TX:1078	RX:358;
14.12.2007 23:13	3173XX	CSQ=10	STAT=1	COPS=26201	SERVICE_MASK=499711	4	APL	34	SYSTEM RUNNING SUCCESSFUL	CellID:4389	Version:1.014	TXS:449	RXS:358	TX:1078	RX:358;
14.12.2007 23:30	3173XX	CSQ=10	STAT=1	COPS=26201	SERVICE_MASK=499711	4	APL	34	SYSTEM RUNNING SUCCESSFUL	CellID:4389	Version:1.014	TXS:2737	RXS:3931	TX:3366	RX:3931;
14.12.2007 23:46	3173XX	CSQ=10	STAT=1	COPS=26201	SERVICE_MASK=499711	4	APL	34	SYSTEM RUNNING SUCCESSFUL	CellID:4389	Version:1.014	TXS:3089	RXS:4469	TX:3718	RX:4469;

Entries in log

Column A:

Time stamp

Column B:

Product number

Column C:

Signal quality (CSQ value)

Column D:

GSM login status

STAT = --- = Function not activated yet

STAT = 1 = Logged in to home network

STAT = 2 = Not logged in; searching for network

STAT = 3 = Login rejected

STAT = 5 = Logged in to third-party network (roaming)

Column E:

Indication of the network operator identification with the 3-digit country code (MCC) and the 2-3-digit network operator code (MNC).

Example: 26201 (262 = country code / 01 = network operator code)

Column F:

Coded operating status (for Hotline)

Column G:

Category of the log report (for Hotline)

Column H:

Internal source of the log report (for Hotline)

Column I:

Internal report number (for Hotline)

Column J:

Log report in plain text

Columns K-P:

Additional information on the plain text report, such as:

- Cell ID (identification number of the active GSM cell)
- Software version
- TXS, RXS (IP packets transmitted in the current connection)
- TX, RX (IP packets transmitted since the last factory settings reboot)

9.3 Remote logging

The SINAUT MD741-1 can transfer the system log once per day via FTP (= File Transfer Protocol) to an FTP server.

The current system log and the system log files in the archive are transferred. After successful transfer the transferred logs are deleted in the SINAUT MD741-1.

If the transfer fails, the SINAUT MD741-1 tries once again to transfer the data after 24 hours.

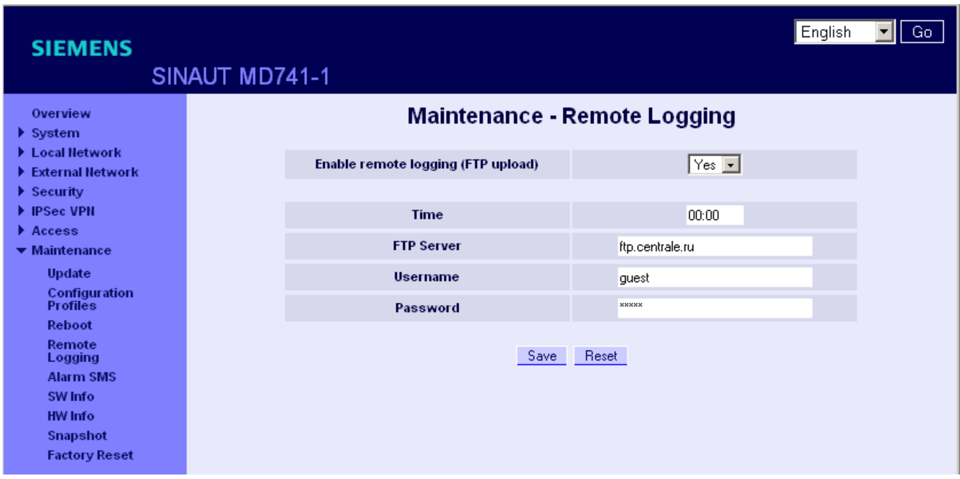


Figure 9-3 Maintenance > Remote Logging

Enable remote logging (FTP upload)

Yes activates the function.

Time

Specifies the daily time, when the log files will be transmitted to the FTP server.

FTP Server

Specifies the address of the *FTP server,* to which the log files are to be transferred. The address can be specified as a hostname (e.g. ftp.server.de) or as an IP address.

Username

Specifies the username for logging in to the FTP server.

Password

Specifies the password for logging in to the FTP server.

Factory setting

The factory settings for the SINAUT MD741-1 are as follows:

Enable remote logging (FTP upload)	**No (switched off)**
Time	**00:00**
FTP Server	**NONE**
Username	**guest**
Password	**guest**

9.4 Snapshot

This function is used for support purposes.

The service snapshot downloads important log files and current device settings that could be important for fault diagnosis and saves them in a file.

If you contact our Hotline in the event of a problem with the SINAUT MD741-1, in many cases they will ask you for the snapshot file.

Note

This file contains the access parameters for EGPRS and GPRS and the addresses of the remote station. It does not contain the username and password for access to the SINAUT MD741-1.

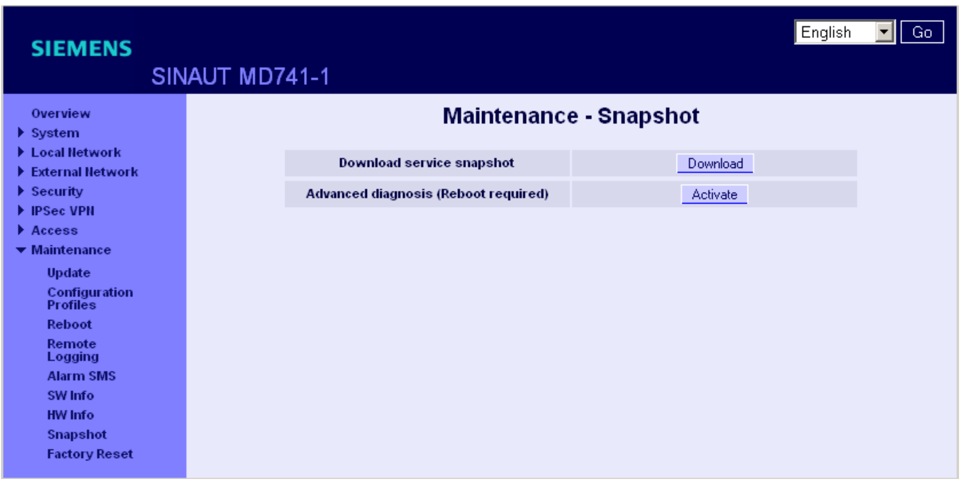


Figure 9-4 Maintenance > Snapshot

This function is used for support purposes.

The service snapshot downloads important log files and current device settings that could be important for fault diagnosis and saves them in a file.

If you contact our Hotline in the event of a problem with the SINAUT MD741-1, in many cases they will ask you for the snapshot file.

Note

This file contains the access parameters for EGPRS and GPRS and the addresses of the remote station. It does not contain the username and password for access to the SINAUT MD741-1.

Download service snapshot

Click on download. You can select the location on the Admin PC where the snapshot file will be saved.

The filename of the snapshot file has the following structure:

<hostname>_Snapshot_<Date&TimeCode>.tgz,

e.g.: md741_Snapshot_200711252237.tgz

Advanced diagnosis

Only *Activate* the *Advanced diagnosis* if asked to do so by our Hotline. In operation with advanced diagnosis, information is written to the diagnosis logs much more often. Some additional information is also saved. This is useful for systematic troubleshooting.

Note

When advanced diagnosis is active, the frequent write access to the non-volatile memory of the SINAUT MD741-1 can lead to a reduction of its service life.

Factory setting

The factory settings for the SINAUT MD741-1 are as follows:

Advanced diagnosis	**Off (Activate)**

9.5 Hardware information

Shows important information for hardware identification. This information is often needed in the event of queries to our Hotline.

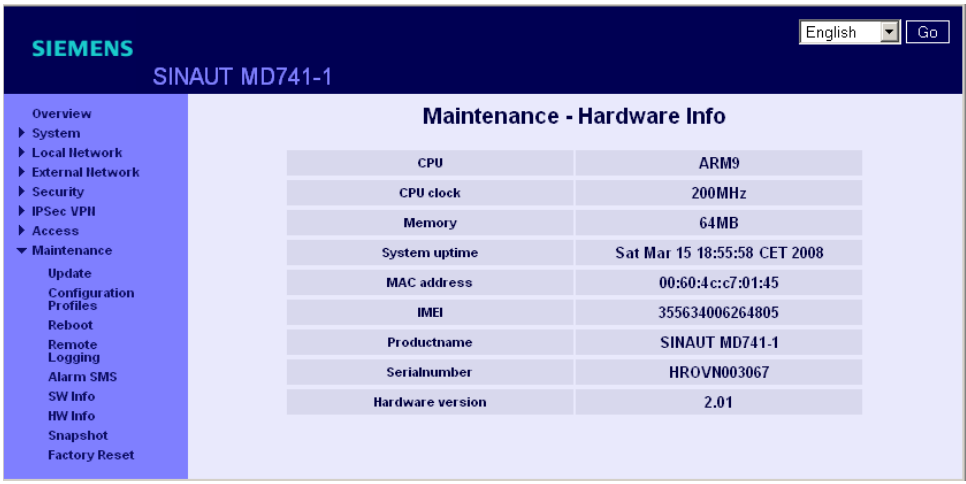


Figure 9-5 Maintenance > Hardware info

9.6 Software information

Shows important information for software identification. This information is often needed in the event of queries to our Hotline.

Planned updates are additionally shown. See also Chapter 10.4.

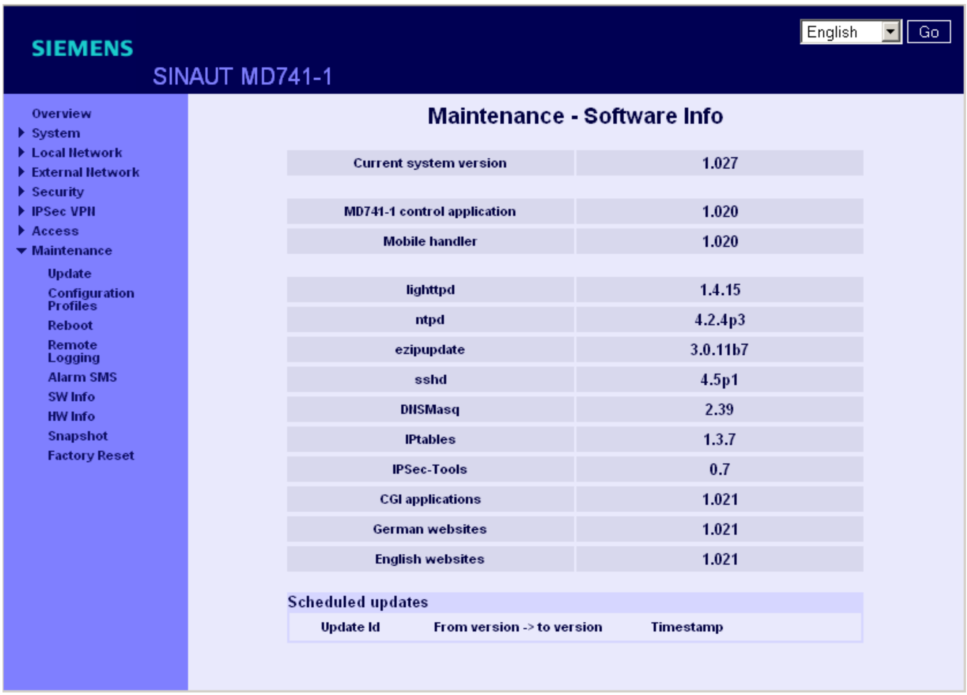


Figure 9-6 Maintenance > Software info

Additional functions

10

10.1 Service Center

The SINAUT MD741-1 also uses the Short Message Service (SMS) of the GSM network. You can specify a special SMS center.

Figure 10-1 Maintenance > Service Center

SMS service center call number

To ensure that the SMS function works reliably, enter the call number of the service center (SMSC) here. If there is no entry made here, the default SMSC of your network provider will be used.

10.2 Alarm SMS

The SINAUT MD741-1 can transmit short alarm messages using the SMS (= Short Message Service) of the GSM network. The sending of an alarm SMS message can be triggered by the following event:

- Event 1 No GPRS connection

For the event, you can specify a separate call number to which the alarm message will be sent. You can enter any text as the alarm message. The following characters are available:

a b c d e f g h I j k l m n o p q r s t u v w x y z A B C D E F G H I J K L M N O P Q R S T U V W X Y Z 0 1 2 3 4 5 6 7 8 9 , ! ?

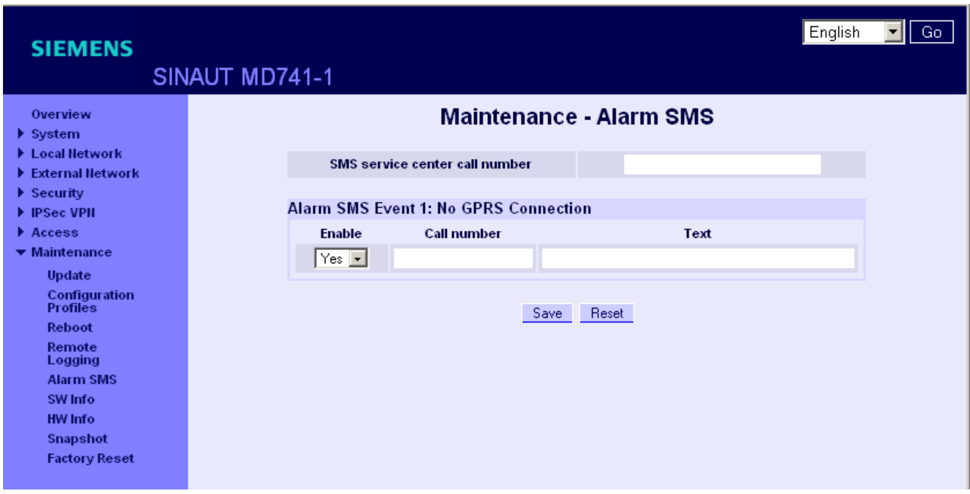


Figure 10-2 Maintenance > Alarm SMS

Alarm SMS Event 1: No GPRS Connection

Event 1 The GPRS connection cannot be established despite multiple attempts. The SINAUT MD741-1 then transmits an alarm message.

Settings

Enable

With *Yes*, the alarm message is sent if the event occurs, with *No*, it is not.

Call number

Here, enter the call number of the end device to which the alarm message will be sent using SMS. The end device must support reception of SMS messages via GSM or fixed network.

Text

Here enter the text that will be sent as an alarm message.

Factory settings

The factory settings of the SINAUT MD741-1 are as follows:

SMS service center call number	**-**
Alarm SMS Event 1: No GPRS connection	**No** (turned off)
Call number	**-**
Text	**-**

10.3 SMS - Messaging from the local network

With the SMS messaging function, applications connected to the local interface of the SINAUT MD741-1 can send SMS messages via the GSM network.

Figure 10-3 Maintenance > SMS over IP

To send an SMS message, the application must establish a TCP/IP connection to the SINAUT MD741-1 via the local interface.

Via this TCP/IP connection, the application transfers the text of the SMS to the SINAUT MD741-1 that packs the text in an SMS message and sends it.

Frame format for the SMS message

The text must be transferred in a frame via the TCP/IP connection to the SINAUT MD741-1. The frame must have the following format:

Username#Password#CommandCode#Seq-Num;Callnumber;Message:

Example:
`user#password#105#01;004943465789;my SMS text:`

Username

Enter a user name to check the permission for sending an SMS message. Maximum of 10 characters.

Password

Enter the password belonging to the user name. Maximum of 10 characters.

CommandCode

Command to send an SMS message from the local network This value of 105 is fixed and must not be modified.

Seq-Num

The sequence number is used to assign several requests at the same time The function is not currently supported.

The sequence number consists of 2 numeric characters from 01 to 99

Call number

Call number of the SMS recipient with a maximum of 40 characters. International numbers (+49) are permitted.

Message

SMS text with a maximum of 160 characters

The following forbidden characters must not occur in the SMS text:

Separator for the first command level

; Separator for the second command level

: Identifies the end of the message

Enable SMS messaging from the local network

Select *Yes* to be able to send SMS messages from the local network.

Select *No* if you do not want to send SMS messages from the local network.

Username

User name that must be included in the frame before the text is sent using SMS (see above: "Frame format"). Maximum of 10 characters.

Password

Password that must be included in the frame before the text is sent using SMS (see above: "Frame format"). Maximum of 10 characters.

Port number

TCP/IP port on which the SINAUT MD741-1 accepts the TCP/IP connection for sending SMS messages.

Firewall Rules

To allow the TCP/IP connection to be established for sending SMS messages, a firewall rule must be set up on the SINAUT MD741-1.

With *New*, you insert sources ("From IP") for the TCP/IP connection for sending SMS messages. With *Delete*, you remove the connections.

From IP (internal)

Enter the IP address of the communications partner that is allowed to send IP packets to the local network. Do this by specifying the IP address or an IP range for the partner station. 0.0.0.0 means all addresses.

To specify a range, use the CIDR notation - see Glossary.

Action

The drop-down list below Action relates to the TCP/IP connection of the IP address shown to the left beside the drop-down list. The following three options are available:

- "Accept": Enables the TCP/IP connection for sending SMS messages.
- "Reject": The data packets are rejected, and the sender receives a message about the rejection.
- "Drop": The data packets may not pass and are discarded. The sender does not receive any notification of this.

Log

For each firewall rule, you can specify whether or not the event is logged (Log = Yes) or whether the factory default is retained (Log = No).

The log is kept in the firewall log, see section **Fehler! Verweisquelle konnte nicht gefunden werden.**.

Factory settings

The factory settings of the SINAUT MD741-1 are as follows:

User name	User
Password	Password
Port number	26864
Firewall rules	Not active
From IP	0.0.0.0
Action	Accept
Log	No

10.4 Software Update

The Update function can be used to load new operating software to the SINAUT MD741-1 and activate this software.

In an immediate update the new software will be unzipped. This process can take several minutes. After that the actual update process begins, which is indicated by the LEDs lighting up in sequence.

The settings of the SINAUT MD741-1 will be accepted insofar as the settings still have the same effect in the new software version as they did before the update.

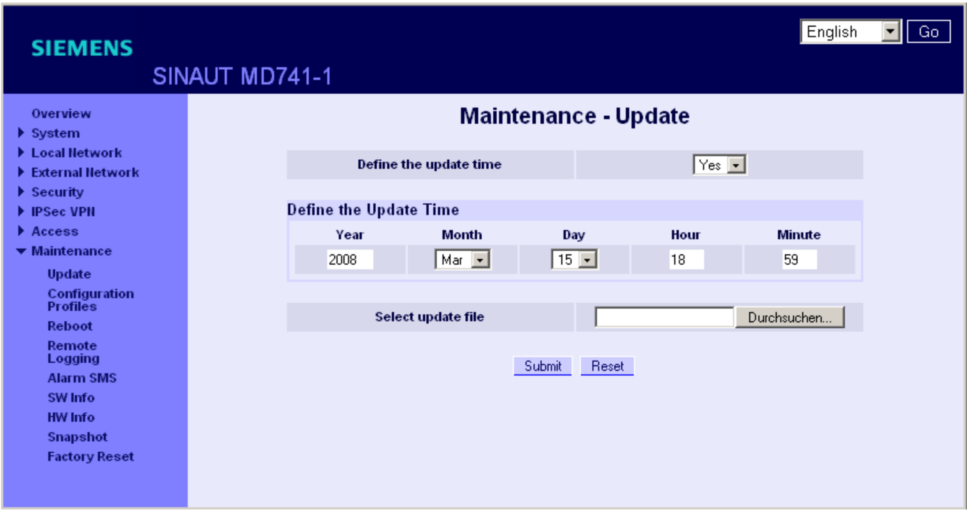


Figure 10-4 Maintenance > Update

Define the update time

No

Immediate update - The new operating software is activated immediately after you load the software and click on *Submit*.

Yes

Time-controlled update - The new operating software is activated at the defined update time. The software must have been loaded already.

Define the update time

If you want to have the update carried out with time control, specify the time when the new operating software is to be activated.

Specify the Year – Month – Day – Hour – Minute.

Select update file

Use *Browse* to select the file, which includes the new operating software, for example:

MD741_v1.024-v1.027.tgz

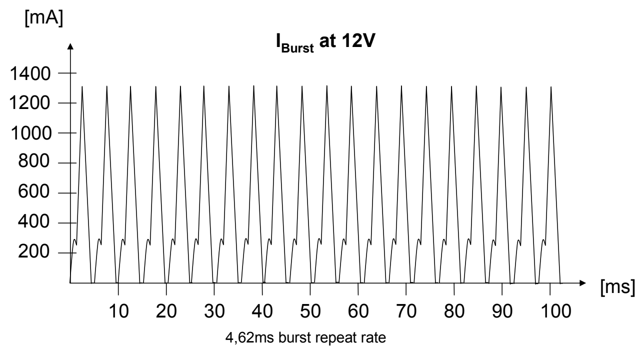
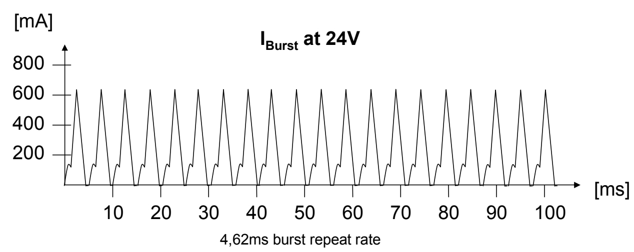
Load the firmware to the device with *Open*.

Submit

With Submit the operating software is either activated immediately or the operating software is activated at the specified time.

Technical Data 11

Interfaces	Application interface	10/100 Base-T (RJ45 plug) Ethernet IEEE802 10/100 Mbit/s
	Service interface	USB-A (reserved for later applications)
Security functions		Stateful inspection firewall Anti-spoofing Port forwarding
Additional functions		DNS cache, DHCP server, NTP, remote logging, connection monitoring, alarm-SMS
Management		Web-based administration user interface, ssh console
Wireless connection	EDGE / GPRS	EDGE Multislot class 12 / EDGE Multislot class 12
	Coding schemes GSM Module	CS-1, CS-2, CS-3, CS-4 EGPRS (EDGE) / Quad band
	EDGE (EGPRS)	Multislot Class 12 Mobile Station Class B Modulation and Coding Scheme MCS 1 – 9
	GPRS	Multislot Class 12 Full PBCCH support Mobile Station Class B Coding Scheme 1 – 4
	EDGE / GPRS	During the data transmission via EGPRS or GPRS the device automatically selects from the following classes: - from EGPRS Multislot Class 12 (4Tx slots) to EGPRS Multislot Class 10 (2Tx slots), - from EGPRS Multislot Class 10 (2Tx slots) to EGPRS Multislot Class 8 (1Tx), - from GPRS Multislot Class 12 (4Tx slots) to GPRS Multislot Class 8 (1Tx) - from GPRS Multislot Class 10 (2Tx slots) to GPRS Multislot Class 8 (1Tx)
	CSD / MTC	V.110, RLP, non-transparent 2.4, 4.8, 9.6, 14.4kbps
	SMS (TX)	Point to point, MO (outgoing)

	Max. transmitting power (acc. to output 99, V5)	Class 4 (+33dBm ±2dB) for EGSM850 Class 4 (+33dBm ±2dB) for EGSM900 Class 1 (+30dBm ±2dB) for GSM1800 Class 1 (+30dBm ±2dB) for GSM1900 Class E2 (+27dBm ± 3dB) for GSM 850 8-PSK Class E2 (+27dBm ± 3dB) for GSM 900 8-PSK Class E2 (+26dBm +3 /-4dB) for GSM 1800 8-PSK Class E2 (+26dBm +3 /-4dB) for GSM 1900 8-PSK
	Antenna connection	Nominal impedance: 50 ohms, jack: SMA
Ambient conditions	Temperature range	Operation: -20 °C to +60 °C Storage: -40 °C to +70 °C
	Air humidity	0-95 %, non-condensing
Housing	Design	Top-hat rail housing
	Material	Plastic
	Protection class	IP20
	Dimensions	114 mm x 45 mm x 99 mm
	Weight	approx. 280g
DE	CE	Yes
	GSM/EGPRS module Environment	Conforms to GCF, PTCRB The device complies with the European Directives RoHS and WEEE.
Power supply	Input voltage	12 - 30 V DC (24 V DC nominal)
	Input Current	510 – 230 mA DC
	Power input	4.4 W typical at 12 V 4.0 W typical at 24 V 4.5 W typical at 30 V
	Current consumption	See table below.
	Input current characteristic	 

Current consumption [3]	*Input voltage*	*Connected, no data transfer*	*Continuous data transfer with low signal quality* [1]	*Continuous data transfer with medium signal quality* [2]	*Burst*
Operating mode	[V]	[mA]	[mA]	[mA]	[mA]
GSM-CSD	12	174	315	263	1000
	24	97	168	137	450
	30	82	137	116	360
EGPRS / GPRS	12	174	365	282	1260
	24	97	182	147	550
	30	82	150	121	420

(1) Measured at GSM900 Power Level 5 (33dBm transmitting power)
(2) Measured at GSM900 Power Level 10 (23dBm transmitting power)
(3) USB port not used

Applied Standards and Approvals 12

Note

The approvals that apply to the device are printed on the device.

12.1 EU Declaration of Conformance

Marking

CE

Applied European directives

When used within the intended purpose, the equipment is compliant to the requirements of the following European directives:

- Directive 1999/5/EC (R&TTE) of the European Parliament and of the Council of 9 March 1999 on radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity,
- Directive 2006/95/EC (LVD) of the European Parliament and of the Council of 12 December 2006 on the harmonization of the laws of Member States relating to electrical equipment designed for use within certain voltage limits,
- Directive 2004/108/EC (EMC) of the European Parliament and of the Council of 15 December 2004 on the approximation of the laws of the Member States relating to electromagnetic compatibility and repealing Directive 89/336/EEC
- Directive 94/9/EC (ATEX) of the European Parliament and the Council of 23 March 1994 on the approximation of the laws of the Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres.

You will find the EU declaration of conformity for this product on the Internet at the following address:

Link to the declaration of conformity:
(http://support.automation.siemens.com/WW/view/en/10805878) → "Entry list" tab

Filter settings:
Entry type: "Certificates" → Certificate type: "EU declaration of conformity" →
Search item(s): <name of the module>

Directive 1999/5/EC (R&TTE)

Applied standards

- EN301 511: v.9.0.2
- 3GPP TS 51.010-1: v. 5.10.0

Classification

Telecommunication equipment, Radio equipment, Device class 1

Directive 2006/95/EC (LVD)

Applied standards

- EN 60950:2006

Directive 2004/108/EC (EMC)

Applied standards

- EN55022: 2006 Limit A
- EN55024:1998 + A1 : 2001 + A2 : 2003
- EN61000-6-2: 2001

Warning

The SINAUT MD741-1 is a Class A device. This device can cause radio interference in residential areas; in this case the user may be required to take appropriate measures.

Directive 94/9/EC (ATEX)

Additional marking (sample)

6NH9741-1AA00, SINAUT MD741-1 GSM/GPRS Router

II 3 G Ex nA IIC T4 Ta= -20°C to 60°C

Applied standards

- EN60079-15 (Type of protection “n”)

Classification

Group II, Category 3, Gas Atmosphere, Non-sparking equipment, Temperature class T4, Ambient temperature range: -20°C … +60°C

Specific Conditions of Use:

1. The SINAUT MD741-1 shall be installed in an Enclosure which maintains an ingress protection rating of IP54; meets the enclosure requirements of EN60079-0 and is only accessible with the use of a tool.
2. The USB (X1) port shall not be used.
3. On installation the SINAUT MD741-1 shall be provided with supply transient protection external to the apparatus such that the voltage at the supply terminals of the SINAUT MD741-1 shall not exceed 42 V.
4. When the Antenna is mounted external to the final Enclosure it shall be mounted and connected in a manner which maintains an ingress protection rating of IP54 and meets the enclosure requirements of EN60079-0.

12.2 Compliance to FM, UL and CSA

FM certification

Marking (sample)

CLI, DIV2, GP. A,B,C,D T4 Ta= -20°C to 60°C
CLI, Zone 2 IIC, T4 Ta= -20°C to 60°C

Applied standards

- Factory Mutual Approval Standard Class Number 3611

Classification

Class I, Division 2, Group A, B, C, D, Temperature class T4, Ambient temperature range: -20°C … +60°C

Class I, Zone 2, Group IIC, 135°C maximum surface temperature, Ambient temperature range: -20°C … +60°C

You can download the FM marking by follow the link:

http://support.automation.siemens.com/WW/view/en/35029750

UL/CSA Certification

Marking

LISTED
UL60950-1
3RUX

Applied standards

- UL 60950, 1st edition
- CSA C22.2 No.60950

12.3 Compliance to FCC

Marking

SINAUT MD741-1
FCC ID: LYHMD741-1
contains MC75 FCC ID: QIPMC75

Applied standards

- FCC Part 15
- FCC Part 15.19
- FCC Part 15.21

Mandatory user information

FCC Part 15

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer / installer or an experienced radio/TV technician for help.

FCC Part 15.19

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

1. this device may not cause harmful interference, and
2. this device must accept any interference received, including interference that may cause undesired operation.

FCC Part 15.21

Modifications not expressly approved by this company could void the user's authority to operate the equipment.

Installation by qualified personnel only

You may only use the SINAUT MD741-1 with an antenna of the SINAUT MD741-1 accessory program.

The installation of the SINAUT MD741-1 and the antenna as well as servicing is to be performed by qualified technical personnel only. When servicing the antenna, or working at distances closer than those listed below, ensure the transmitter has been disabled.

Contains FCC ID: QIRMC75 (GSM Module)

This device contains GSM, GPRS Class12 and EGPRS Class 10 functions in the 900 and 1800 MHz Band which are not operational in U.S. Territories.

This device is to be used only for mobile and fixed applications. The antenna(s) used for this transmitter must be installed to provide a separation distance of at least 20cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter.

Users and installers must be provided with antenna installation instructions and transmitter operating conditions for satisfying RF exposure compliance. Antennas used for this OEM module must not exceed 8.4dBi gain (GSM 1900) and 2.9dBi (GSM 850) for mobile and fixed operating configurations. This device is approved as a module to be installed in other devices.

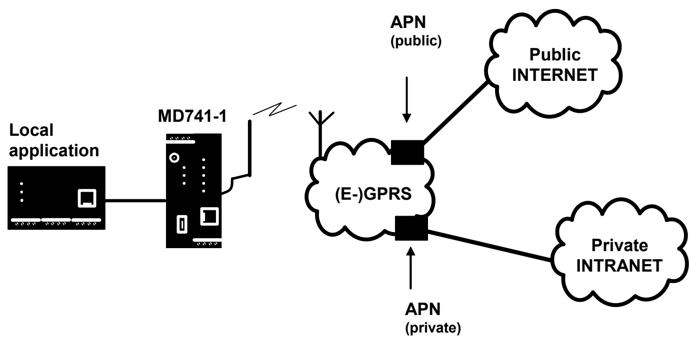
Glossary

AES

Advanced **E**ncryption **S**tandard. The NIST (National Institute of Standards and Technology) has been developing the AES encryption standard jointly with industrial companies for years. This → symmetrical encryption is designed to replace the previous DES standard. The AES standard specifies three different key sizes with 128, 192 and 256 bits.
In 1997, the NIST launched the AES initiative and announced its conditions for the algorithm. Of the encryption algorithms proposed, the NIST short-listed five; the algorithms MARS, RC6, Rijndael, Serpent and Twofish. In October 2000, the encryption algorithm chosen was Rijndael.

APN (Access Point Name)

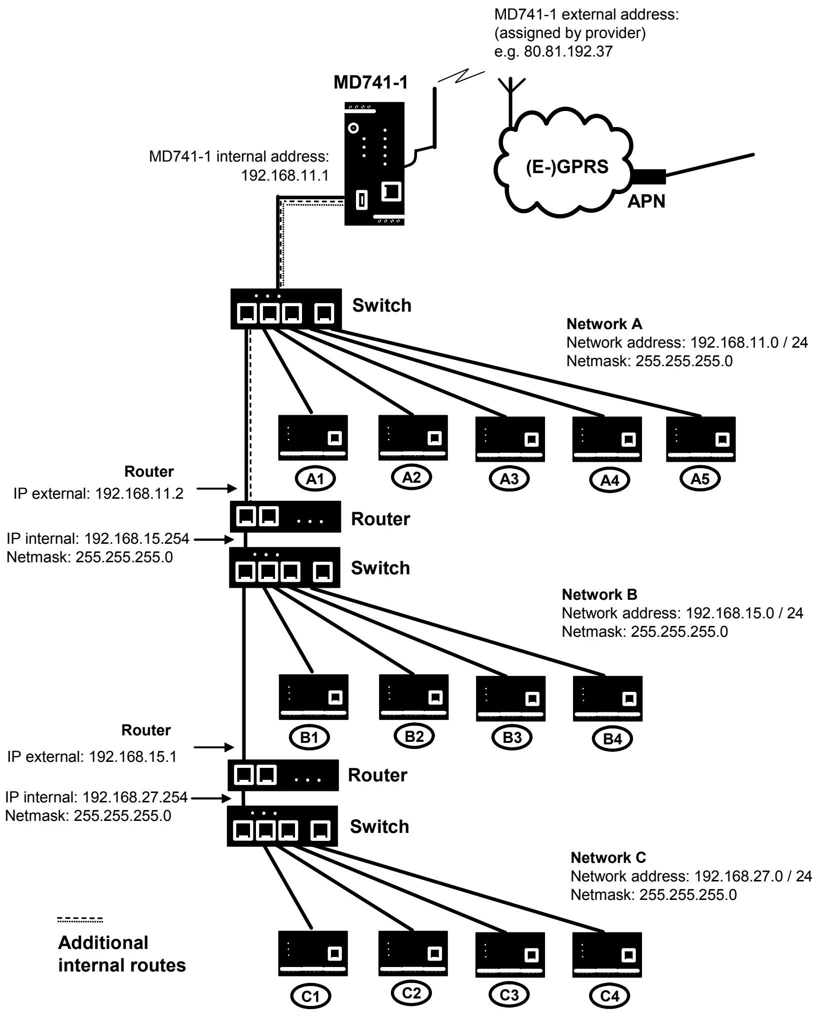
Trans-network connections, e.g. from a GPRS network to the Internet, are created in the GPRS network via so-called APNs.



An end device that wants to establish a connection via the GPRS network specifies an APN to indicate which network it wants to be connected to: the Internet or a private company network that is connected via a dedicated line.
The APN designates the transfer point to the other network. It is communicated to the user by the network operator.

Additional Internal Routes

The following sketch shows how the IP addresses could be distributed in a local network with subnetworks, what network addresses result from this, and what the specification for an additional internal route could look like.



Network A is connected to the SINAUT MD741-1 and via it to a remote network. Additional internal routes show the path to additional networks (networks B, C), which are connected to each other via gateways (routers). For the SINAUT MD741-1, in the example shown networks B and C can both be reached via gateway 192.168.11.2 and network address 192.168.11.0/24.

<table>
<tr><td colspan="6">Network A</td></tr>
<tr><td>Computer</td><td>A1</td><td>A2</td><td>A3</td><td>A4</td><td>A5</td></tr>
<tr><td>IP address</td><td>192.168.11.3</td><td>192.168.11.4</td><td>192.168.11.5</td><td>192.168.11.6</td><td>192.168.11.7</td></tr>
<tr><td>Network mask</td><td>255.255.255.0</td><td>255.255.255.0</td><td>255.255.255.0</td><td>255.255.255.0</td><td>255.255.255.0</td></tr>
<tr><td>Network B</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Computer</td><td>B1</td><td>B2</td><td>B3</td><td>B4</td><td rowspan="7">Additional internal routes:
Network:
192.168.15.0/24
Gateway:
192.168.11.2
Network:
192.168.27.0/24
Gateway:
192.168.11.2</td></tr>
<tr><td>IP address</td><td>192.168.15.3</td><td>192.168.15.4</td><td>192.168.15.5</td><td>192.168.15.6</td></tr>
<tr><td>Network mask</td><td>255.255.255.0</td><td>255.255.255.0</td><td>255.255.255.0</td><td>255.255.255.0</td></tr>
<tr><td>Network C</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Computer</td><td>C1</td><td>C2</td><td>C3</td><td>C4</td></tr>
<tr><td>IP address</td><td>192.168.27.3</td><td>192.168.27.4</td><td>192.168.27.5</td><td>192.168.27.6</td></tr>
<tr><td>Network mask</td><td>255.255.255.0</td><td>255.255.255.0</td><td>255.255.255.0</td><td>255.255.255.0</td></tr>
</table>

Asymmetrical encryption

In asymmetrical encryption, data are encrypted with one key and decrypted with a second key. Both keys are suitable for encryption and decryption. One of the keys is kept secret by its owner (Private Key), the other is issued to the public (Public Key), i.e. possible communication partners.
A message encrypted with a Public Key can only be decrypted and read by the recipient who has the corresponding Private Key. A message encrypted with the Private Key can be decrypted by any recipient who has the corresponding Public Key. Encryption with the Private Key shows that the message actually originates from the owner of the corresponding Public Key. We therefore speak of a digital signature.
Asymmetrical encryption methods such as RSA are, however, slow and vulnerable to certain attacks, which is why they are often combined with a symmetrical method (→ symmetrical encryption). On the other hand, concepts are also possible which avoid the complex administration of symmetrical keys.

CIDR

Classless Inter-Domain Routing
IP netmasks and CIDR are notations for grouping a number of IP addresses into an address space. Thus a range of contiguous addresses is treated as a network.
The CIDR method reduces, for example the routing tables stored in routers by means of a postfix in the IP address. This postfix can be used to designate a network together with its subnetworks. This method is described in RFC 1518.
In order to specify a range of IP addresses to the SINAUT MD741-1, or when configuring the firewall, it may be necessary to specify the address space in the CIDR notation. The following table shows the IP netmask on the left-hand side, and to the far right the corresponding CIDR notation.

IP netmask	binary				CIDR
255.255.255.255	11111111	11111111	11111111	11111111	32
255.255.255.254	11111111	11111111	11111111	11111110	31
255.255.255.252	11111111	11111111	11111111	11111100	30
255.255.255.248	11111111	11111111	11111111	11111000	29
255.255.255.240	11111111	11111111	11111111	11110000	28
255.255.255.224	11111111	11111111	11111111	11100000	27
255.255.255.192	11111111	11111111	11111111	11000000	26
255.255.255.128	11111111	11111111	11111111	10000000	25
255.255.255.0	11111111	11111111	11111111	00000000	24
255.255.254.0	11111111	11111111	11111110	00000000	23
255.255.252.0	11111111	11111111	11111100	00000000	22
255.255.248.0	11111111	11111111	11111000	00000000	21
255.255.240.0	11111111	11111111	11110000	00000000	20
255.255.224.0	11111111	11111111	11100000	00000000	19
255.255.192.0	11111111	11111111	11000000	00000000	18
255.255.128.0	11111111	11111111	10000000	00000000	17
255.255.0.0	11111111	11111111	00000000	00000000	16
255.254.0.0	11111111	11111110	00000000	00000000	15
255.252.0.0	11111111	11111100	00000000	00000000	14
255.248.0.0	11111111	11111000	00000000	00000000	13
255.240.0.0	11111111	11110000	00000000	00000000	12
255.224.0.0	11111111	11100000	00000000	00000000	11
255.192.0.0	11111111	11000000	00000000	00000000	10
255.128.0.0	11111111	10000000	00000000	00000000	9
255.0.0.0	11111111	00000000	00000000	00000000	8
254.0.0.0	11111110	00000000	00000000	00000000	7
252.0.0.0	11111100	00000000	00000000	00000000	6
248.0.0.0	11111000	00000000	00000000	00000000	5
240.0.0.0	11110000	00000000	00000000	00000000	4
224.0.0.0	11100000	00000000	00000000	00000000	3
192.0.0.0	11000000	00000000	00000000	00000000	2
128.0.0.0	10000000	00000000	00000000	00000000	1
0.0.0.0	00000000	00000000	00000000	00000000	0

Example: 192.168.1.0 / 255.255.255.0 corresponds to CIDR: 192.168.1.0/24

Client / Server

In a client/server environment, a server is a program or computer that receives queries from a client program or client computer and answers them.
In data communication, a computer that establishes a connection to a server (or host) is also referred to as a client. That means that the client is the computer that is calling and the server (or host) is the one being called.

CSD 9600

CSD (9600) stands for Circuit Switched Data or dial-in data connection. Here a connection is created between two users (end points of the connection), similar to a telephone call over a public telephone network. User 1 dials the telephone number of user 2. The network signals to user 2 that there is a call, user 2 accepts the call and the network establishes the connection until one of the users terminates the connection again.
In a GSM network this service is called CSD, and allows data transmission at 9600 bit/s or 14400 bit/s, with transmission being either secured or unsecured. Possible connections are GSM modem to GSM modem, analog modem to GSM and ISDN modem to GSM modem.

CSQ / RSSI

The CSQ value is a value defined in the GSM standard for indicating the signal quality. CSQ values correspond to the received field strength RSSI (= Received Signal Strength Indication):

CSQ	RSSI
< 6	< -101 dBm
6…10	-101…-93 dBm
11…18	-91…-77 dBm
> 18	> 75 dBm
99	Not logged in

Datagram

In the transmission protocol TCP/IP, data are sent in the form of data packets, the so-called IP datagrams. An IP datagram has the following structure:
1. IP Header
2. TCP/UDP Header
3. Data (Payload)

The IP Header contains:

- the IP address of the sender (source IP address)
- the IP address of the recipient (destination IP address)
- the protocol number of the protocol of the next higher protocol layer (according to the OSI layer model)
- the IP Header Checksum for checking the integrity of the header upon receipt.

TCP/UDP Header contains the following information:

- the port of the sender (source port)
- the port of the recipient (destination port)
- a checksum for the TCP Header and a few items of information from the IP Header (source and destination IP addresses, etc.)

DES/3DES

The symmetrical encryption algorithm (→ symmetrical encryption) DES, originally developed by IBM and checked by the NSA, was determined in 1977 by the American National Bureau of Standards, the predecessor of today's National Institute of Standards and Technology (NIST), as the standard for American government institutions.
As this was the first standardized encryption algorithm of all, it quickly established itself in industry and hence outside the USA.
DES works with a key length of 56 bits, which is no longer considered secure due to the increase in computing power since 1977.
3DES is a variant of DES. It works with 3-times larger keys, i.e. 168 bits long. It is still considered secure today and is, among other things, also part of the IPsec standard.

DHCP

The Dynamic Host Configuration Protocol (DHCP) performs automatic dynamic assignment of IP addresses and other parameters in a network. The Dynamic Host Configuration Protocol uses UDP. It was defined in RFC 2131 and was assigned the UDP ports 67 and 68. DHCP uses the client – server method, in which the client is assigned the IP addresses by the server.

DNS

Addressing in IP networks is always by means of IP addresses. It is generally preferable, however, to specify the addressing in the form of a domain address (i.e. in the form www.abc.xyz.de). If the addressing is by means of the domain address, then the sender first sends the domain address to a domain name server (DNS) and gets back the associated IP address. Only then does the sender address its data to this IP address.

DynDNS provider

Also *Dynamic DNS provider*. Every computer that is connected to the Internet has an IP address (IP = Internet Protocol). An IP address consists of up to 4 three-digit numbers, with dots separating each of the numbers. If the computer is online via the telephone line via modem, ISDN or ADSL, then the Internet service provider dynamically assigns it an IP address, i.e. the address changes from session to session. Even if the computer is online for more than 24 hours without interruption (e.g. in the case of a flat rate), the IP address is changed periodically.
For a local computer to be accessible via the Internet, its address must be known to the external remote station. This is necessary for it to establish a connection to the local computer. This is not possible, however, if the address of the local computer constantly changes. It is possible, however, if the user of the local computer has an account with a DynamicDNS provider (DNS = Domain Name Server).
Then he can specify there a hostname under which the computer can be accessed in the future, e.g.: www.xyz.abc.de. Moreover, the DynamicDNS provider makes available a small program that has to be installed and executed on the computer concerned. In each Internet session of the local computer this tool reports to the DynamicDNS provider which IP address the computer has at the moment. Its domain name server registers the current hostname - IP address assignment and reports this to other domain name servers in the Internet.
If now an external computer wants to establish a connection with a local computer which is registered with the DynamicDNS provider, the external computer uses the hostname of the local computer as the address. In this way a connection is established with the responsible DNS (Domain Name Server) in order to look up there the IP address which is currently assigned to this hostname. The IP address is transmitted back to the external computer, and then used by it as the destination address. This now leads precisely to the desired local computer.
As a rule, all Internet addresses are based on this method: First a connection is established to a DNS in order to determine the IP addresses assigned to this hostname. Once that has been done, the IP address that was "looked up" is used to establish the connection to the desired remote station, which can be any Web site.

EDGE

EDGE (= Enhanced Data Rates for GSM Evolution) refers to a method in which the available data rates in GSM mobile phone networks are increased by introducing an additional modulation process. With EDGE, GPRS is expanded to become EGPRS (Enhanced GPRS), and HSCSD is expanded to become ECSD.

EGPRS

EGPRS stands for "Enhanced General Packet Radio Service", which describes a packet-oriented data service based on GPRS, which is accelerated by means of EDGE technology.

GPRS

GPRS is the abbreviation for "General Packet Radio Service", a data transmission system of GSM2+ mobile phone systems. GPRS systems use the basestations of GSM networks as their wireless equipment, and their own infrastructure for coupling to other IP networks, such as the Internet. Data communication is packet-oriented; the Internet Protocol (IP) is used. GPRS provides data rates of up to 115.2 KBit/s.

GSM

GSM (= Global System for Mobile Communication) is a standard that is used worldwide for digital mobile phone networks. In addition to the voice service for telephone calls, GSM supports various data services, such as fax, SMS, CSD and GPRS. Depending on the legal requirements in the various countries, the frequency bands 900 MHz, 1800 MHz or 850 MHz and 1900 MHz are used.

HTTPS

HTTPS (=HyperText Transfer Protocol Secure) is a variant of the familiar HTTP, which is used by any Web browser for navigation and data exchange in the Internet.
In HTTPS the original protocol is supplemented with an additional component for data protection. While in HTTP data are transmitted unprotected in plain text, in HTTPS data are transmitted only after an exchange of digital certificates, and in encrypted form.

IP address

Every host or router on the Internet / an intranet has a unique IP address (IP = Internet Protocol). The IP address is 32 bits (= 4 bytes) long, and is written as 4 numbers (each in the range from 0 to 255), which are separated from each other by dots.
An IP address has 2 parts: the network address and the host address. All hosts of a network have the same network address, but different host addresses. Depending on the size of the network in question - a distinction is made between networks of Class A, B and C - the two address components may be of different sizes:

	1st byte	2nd byte	3rd byte	4th byte
Class A	Netw. addr.	Host addr.		
Class B	Netw. addr.		Host addr.	
Class C	Netw. addr.			Host addr.

It can be seen from the first byte of the IP address whether the IP address designates a network of Class A, B or C. The following definitions apply:

	Value of the 1st byte	Bytes for the network address	Bytes for the host address
Class A	1-126	1	3
Class B	128-191	2	2
Class C	192-223	3	1

If you do the arithmetic, you can see that there can be a maximum of 126 Class A networks worldwide, and each of these networks can comprise a maximum of 256 x 256 x 256 hosts (3 bytes of address space). There can be 64 x 256 Class B networks, each of which can contain up to 65,536 hosts (2 bytes of address space: 256 x 256). There can be 32 x 256 x 256 Class C networks, each of which can contain up to 256 hosts (1 byte of address space).

IP packet
See Datagram

IPsec
IP security (IPsec) is a standard that makes it possible to ensure the authenticity of the sender, the confidentiality and the integrity of the data in IP datagrams by means of encryption. The components of IPSec are the Authentication Header (AH), the Encapsulating Security Payload (ESP), the Security Association (SA), the Security Parameter Index (SPI) and the Internet Key Exchange (IKE).
When communication starts the computers involved clarify the method used and its implications, e.g. Transport Mode or Tunnel Mode.
In Transport Mode an IPSec header is inserted into each IP datagram between the IP header and the TCP or UDP header. As the IP header is not changed this mode is suitable only for a host-to-host connection.
In Tunnel Mode an IPSec header and a new IP header are inserted in front of the entire IP datagram. This means that the original datagram is contained, encrypted as a whole, in the payload of the new datagram.
The Tunnel Mode is used in the VPN: the devices at the tunnel ends perform the encryption and decryption of the datagrams, while the datagrams themselves remain completely protected as they pass through the tunnel, i.e. during transmission via a public network.

NAT (Network Address Translation)
In Network Address Translation (NAT) - often also referred to as *IP Masquerading* - an entire network is "hidden" behind a single device, the NAT router. This device is usually a router. The internal computers in the local network remain hidden with their IP addresses when they communicate to the outside via the NAT router. For the external communication partners only the NAT router with its own IP address appears.
However, in order for internal computers to be able to communicate direct with external computers (on the Internet) the NAT router must change the IP datagrams passing from internal computers to the outside and from the outside to an internal computer.
If an IP datagram is sent from the internal network to the outside the NAT router changes the datagram's IP and TCP headers. It replaces the source IP address and the source port with its own official IP address and its own, previously unused port. To this end it creates a table showing the correlation between the original values and the new ones.
When receiving a reply datagram the NAT router recognises by means of the destination port specified that the datagram is actually intended for an internal computer. Using the table the NAT box exchanges the destination IP address and the destination port and forwards the datagram to the internal network.

Network mask / Subnet mask

A company network with access to the Internet is normally officially assigned only a single IP address, e.g. 134.76.0.0. In this example address it can be seen from the 1st byte that this company network is a Class B network, i.e. the last 2 bytes can be used freely for host addressing. Arithmetically that represents an address space of 65,536 possible hosts (256 x 256).
Such a huge network is not very practical. It is necessary here to form subnetworks. This is done using a subnet mask. Like an IP address, this is a field 4 bytes long. The value 255 is assigned to each of the bytes that represent the network address. The main purpose of this is to "hide" a part of the host address range in order to use it for the addressing of subnetworks. For example, in a Class B network (2 bytes for the network address, 2 bytes for the host address), by means of the subnet mask 255.255.255.0 it is possible to take the 3rd byte, which was actually intended for host addressing, and use it now for subnet addressing. Arithmetically that means that 256 subnets with 256 hosts each could be created.

Port number

The Port Number field is a 2-byte field in UDP and TCP headers. The assignment of port numbers serves to identify various data flows that are processed simultaneously by UDP/TCP. The entire data exchange between UDP/TCP and the application processes takes place via these port numbers. The assignment of port numbers to application processes is performed dynamically and randomly. Fixed port numbers are assigned for certain frequently-used application processes. These are called Assigned Numbers.

PPPoE

Acronym for Point-to-Point Protocol over Ethernet. It is based on the standards PPP and Ethernet. PPPoE is a specification for connecting users to the Internet via Ethernet using a jointly used broadband medium such as DSL, Wireless LAN or cable modem.

PPTP

Acronym for Point-to-Point Tunneling Protocol. This protocol was developed by Microsoft, U.S. Robotics and others in order to transmit data securely between two VPN nodes (→ VPN) over a public network.

Private Key, Public key; Certification (X.509)	In asymmetrical encryption algorithms 2 keys are used: a *Private Key* and a *Public Key*. The public key serves to encrypt data and the private key to decrypt them. The public key is provided by the future recipient of the data to those who will send the data to him in encrypted form. The private key is possessed only by the recipient and serves to decrypt the received data. **Certification:** So that the user of the public key (for encryption) can be certain that the public key conveyed to him really does come from the entity that is to receive the data to be sent, certification can be used: the verification of the authenticity of the public key and the consequent link between the identity of the sender and his key is performed by a *Certification Authority or CA*. This is done according to the rules of the CA, for example by the sender being required to appear in person. Following successful inspection the CA signed the sender's public key with its (digital) signature. A *certificate* is created. An X.509 certificate makes a connection between an identity in the form of an 'X.500 Distinguished Name' (DN) and a public key. This connection is authenticated by the digital signature of an X.509 Certification Authority (CA). The signature - an encryption with the signature key - can be checked with the private key issued by the CA to the certificate holder.
Protocol, Transfer protocol	Devices that communicate with each other must use the same rules. They have to "speak the same language". Such rules and standards are called protocols or transfer protocols. Frequently used protocols include IP, TCP, PPP, HTTP and SMTP. TCP/IP is the umbrella term for all protocols that are based on IP.
Service provider	Supplier, company or institution that gives users access to the Internet or to an online service.
Spoofing, Anti-Spoofing	In Internet terminology, spoofing means to specify a forged address. The forged Internet address is used to pose as an authorised user. Anti-spoofing means mechanisms to reveal or prevent spoofing.
SSH	SSH (Secure Shell) is a protocol that enables secure, encrypted data exchange between computers. Secure SHell is used for remote access to the input console from LINUX-based machines.

Stateful inspection firewall

A stateful inspection firewall is a packet filtering method. Packet filters only let IP packets through if this has been defined previously using firewall rules. The following is defined in the firewall rules:

- which protocol (TCP, UDP, ICMP) can go through,
- the permitted source of the IP packets (From IP / From port)
- the permitted destination of the IP packets (To IP / To port)

It is likewise defined here what will be done with IP packets that are not allowed through (discard, reject).
For a simple packet filter it is always necessary to create two firewall rules for a connection:

- One rule for the query direction from the source to the destination, and
- a second rule for the query direction from the destination to the source.

It is different with a stateful inspection firewall. Here a firewall rule is only created for the query direction from the source to the destination. The firewall rule for the response direction from the destination to the source results from analysis of the data previously sent. The firewall rule for the responses is closed again after the responses are received or after a short time period has elapsed. Thus responses can only go through if there was a previous query. This means that the response rule cannot be used for unauthorised access. What is more, special procedures make it possible for UDP and ICMP data to also go through, even though these data were not requested before.

Symmetrical encryption

With symmetrical encryption the data are encrypted and decrypted using the same key. Examples of symmetrical encryption algorithms are DES and AES. These are fast, but require complex administration as the number of users increases.

TCP/IP (Transmission Control Protocol/Internet Protocol

Network protocol that is used to connect two computers on the Internet.
IP is the basic protocol.
UDP builds on IP, and sends individual packets. These can arrive at the recipient in a different sequence from the one they were sent in, or they can even get lost.
TCP serves to secure the connection, and ensures, for example, that the data packets are forwarded to the application in the right sequence.
UDP and TCP provide, in addition to the IP addresses, port numbers between 1 and 65535, which can be used to distinguish the various services.
A number of additional protocols are based on UDP and TCP, such as HTTP (Hyper Text Transfer Protocol), HTTPS (Secure Hyper Text Transfer Protocol), SMTP (Simple Mail Transfer Protocol), POP3 (Post Office Protocol, Version 3), DNS (Domain Name Service).
ICMP builds on IP, and contains control messages.
SMTP is an e-mail protocol based on TCP.
IKE is an IPsec protocol based on UDP.
ESP is IPsec protocol based on IP.
On a Windows PC, WINSOCK.DLL (or WSOCK32.DLL) handles both of these protocols.
(→ Datagram)

UDP

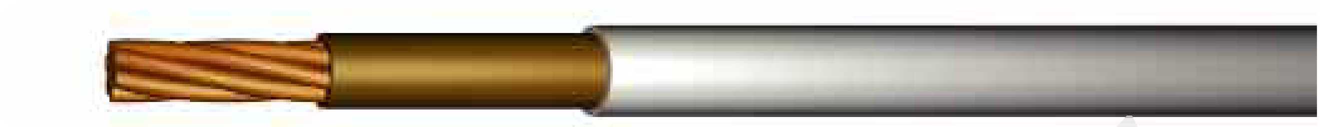
See TCP/IP

VPN (Virtual Private Network)

A **V**irtual **P**rivate **N**etwork (VPN) connects several separate private networks (subnets) via a public network, e.g. the Internet, to form a shared network. Confidentiality and authenticity are ensured by using cryptographic protocols. A VPN therefore provides an inexpensive alternative to dedicated lines when it comes to setting up a supraregional corporate network.

X.509

A kind of "seal" which proves the authenticity of a Public Key (→ asymmetrical encryption) and appendant data.
So that the user of the public key for encryption can be certain that the public key conveyed to him really does come from its issuer and hence from the entity that is to receive the data to be sent, certification can be used. This verification of the authenticity of the public key and the consequent link between the identity of the issuer and his key is performed by a *Certification Authority or CA.* This is done according to the rules of the CA, for example by the issuer of the public key being required to appear in person. Following successful inspection the CA signs the public key with its (digital) signature. A certificate is created.
An X.509(v3) certificate therefore contains a public key, information about the key owner (given as Distinguished Name (DN)), permitted designated uses, etc. and the signature of the CA.
The signature is created as follows: from the bit sequence of the public key, the data on its owner and other data, the CA creates an individual bit sequence which can be up to 160 bits long, the HASH value. This is encrypted by the CA using its private key and added to the certificate. Encryption with the CA's private key is proof of authenticity, i.e. the encrypted HASH character sequence is the digital signature of the CA. Should the data of the certificate be changed without authorization, the HASH value is no longer correct and the certificate then becomes worthless.
The HASH value is also known as the fingerprint. As it is encrypted with the private key of the CA, anyone in possession of the corresponding public key can decrypt the bit sequence and thus check the authenticity of the fingerprint or signature in question.
Involving certification authorities means that not every key owner needs to know the other one, but only the certification authority used. The additional key information also simplifies the administrability of the key.
X.509 certificates are employed, e.g. in e-mail encryption, using S/MIME or IPsec.



SURFACE WIRING CABLES PVC 6181Y

Plain annealed stranded circular copper conductor, single core, PVC insulated, PVC sheathed, Ref 6181 Y. 300/500 volts grade to BS6004 120mm rated at 600/1000 V. Brown/Grey or Blue/Grey. Flame propagation to BS EN 50265.

CCC Code	Conductor Size (mm^2)	Stranding (mm)	No. Of Cores	Weight (Kg/Km)	Overall Diameter (mm)	Gland Size (mm)	Nylon Cleat Size
6181Y1	1.0	1/1.13	1	28	4.5	20/16	-
6181Y1/5	1.5	1/1.38	1	36	5.1	20/16	-
6181Y2/5	2.5	1/1.78	1	51	6.0	20/16	-
6181Y4	4.0	7/0.85	1	75	6.8	20/16	-
6181Y6	6.0	7/1.04	1	98	7.4	20/16	-
6181Y10	10.0	7/1.35	1	150	8.8	20S	-
6181Y16	16.0	7/1.70	1	220	10.5	20S	0.5
6181Y25	25.0	7/2.14	1	340	12.5	20	0.5
6181Y35	35.0	7/2.52	1	440	13.5	25	0.6
6181Y50	50.0	19/1.78	1	540	14.38	25	0.6
6181Y70	70.0	19/2.14	1	750	15.3	25	0.7
6181Y95	95.0	19.2.52	1	1010	17.7	25	0.7
6181Y120	120.0	37/2.03	1	1250	19.3	32	0.8

Temperature limits:
-15 to +70°C.

•Bending radius:
up to 10mm2 - 3 x overall diameter. over 10mm2 - 4 x overall diameter.

Should not be installed at temperatures below 0°C or above +60°C.

SURFACE WIRING CABLES PVC 624*Y

Plain annealed copper conductor, PVC insulated one, two or three cores laid flat with an uninsulated circuit protective conductor and PVC sheathed. Grey. Ref 6241/2/3Y 300/500 V to BS6004. Flame propagation to BS EN 50265.

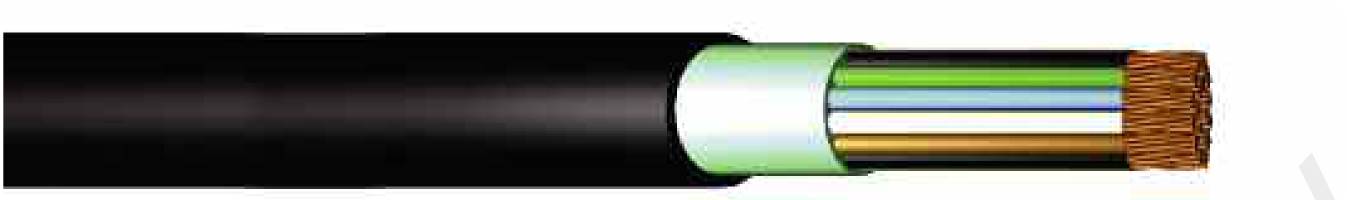
CCC Code	Conductor Size (mm^2)	Stranding (mm)	No. Of Cores	CPC Size (mm^2)	Weight (Kg/Km)	Overall Diameter (mm)
6241Y1BR	1.0	1/1.13	1	1.0	49	4.15 X 5.40
6241Y1/5BR	1.5	1/1.37	1	1.0	51	4.65 X 5.80
6242Y1	1.0	1/1.13	2	1.0	69	4.10 X 8.65
6242Y1/5	1.5	1/1.38	2	1.0	85	4.55 X 8.80
6242Y1/5BRBR	1.5	1/1.38	2	1.0	85	4.55 X 8.80
6242Y2/5	2.5	1/1.77	2	1.5	120	5.40 X 10.50
6242Y4	4.0	7/0.85	2	1.5	175	6.10 X 12.00
6242Y6	6.0	7/1.04	2	2.5	240	6.90 X 13.80
6242Y10	10.0	7/1.35	2	4.0	390	8.40 X 18.50
6242Y16	16.0	7.1.70	2	6.0	560	9.70 X 20.60
6243Y1	1.0	1/1.13	3	1.0	92	4.60 X 10.20
6243Y1/5	1.5	1/1.37	3	1.0	115	4.75 X 11.45
6243Y2/5	2.5	1/1.77	3	1.5	170	5.45 X 13.40

Temperature limits:
- 15 to + 70°C.

*Bending radius:
Up to 10mm - 3 x overall diameter.
Above 25mm - 6 x overall diameter.

Please note that gland and cleat sizes are intended to be indicative and may vary according to different manufacturers tolerances.

*All bending radii shown are indicative only as each individual manufacturer has their own criteria for their product. Specification of the minimum bending radius (MBR) of cables is not referred to in cable standards. This is a manufacturer declaration, based on their own judgement and experience of the capabilities of their cable, it is not a specification defined in standards.



INSTRUMENTATION AND CONTROL CABLES - PAS5308

PAS5308 PART 1, TYPE 1 CONSTRUCTION, OVERALL SCREENED LSZH

Plain annealed flexible copper conductors, XLPE insulated, laid up to form pairs, collective aluminium/mylar tape screen complete with 0.5mm^2 drain wire, low smoke zero halogen (LSZH) sheath, Blue or Black, to PAS5308 Part 1, Type 1 LSZH.

CCC Code	Conductor Size (mm^2)	Stranding (mm)	No. Of Pairs	Weight (Kg/Km)	Overall Diameter (mm)	Brass A2 Gland
7246	0.75	24/0.20	1	69	6.30	20/16
7247	0.75	24/0.20	2	99	7.30	20/16
7248	0.75	24/0.20	5	242	13.30	20
7249	0.75	24/0.20	10	380	17.70	25
7250	0.75	24/0.20	20	684	23.50	32
7251	0.75	24/0.2	30	989	28.50	40
7243	0.75	24/0.2	1 TRIPLE	83	6.8	20/16
7273	1.5	7/0.53	1	87	7.3	20/16
7274	1.5	7/0.53	2	145	8.7	20S
7275	1.5	7/0.53	5	345	15.4	25
7276	1.5	7/0.53	10	575	20.60	32
7277	1.5	7/0.53	20	1075	27.50	40
7278	1.5	7/0.53	1 TRIPLE	115	8.40	20S

Temperature limits:
-20 to +65°C.

*Bending radius:
5 x overall diameter.

Core identification:
Part 1 colour code chart on page 86.

Part 2 colour code chart on page 87.

Should not be installed at temperatures below 0°C.

INSTRUMENTATION AND CONTROL CABLES - PAS5308

PAS5308 PART 1, TYPE 1 CONSTRUCTION, INDIVIDUALLY SCREENED LSZH

Plain annealed flexible copper conductors, XLPE insulated, laid up to form pairs, each pair individually aluminium/mylar tape screened. Complete with 0.5mm^2 drain wire, collective aluminium/mylar tape screen complete with 0.5mm^2 drain wire, low smoke zero halogen (LSZH) outer sheath, Black or Blue, generally to PAS5308 Part 1, Type 1 LSZH.

CCC Code	Conductor Size (mm^2)	Stranding (mm)	No. Of Pairs	Weight (Kg/Km)	Overall Diameter (mm)	Brass A2 Gland
72712	0.5	16/0.2	2	161	11.00	20S
72713	0.5	16/0.2	5	253	14.20	25
72714	0.5	16/0.2	10	408	20.10	32
72715	0.5	16/0.2	20	753	26.30	40
72716	0.5	16/0.2	30	1153	31.30	40
71149	0.75	24/0.20	2	184	11.80	20
71150	0.75	24/0.20	5	299	15.30	25
71151	0.75	24/0.20	10	489	21.70	32
71152	0.75	24/0.20	20	920	28.80	40
7253	0.75	24/0.2	30	1445	34.50	50S

Temperature limits:
-20 to +65°C.

*Bending radius:
5 x overall diameter.

Core identification:
Part 1 colour code chart on page 86.

Part 2 colour code chart on page 87.

Should not be installed at temperatures below 0°C.

Please note that gland and cleat sizes are intended to be indicative and may vary according to different manufacturers tolerances.

*All bending radii shown are indicative only as each individual manufacturer has their own criteria for their product. Specification of the minimum bending radius (MBR) of cables is not referred to in cable standards. This is a manufacturer declaration, based on their own judgement and experience of the capabilities of their cable, it is not a specification defined in standards.

SIEMENS

SIMEAS® P
Power Meter

7KG775x

Betriebsanleitung	Bestell-Nr.	E50417-B1074-C339-A4
Operating Instructions	Order no:	E50417-B1074-C339-A4

Ausgabe 04/2008

1 Betriebsanleitung 2
1.1 Konformität 2
1.2 Allgemeine Hinweise 3
1.3 Qualifiziertes Personal 5
1.4 Bestelldaten 6
1.5 Anwendungsbereich 7
1.6 Arbeitsweise 8
1.7 Prinzipschaltbild 9
1.8 Messgrößen 11
1.9 Technische Daten 13
1.10 Kommunikationsschnittstelle 19
1.11 Abmessungen 20
1.11.1 Gerätevarianten 7KG7750 20
1.11.2 Gerätevariante 7KG7755 23
1.12 Anschlussklemmen 24
1.13 Montage und Betrieb 27
1.13.1 Montage 28
1.14 Lagerung 30
1.15 Elektrischer Anschluss 30
1.16 Anschlussbeispiele 32
1.17 Inbetriebnahme 36
1.18 Parametrierübersicht 37
1.18.1 Bedienungshinweise 37
1.18.2 Tastenfunktion 38
1.18.3 Screenaufbau 38
1.18.4 Anmerkungen 39
1.18.5 Parametrierübersicht 7KG7750 40
1.19 Prüfung und Abgleich 41
1.20 Wartung, Instandsetzung und Reinigung 42

2 Operating Instructions 44
2.1 Conformity 44
2.2 General Information 45
2.3 Qualified Personnel 47
2.4 Ordering Data 48
2.5 Range of Application 49
2.6 Mode of Operation 50
2.7 Block Diagram 51
2.8 Measured Values 53
2.9 Technical Data 55
2.10 Communication Interface 60
2.11 Dimensions 61
2.11.1 Device Variants 7KG7750 61
2.11.2 Device Variant 7KG7755 64
2.12 Connection Terminals 65
2.13 Mounting and Operation 68
2.13.1 Mounting the Device 69
2.14 Storage 71
2.15 Electrical Connection 71
2.16 Connection Examples 73
2.17 Commissioning 77
2.18 Configuration Overview 78
2.18.1 Operating Notes 78
2.18.2 Button Functions 79
2.18.3 Screen Structure 79
2.18.4 Notes 80
2.18.5 Overview of the Programming Levels: 7KG7750 81
2.19 Testing and Calibration 82
2.20 Maintenance, Repair and Cleaning 83

1 Betriebsanleitung

1.1 Konformität

Das Produkt entspricht den Bestimmungen der Richtlinie des Rates der Europäischen Gemeinschaften zur Angleichung der Rechtsvorschriften der Mitgliedsstaaten über die elektromagnetische Verträglichkeit (EMV-Richtlinie 2004/108/EG) und betreffend elektrische Betriebsmittel zur Verwendung innerhalb bestimmter Spannungsgrenzen (Niederspannungsrichtlinie 2006/95/EG).

Diese Konformität ist das Ergebnis einer Prüfung, die durch die Siemens AG gemäß den Richtlinien in Übereinstimmung mit den Fachgrundnormen EN 61000-6-2 und EN 61000-6-4 für die EMV-Richtlinie und der Norm EN 61010-1 für die Niederspannungsrichtlinie durchgeführt worden ist.

Das Gerät ist für den Einsatz im Industriebereich gemäß der Norm EN 61000-6-4 entwickelt und hergestellt.

Das Erzeugnis steht im Einklang mit den Normen IEC 60688, EN 60688 bzw. DIN EN 60688.

1.2 Allgemeine Hinweise

Diese Betriebsanleitung enthält die erforderlichen Informationen für den bestimmungsgemäßen Gebrauch der darin beschriebenen Produkte. Sie wendet sich an technisch qualifiziertes Personal, welches speziell ausgebildet ist oder einschlägiges Wissen auf dem Gebiet der Mess-, Steuerungs- und Regelungstechnik, im folgenden Automatisierungstechnik genannt, besitzt.

Die Kenntnis und das technisch einwandfreie Umsetzen der in dieser Anleitung enthaltenen Sicherheitshinweise und Warnungen sind Voraussetzung für gefahrlose Installation und Inbetriebnahme, sowie für Sicherheit bei Betrieb und Instandhaltung des beschriebenen Produkts. Nur qualifiziertes Personal im Sinne der nachfolgenden Erläuterung verfügt über das erforderliche Fachwissen, um die in dieser Unterlage in allgemeingültiger Weise gegebenen Sicherheitshinweise und Warnungen im konkreten Einzelfall richtig zu interpretieren und in die Tat umzusetzen.

Diese Betriebsanleitung ist fester Bestandteil des Lieferumfangs. Sie kann jedoch nicht sämtliche Details zu allen Ausführungen des beschriebenen Produkts und auch nicht jeden denkbaren Fall der Aufstellung, des Betriebes oder der Instandhaltung berücksichtigen.

Sollten weitere Informationen gewünscht werden oder sollten besondere Probleme auftreten, die in dieser Unterlage nicht ausführlich genug behandelt werden, dann können zusätzliche Auskünfte von der örtlichen Siemens-Niederlassung oder von der auf der Rückseite dieser Betriebsanleitung stehenden Adresse erhalten werden.

WARNUNG!

Das Betriebsmittel (Gerät, Baugruppe) darf nur in der vom Hersteller zugelassenen Weise eingesetzt werden. Anderenfalls kann die Schutzwirkung des Gerätes gemindert werden.

Außerdem weisen wir darauf hin, dass der Inhalt dieser Produkt-Dokumentation nicht Teil einer früheren oder bestehenden Vereinbarung, Zusage oder eines Rechtsverhältnisses ist oder dieses abändern soll. Sämtliche Verpflichtungen von Siemens ergeben sich aus dem jeweiligen Kaufvertrag, der auch die vollständige und allein gültige Gewährleistungsregelung enthält. Diese vertraglichen Gewährleistungsbestimmungen werden auch durch die Ausführungen in dieser Unterlage weder erweitert noch beschränkt.

Gleichspannung

Wechselspannung

3-Phasen-Wechselspannung

Beachten Sie die Dokumentation.

Schutzleiter

WARNUNG!

Beim Betrieb elektrischer Geräte stehen zwangsläufig bestimmte Teile dieser Geräte unter gefährlicher Spannung. Bei Nichtbeachtung der Warnhinweise können deshalb schwere Körperverletzungen oder Sachschäden auftreten.

Nur entsprechend qualifiziertes Personal darf an diesem Gerät arbeiten. Der einwandfreie und sichere Betrieb dieses Gerätes setzt sachgemäßen Transport, fachgerechte Lagerung, Aufstellung und Montage, sowie sorgfältige Bedienung und Instandhaltung voraus.

Insbesondere sind die Allgemeinen Errichtungs- und Sicherheitsvorschriften für das Arbeiten an Starkstromanlagen (z. B. DIN VDE oder andere nationale oder internationale Vorschriften) zu beachten. Nichtbeachtung kann Tod, Körperverletzung oder erheblichen Sachschaden zur Folge haben.

1.3 Qualifiziertes Personal

Dies sind Personen, die mit Aufstellung, Montage, Inbetriebsetzung und Betrieb des Produktes vertraut sind und über die ihrer Tätigkeit entsprechenden Qualifikationen verfügen, wie z.B.:

- Ausbildung oder Unterweisung bzw. Berechtigung Geräte/Systeme gemäß den Standards der Sicherheitstechnik für elektrische Stromkreise, hohen Druck und aggressive Medien zu betreiben und zu warten.
- Ausbildung oder Unterweisung gemäß den Standards der Sicherheitstechnik in Pflege und Gebrauch angemessener Sicherheitsausrüstung.
- Schulung in Erster Hilfe.

1.4 Bestelldaten

Bezeichnung	Bestellnummer
Power Meter	
SIMEAS P50 Schalttafeleinbaugerät 96 mm x 96 mm mit Grafikdisplay	7KG 7 7 5 0 - 0 ☐ A 0 ☐ - 0 A A ☐
I/O-Module (optional)	
ohne (Standard)	A
2 Binärausgänge	B
2 Binäreingänge	C
2 Analogausgänge (DC: 0 bis 20 mA / 4 bis 20 mA)	D
2 Analogeingänge (DC: 0 bis 20 mA)	E
3 Relaisausgänge	G
Schutzklasse Front	
IP 41	**1**
IP 65	**3**
Kommunikationsprotokolle	
PROFIBUS DP und Modbus RTU/ASCII	**0**
IEC 60870-5-103 und Modbus RTU/ASCII	**1**
SIMEAS P55 Hutschienengerät 96 mm x 96 mm, Schutzklasse Front IP 20	7KG 7 7 5 5 - 0 ☐ A 0 0 - 0 A A ☐
I/O-Module (optional)	
ohne (Standard)	A
2 Binärausgänge	B
2 Binäreingänge	C
2 Analogausgänge (DC: 0 bis 20 mA / 4 bis 20 mA)	D
2 Analogeingänge (DC: 0 bis 20 mA)	E
3 Relaisausgänge	G
Kommunikationsprotokolle	
PROFIBUS DP und Modbus RTU/ASCII	**0**
IEC 60870-5-103 und Modbus RTU/ASCII	**1**

1.5 Anwendungsbereich

SIMEAS P ist ein Gerät zur Erfassung von Messwerten in Energieversorgungsnetzen.

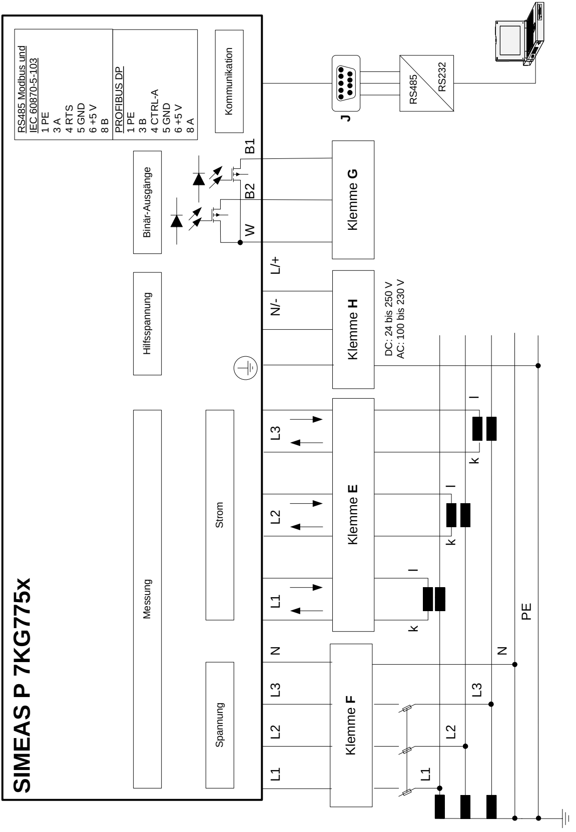
Anwendung findet es in allen Bereichen von der Industrie bis zum Gewerbe. Durch einfachste Parametrierung kann jeder Anwender die Darstellung seiner Messwerte individuell nach seinen Wünschen und Erfordernissen anpassen.

Eine RS485-Schnittstelle mit den Standardprotokollen PROFIBUS DP-V1, Modbus RTU/ASCII oder IEC 60870-5-103 ermöglicht das einfache Einbinden in Netzwerke. Damit können Messwerte mehrerer SIMEAS P in einer Masterstation zentral angezeigt, ausgewertet oder weiterverarbeitet werden.

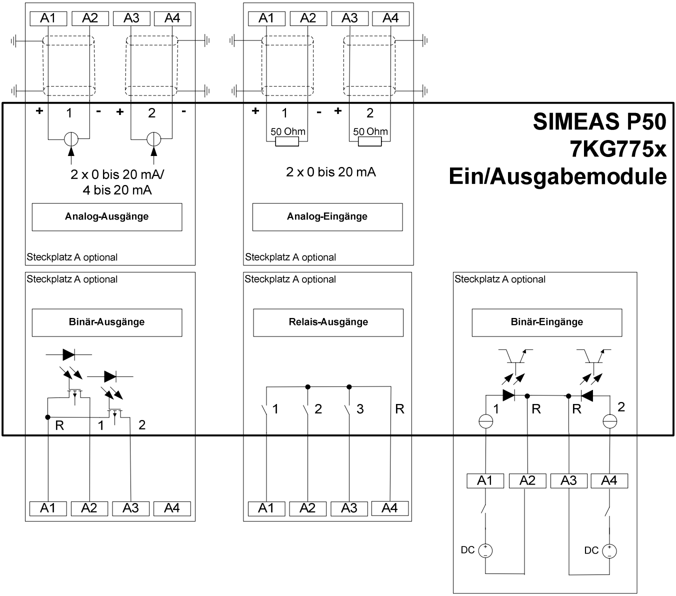
1.6 Arbeitsweise

Eingangsspannungen und Eingangsströme werden abgetastet und daraus die Effektivwerte gebildet. Alle abgeleiteten Messgrößen werden dann von einem Prozessor errechnet.
Diese stehen zur Anzeige in den Screens, zur Übertragung über die serielle Schnittstelle oder zur Aufzeichnung im Speicher zur Verfügung.
SIMEAS P bietet die Möglichkeit, mehrere Grenzwertgruppen mit Grenzwerten der Messgrößen zu parametrieren. Diese können mit UND / ODER verknüpft und deren Verletzungen an Zählern angezeigt oder an Binärausgängen ausgegeben werden. Auch eine Triggerung des Oszilloskops oder ein Start der Aufzeichnung sind damit möglich.
Die Darstellung der Messgrößen in den Screens des Graphikdisplays von SIMEAS P kann der Anwender individuell nach seinen Erfordernissen gestalten. Es können bis zu 20 Screens über die Fronttasten angewählt werden. Anzahl, Art, Inhalt und Reihenfolge sind parametrierbar.
Eine Grundeinstellung ist dabei ab Werk vorprogrammiert.
In den Messwertscreens befindet sich eine Statuszeile die Zustand, Anschaltung sowie Diagnosemeldungen des SIMEAS P anzeigt. Eine Aktualisierung der Anzeige erfolgt dabei im Zyklus von 1 s.

1.7 Prinzipschaltbild



Ein-/Ausgabemodule (optional):



Das Gerät 7KG775x kann gemäß Bestelldaten (s. Abschnitt 1.4) mit einem Ein- oder Ausgabemodul geliefert werden:

- Binäreingänge (2 Kontakte mit gemeinsamer Wurzel)
- Binärausgänge (2 Kontakte mit gemeinsamer Wurzel)
- Relaisausgänge (3 Kontakte mit gemeinsamer Wurzel)
- Analogeingänge (2 Kanäle)
- Analogausgänge (2 Kanäle)

1.8 Messgrößen

Messgröße	Messpfad [1]	Auswahl	Fehler-grenzen [2]
Spannung	L1-N, L2-N, L3-N	▼ ■ ●	±0,2 %
Spannung	L1-L2, L2-L3, L3-L1, Σ [3]	▼ ■ ●	±0,2 %
Strom	L1, L2, L3, N, Σ [3]	▼ ■ ●	±0,2 %
Wirkleistung P + Bezug, - Lieferung	L1, L2, L3, Σ	▼ ■ ●	±0,5 %
Blindleistung Q + kap, - ind	L1, L2, L3, Σ	▼ ■ ●	±0,5 %
Scheinleistung S	L1, L2, L3, Σ	▼ ■ ●	±0,5 %
Leistungsfaktor |cosφ| [4]	L1, L2, L3, Σ	▼ ■ ●	±0,5 %
Wirkfaktor cosφ [4]	L1, L2, L3, Σ	▼ ■ ●	±0,5 %
Phasenwinkel [4]	L1, L2, L3, Σ	▼ ■ ●	±2°
Netzfrequenz [5]	L1-N	▼ ■ ●	±10 mHz
Wirkenergie E Bezug	L1, L2, L3, Σ	▼ ■	±0,5 %
Wirkenergie E Lieferung	L1, L2, L3, Σ	▼ ■	±0,5 %
Wirkenergie absolut	L1, L2, L3, Σ	▼ ■	±0,5 %
Wirkenergie Saldo	Σ	▼ ■	±0,5 %
Blindenergie Q kap	L1, L2, L3, Σ	▼ ■	±0,5 %
Blindenergie Q ind	L1, L2, L3, Σ	▼ ■	±0,5 %
Blindenergie Q Absolut	L1, L2, L3, Σ	▼ ■	±0,5 %

Messgröße	**Messpfad** [1]	**Auswahl**	**Fehler-grenzen** [2]
Scheinenergie	L1, L2, L3, Σ	▼ ■	±0,5 %
Unsymmetrie Spannung	Vierleiternetz	▼ ■ ●	±0,5 %
Unsymmetrie Strom	Vierleiternetz	▼ ■ ●	±0,5 %
THD Spannung	L1, L2, L3	▼ ■ ●	±0,5 %
THD Strom	L1, L2, L3	▼ ■ ●	±0,5 %
Oberschwingung U 5., 7., 11., 13., 17. und 19. H.	L1, L2, L3	▼ ■ ●	
Oberschwingung I 5., 7., 11., 13., 17. und 19. H.	L1, L2, L3	▼ ■ ●	
Grenzwertverletzung	Zähler 1 bis 4	▼ ■	
Analogeingänge	extern	▼ ■	±0,5%
Binäreingänge	extern	▼ ■	

1) Die Darstellung der Leiter ist abhängig von der Anschlussart
2) Fehlergrenzen bezogen auf: 0,5 bis 1,2 x Nennbereich.
3) Mittelwert aller Leiterkreise
4) Messung ab 2 % der Scheinleistung im gewählten Messbereich
5) Messung ab 30 % der Eingangsspannung L1-N

▼ Darstellbare Messgrößen in Messwertscreens
■ Wählbare Messgrößen über Kommunikation
● Auswahl von Messgrößen für Listenscreens und Oszilloskop

1.9 Technische Daten

Eingang	Nur zum Anschluss an Wechselspannungssysteme
Eingang Wechselspannung	U_E 3 Spannungseingänge
Maximale Netzspannung Überlast Frequenzbereich f_E Kurvenform Messbereiche Eingangsspannung U_E Dauerüberlastbarkeit Stoßüberlastbarkeit Eingangswiderstand (L - N) Leistungsaufnahme je Leiter	Y 400 V / Δ 690 V 20 % 45 Hz bis 65 Hz, ab > 30 % U_E Sinus oder verzerrt bis zur 21. Harmonischen 100 V/110 V; 190 V; 400 V; 690 V (L-L) 1,5 x U_E 2,0 x U_E 3 Phasen symmetrisch: 4,2 MΩ 1 Phase: 8,4 MΩ 38 mW (U_{LE} = 400 V)
Eingang Wechselstrom	I_E 3 Stromeingänge
Eingangsstrom I_E Max. Nennspannung Dauerüberlastung Stoßüberlastbarkeit Leistungsaufnahme je Leiter	1 A; 5 A AC: 150 V 10 A 100 A für 1 s 83 µVA bei 1 A; 2,1 mVA bei 5 A
Binäreingänge	(optional)
max. Eingangsspannung Stromaufnahme bei High-Pegel Low-Pegel High-Pegel Signalverzögerung	DC: 300 V 1,8 mA ≤ 10 V ≥ 19 V Max. 3 ms
Analogeingänge	(optional)
Messbereich Aussteuerbereich Eingangswiderstand Genauigkeit	DC: 0 bis 20 mA DC: 0 bis 24 mA 50 Ω ±0,1 % 0,5 % vom Messbereichsendwert

Binärausgänge	Intern bzw. optional über potentialfreie Halbleiterrelais
max. Schaltspannung max. Kontaktstrom Anzahl der Schaltspiele Innenwiderstand zulässige Schaltfrequenz	AC: 230 V; DC: 250 V 100 mA dauernd 300 mA für 100 ms unbegrenzt bei Beachtung max. Schaltspannung und max. Kontakt-strom 50 Ω 10 Hz
Analogausgänge	(optional)
Nennausgangsstrom Austeuerbereich Max. Lastwiderstand Genauigkeit	DC: 0 bis 20 mA DC: 0 bis 24 mA 250 Ω Typ. 0,2 %; max. 1,1 % vom Nenn-wert
Relaisausgänge	(optional)
Max. Schaltspannung Max. Kontaktdauerstrom Min. Kontaktdauerstrom Max. Schaltleistung (ohmsche Last) Max. Ansprechzeit Max. Abfallzeit Anzahl der Schaltspiele	AC: 270 V / DC: 150 V 5 A 1 mA bei DC: 5 V AC: 5 A / 250 V oder DC: 5 A / 30 V 10 ms 7 ms $1{,}5 \times 10^5$ bei max. 30 V / 5 A (DC) bzw. 120 V / 3 A (AC) 3×10^4 bei max. 250 V / 5 A (AC)

Display	Grafikdisplay
Auflösung Größe	(128 x 64) Pixel 40 mm x 60 mm
Maße/Masse	
Maße Masse	96 mm x 96 mm x 90 mm ca. 0,6 kg (ohne Ein-/Ausgabemodule) ca. 0,65 kg (mit 1 Modul)

Überspannungskategorie	nach IEC 61010 Teil1
Spannungsmesseingänge U_E bis 400 V (L-L) U_E bis 690 V (L-L) Strommesseingänge U_E bis 150 V Stromversorgung Binärausgänge, Binäreingänge und Relaisausgänge Analogausgänge und Analog-eingänge	 Kat. III Kat. II Kat. III Kat. II Kat. II Kat. III
Versorgungsspannung	Mehrbereichsnetzteil AC / DC
Nennbereich Gesamtbereich Leistungsaufnahme Frequenzbereich	DC: 24 V bis 250 V oder AC: 100 V bis 230 V ±20 % vom Nennbereich max. 6 W oder 9 VA 45 Hz bis 65 Hz
Batterie	
Typ	VARTA CR2032, 3 V, Li-Mn o.ä.

Kommunikationsschnittstelle	
Anschluss	9-pol. DSUB-Buchse, female
Datenübertragung PROFIBUS DP-V1	Baudrate: 9600 bit/s bis 12 Mbit/s
Datenübertragung IEC 60870-5-103	Baudrate: 9600, 19200, 38400 bit/s
Datenübertragung Modbus RTU/ASCII PC-RS485	Baudrate: 300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200 bit/s

Isolationsprüfung, Stückprüfung, 2 s	nach IEC 61010-1
Spannungseingänge Binärausgänge	AC: 2,2 kV
Stromeingänge	AC: 1,35 kV
Versorgungsspannung	DC: 3,1 kV
Serielle Schnittstelle	AC: 500 V
I/O-Module (optional)	
Binäreingänge und Binär-/ Relaisausgänge gegen PE	AC: 2,2 kV
Analogeingänge und Analog-ausgänge gegen PE	AC: 500 V

Isolierung der Ein- und Ausgänge	
Signaleingänge (Strom)	Verstärkt, AC: max. 150 V, Kat. III
Signaleingänge (Spannung)	Schutzimpedanz, AC: max. 600 V, Kat. II oder AC: max. 300 V, Kat. III
Stromversorgung	Verstärkt, AC: max. 230 V DC: max. 250 V, Kat. II
Ausgänge	Verstärkt, AC: max. 230 V DC: max. 250 V Kat. II

Referenzbedingungen	Die vorgenannten Genauigkeitsangaben gelten unter Referenzbedingungen
Eingangsstrom I_E	I_{EN} ±1 %
Eingangsspannung U_E	U_{EN} ±1 %
Frequenz f_E	45 Hz bis 65 Hz
Kurvenform	Sinus, Klirrfaktor ≤ 5 %
Umgebungstemperatur T_U	23 °C ±1 °C
Versorgungsspannung U_H	U_{HN} ±1 %
Anwärmzeit	≥ 15 min
Fremdfelder	keine

Umweltbedingungen	Das Gerät darf nur in geschlossenen Räumen verwendet werden.
Umgebungstemperatur	Gemäß IEC 60688
Arbeitstemperaturbereich	0 °C bis 55 °C
Lagertemperaturbereich	-25 °C bis +70 °C
Maximale relative Luftfeuchte	80 %, bei Temperaturen bis zu +31 °C; linear abnehmend bis zu 50 % bei +40 °C
Maximale Höhe über dem Meeresspiegel	2000 m
Verschmutzungsgrad	2, keine Betauung

Zusätzliche Technische Daten	
Interne Sicherung	Nicht austauschbar Typ T500mA/250V laut IEC 60127
Interne Sicherung, sekundär	Nicht austauschbar Typ F2A/125V laut UL 248-14

Schutzklasse gemäß IEC 60529	
Gerät	
- Front	IP 20 / IP 41 / IP 65 siehe Bestelldaten 1.4
- Rückseite	IP 20
Personenschutz	IP 1x

1.10 Kommunikationsschnittstelle

Pin-Nr.	RS485-Schnittstelle Modbus und IEC 60870-5-103	PROFIBUS- Schnittstelle
1	Schutzerde	Schutzerde
2		
3	A	B (RxD/TxD-P)
4	RTS	CTRL-A
5	GND	GND
6	+5 V	+5 V
7		
8	B	A (RxD/TxD-N)
9		

Die Busterminierung erfolgt im Anschlusskabel.
An der D-SUB-Buchse ist die potentialgetrennte Versorgungsspannung der Schnittstelle verfügbar, damit im Anschlusskabel die Abschlusswiderstände für die Datensignale angeschlossen werden können.

ACHTUNG!

Die RS485 Kommunikationsschnittstelle ist ein SELV-Schaltkreis (Separated Extra Low Voltage), ehemals Schutzkleinspannung). Geräte, die an diese Schnittstelle angeschlossen werden, müssen ebenfalls SELV-Schaltkreise sein und der Norm IEC/EN 60950 entsprechen.

1.11 Abmessungen

1.11.1 Gerätevarianten 7KG7750

Hinweis: Alle Maße in mm!

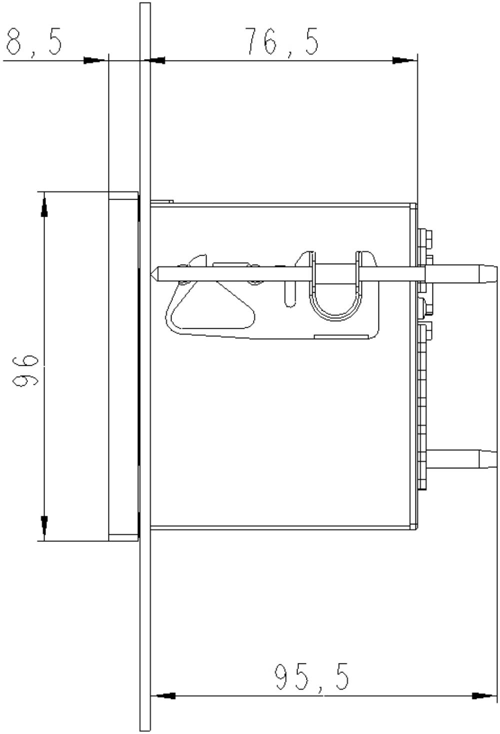


Abbildung 1: 7KG7750 Variante IP 41

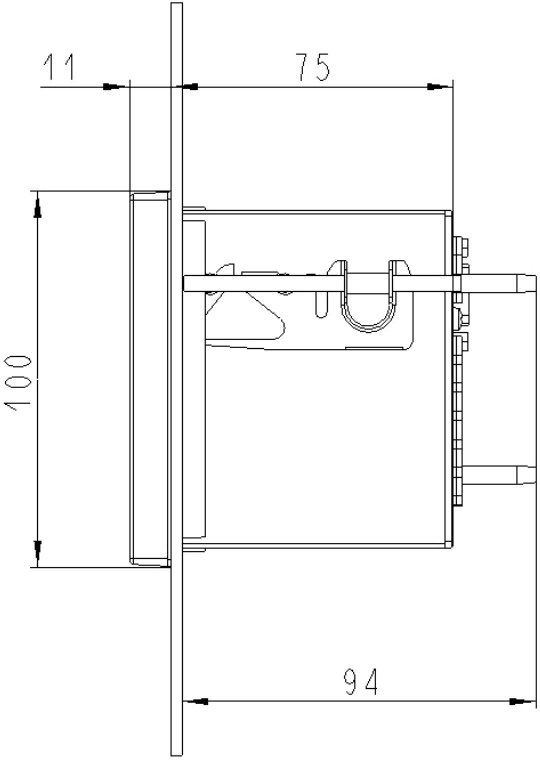


Abbildung 2: 7KG7750 Variante IP 65

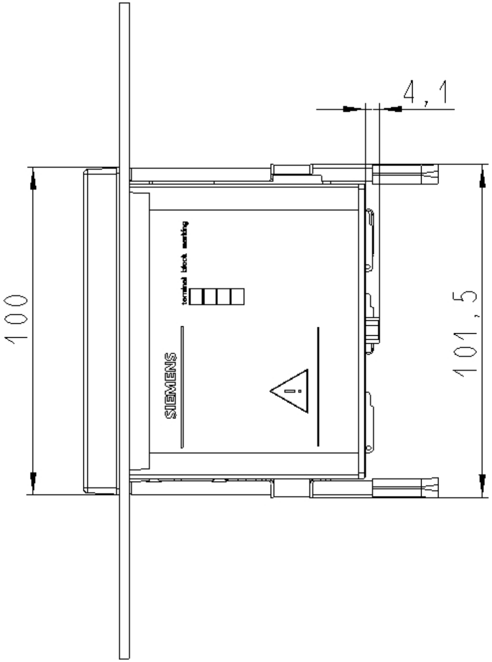


Abbildung 3: 7KG7750

Technische Daten Gehäuse

Gehäuseausführung:	Schalttafel-Einbaugehäuse IEC 61554/ DIN 43700
Schalttafelausschnitt	$92{,}0^{+0{,}8}$ mm x $92{,}0^{+0{,}8}$ mm
Schutzart	Front IP 41 oder IP 65 Klemmen IP 20

1.11.2 Gerätevariante 7KG7755

Hinweis: Alle Maße in mm!

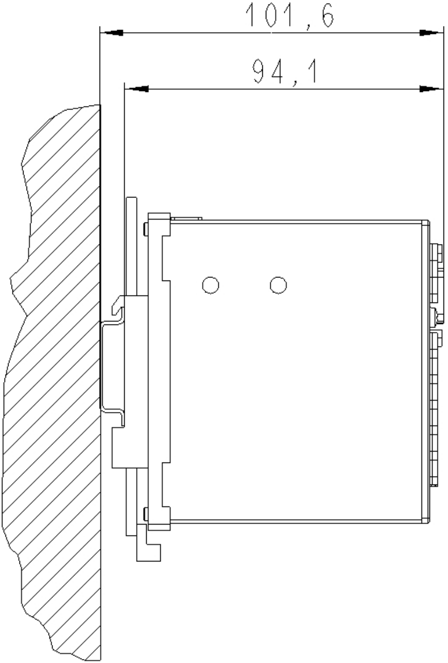
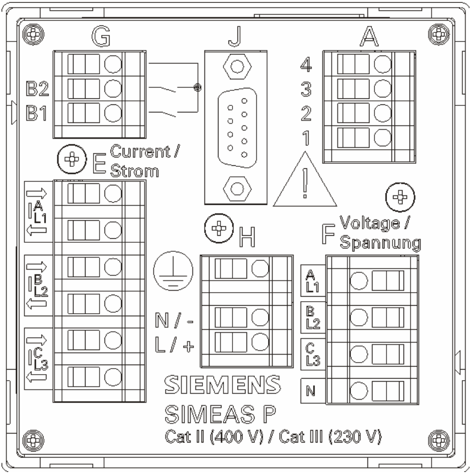


Abbildung 4: 7KG7755 für Hutschienenmontage

Technische Daten Gehäuse

Gehäuseausführung:	Hutschienengehäuse
Schutzart:	Front IP 20
	Klemmen IP 20

1.12 Anschlussklemmen



Anschlusselemente
Klemmen für Versorgungsspannung, Spannungseingänge, Stromeingänge, Binärausgänge, I/O-Module (optional):

Leiterquerschnitt:	2,5 mm^2
Leiterquerschnitt mit Aderendhülse:	1,5 mm^2
Abisolierlänge:	9 mm
Anzugsdrehmoment:	0,4 bis 0,5 Nm
RS485-Busschnittstelle:	9-polige DSUB-Buchse

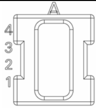
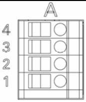
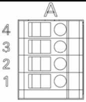
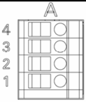
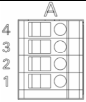
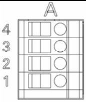
Achtung

Erdung muss an SIMEAS P immer angeschlossen sein.

Tabelle 1 Anschlussbelegung

Klemme	**Funktion**	
E1	I_{L1}	Phasenstrom 1, Eingang
E2	I_{L1}	Phasenstrom 1, Ausgang
E3	I_{L2}	Phasenstrom 2, Eingang
E4	I_{L2}	Phasenstrom 2, Ausgang
E5	I_{L3}	Phasenstrom 3, Eingang
E6	I_{L3}	Phasenstrom 3, Ausgang
F1	U_{L1}	Phasenspannung 1
F2	U_{L2}	Phasenspannung 2
F3	U_{L3}	Phasenspannung 3
F4	U_{N}	Nullleiter
G1	Wurzel	Gemeinsame Basis für alle Binärausgänge
G2	B2	Binärausgang 2
G3	B1	Binärausgang 1
H1		Schutzerde
H2	N/-	Versorgungsspannung -
H3	L/+	Versorgungsspannung +
A1 ... A4	Optional, siehe Tabelle 2, Ein-/Ausgabemodule	

Tabelle 2 Ein-/Ausgabemodule

Modultyp	**Klemme**	**Belegung**	**Bestellnr. (siehe 1.4)**
Nicht bestückt			**A**
BA 2 Binär-ausgänge		n.c. BO2+ BO1+ BOR	**B**
BE 2 Binär-eingänge		BI2+ BIR BIR BI1+	**C**
AA 2 Analog-ausgänge		AO2- AO2+ AO1- AO1+	**D**
AE 2 Analog-eingänge		AI2- AI2+ AI1- AI1+	**E**
RA 3 Relais-ausgänge		ROR RO3 RO2 RO1	**G**

1.13 Montage und Betrieb

WARNUNG!

Beim Betrieb elektrischer Geräte stehen zwangsläufig bestimmte Teile dieser Geräte unter gefährlicher Spannung. Bei Nichtbeachtung der Bedienungshinweise können deshalb schwere Körperverletzungen oder Sachschäden auftreten. Insbesondere müssen alle Warnhinweise unbedingt beachtet werden.

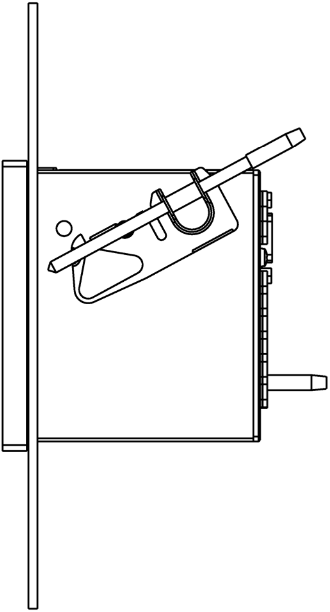
Power Meter SIMEAS P sind Einbaugeräte und somit in einen Schaltschrank oder Verteilerkasten einzubauen. Nach dem Einbau muss der gesamte Klemmenbereich abgedeckt sein. Nur so ist das Gerät ausreichend gegen unzulässiges Berühren spannungsführender Teile geschützt.

- Die Einbaustelle soll möglichst erschütterungsfrei sein. Die zulässige Umgebungstemperatur muss eingehalten werden (siehe Technische Daten, Abschnitt 1.9).
- Der Betrieb außerhalb des zulässigen Arbeitstemperaturbereiches kann zu Fehlmessungen und zum Ausfall des Gerätes führen.
- Schraubklemmen für max. 2,5 mm^2
- Eine Betauung des Gerätes im Betrieb ist nicht zulässig.
- Es wird empfohlen, die Geräte so anzuordnen, dass sie keiner direkten Sonneneinstrahlung und keinem starken Temperaturwechsel ausgesetzt sind.

1.13.1 Montage

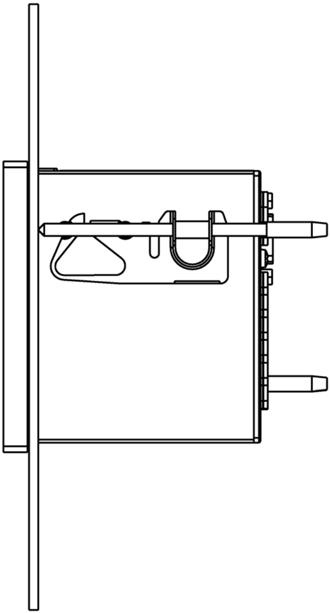
Zur Montage der Geräte gehen Sie folgendermaßen vor:

- Schwenken Sie das mitgelieferte Befestigungselement um den hinteren Kegel ein.



Hinweis: Minimale Dicke der Montageplatte: 1 mm; Stahl

- Stellen Sie das Befestigungselement waagerecht. Schrauben Sie es mit einem Schraubendreher (0,6 x 4,5) mm fest, bis die Rutschkupplung wirksam wird.



Hinweis: Ein ausreichender Schutz gegen das Berühren spannungsführender Teile ist nur gewährleistet, wenn die oben beschriebene Montage korrekt ausgeführt wurde.

1.14 Lagerung

Es wird empfohlen, bei der Lagerung der Geräte einen eingeschränkten Temperaturbereich zwischen +10 °C und +35 °C einzuhalten, um einer vorzeitigen Alterung von Bauelementen, insbesondere von Elektrolytkondensatoren vorzubeugen.
Außerdem empfiehlt es sich, Reservegeräte einmal jährlich für ein bis zwei Tage an Versorgungsspannung zu legen, um die in der Stromversorgung eingesetzten Elektrolytkondensatoren zu formieren. Ebenso sollte vor einem geplanten Einsatz der Geräte verfahren werden.

1.15 Elektrischer Anschluss

WARNUNG!

Die folgenden Arbeiten werden teilweise bei Vorhandensein gefährdender Spannungen durchgeführt. Sie dürfen deshalb nur von entsprechend qualifizierten Personen vorgenommen werden, die mit den Sicherheitsbestimmungen und Vorsichtsmaßnahmen vertraut sind und diese befolgen.

Bei der elektrischen Installation sind die Vorschriften über das Errichten von Starkstromanlagen zu beachten.

- Die Sekundäranschlüsse von zwischengeschalteten Stromwandlern müssen an diesen kurzgeschlossen sein, bevor die Stromzuleitungen zu dem Gerät unterbrochen werden.

- Die Erdungsklemme ist mit der Schutzerde der Schalttafel oder des Schrankes zu verbinden.
- Bei Anschluss einer Versorgungsgleichspannung muss die Polarität beachtet werden.
- Vor der Inbetriebnahme sind alle Anschlüsse auf sachgerechte Ausführung zu prüfen.
- Die Polarität und die Phasenzuordnung der Messwandler ist zu überprüfen.
- Bevor das Gerät erstmalig an Spannung gelegt wird, sollte es mindestens zwei Stunden im Betriebsraum gelegen haben, um einen Temperaturausgleich zu schaffen und Feuchtigkeit und Betauung zu vermeiden.

Hinweise für Messungen

- Bei Messungen in 3-Leiternetzen ohne Nullleiter mit V-Schaltung und einer Nennspannung von U_{LL} = 690 V muss die Spannung auf $U_{LL} \leq$ 400 V transformiert werden. Der zu parametrierende Messbereich ist dann ebenfalls U_{LL} = 690 V.
- In IT-Netzen kann das SIMEAS P nicht direkt angeschlossen werden, da die Messspannung gegen den PE-Anschluss gemessen wird und die Eingangsimpedanz des Gerätes einen Ableitstrom gegen Erde verursacht. Der Ableitstrom kann die Isolationsüberwachung in IT-Netzen zum Ansprechen bringen. Es ist darauf zu achten, dass die maximal zulässige Spannung an den Eingängen des SIMEAS P gegen Erde U_{L-PE} = 480 V nicht überschritten wird (z. B. bei einem Erdschluss einer Phase). In IT-Netzen **müssen** Spannungswandler verwendet werden.

1.16 Anschlussbeispiele

Die nachstehend aufgeführten Eingangsbeschaltungen sind Beispiele. Das Gerät kann bis zu den maximal zulässigen Strom- und Spannungswerten auch ohne zwischengeschaltete Strom- oder Spannungsmesswandler angeschlossen werden.

Spannungswandler können in Sternschaltung oder Dreieck-Schaltung benutzt werden.

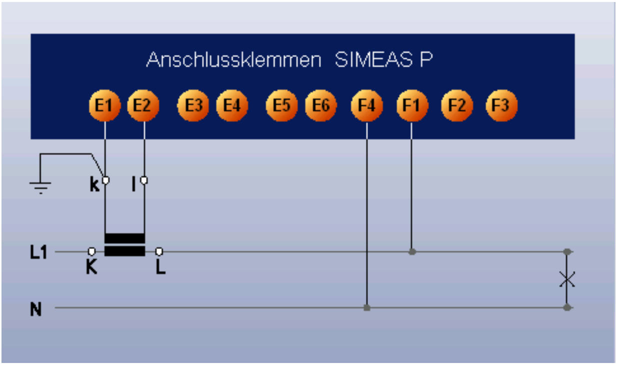
Alle für die Messung nicht benötigten Ein- oder Ausgangsklemmen bleiben frei.

Bezeichnung der Anschlüsse von Wechsel- und Drehstrommessgeräten nach DIN 43807 / Okt. 1983:

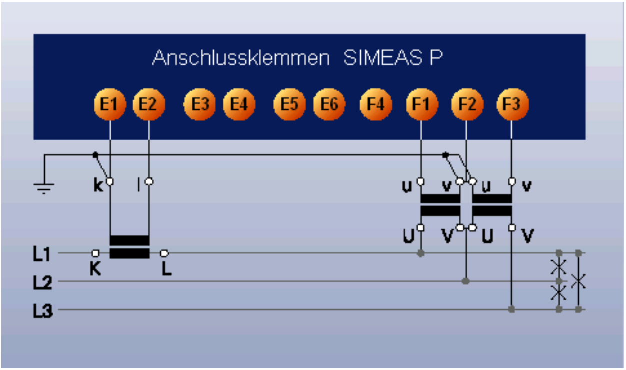
DIN 43807	1	3	4	6	7	9	11	2	5	8
Anschluss	I_{L1} ↑	I_{L1} ↓	I_{L2} ↑	I_{L2} ↓	I_{L3} ↑	I_{L3} ↓	N	U_{L1}	U_{L2}	U_{L3}
SIMEAS	E1	E2	E3	E4	E5	E6	F4	F1	F2	F3

Achtung:
Die durchgehende Erdverbindung der Messwandler ist nur der Einfachheit halber so dargestellt.

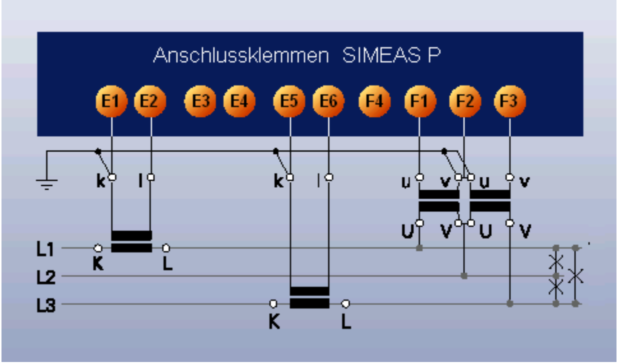
Die Erdung muss direkt am Wandler und für jeden Wandler einzeln ausgeführt werden.



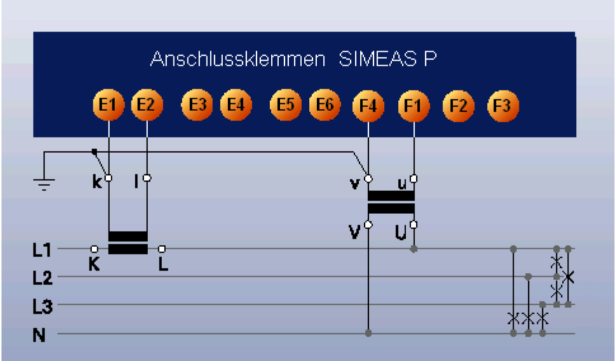
Einphasen-Wechselstrom



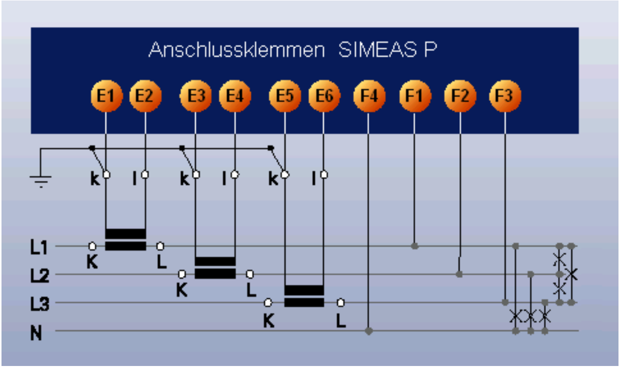
Dreileiter - Drehstrom gleiche Belastung



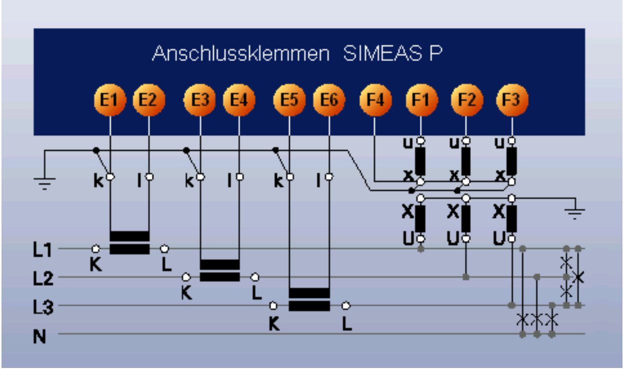
Dreileiter - Drehstrom beliebige Belastung



Vierleiter - Drehstrom gleiche Belastung



Vierleiter - Drehstrom beliebige Belastung (Niederspannungsnetz)



Vierleiter - Drehstrom beliebige Belastung (Hochspannungsnetz)

1.17 Inbetriebnahme

Bevor die Versorgungsspannung eingeschaltet wird, ist zu prüfen, ob die Betriebsdaten mit den Werten auf dem Typenschild übereinstimmen. Dies betrifft im Besonderen die Versorgungsspannung und die Nennwerte von Strom und Spannung der Anlage. Nach 15 Minuten Anwärmzeit hält das Gerät die angegebenen Fehlergrenzen ein.

Zur Versorgung des batteriegepufferten Speichers und der Echtzeituhr ist eine Batterie im Lieferumfang enthalten. Diese Batterie wird isoliert im Gerät ausgeliefert. Nehmen Sie die Batteriefachabdeckung an der Oberseite des Gerätes ab und entfernen Sie die Batterie und die Isolierung. Setzen die Batterie ohne Isolierung unter Beachtung der auf dem Typenschild aufgedruckten Polarität ein und schließen Sie die Abdeckung.

Bei Unterschreitung der Batteriespannung erscheint ein blinkendes Batteriesymbol in der Statuszeile. Wechseln Sie in diesem Fall die Batterie. Die Batterie muss mit einem isolierten Werkzeug entnommen werden, um ein Kurzschließen zu vermeiden.

WARNUNG!

Arbeiten an der Batterie und der Batteriewechsel dürfen nur von qualifiziertem Fachpersonal durchgeführt werden.
Die Batterie kann bei falscher Behandlung explodieren: Vertauschen Sie die Polarität der Batterie nicht! Versuchen Sie nicht, die Batterie zu öffnen! Entladen Sie die Batterie nicht komplett! Werfen Sie die Batterie nicht ins Feuer!
Die gelieferte Batterie enthält Lithium. Werfen Sie die Batterie nicht in den Abfall. Die Batterie muss in Übereinstimmung mit geltenden gesetzlichen Bestimmungen entsorgt werden.

Nach dem Einschalten (Anlegen der Versorgungsspannung) befindet sich das Gerät in den ersten 15 Sekunden in der Startphase.

```
Power Meter

SIMEAS-P

SIMEAS 7KG7750
Version:xx.xx.xx
```

1.18 Parametrierübersicht

1.18.1 Bedienungshinweise

In diesem Kapitel werden alle Einstellungsmöglichkeiten des SIMEAS P über seine Fronttasten beschrieben.

Aus den Messwertscreens erfolgt der Zugang in das Hauptmenü der Parametrierungsebene über die Taste ENTER.

1.18.2 Tastenfunktion

Mit den Tasten ▼ ▲ können folgende Funktionen ausgeführt werden:

- Bewegen des Cursors auf Eingabezeile
- Durchschalten bei Parametereingaben aus Auswahllisten
- Durchschalten von Ziffern und Zeichen bei Eingabe von Zahlenwerten

Durch längeres Drücken der Tasten erfolgt die Weiterschaltung automatisch. Mit den Tasten erfolgt generell ein Rundlauf bei Cursor, Parametern oder Zahlen.
Die Bestätigung der ausgewählten Zeile, des Parameters oder der Zahl erfolgt mit der Taste ENTER.

1.18.3 Screenaufbau

Bei Anwahl ***** mit der Taste ENTER springt der Cursor direkt zur Eingabe.
Bei Anwahl **>** und ENTER öffnet sich ein neuer Screen zur weiteren Eingabe.
Mit **<** OK wird die Einstellung bestätigt und eine Ebene zurückgeschaltet.
Mit **<** Abbruch werden die geänderten Einstellungen nicht gespeichert und zu den Screens in Ebene 1 zurückgeschaltet.

```
*Anzahl Screens:  4
*Intervall scr.:  0Sek
*Beleuchtung:    99Min
*Kontrast:        4
>Aufbau Screens

<OK
<Abbruch
```

1.18.4 Anmerkungen

- Die Auswahl an Messgrößen ist abhängig von der gewählten Anschlussart.
- Die Eingabe von Zahlen wird plausibilisiert. Der Eingabewert wird dann auf den Maximalwert gesetzt.
- Wird während des Parametrierens die Versorgungsspannung ausgeschaltet, erscheint bei erneutem Einschalten des Gerätes ein Hinweistext zur Auswahl. Deshalb sollte die Versorgungsspannung nur in Ebene 1 (Messwert-Screens) ausgeschaltet werden.

Hinweis:

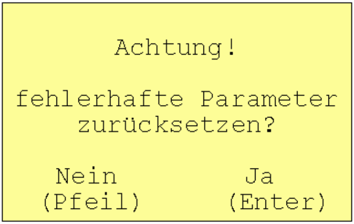
Verlassen Sie bei jeder Parametrierung immer vollständig die Parametrierscreens (OK oder Abbruch), bis Sie wieder die Anzeige der Messwerte erreicht haben. Nur so stellen Sie sicher, dass alle Parameter übernommen werden.

Hinweis:

Bitte prüfen Sie anschließend die Parametrierung und die Abgleichdaten, um die korrekte Funktion des SIMEAS P sicherzustellen.
Falls Sie das Gerät selbst abgeglichen haben, wird dieser Abgleich nicht durch Werkseinstellungen ersetzt.

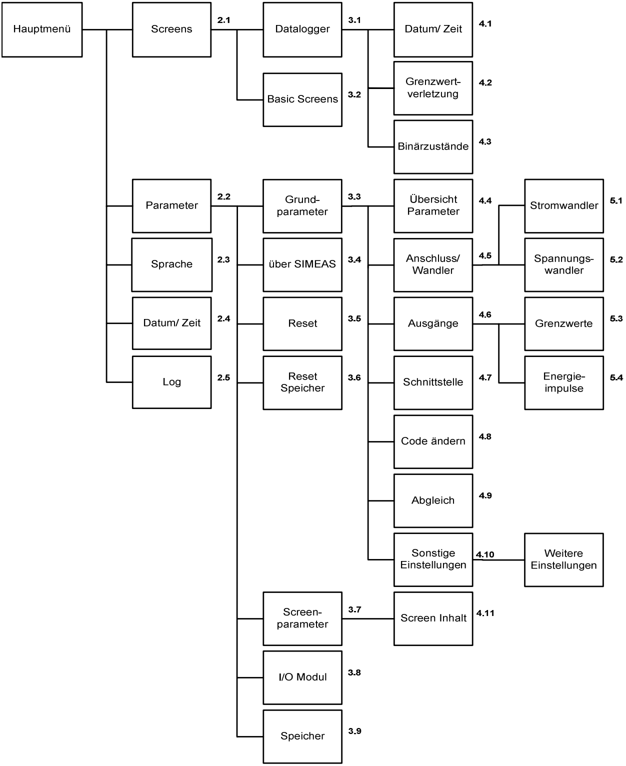
Hinweistext

Bei „Nein“ durch ▼ ▲ werden die Einstellungen vor dem Ausfall der Versorgungsspannung übernommen. Bei „Ja“ durch Taste ENTER wird auf Werkseinstellung zurückgesetzt.



1.18.5 Parametrierübersicht 7KG7750

Eine ausführliche Beschreibung der Geräteparametrierung finden Sie im SIMEAS P Handbuch (Bestell-Nr. E50417-B1000-C340-A1).



1.19 Prüfung und Abgleich

WARNUNG!

Bei den Arbeiten sind die Festlegungen und Durchführungsanweisungen der Unfallverhütungsvorschrift BGV A3 zu beachten, besonders „Paragraph 8: Zulässige Abweichungen“. Es ist geeignetes Elektrowerkzeug zu verwenden.

Zum Prüfen des Power Meters SIMEAS P ist eine Abgleicheinrichtung erforderlich, welche Wechselspannungen, Wechselströme und Phasenwinkel mit einem Fehler von ≤ 0,1 % abgeben kann.

Bei galvanisch getrennten Prüfeinrichtungen muss N mit Erde verbunden werden.

Eine ausführliche Beschreibung des Abgleichs des Gerätes finden Sie im SIMEAS P Handbuch
(Bestell.-Nr. E50417-B1000-C340-A1), Kapitel 6.1.

1.20 Wartung, Instandsetzung und Reinigung

Power Meter SIMEAS P bedürfen keiner besonderen Wartung. Er kann bei Bedarf in einem Labor geprüft und auch neu abgeglichen werden.

Von einer Instandsetzung defekter Geräte vor Ort wird dringend abgeraten, da spezielle elektronische Bauelemente eingesetzt sind, die nach den Richtlinien für elektrostatisch gefährdete Bauelemente (EGB) zu behandeln sind.

Sollte ein Defekt vermutet werden, empfiehlt es sich, das komplette Gerät ins Herstellerwerk einzusenden. Hierzu ist möglichst die Original-Transportverpackung oder eine gleichwertige Verpackung zu verwenden.

Wenn einzelne Baugruppen vor Ort ausgetauscht werden müssen, so sind unbedingt die EGB-Vorschriften zu beachten.

WARNUNG!

Bei Durchführung der Änderungsmaßnahmen vor Ort sind unbedingt die Handhabungshinweise für den Umgang mit elektrostatisch gefährdeten Baugruppen und Bauelementen zu beachten (EGB).

Reinigung
Das Gerät sollte in einer trockenen, schmutzfreien Umgebung installiert werden. Nach der Installation muss das Gerät nicht gereinigt werden. Für ein einwandfreies Funktionieren müssen die Umgebungsbedingungen eingehalten werden (siehe Technische Daten, Abschnitt 1.9).
Schalten Sie gegebenenfalls das Gerät aus und wischen Sie es mit einem sauberen, trockenen und weichen Tuch ab. Benutzen Sie keine Lösungsmittel.

2 Operating Instructions

2.1 Conformity

This product complies with the directive of the Council of the European Communities on the approximation of the laws of the member states relating to electromagnetic compatibility (EMC Council Directive 2004/108/EC) and concerning electrical equipment for use within specified voltage limits (Low Voltage Directive 2006/95/EC).

This conformity has been proved by tests performed according to the Council Directives in agreement with the generic standards EN 61000-6-2 and EN 61000-6-4 (for EMC Directive) and with the standard EN 61010-1 (for Low Voltage Directive) by Siemens AG.

This device was designed and produced for industrial use according to the standard EN 61000-6-4.

The product conforms to the standards IEC 60688, EN 60688 or DIN EN 60688.

2.2 General Information

These operating instructions include the information required for proper use of the corresponding products. These operating instructions are intended for technically qualified personnel with sufficient competence and knowledge in the areas of instrumentation and control engineering, which will be referred to as automation engineering throughout the rest of these operating instructions.

In order to ensure safe installation and commissioning, as well as safe operation and maintenance, all personnel should fully understand and comply with all safety information and warnings contained in this document in a technically correct manner. Only personnel who meet the requirements outlined in Chapter 2.3 for qualified personnel possess the expertise and knowledge required to apply the general safety information and warnings of this document correctly for each specific and individual scenario.

While these operating instructions are included with the product, it is important to note that not every aspect of the product, nor every possible installation, operation and maintenance scenario, can be thoroughly discussed.

If more information is required, or if specific problems arise which are not discussed in this document, additional information can be requested from your local Siemens subsidiary or from the address given on the back cover of this document.

WARNING!

If the equipment described in these operating instructions is used in a manner other than that specified by the manufacturer, the protection provided by the equipment may be impaired.

Furthermore, the contents of this operating instructions are not part of an earlier or existing agreement, consent, or a legal regulation and do not represent a modification of any of these. All commitments of Siemens are specified in the specific purchase contract, which also includes the entire and unique warranty regulations. The contractual warranty regulations are neither extended nor restricted by the information in this document.

Explanation of symbols marked on the equipment

	DC voltage
	AC voltage
	3-phase AC voltage
	Documentation needs to be consulted
	Protective ground

WARNING!

During operation of electric devices, certain parts of the device are subject to dangerous voltages. Ignoring the warning notes can result in severe injury or damage to property.

Only qualified personnel should be allowed to operate this device. Appropriate transportation, storage, installation and assembly, as well as careful operation and maintenance, are basic requirements for proper and safe operation of this device.

In particular, the general mounting and safety regulations (e. g. IEC or national standards) regarding the correct use of power systems must be observed and complied with. Non-compliance can result in death, personal injury or substantial property damage.

2.3 Qualified Personnel

These are persons who are familiar with the installation, assembly, commissioning and operation of the product and who possess the following qualifications:

- training or instruction and authority to operate and service devices/systems according to all applicable safety standards and rules for electric circuits and devices
- education or instruction in the maintenance and use of appropriate safety equipment according to all applicable safety standards
- first aid training

2.4 Ordering Data

Description	Order-No.
Power Meter	
SIMEAS P50	7KG 7 7 5 0 - 0 ☐ A 0 ☐ - 0 A A ☐
Built in device for control panels 96 mm x 96 mm with graphic-display (standard)	
I/O-Module (optional)	
Without (standard)	A
2 binary outputs	B
2 binary inputs	C
2 analog ouputs (DC: 0 to 20 mA / 4 to 20 mA)	D
2 analog inputs (DC: 0 to 20 mA)	E
3 relay outputs	G
Front protection class	
IP 41	**1**
IP 65	**3**
Communication protocols	
PROFIBUS DP and Modbus RTU/ASCII	**0**
IEC 60870-5-103 and Modbus RTU/ASCII	**1**
SIMEAS P55	7KG 7 7 5 5 - 0 ☐ A 0 0 - 0 A A ☐
Snap on mounting unit 96 mm x 96 mm, front protection class IP 20	
I/O-Module (optional)	
Without (standard)	A
2 binary outputs	B
2 binary inputs	C
2 analog ouputs (DC: 0 to 20 mA / 4 to 20 mA)	D
2 analog inputs (DC: 0 to 20 mA)	E
3 relay outputs	G
Communication protocols	
PROFIBUS DP and Modbus RTU/ASCII	**0**
IEC 60870-5-103 and Modbus RTU/ASCII	**1**

2.5 Range of Application

The Power Meter SIMEAS P is capable of recording several different power system measurements. In addition, the SIMEAS P is designed to be utilized in a number of different industries.

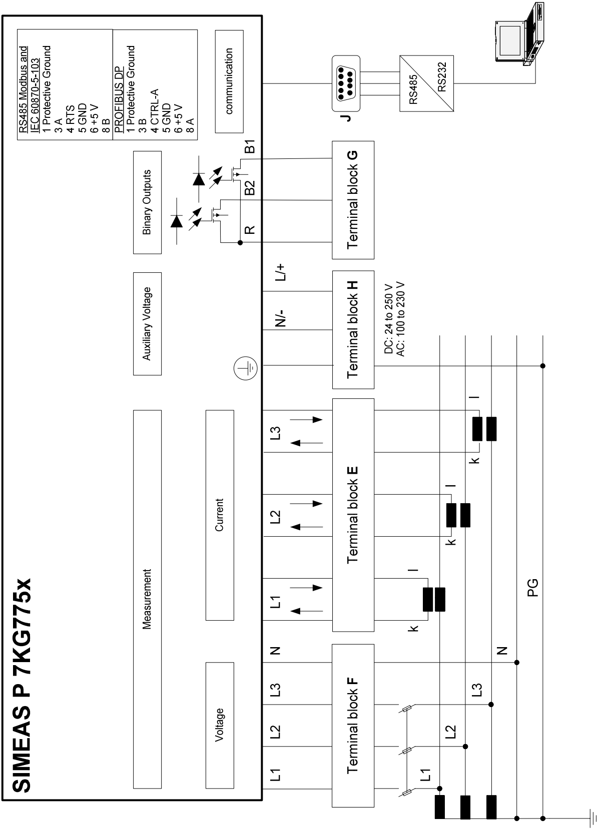
The display of measured quantities can be easily configured to the specific requirements of the user.

Network linking is possible with the integral RS485 port equipped with the standard PROFIBUS DP-V1, Modbus RTU/ASCII or IEC 60870-5-103 protocol which provide for indication, evaluation and processing of several SIMEAS P measurements at a central master station.

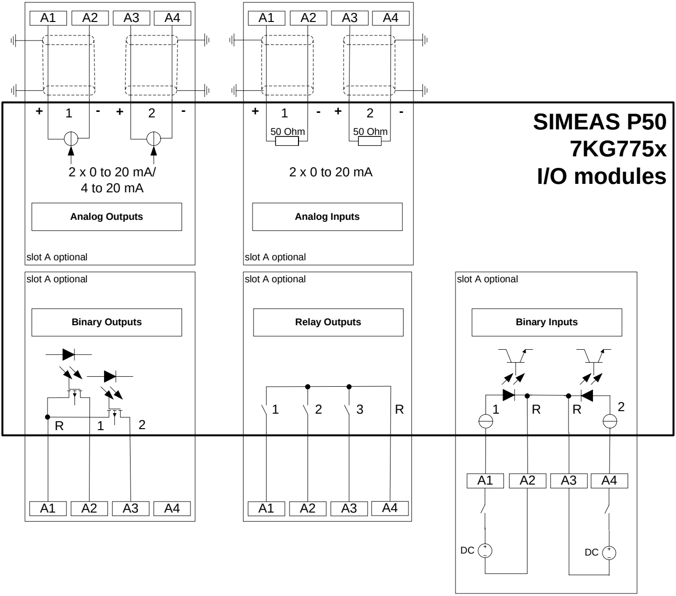
2.6 Mode of Operation

Input voltages and currents are sampled for calculation of the corresponding RMS values. All measurements derived from sampled values are calculated by a processor. Measured quantities can be displayed on the screens and/or transmitted via the serial interface.
With the SIMEAS P, it is possible to program limit value groups for various measured quantities to activate limit violations when the value of a specific measured quantity exceeds a programmed threshold. In addition, it is possible use logical elements (AND, OR) to combine two or more measured quantities for the purpose of generating a limit violation. Limit violations are counted, indicated on the screen and/or utilized to operate the binary output contacts. The oscilloscope may be triggered via a limit violation as well. All measured quantities can be displayed on the SIMEAS P screens as required by the user. Up to 20 screens can be selected with the front keys. The number, type, content and sequence of the screens are configurable. SIMEAS P is delivered with pre-programmed default settings.
A status line displayed in the measured value screens indicates status, interfacing and diagnostic messages for the SIMEAS P.
The display is automatically refreshed every second.

2.7 Block Diagram



I/O modules (optional):



An additional input or output module is available (optional):

- binary input (2 contacts with common contact)
- binary output (2 contacts with common contact)
- relay output (3 contacts with common contact)
- analog input (2 channels)
- analog output (2 channels)

2.8 Measured Values

Measured values	Measuring path [1]	Menu	Tolerances [2]
Voltage	L1-N, L2-N, L3-N	▼ ■ ●	±0.2 %
Voltage	L1-L2, L2-L3, L3-L1, Σ [3]	▼ ■ ●	±0.2 %
Current	L1, L2, L3, N, Σ [3]	▼ ■ ●	±0.2 %
Active power P + import, - export	L1, L2, L3, Σ	▼ ■ ●	±0.5 %
Reactive power Q + cap, - ind	L1, L2, L3, Σ	▼ ■ ●	±0.5 %
Apparent power S	L1, L2, L3, Σ	▼ ■ ●	±0.5 %
Power factor $\lvert\cos\varphi\rvert$ [4]	L1, L2, L3, Σ	▼ ■ ●	±0.5 %
Active power factor $\cos\varphi$ [4]	L1, L2, L3, Σ	▼ ■ ●	±0.5 %
Phase angle [4]	L1, L2, L3, Σ	▼ ■ ●	±2°
Frequency [5]	L1-N	▼ ■ ●	±10 mHz
Active energy import	L1, L2, L3, Σ	▼ ■	±0.5 %
Active energy export	L1, L2, L3, Σ	▼ ■	±0.5 %
Active energy absolute	L1, L2, L3, Σ	▼ ■	±0.5 %
Active energy sum	Σ	▼ ■	±0.5 %
Reactive energy cap	L1, L2, L3, Σ	▼ ■	±0.5 %
Reactive energy ind	L1, L2, L3, Σ	▼ ■	±0.5 %
Reactive energy absolute	L1, L2, L3, Σ	▼ ■	±0.5 %

Measured values	**Measuring path** [1]	**Menu**	**Tolerances** [2]
Apparent energy	L1, L2, L3, Σ	▼ ■	±0.5 %
Unbalance voltage	Four-wire system	▼ ■ ●	±0.5 %
Unbalance current	Four-wire system	▼ ■ ●	±0.5 %
THD voltage	L1, L2, L3	▼ ■ ●	±0.5 %
THD current	L1, L2, L3	▼ ■ ●	±0.5 %
Harmonic voltage U 5. 7. 11. 13. 17. 19. H.	L1, L2, L3	▼ ■ ●	
Harmonic current I 5. 7. 11. 13. 17. 19. H.	L1, L2, L3	▼ ■ ●	
Limit violations	counter 1 to 4	▼ ■	
Analog inputs	external	▼ ■	±0.5 %
Binary inputs	external	▼ ■	

1) Phases are displayed based on the type of connection.
2) Tolerances are applicable from 0.5 to 1.2 times nominal value.
3) Average value of all phases.
4) Measuring beginning with 2 % of the apparent power in selected measurement range
5) Measuring beginning with 30 % of the input voltage L1-N

▼ Measured values can be displayed on measured value screens
■ Measured values selectable over communication
● Measured values selectable for list screens and oscilloscope

2.9 Technical Data

Input signals	Only for connection to AC systems
AC voltage inputs	U_I 3 voltage inputs
Max. system voltage	Y 400 V / Δ 690 V
Overload	20 %
Frequency range f_i	45 Hz to 65 Hz, min. > 30 % U_{IN}
Waveform	Sinusoidal or distorted up to the 21st harmonic
Input voltage U_i	100 V/110 V; 190 V; 400 V; 690 V (L-L)
Continuous overload capacity	1.5 x U_i
Surge withstand capability	2.0 x U_i
Input resistance (L - N)	3 phases symmetrical: 4.2 MΩ 1 phase: 8.4 MΩ
Power consumption per phase	38 mW (U_{LE} = 400 V)
AC current inputs	I_I 3 current inputs
Input current I_i	1 A; 5 A
Maximum voltage	AC: 150 V
Continuous overload	10 A
Surge withstand capability	100 A for 1 s
Power consumption per phase	83 µVA at 1 A; 2.1 mVA at 5 A
Binary inputs	(optional)
Max. input voltage	DC: 300 V
Current consumption for high level	1.8 mA
Threshold voltage low	≤ 10 V
Threshold voltage high	≥ 19 V
Signal delay	max. 3 ms
Analog inputs	(optional)
Measuring range	DC: 0 to 20 mA
Input range	DC: 0 to 24 mA
Input resistance	50 Ω ±0.1 %
Accuracy	0.5 % of the measuring range limit

Binary outputs	Internal and optional via isolated solid-state relay
Permissible voltage Permissible current Number of operations Internal resistance Permissible operating frequency	AC: 230 V; DC: 250 V 100 mA continuous 300 mA for 100 ms Unlimited; considering the "Permissible voltage" and the "Permissible current" 50 Ω 10 Hz
Analog outputs	(optional)
Output current Output range Max. load resistance Accuracy	DC: 0 to 20 mA DC: 0 to 24 mA 250 Ω 0.2 % (typical); max. 1.1 % of the nominal value
Relay output contacts	(optional)
Max. switching voltage Max. permanent current Min. permanent current Rating (resistive) Max. response time Max. release time Number of operations	AC: 270 V / DC: 150 V 5 A 1 mA at DC: 5 V AC: 5 A / 250 V or DC: 5 A / 30 V 10 ms 7 ms 1,5 x 10^5 for max. 30 V / 5 A (DC) or 120 V / 3 A (AC) 3 x 10^4 for max. 250 V / 5 A (AC)

Display	Graphic display
Resolution Dimensions	(128 x 64) pixels 40 mm x 60 mm
Dimensions, Mass	
Dimensions Mass	96 mm x 96 mm x 90 mm ca. 0,6 kg (without I/O module) ca. 0,65 kg (with I/O module)

Over voltage category	According to IEC 61010 Part1
Voltage measurement V_{IN} to 400 V (ph-ph) V_{IN} to 690 V (ph-ph) Current measurement V_{IN} to 150 V Power Supply Binary outputs, binary inputs and relay outputs Analog inputs and analog outputs	 Cat III Cat II Cat III Cat II Cat II Cat III
Auxiliary power	Multi-range power supply unit AC / DC
Nominal range Total range Power consumption Frequency range	DC: 24 to 250 V or AC: 100 V/230 V ±20 % of nominal range max. 6 W or 9 VA 45 Hz to 65 Hz
Battery	
Type	VARTA CR2032, 3 V, Li-Mn

Communication interface	
Connection	9-pole D-sub female connector
Data transfer PROFIBUS DP-V1	Baud rate: 9600 bit/s to 12 Mbit/s
Data transfer IEC 60870-5-103	Baud rate: 9600, 19200, 38400 bit/s
Data transfer Modbus RTU/ASCII PC-RS485	Baud rate: 300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200 bit/s

Dielectric test, routine test, 2 s	according to IEC 61010-1
Voltage inputs, binary outputs	AC: 2.2 kV
Current inputs	AC: 1.35 kV
Power supply	DC: 3.1 kV
Serial interface	AC: 500 V
Additional for I/O modules	
Binary inputs and binary/relay outputs to PG	AC: 2.2 kV
Analog inputs and analog outputs to PG	AC: 500 V

Insulation type of inputs and outputs	
Signal inputs (current)	Reinforced, AC: max. 150 V, Cat III
Signal inputs (voltage)	Protective impedance, AC: max. 600 V, Cat II or AC: max. 300 V, Cat III
Power supply	Reinforced, AC: max. 230 V, DC: max. 250 V, Cat II
Output contacts	Reinforced, AC: max. 230 V, DC: max. 250 V, Cat II

Reference conditions	The stated error limits apply for reference conditions
Input current I_i	I_{iN} ±1 %
Input voltage U_i	U_{iN} ±1 %
Frequency f_i	45 to 65 Hz
Waveform	Sinus, harmonic distortion ≤ 5 %
Ambient temperature T_A	23 °C ±1 °C
Auxiliary voltage U_H	U_{HN} ±1 %
Warm-up time	≥ 15 min
External fields	no

Environmental conditions	The device is designed for indoor use only
Ambient Temperature	According to IEC 60688
Operating Temperature Range	32 °F to 131 °F (0 °C to 55 °C)
Storage Temperature Range	-13 °F to 158 °F (-25 °C to 70 °C)
Max. relative humidity	80 % for temperatures up to 31 °C decrease linearly to 50 % at 40 °C
Max. altitude above sea level	2000 m
Pollution degree	2, no condensation

Additional Technical Data	
Internal fuse	Not replaceable Type T500 mA/250 V according IEC 60127
Internal fuse, secondary	Not replaceable Type F2A/125 V according UL 248-14

Protection class according IEC 60529	
Device	
Front	IP 20, IP 41 or IP 65 see ordering data 2.4
Rear	IP 20
Personnel protection	IP 1x

2.10 Communication Interface

Pin-No.	RS485-Interface Modbus and IEC 60870-5-103	PROFIBUS-Interface
1	Protective Earth	Protective Earth
2		
3	A	B (RxD/TxD-P)
4	RTS	CTRL-A
5	GND	GND
6	+5 V	+5 V
7		
8	B	A (RxD/TxD-N)
9		

The bus is terminated at the connection cable.
The isolated interface supply voltage is provided via the D-subminiature female connector. Therefore, the matching resistors for signals can be connected to the cable.

WARNING!

All computing devices connected to the RS485 communication interface port shall be connected to a SELV (Separated Extra Low Voltage) circuit and must comply with the following standard: IEC/EN 60950.

2.11 Dimensions

NOTE: All dimensions in mm.

2.11.1 Device Variants 7KG7750

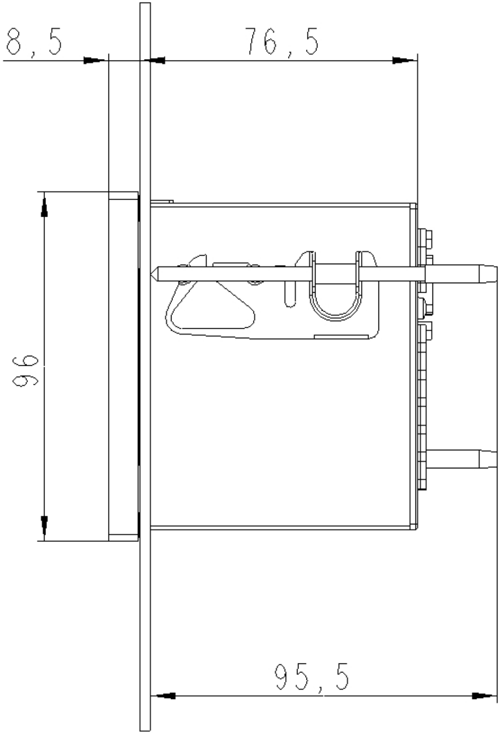


Figure 1: 7KG7750 variant IP 41

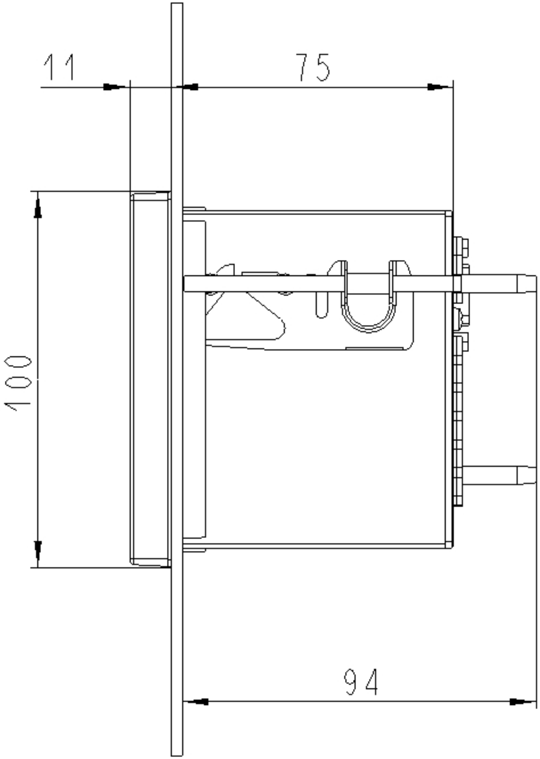


Figure 2: 7KG7750 variant IP 65

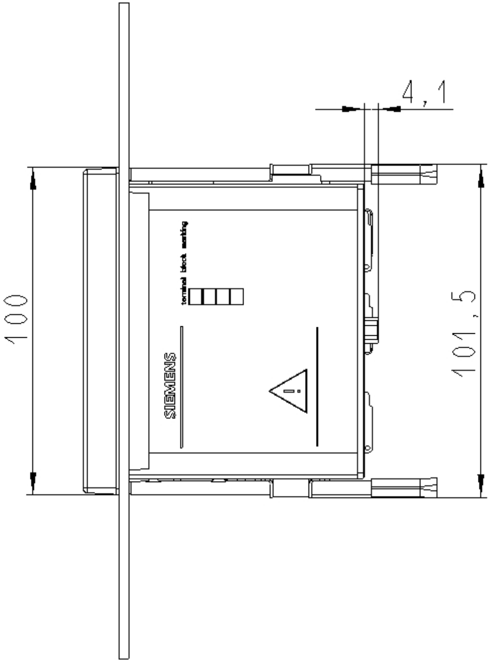


Figure 3: 7KG7750

Technical Data for Housing

Housing:	Flush mounting according to IEC 61554/ DIN 43700
Panel section:	$92{,}0^{+0{,}8}$ mm x $92{,}0^{+0{,}8}$ mm
Protection class:	front: IP 41 or IP 65 terminals: IP 20

2.11.2 Device Variant 7KG7755

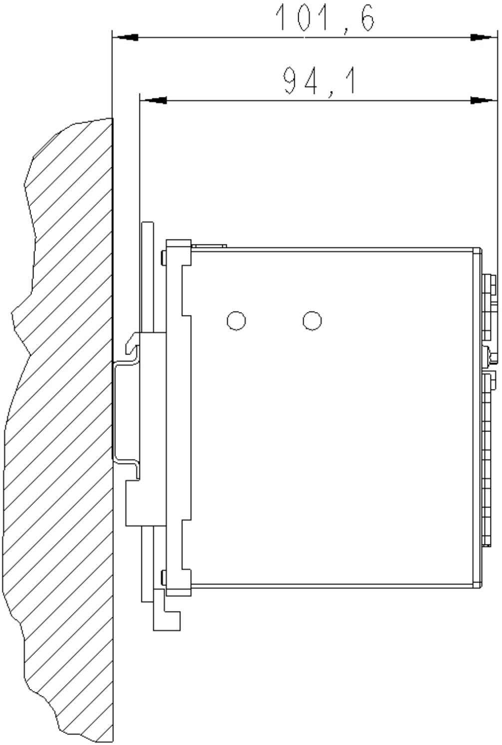
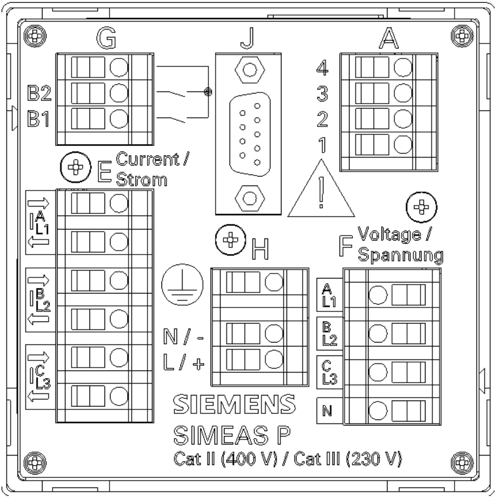


Figure 4: 7KG7755 variant standard rail mounting

Technical Data for Housing

Housing:	Standard rail mounting
Protection class:	Front IP 20, Terminals IP 20

2.12 Connection Terminals



Terminals

Terminals for auxiliary supply, voltage inputs, current inputs, binary outputs, I/O modules (optional):

Conductor cross section, rigid max.:	2.5 mm^2
Conductor cross section with ferrule:	1.5 mm^2
Stripping length:	9 mm
Tightening torque:	0.4 Nm to 0.5 Nm
RS485-Interface:	9-pole D-sub miniature female connector

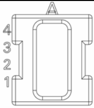
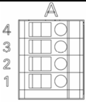
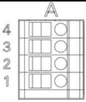
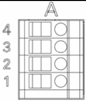
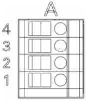
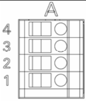
Attention

Ground needs to be connected to the SIMEAS P prior operation.

Table 1: Terminal Assignment

Terminal	Function	
E1	I_{L1}	Phase current 1, in
E2	I_{L1}	Phase current 1, out
E3	I_{L2}	Phase current 2, in
E4	I_{L2}	Phase current 2, out
E5	I_{L3}	Phase current 3, in
E6	I_{L3}	Phase current 3, out
F1	U_{L1}	Phase voltage 1
F2	U_{L2}	Phase voltage 2
F3	U_{L3}	Phase voltage 3
F4	U_N	Neutral
G1	Root	Common path for output contacts
G2	B2	Binary output contact 2
G3	B1	Binary output contact 1
H1		Protective ground
H2	N/-	Supply voltage -
H3	L/+	Supply voltage +
A1 to A4	optional, see Table 2, I/O modules	

Table 2: I/O modules

Module Type	**Terminal**	**Allocation**	**Ordering Code (refer to section 2.4)**
Not equipped			**A**
BO 2 binary outputs		n.c. BO2+ BO1+ BOR	**B**
BI 2 binary inputs		BI2+ BIR BIR BI1+	**C**
AO 2 analog outputs		AO2- AO2+ AO1- AO1+	**D**
AI 2 analog inputs		AI2- AI2+ AI1- AI1+	**E**
RO 3 relays outputs		ROR RO3 RO2 RO1	**G**

2.13 Mounting and Operation

WARNING!

During operation of electric devices, certain parts of the device are subject to dangerous voltages. Ignoring the warning notes can result in severe injury or damage to property. Strict compliance with all safety information is imperative.

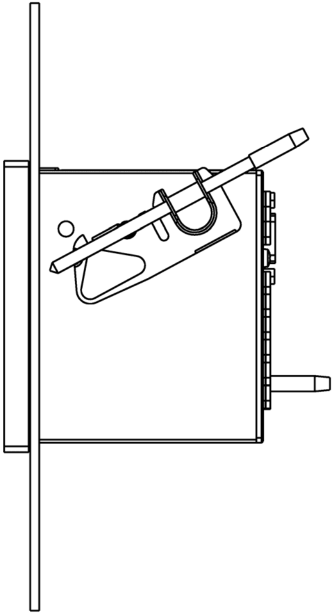
The SIMEAS® P is a build-in device and must therefore be installed on a switchboard or in a control cabinet. After installation, it is important that all terminals are properly covered to prevent accidental contact with energized parts.

- The device location should be largely free from vibrations. The device must be operated within allowable ambient temperature limits (see technical specifications).
- Operating the device outside of the operating temperature range can lead to measurement errors and device failure.
- Screw-type terminals for 2.5 mm^2
- Steps must be taken to prevent condensation on or within the device during operation.
- Steps should be taken to minimize exposure of the device to direct sun light and large temperature variations.

2.13.1 Mounting the Device

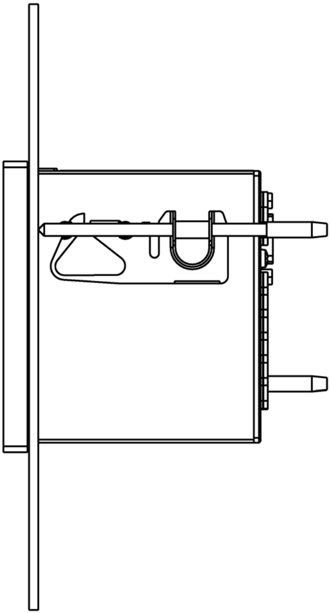
To mount the device proceed as follows:

- Swing the mounting element (provided with the device) over the rear cone.



Note: Minimum thickness of the mounting plate: 1 mm; steel

- Move the mounting element to the position. Use a screw driver (0.6 x 4.5) mm to fix the mounting elements until the slipping clutch takes effect.



Note: To prevent accidental contact with energized parts the above described mounting must be taken carefully and correctly.

2.14 Storage

During storage, a temperature range between +10 °C and +35 °C is recommended in order to prevent premature aging of components, particularly the electrolytic capacitors. For longer storage periods, it is recommended that voltage be applied to the device power supply for one or two days every other year, in order to regenerate the electrolytic capacitors. The same is valid before the device is finally installed.

2.15 Electrical Connection

WARNING!

Some of the following steps are carried out in the presence of hazardous voltages. They must be performed only by qualified personnel who are thoroughly familiar with safety regulations and precautionary measures; and pay due attention to them.

During electrical installation, all rules and regulations for power systems must be observed.

- If current transformers are used, the secondary connections of the current transformers must be short-circuited before the current leads to the device are interrupted.
- The protective ground terminal of the device must be connected to the protective ground of the panel or cubicle.
- For connection of an auxiliary DC voltage, the correct polarity must be used.

- All of the terminals should be checked to verify proper connections.
- The polarities and phasing of all instrument transformers should be checked.
- Before initial energization with supply voltage, the device shall be situated in the operating area for at least two hours to ensure temperature equalization and to avoid humidity and condensation problems.

Notes for measurings

- For measurements in three-phase networks without neutral in V-connection and a nominal voltage of U_{LL} = 690 V, the voltage must be transformed to $U_{LL} \leq$ 400 V. The measuring range to be parameterized is then also U_{LL} = 690 V.
- In IT networks, the SIMEAS P cannot be connected directly because the voltage is measured against the PE conductor connection and the input impedance of the device causes a leakage current against earth. The leakage current can cause tripping of the leakage protective system in IT networks. Please make sure that the maximum permissible input voltage of the SIMEAS P against earth $U_{L\text{-}PE}$ = 480 V is not exceeded (e.g., due to an earth fault of one phase). Voltage transformers must be used in IT networks.

2.16 Connection Examples

The input connections shown below are only examples. Direct connection without the use of current or voltage transformers can be made to the SIMEAS P as long as the maximum allowable current and voltage ratings of the SIMEAS P are not exceeded.

The voltage transformers can be connected in wye connection or delta connection.

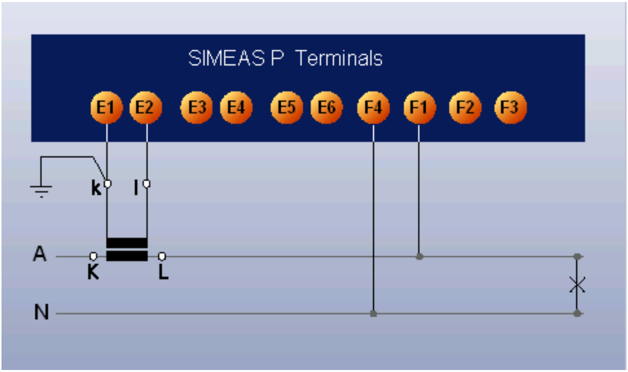
All inputs not required for measurements have to remain disconnected.

Connections of measuring devices of alternating and three-phase alternating current according to DIN 43807/Oct. 1983:

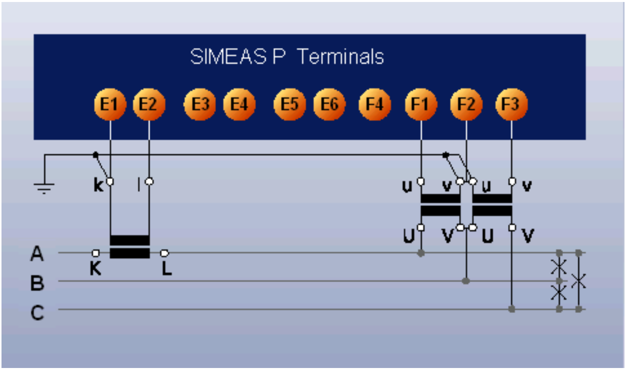
DIN 43807	1	3	4	6	7	9	11	2	5	8
Connection	I_{L1} ↑	I_{L1} ↓	I_{L2} ↑	I_{L2} ↓	I_{L3} ↑	I_{L3} ↓	N	U_{L1}	U_{L2}	U_{L3}
SIMEAS	E1	E2	E3	E4	E5	E6	F4	F1	F2	F3

Attention:
The single grounding connection of the measuring transformers is only for the sake of simplicity in such a way represented.

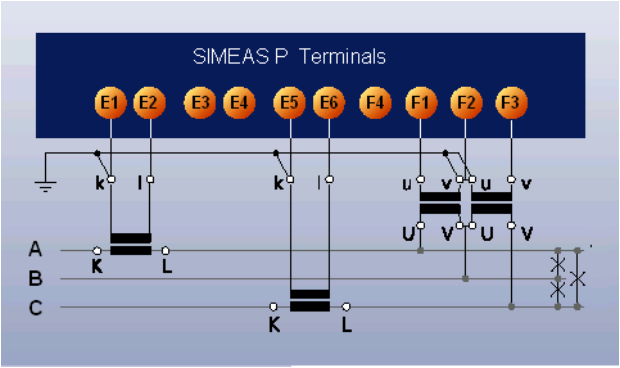
The grounding must be executed directly at the measuring transformers and for each transformer in particular.



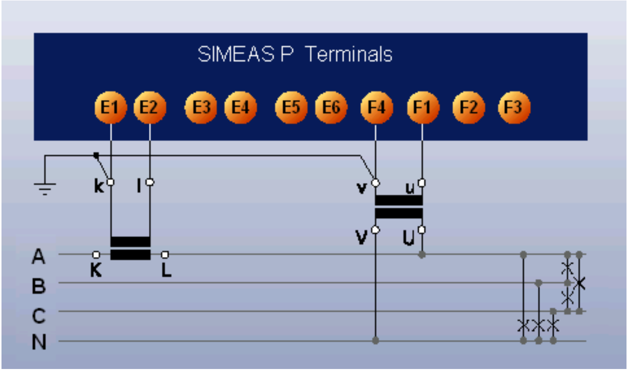
Single-phase AC current



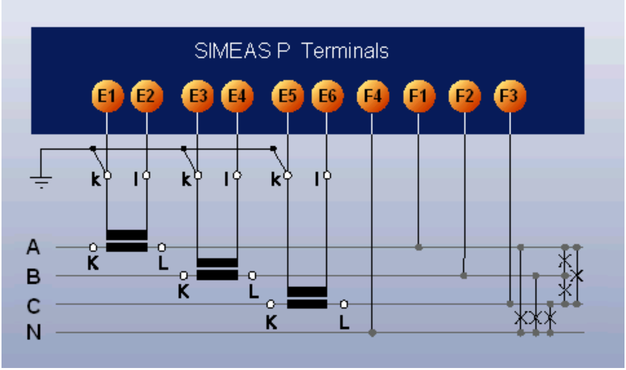
Three-wire three-phase balanced



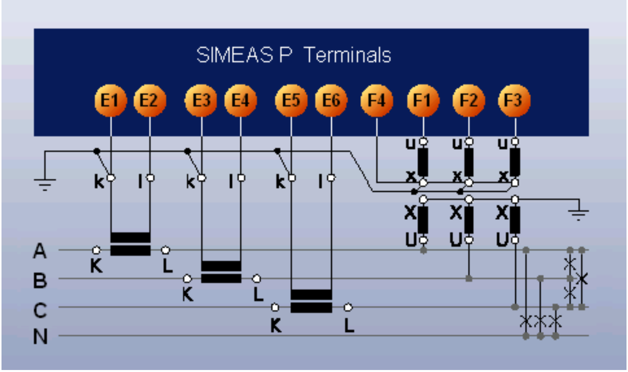
Three-wire three-phase, unbalanced



Four-wire three-phase, balanced



Four-wire three-phase, unbalanced
(low-voltage system)



Four-wire three-phase, unbalanced
(high-voltage system)

2.17 Commissioning

The ratings and information on the nameplate should be checked prior to connecting the power supply voltage. In particular, power supply voltage ratings, as well as input voltage and current ratings should be verified. A warm-up period of 15 minutes is required before the device will perform within specified accuracy limits.

The battery serves to buffer the memory and the real-time clock of the SIMEAS P. The battery is included in the delivery scope. The battery is delivered in an isolated state. Remove the cover of the battery slot on the top of the device and remove the battery and the isolation. Insert the battery without isolation according to the polarity printed on the top of the device (marking shield) and replace the battery cover.

If the battery voltage is low a blinking battery symbol occurs in status line of the display. Please change the battery in this case as described before. Use an isolated tool to remove the battery from the device to avoid a short-circuit!

WARNING!

Servicing of the battery circuit and replacing of the battery must be performed by qualified personnel only.
Battery may explode if mistreated: Do not reverse the polarity! Do not disassemble! Do not completely discharge! Do not throw the battery into a fire!
The supplied battery contains lithium. Do not throw the battery into the trash! It must be disposed of in accordance with the applicable regulations!

After applying voltage to the power supply, the SIMEAS P will run in the startup-phase for 15 seconds.

```
Power Meter

SIMEAS-P

SIMEAS 7KG7750
Version:xx.xx.xx
```

2.18 Configuration Overview

2.18.1 Operating Notes

This chapter describes the basic setting options of the SIMEAS P that are made via the front buttons

The Main Menu of the programming level can be accessed from the Measured Values screens via the ENTER button.

2.18.2 Button Functions

The following functions are performed via the ▼ ▲ buttons:

- Moving the cursor to the entry line.
- Scrolling through selection lists when entering settings.
- Selecting numbers when entering numerical values.

If the buttons are held down, the scrolling continues automatically. The selected line, setting or number is confirmed by pressing the ENTER button.

2.18.3 Screen Structure

Selecting ***** and pressing ENTER moves the cursor directly to the data entry field on the same line.
Selecting **>** and pressing ENTER opens a new window for additional data entry.
Selecting **< ok** and pressing ENTER confirms the settings and returns the user to the previous level.
Selecting **< cancel** and pressing ENTER cancels the setting changes just made and returns the user to the previous level.

```
*nr. screens:    10
*repeat ratio:  10Sec
*illumination:   2Min
*contrast:        3
>screen structure

<ok
<cancel
```

2.18.4 Notes

- The selection of the measured quantity depends on the selected input voltage and current connections.
- If the number selected is too large, #ERR# is displayed and the input value is automatically set to the maximum value.
- If the power supply voltage is switched off during programming, the message illustrated below appears when the device is restarted. Therefore, the power supply voltage should only be switched off in level 1 (measuring screens).

Note:
This means, that you should always leave the parameter screens completely (OK or Cancel) until the measurement screens are displayed again. This ensures that all parameters will be accepted by the device.

Note:
Please check the parameters and the adjustment data afterwards, to ensure the correct function of the SIMEAS P.
If you have adjusted the device manually, these data will not be overwritten by default settings.

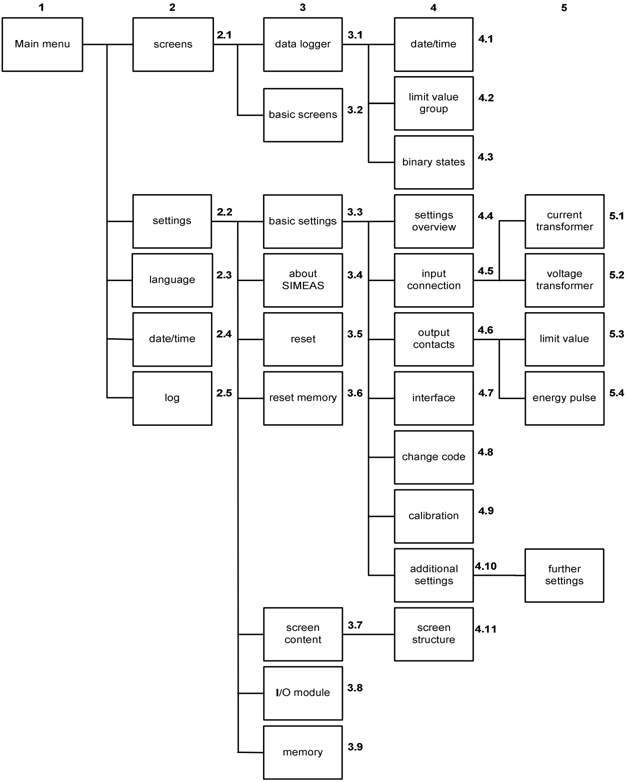
Message

Select "No" via the ▼ ▲ buttons to retain the settings as they existed prior to the loss of power supply voltage.
Choose "Yes" by pressing the ENTER button to restore the default settings.

```
Attention!

Parameter incorrect
reset?

No            Yes
(arrow)       (Enter)
```

2.18.5 Overview of the Programming Levels: 7KG7750

A detailed description of the device programming is given in the SIMEAS P Manual (Ordering no: E50417-B1076-C340-A1).



2.19 Testing and Calibration

WARNING!

The following measures must be carried out in compliance with the accident prevention instructions. Appropriate electrical tools must be used.

A calibration instrument, which indicates AC voltages, AC currents, and phase angles with an error of ≤ 0.1 %, is required for testing and calibrating the Power Meter.

For isolated test instruments, terminal N must be grounded.

A detailed description of the device calibration is given in the SIMEAS P instruction manual (Order No: E50417-B1076-C340-A1), chapter 6.1.

2.20 Maintenance, Repair and Cleaning

The SIMEAS P does not require special maintenance. If necessary, it can be checked in a laboratory and readjusted.

Repair of defective modules is never recommended because specially selected electronic components are used which must be handled in accordance with the procedures required by **E**lectrostatically **E**ndangered **C**omponents (EEC).

Therefore, if a device defect is suspected, it is recommended that the complete device be returned to the manufacturer. Use the original transport packaging or an appropriate packaging for return.

If it is unavoidable to replace individual modules, it is imperative that the standards related to the handling of Electrostatically Endangered Components are observed.

WARNING!

When carrying out changes on site, the instructions for handling electrostatically endangered components must be observed (EEC).

Cleaning

The meter should be mounted in a dry, dirt free location. Once installed, it is not necessary to clean the device.

To operate properly and effectively, environmental conditions should fall within the guidelines listed in the Technical Data, chapter 2.9.

If necessary, the device can be switched off and wiped with a clean, dry and soft cloth. Do not use solvents.

Notes

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

SIEMENS

Power Meter

SIMEAS P 7KG7750/55

Manual

Foreword, Contents

Commissioning 1

Operation 2

Measured Quantities 3

Device Parameterization 4

Parameterization via PC Software 5

Calibration 6

Technical Data 7

E50417-B1076-C340-A4

Note

Please observe the instructions and warnings for your safety in the foreword.

Subject to technical alterations.
Document Release V01.11.02
Edition 05.2011

Siemens Aktiengesellschaft

Order No.: E50417-B1076-C340-A4

Foreword

Purpose of the manual

This manual describes the commissioning, operation and parameterization of the Power Meter SIMEAS P 7KG7750/55.

Target audience

This manual is directed to the user of the Power Meter SIMEAS P.

Validity of the manual

This manual is valid for the devices SIMEAS P 7KG7750/55.

Additional support

For any questions concerning your system, please contact your local Siemens representative.

Hotline

Our Customer Support Center provides around-the-clock service.

Phone: +49 180 5 247000

Fax: +49 180 5 242471

E-mail: support.energy@siemens.com

Internet: http://www.powerquality.de/pq_da/index_e.htm

FAQ: http://www.siemens.com/energy-support/faq-en

Further documents

SIMEAS P Power Meter 7KG775x Operating Instructions

Ordering no. E50417-B1074-C339

SIMEAS P PROFIBUS DP Manual

Ordering no. E50417-B1076-C238

Power Meter SIMEAS P Modbus Manual

Ordering no. E50417-B1076-C241

Power Meter SIMEAS P 7KG7750/55 Communication Protocol IEC 60870-5-103 Manual

Ordering no. E50417-B1076-C375

Training courses

Please ask our Training Center for information on the individual courses available:

Siemens AG

Power Transmission and Distribution
Power Training Center

Humboldtstr. 59
90459 Nuremberg

Germany

Phone: +49 911 433-7005

Fax: +49 911 433-7929

Internet: www.ptd-training.com

Information for your safety

This manual does not represent a complete listing of all the safety measures required to operate the equipment (module, device) since specific operating conditions may make further measures necessary. However, it contains information which you have to observe in order to ensure your personal safety and in order to avoid material damage. The information is highlighted by a warning triangle and, depending on the degree of danger, is shown as follows:

DANGER

DANGER means that death or severe injury **will** result if the measures specified are not taken.

- Comply with all instructions, in order to avoid death or severe injuries.

WARNING

WARNING means that death or severe injury **may** result if the measures specified are not taken.

- Comply with all instructions, in order to avoid death or severe injuries.

CAUTION

CAUTION means that minor or moderate injury **can** occur if the measures specified are not taken.

- Comply with all instructions, in order to avoid moderate or minor injuries.

NOTICE

NOTICE means that property damage **can** result if the measures specified are not taken.

- Comply with all instructions, in order to avoid material damage.

Note

Important information about the product, product handling or a certain section of the documentation, which must be given particular attention.

Qualified personnel

Commissioning and operation of the equipment (module, device) described in this manual must be performed by qualified personnel only. As used in the safety notes contained in this manual, qualified personnel are those persons who are authorized to commission, release, ground, and tag devices, systems and electrical circuits in accordance with the safety standards.

Use as prescribed

The equipment (device, module) must not be used for any other purposes than those described in the Catalogue and the Technical Description. If it is used together with third party devices and components, these must be recommended or approved by Siemens.

Correct and safe operation of the product requires adequate transportation, storage, installation, and mounting as well as appropriate use and maintenance.

During operation of electrical equipment, it is unavoidable that certain parts of this equipment will carry dangerous voltages. Severe injury or damage to property can occur if the appropriate measures are not taken:

- Before making any connections at all, ground the equipment at the PE terminal.
- Hazardous voltages can be present on all switching components connected to the power supply.
- Even after the supply voltage has been disconnected, hazardous voltages can still be present in the equipment (capacitor storage).
- Equipment with current transformer circuits must not be operated while open.
- The limit values indicated in the manual must not be exceeded; that also applies to testing and commissioning.

Statemant of Conformity

	This product complies with the directive of the Council of the European Communities on the approximation of the laws of the member states relating to electromagnetic compatibility (EMC Council Directive 2004/108/EC) and concerning electrical equipment for use within specified voltage limits (Low Voltage Directive 2006/95/EC). This conformity has been proved by tests performed according to the Council Directives in agreement with the generic standards EN 61000-6-2 and EN 61000-6-4 (for EMC Directive) and with the standard EN 61010-1 (for Low Voltage Directive) by Siemens AG. This device was designed and produced for industrial use according to the standard EN 61000-6-4. The product conforms to the standards IEC 60688, EN 60688 or DIN EN 60688.

Contents

1 Commissioning 11

1.1 Delivery 12

1.2 Ordering Data 13

1.2.1 SIMEAS P 7KG7750 13

1.2.2 SIMEAS P 7KG7755 14

1.2.3 Parameterization Package. 14

1.3 Dimensions 15

1.3.1 Device Variant SIMEAS P 7KG7750 15

1.3.2 Device Variant SIMEAS P 7KG7755 18

1.4 Block Diagram 19

1.5 Interface and Terminals. 21

1.5.1 Terminal Assignment SIMEAS P 7KG7750/55 21

1.5.2 Terminal Assignment 22

1.5.3 Assignment of the Interface 24

1.5.4 Connection Examples 25

1.5.4.1 General 25

1.5.4.2 Single-phase 25

1.5.4.3 Three-phase, Three-wire, Balanced. 26

1.5.4.4 Three-phase, Three-wire, Unbalanced (2 I, Aron Circuit) 26

1.5.4.5 Three-phase, Four-wire, Balanced. 27

1.5.4.6 Three-phase, Four-wire, Unbalanced (Low-voltage System). 27

1.5.4.7 Three-phase, Four-wire, Unbalanced (High-voltage System) 27

1.5.5 Commissioning 28

1.5.6 Electrical Connection 28

2 Operation 31

2.1 Screen Display 32

2.2 Screen Content 32

2.2.1 Screen Types. 32

2.2.1.1 3 Measured Values - Digital 33

2.2.1.2 6 Measured Values - Digital 33

2.2.1.3 U, I and cos f (Phasors) 33

2.2.1.4 3 Min-Max Values 34

2.2.2 Status Bar 35

3 Measured Quantities 37

3.1 Measured Quantities - Depend on the Connection Type 38

3.2 Formulas and Calculation of Derived Quantities 42

3.2.1 Calculation of Derived Quantities 42

3.2.2 Remarks to the Measuring Quantities 44

3.3 Connection Modes 47
3.3.1 Four-wire Three-phase Current with Any Load 47
3.3.2 Single-phase AC 47
3.3.3 Four-wire Three-phase Current with Symmetrical Load 47
3.3.4 Three-wire Three-phase Current with Symmetrical Load 47
3.3.5 Three-wire Three-phase Current with Any Load 48
3.4 View of Measured Quantities and Error Limits 49

4 Device Parameterization 51

4.1 Operating Notes 52
4.1.1 Button Functions 52
4.1.2 Windows Structure 52
4.1.3 Notes on Parameterization 53
4.2 Overview of the Levels 54
4.3 Main Menu 55
4.3.1 Screens 55
4.3.2 Settings 55
4.3.3 Language 56
4.3.4 Date / Time 56
4.3.5 Log 57
4.4 Basic Settings 58
4.4.1 Settings Overview 58
4.4.2 Connection / Transformer 59
4.4.2.1 Current Transformer 59
4.4.2.2 Voltage Transformer 60
4.4.3 Outputs 62
4.4.3.1 Screen for Energy Pulses 63
4.4.3.2 Screen for Limit Values 63
4.4.4 Communication Interface 65
4.4.4.1 General Settings 65
4.4.4.2 IEC 60870-5-103 Settings 66
4.4.5 Changing the Password 67
4.4.5.1 Password of Code 1 67
4.4.5.2 Password of Code 2 67
4.4.6 Calibration 68
4.4.7 Additional Settings 68
4.4.8 Further Settings. 69
4.5 About SIMEAS 72
4.6 Reset 72
4.7 Reset Memory 73
4.8 Parameterization Screens 73
4.9 I/O Modules 75
4.10 Memory Management 75
4.11 Data Logger 76
4.11.1 Data Logger Date and Time 76
4.11.2 Data Logger Limit Violation Group 76
4.11.3 Data Logger Binary States 77

4.12	Overflow of Measured Values	78
5	**Parameterization via PC Software**	**79**
5.1	Basics	80
5.2	Overview of Parameterization	81
5.2.1	Overview of Parameterization 7KG7750	81
5.2.2	Overview of Parameterization 7KG7755	81
5.3	Date / Time Settings and Transmit	82
5.4	Dialog Window SIMEAS P	83
5.5	Basic Settings	84
5.5.1	Connection / Transformer	84
5.6	Screens Setting on SIMEAS P 7KG7750	86
5.6.1	Basic Screen Settings	87
5.6.2	Contents	88
5.7	Input / Output Modules	89
5.7.1	Binary / Relay Outputs	90
5.7.2	Information on Energy Pulse Measurement	91
5.7.2.1	Parameterization via Device	91
5.7.2.2	Pulse Time, Switch Off Time, Number of Pulses	91
5.7.2.3	Parameterization of Energy Pulses	92
5.7.2.4	Parameterization of Energy Pulses via Parameterization Software	93
5.7.3	Basic Settings	94
5.7.4	Analog Outputs (optional)	95
5.7.5	Analog Inputs (optional)	96
5.7.6	Binary Inputs (optional)	97
5.8	Additionals	98
5.8.1	Options	99
5.8.2	Device Code	100
5.8.3	Limit Value Groups	102
5.8.4	Clock Change	103
5.9	Memory Management	104
5.9.1	Splitting	105
5.9.2	Mean Values	108
5.9.3	Power Values.	109
5.9.4	Oscilloscope	111
5.9.4.1	Characteristics of „Instantaneous Values“ Recording	111
5.9.4.2	Characteristics of "RMS Value" Recording	112
5.9.5	Parameterization Oscilloscope	113
5.9.6	Limit Violation	114
5.9.7	Binary States	115
5.10	Updating the Firmware	116
5.11	Resetting Values in the Device	118

5.12 Reading the Device Memory 119
5.12.1 Handling 119
5.12.2 Charts / Diagrams 120
5.12.3 Diagrams 120
5.12.4 Timestamps 120
5.12.5 Mean Value Record 120
5.12.6 Power Value Record 121
5.12.7 Oscilloscope 121
5.12.8 Limit Violation Record 121
5.12.9 Binary States 122
5.12.10 Log Entries 122
5.13 Changing the Communication Parameters 123

6 Calibration 125

6.1 Overview 126
6.2 Connection Diagrams for Adjustment 127
6.3 Procedure 128

7 Technical Data 129

7.1 SIMEAS P 7KG7750 130
7.2 SIMEAS P 7KG7755 134

Commissioning

1

Contents

The following chapters describe all aspects of commissioning.

1.1	Delivery	12
1.2	Ordering Data	13
1.3	Dimensions	15
1.4	Block Diagram	19
1.5	Interface and Terminals	21

1.1 Delivery

Delivery note

The power meter will be delivered in a cardboard box containing the SIMEAS P logo.

Contents of delivery

1 Device SIMEAS P

2 Panel mounting fittings (only 7KG7750)

1 Operating Instruction (Ordering no. E50417-B1074-C339)

1 Return Card

1 Device Test Report

1 Battery VARTA CR2032

WARNING

Warning: Danger of explosion of the battery.

Nonobservance of the safety instructions means that death, severe injuries or considerable material damages can occur.

- Servicing of the battery circuit and replacing of the battery must be performed by qualified personnel only. Battery may explode if mistreated.
- Do not reverse the polarity!
- Do not disassemble the battery!
- Do not completely discharge the battery!
- Do not throw the battery into a fire!

WARNING

Warning about battery disposal.

Nonobservance of the safety instructions means that death, severe injuries or considerable material damages can occur.

- When discharged, or when properly secured against short-circuit, lithium batteries can be disposed of through retailers or at depots run by competent organizations (e.g. in Germany GRS collection points).

Note

The lithium-batteries in the equipment are subject to special provision 188/A45 of the dangerous goods regulations of the different transport modes (as in edition 2003, lithium content and tests of UN Manual of Tests and Criteria).

This is only valid for the original battery or original spare batteries. For general transport security by shipment as freight: Electric equipment is only to be sent as freight if shut off.

1.2 Ordering Data

1.2.1 SIMEAS P 7KG7750

Description	Order No.															
Power Meter																
SIMEAS P 7KG7750	7KG	7	7	5	0	-	0		A	0		-	0	A	A	
Built in device for control panels 96 mm x 96 mm with graphic display																
I/O module (optional)																
Without (standard)								**A**								
2 binary outputs								**B**								
2 binary inputs								**C**								
2 analog outputs DC 0 mA to 20 mA / DC 4 mA to 20 mA								**D**								
2 analog inputs DC 0 mA to 20 mA								**E**								
3 relay outputs								**G**								
Front protection class																
IP 41											**1**					
IP 65											**3**					
Communication interface and protocols																
PROFIBUS DP and Modbus RTU/ASCII / RS485																**0**
IEC 60870-5-103 and Modbus RTU/ASCII / RS485																**1**

1.2.2 SIMEAS P 7KG7755

Description	Order No.															
Power Meter																
SIMEAS P 7KG7755	7KG	7	7	5	5	-	0		A	0	0	-	0	A	A	
Snap on mounting unit 96 mm x 96 mm, without grafic display, front protection class IP 20																
I/O Module (optional)																
Without (standard)								A								
2 binary outputs								B								
2 binary inputs								C								
2 analog outputs DC 0 mA to 20 mA / DC 4 mA to 20 mA								D								
2 analog inputs DC 0 mA to 20 mA								E								
3 relay outputs								G								
Communication interface and protocols																
PROFIBUS DP and Modbus RTU/ASCII / RS485																0
IEC 60870-5-103 and Modbus RTU/ASCII / RS485																1

1.2.3 Parameterization Package

Description	Order No.															
SIMEAS P Parameterization Package	7KG	7	0	5	0	-	8	A								
Software SIMEAS P PAR, RS232/RS485 adapter																
Type																
RS485 / 5 V-power supply unit / supply voltage AC 230 V / 50 Hz									A							
RS485 / 5 V-power supply unit / supply voltage AC 120 V / 60 Hz									B							

1.3 Dimensions

1.3.1 Device Variant SIMEAS P 7KG7750

Note: All dimensions in mm

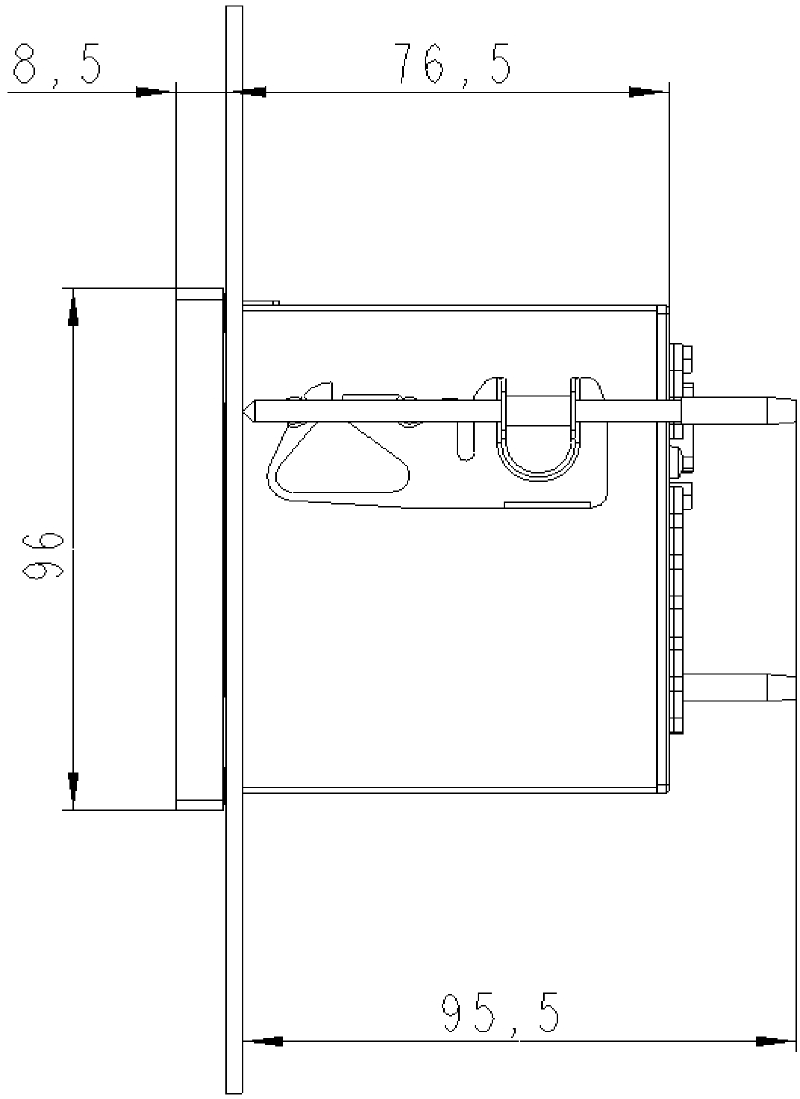


Fig. 1-1 SIMEAS P 7KG7750, variant IP 41

Note: All dimensions in mm

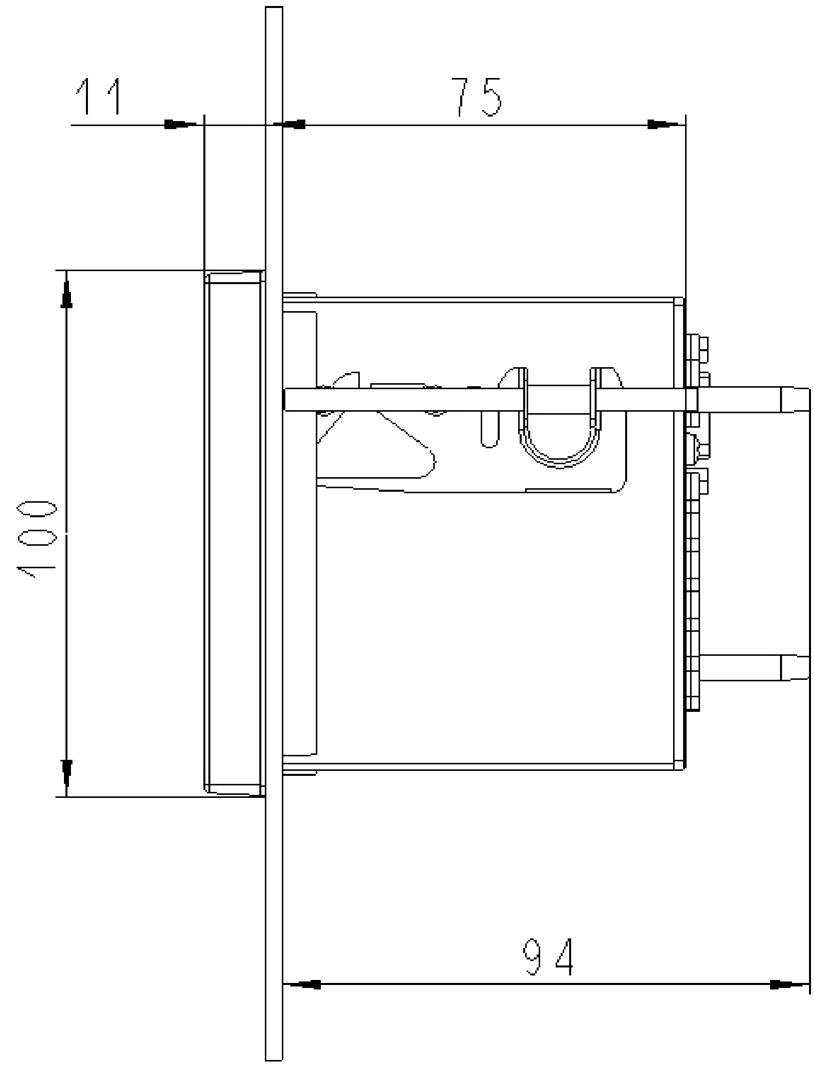


Fig. 1-2 SIMEAS P 7KG7750, variant IP 65

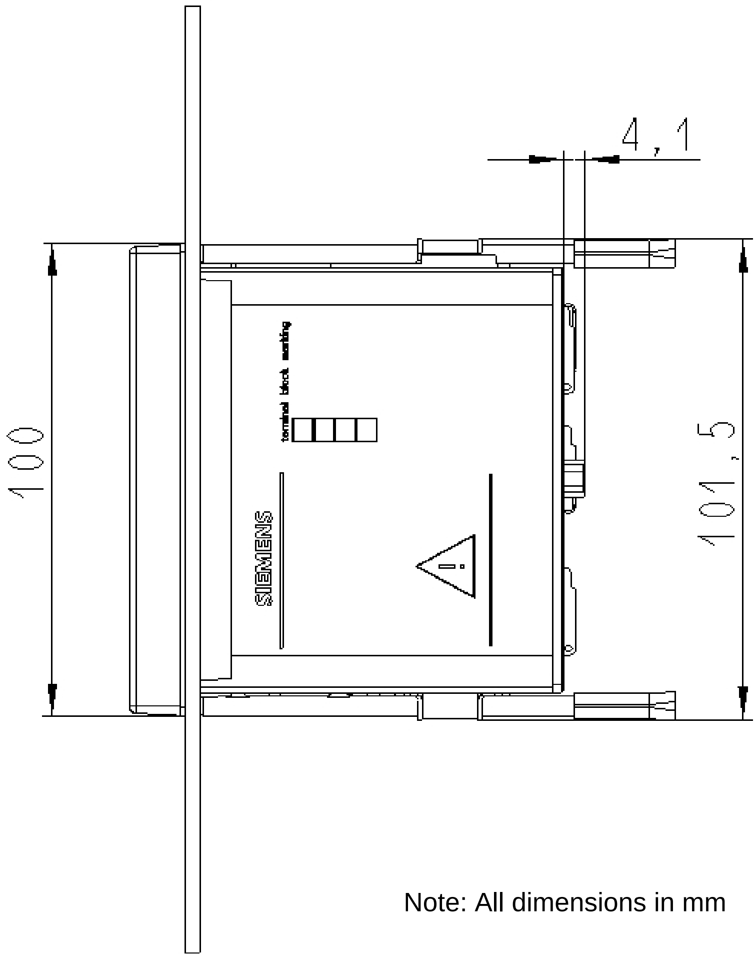


Fig. 1-3 SIMEAS P 7KG7750

Technical Data for Housing

Housing:	Flush mounting according to IEC 61554/DIN 43700
Panel section:	$92.0^{+0,8}$ mm x $92.0^{+0,8}$ mm
Protection class:	front IP 41 or IP 65
	terminals IP 20
	for personal security IP 1x

Terminals

Terminals for power supply, voltage inputs, current inputs, binary outputs, I/O modules (optional):

Conductor cross section, rigid max.:	2.5 mm^2
Conductor cross section with ferrule:	1.5 mm^2
Stripping length:	9 mm
Tightening torque:	0.4 Nm to 0.5 Nm
RS485 interface	9-pole D-Sub miniature female connector

1.3.2 Device Variant SIMEAS P 7KG7755

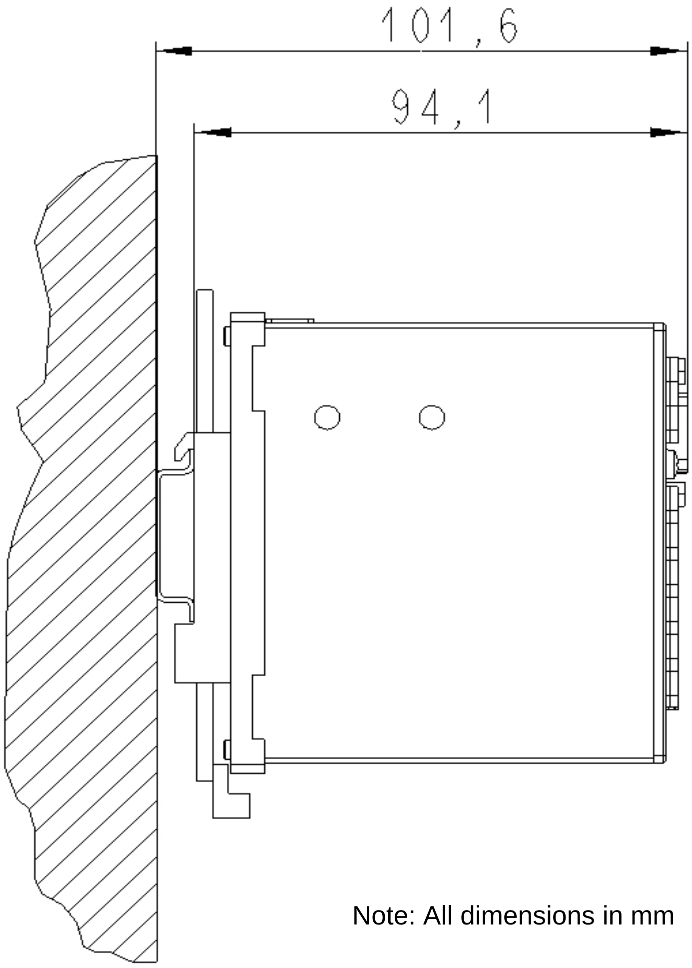


Fig. 1-4 SIMEAS P 7KG7755, snap on mounting unit

Technical Data for Housing

Housing	snap on mounting unit
Protection class	front / terminals IP 20
	for personal security IP 1x

Terminals

Terminals for power supply, voltage inputs, current inputs, binary outputs, I/O modules (optional):

Conductor cross section, rigid max.:	2.5 mm^2
Conductor cross section with ferrule:	1.5 mm^2
Stripping length:	9 mm
Tightening torque:	0.4 Nm to 0.5 Nm
RS485 interface	9-pole D-Sub miniature female connector

1.4 Block Diagram

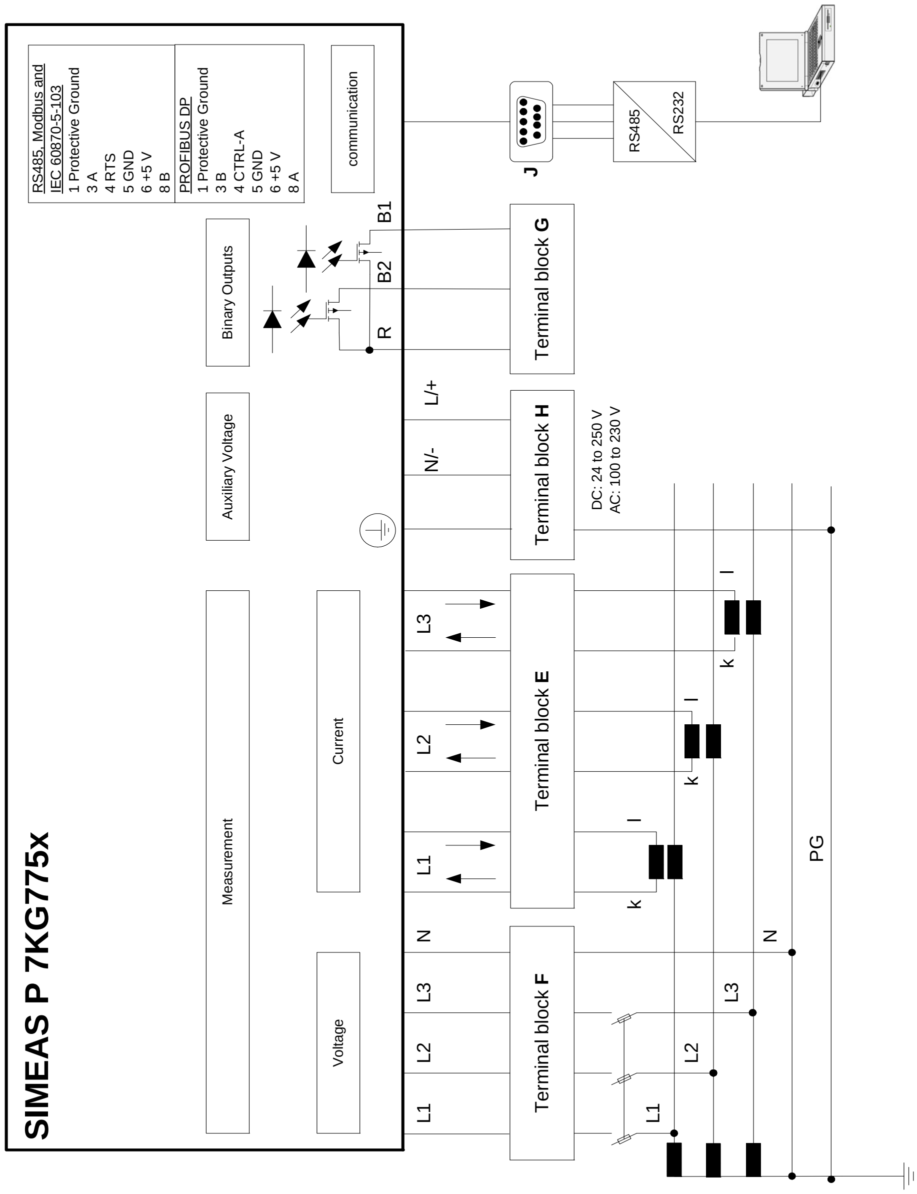


Fig. 1-5 Block diagram SIMEAS P 7KG7750/55

Note

The integrated battery serves to buffer the memory and the real-time clock.

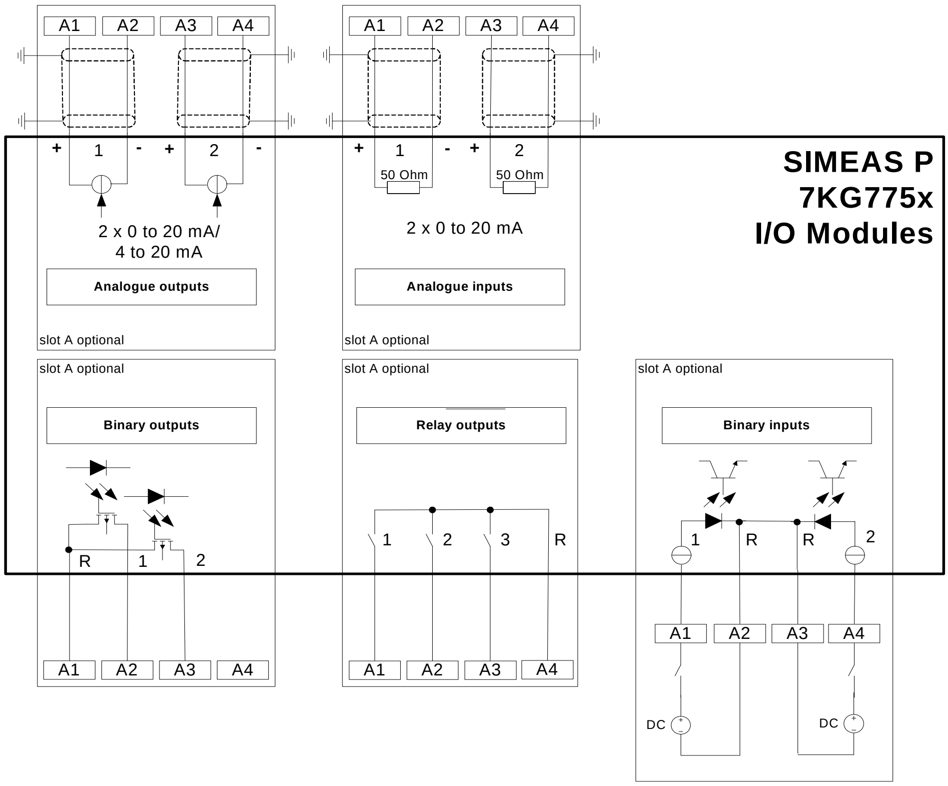


Fig. 1-6 I/O modules (option)

Additional input and output modules (see ordering data, chapter 1.2) are available for the device 7KG7750/55:

- Binary inputs (2 contacts with common contact)
- Binary outputs (2 contacts with common contact)
- Relay outputs (3 contacts with common contact)
- Analog inputs (2 channels)
- Analog outputs (2 channels)

1.5 Interface and Terminals

1.5.1 Terminal Assignment SIMEAS P 7KG7750/55

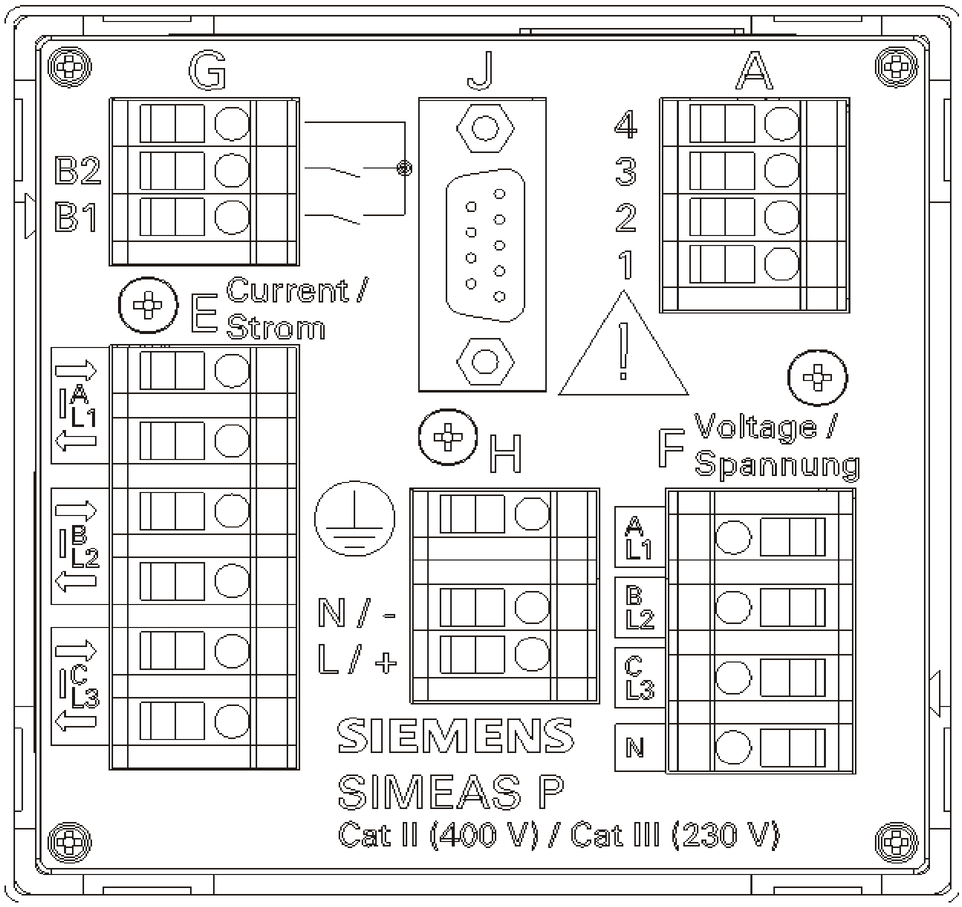


Fig. 1-7 Terminal assignment SIMEAS P 7KG7750/55

WARNING

Warning about missing protection.

Nonobservance of the safety instructions means that death, severe injuries or considerable material damages can occur.

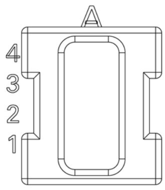
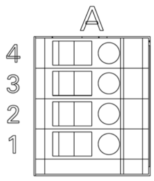
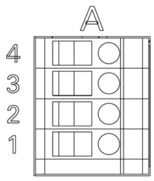
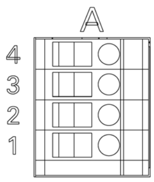
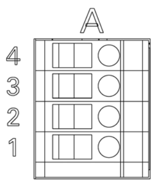
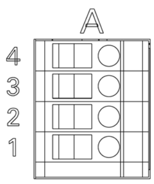
- Always connect the earth to the earthing terminal ⏚ of the SIMEAS P 7KG7750/55.

1.5.2 Terminal Assignment

Table 1-1 Terminal assignment

Terminal	Function		
E1	I_{L1}	I_A	Phase current 1, input
E2	I_{L1}	I_A	Phase current 1, output
E3	I_{L2}	I_B	Phase current 2, input
E4	I_{L2}	I_B	Phase current 2, output
E5	I_{L3}	I_C	Phase current 3, input
E6	I_{L3}	I_C	Phase current 3, output
F1	U_{L1}	U_A	Phase voltage 1
F2	U_{L2}	U_B	Phase voltage 2
F3	U_{L3}	U_C	Phase voltage 3
F4	U_N	U_N	Star point voltage measurement
G1	Common contact	Common contact	Common contact for the internal binary outputs 1 and 2
G2	B2	B2	Binary output 2
G3	B1	B1	Binary output 1
H1			Protective ground
H2	N/-	N/-	Supply voltage -
H3	L/+	L/+	Supply voltage +
A1 to A4	Optional, see Table 1-2, I/O modules		

Table 1-2 I/O modules (see Figure 1-6)

Modul Type	Terminal	Allocation	Ordering no. (see chapter 1.2)
not equipped			**A**
BO 2 binary outputs		n.c. BO2+ BO1+ BOR	**B**
BI 2 binary inputs		BI2+ BIR BIR BI1+	**C**
AO 2 analog outputs		AO2- AO2+ AO1- AO1+	**D**
AI 2 analog inputs		AI2- AI2+ AI1- AI1+	**E**
RO 3 relay outputs		ROR RO3 RO2 RO1	**G**

1.5.3 Assignment of the Interface

Table 1-3 Terminal assignment of RS485 interface

Pin No.	**RS485 Interface**	
	Modbus / IEC 60870-5-103	**Profibus DP**
1	Shield	Shield
2		
3	A	B(RxD/TxD-P)
4	RTS	CTRL-A
5	GND_{EXT}	GND_{EXT}
6	+5 V_{EXT}	+5 V_{EXT}
7		
8	B	A(RxD/TxD-N)
9		

The housing of the RS485 interface is connected to the protective ground. We recommend using standard connecting cables. The bus termination is accomplished via the connecting cable.

The isolated supply voltage of the interface is available at the D-Sub female connector, thus allowing the data signal terminating resistors to be connected to the connecting cable.

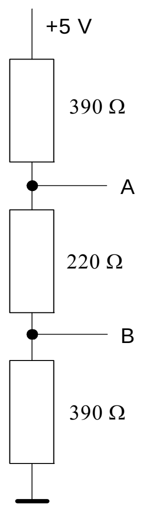


Fig. 1-8 Termination of the RS485 interface (external)

1.5.4 Connection Examples

1.5.4.1 General

The following are examples of current and voltage input connections (according to DIN 43807). The device can be connected without current or voltage transformers as long as the maximum voltage and current ratings of the device are not exceeded.

The voltage transformers can be connected in wye or open-delta configurations.

All input and/or output terminals not required for a particular input voltage and current configuration are not used.

Terminal designation of measuring instruments for single-phase and three-phase alternating current according to DIN 43807 / Oct. 1983:

DIN 43807	1	3	4	6	7	9	11	2	5	8

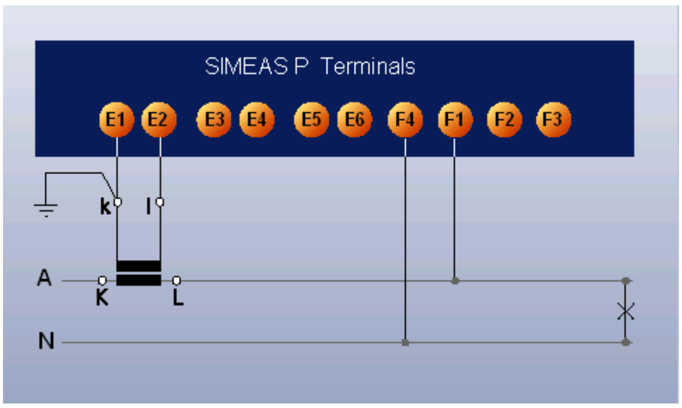
Terminal	I_A ↑	I_A ↓	I_B ↑	I_B ↓	I_C ↑	I_C ↓	N	U_A	U_B	U_C

SIMEAS P	E1	E2	E3	E4	E5	E6	F4	F1	F2	F3

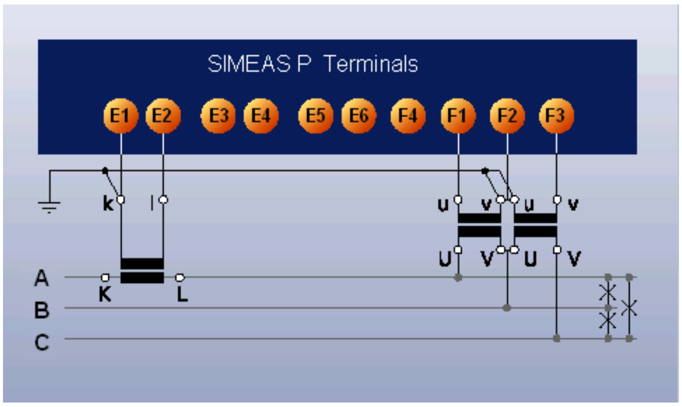
Note

The single ground connection of the instrument transformers is shown for illustration only. Actual grounds must be installed directly at each instrument transformer.

1.5.4.2 Single-phase



1.5.4.3 Three-phase, Three-wire, Balanced



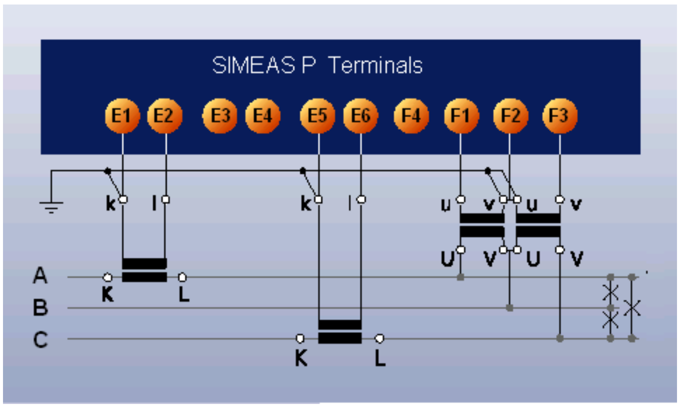
NOTICE

Do not exceed the maximum permissible voltage.

Nonobservance of the safety instructions means that property damage can result.

- The maximum secondary voltage is AC 480 V in this example. Do not exceed the maximum permissible voltage between phase and earth.

1.5.4.4 Three-phase, Three-wire, Unbalanced (2 I, Aron Circuit)



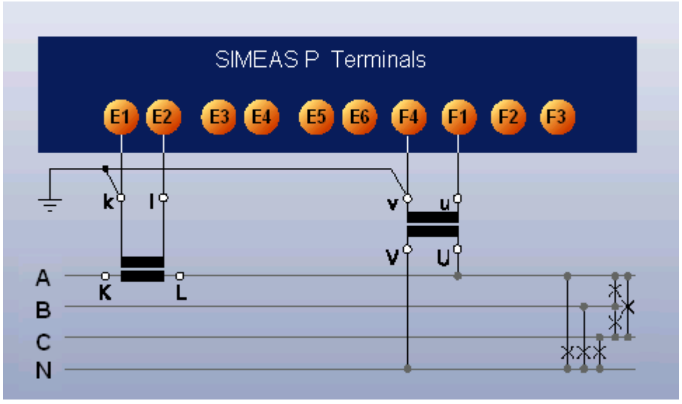
NOTICE

Do not exceed the maximum permissible voltage.

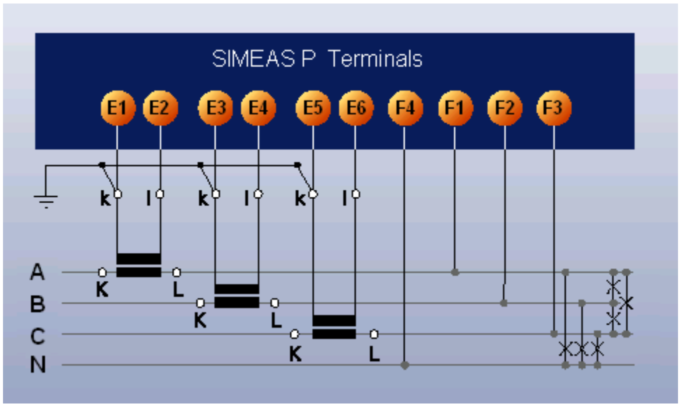
Nonobservance of the safety instructions means that property damage can result.

- The maximum secondary voltage is AC 480 V in this example. Do not exceed the maximum permissible voltage between phase and earth.

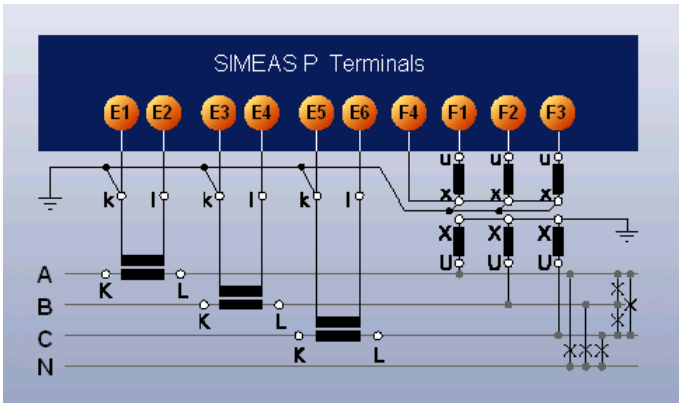
1.5.4.5 Three-phase, Four-wire, Balanced



1.5.4.6 Three-phase, Four-wire, Unbalanced (Low-voltage System)



1.5.4.7 Three-phase, Four-wire, Unbalanced (High-voltage System)



1.5.5 Commissioning

The ratings and information on the nameplate should be checked prior to connecting the power supply voltage. In particular, power supply voltage ratings, as well as input voltage and current ratings should be verified. An operating period of 15 minutes is required before the device will perform within specified accuracy limits.

The battery serves to buffer the memory and the real-time clock of the SIMEAS P. The battery is included in the delivery scope. The battery is delivered in an isolated state. Remove the cover of the battery slot on the top of the device and remove the battery and the isolation. Insert the battery without isolation according to the polarity printed on the top of the device (marking shield) and replace the battery cover.

If the battery voltage is low the battery symbol occurs in status line of the display. Please change the battery in this case as described before. Use an isolated tool to remove the battery from the device to avoid a short circuit!

WARNING

Warning about battery change.

Nonobservance of the safety instructions means that death, severe injuries or considerable material damages can occur.

- All electrical connections must get separated from the device before the battery change.

1.5.6 Electrical Connection

WARNING

Warning about dangerous voltages when operating an electrical device.

Nonobservance of the safety instructions means that death, severe injuries or considerable material damages can occur.

- Only qualified people shall work on and around this device. They must be thoroughly familiar with all warnings and safety notices in this instruction manual as well as with the applicable safety steps, safety regulations, and precautionary measures.
- The following work is partly carried out at existence endangering voltages.

Note

During electrical installation, all rules and regulations for power systems must be observed.

- Short-circuit the current transformer secondary circuits before current connections to the device are opened.
- The protective ground terminal of the device must be connected to the protective ground of the panel or cubicle.
- For connection of an auxiliary DC voltage, the correct polarity must be used.
- All of the terminals should be checked to verify proper connections.
- The polarities and phasing of all instrument transformers should be checked.
- Before initially energizing the device with supply voltage, it shall be situated in the operating area for at least two hours to ensure temperature equalization and to avoid humidity and condensation problems.

Operation 2

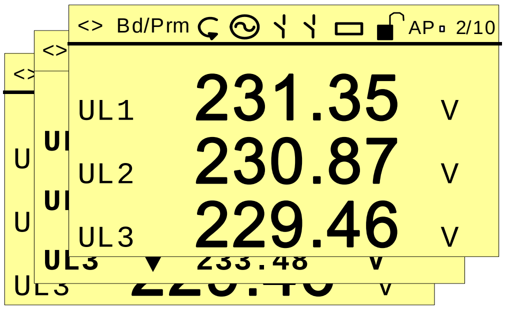
Contents

The following chapters describe the operation of the SIMEAS P 7KG7750. The operation of the SIMEAS P 7KG7755 is not described because this device has no display.

2.1	Screen Display	32
2.2	Screen Content	32

2.1 Screen Display

Once the SIMEAS P has been connected and configured for its measuring task, the measured quantities you have defined are displayed in screens.



- Specific screens can be selected via the two front arrow buttons ▼ ▲ .
- Press an arrow button once to display the next or previous screen.
- Hold an arrow button down to scroll through the screens automatically
- If desired, automatic scrolling can be programmed for normal display. When scrolling, the screens are arranged in a loop format (i.e., the first screen follows the last in one direction, whereas the last screen follows the first in the opposite direction, etc.).

2.2 Screen Content

The simple and individual screen design enables you to read the information relevant to your measuring tasks at a glance. The number of screens (max. 20), the screen types and their contents can be parameterized as required.

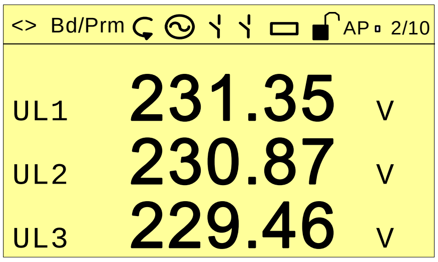
2.2.1 Screen Types

The following screen types are available:

- three measured values - digital
- six measured values - digital
- U, I, cos ϕ
- three min-max values

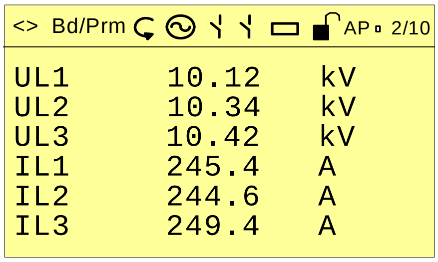
2.2.1.1 3 Measured Values - Digital

Display of any three measured quantities from the measured quantities Table 3-1.



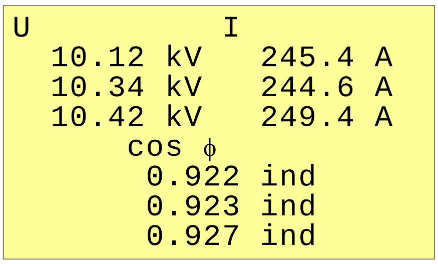
2.2.1.2 6 Measured Values - Digital

Display of any six measured quantities from the measured quantities Table 3-1.



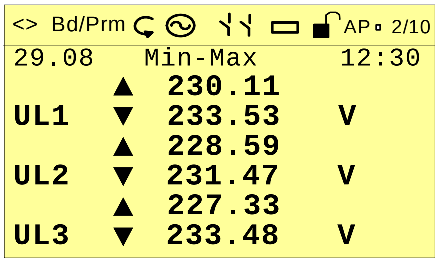
2.2.1.3 U, I and cos ϕ (Phasors)

- fast overview of the network conditions
- digital display of all connected phases
- measured quantities: U, I, cos ϕ



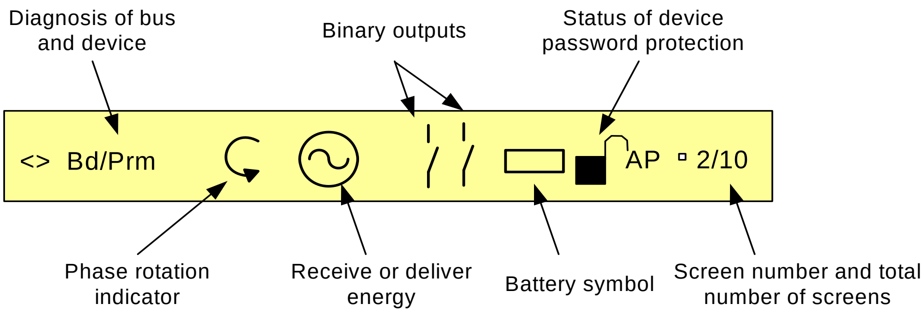
2.2.1.4 3 Min-Max Values

- Up to three measured quantities from the measured quantities tables (except energy and metered values) can be monitored here.
- The minimum, average and maximum values since recording was last initiated are displayed for a specific measured quantity. The values remain valid in case of a power failure.
- Recording is initiated (date and time):
  - when the device is switched on or
  - via "Reset" of the Min-Max values at the programming level.
- If no date/time is set, the duration of the recording is indicated in hours and minutes. If the time is set, the date and time of recording initiation are indicated.

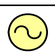
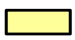
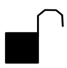


2.2.2 Status Bar

The screens (except for U, I, cos ϕ) have a status line that displays the status of the device.



Meaning of the symbols

Symbol	Meaning
< >	Serial telegram sent / receive
Bd	Searching for the Profibus baud rate
Cfg	Waiting for the correct configuration of Profibus
Prm	Waiting for the correct parameters of Profibus
	Direction of rotation from U_{L1} to U_{L2} (U_A to U_B)
	Receive (this symbol) or delifer (resistor symbol) energy
	Status of binary outputs
	If the battery voltage falls below the defined threshold, then the symbol will be displayed in the status line. Please replace the battery in this case (see chapter 1.5.5).
	If the password protection is active a lock with a closed fastener will be displayed.
A	Recording of average values active
P	Recording of power values active

Measured Quantities 3

Contents

The following chapters describe the measured quantities.

3.1	Measured Quantities - Depend on the Connection Type	38
3.2	Formulas and Calculation of Derived Quantities	42
3.3	Connection Modes	47
3.4	View of Measured Quantities and Error Limits	49

3.1 Measured Quantities - Depend on the Connection Type

Table 3-1 Measured quantities that depend on the input connection type

No.	Measured Quantity	1-phase AC Current	Three-wire Three-phase Balanced	Three-wire Three-phase Unbalanced (3I)	Three-wire Three-phase Unbalanced (2I)	Four-wire Three-phase Balanced	Four-wire Three-phase Unbalanced	Designation
1	(Space line)*	X	X	X	X	X	X	
2	Voltage L1-N	X				X	X	U L1
3	Voltage L2-N						X	U L2
4	Voltage L3-N						X	U L3
5	Voltage L1-L2		X	X	X		X	U L12
6	Voltage L2-L3		X	X	X		X	U L23
7	Voltage L3-L1		X	X	X		X	U L31
8	Voltage E-N*		0	0	0	0	0	U E-N
9	Current L1	X	X	X	X	X	X	I L1
10	Current L2			X	X		X	I L2
11	Current L3			X	X		X	I L3
12	Average current*			X	X		ΣI / 3	I
13	Neutral current N			X			X	I0
14	Real power L1	X					X	P L1
15	Real power L2						X	P L2
16	Real power L3						X	P L3
17	Real power Σ		X	X	X	X	X	P
18	Reactive power L1	X					X	Q L1
19	Reactive power L2						X	Q L2
20	Reactive power L3						X	Q L3
21	Reactive power Σ		X	X	X	X	X	Q
22	Apparent power L1	X					X	S L1
23	Apparent power L2						X	S L2
24	Apparent power L3						X	S L3
25	Apparent power Σ		X	X	X	X	X	S
26	Active factor cos ϕ L1	X					X	COS PHI L1
27	Active factor cos ϕ L2						X	COS PHI L2
28	Active factor cos ϕ L3						X	COS PHI L3
29	Active factor cos ϕ Σ		X	X	X	X	X	COS PHI
30	Power factor L1	X					X	PF L1
31	Power factor L2						X	PF L2
32	Power factor L3						X	PF L3
33	Power factor Σ		X	X	X	X	X	PF

* see Table 3-2, Explanation

No.	Measured Quantity	1-phase AC Current	Three-wire Three-phase Balanced	Three-wire Three-phase Unbalanced (3I)	Three-wire Three-phase Unbalanced (2I)	Four-wire Three-phase Balanced	Four-wire Three-phase Unbalanced	Designation
34	Phase angle L1	X					X	PHI L1
35	Phase angle L2						X	PHI L2
36	Phase angle L3						X	PHI L3
37	Phase angle Σ		X	X	X	X	X	PHI
38	System frequency	X	X	X	X	X	X	f
39	Asymmetrical voltage						X	ASYM U
40	Asymmetrical current						X	ASYM I
41	THD voltage L1	X					X	THDU L1
42	THD voltage L2						X	THDU L2
43	THD voltage L3						X	THDU L3
44	THD current L1	X					X	THDI L1
45	THD current L2						X	THDI L2
46	THD current L3						X	THDI L3
47	Harmonic voltage L1*	X	X	X	X	X	X	HU L1 5, 7, 11, 13, 17, 19
48	Harmonic voltage L2*			X	X		X	HU L2 5, 7, 11, 13, 17, 19
49	Harmonic voltage L3*			X	X		X	HU L3 5, 7, 11, 13, 17, 19
50	Harmonic current L1*	X	X	X	X	X	X	HI L1 5, 7, 11, 13, 17, 19
51	Harmonic current L2*			X	X		X	HI L2 5, 7, 11, 13, 17, 19
52	Harmonic current L3*			X	X		X	HI L3 5, 7, 11, 13, 17, 19
53	Active energy L1 demand*	X					X	WpL1d
54	Active energy L2 demand*						X	WpL2d
55	Active energy L3 demand*						X	WpL3d
56	Active energy Σ demand*		X	X	X	X	X	WpΣd
57	Active energy L1 supply*	X					X	WpL1s
58	Active energy L2 supply*						X	WpL2s
59	Active energy L3 supply*						X	WpL3s
60	Active energy Σ supply*		X	X	X	X	X	WpΣs
61	Active energy L1 total*	X					X	WpL1t
62	Active energy L2 total*						X	WpL2t
63	Active energy L3 total*						X	WpL3t
64	Active energy Σ total*						X	WpΣt
65	Active energy (3L) demand net*	X	X	X	X	X		Wpnet

* see Table 3-2, Explanation

No.	Measured Quantity	1-phase AC Current	Three-wire Three-phase Balanced	Three-wire Three-phase Unbalanced (3I)	Three-wire Three-phase Unbalanced (2I)	Four-wire Three-phase Balanced	Four-wire Three-phase Unbalanced	Designation
66	Reactive energy L1 inductive	X					X	WqL1i
67	Reactive energy L2 inductive						X	WqL2i
68	Reactive energy L3 inductive						X	WqL3i
69	Reactive energy Σ inductive		X	X	X	X	X	WqΣi
70	Reactive energy L1 capacitve	X					X	WqL1c
71	Reactive energy L2 capacitve						X	WqL2c
72	Reactive energy L3 capacitve						X	WqL3c
73	Reactive energy Σ capacitve		X	X	X	X	X	WqΣc
74	Reactive energy total L1*	X					X	WqL1t
75	Reactive energy total L2*						X	WqL2t
76	Reactive energy total L3*						X	WqL3t
77	Reactive energy total Σ*		X	X	X	X	X	WqΣt
78	Apparent energy L1	X					X	WL1
79	Apparent energy L2						X	WL2
80	Apparent energy L3						X	WL3
81	Apparent energy Σ		X	X	X	X	X	WΣ
82	Counter 1 / 2 / 3 / 4*	X	X	X	X	X	X	Cntr. 1, 2, 3, 4
83	Binary inputs	X*	X*	X*	X*	X*	X*	
84	Analog inputs	X*	X*	X*	X*	X*	X*	
* see Table 3-2, Explanation								

Explanations to the Table 3-1

Table 3-2 Explanation

No.	Name	Description
1	(Space line)	If a space line is selected as a measured quantity, the corresponding fields remain empty on the display screens.
8	Voltage E-N	The displayed value of the voltages (E-N) is always 0, but the value of residual voltage is shown, if it occurs.
12	Average current	The average value of the three phase currents is displayed here.
47 to 52	Harmonics U / I	For harmonics up to the 21st, the standards (IEC 61000-2-2 and EN 50160) specify compatibility levels only for harmonics of orders 5, 7, 11, 13, 17, and 19. Those of even order and those divisible by 3 are considered irrelevant. Therefore, on the "Harmonics" screen, selection is limited to all uneven orders up to the 21st. The selection of single harmonics on the measured values screens is limited to the 5th, 7th, 11th, 13th, 17th and 19th. For voltage harmonics, values are displayed as a percentage of the first harmonic. For current harmonics, the values are displayed directly in A.
53 to 60	Active energy demand	The default setting (industry mode) is "Load (standard)" indicated by a positive energy flow direction. You can configure the power supply company mode. In this mode, a positive value indicates "Generator".
61 to 64	Active energy total	The sum of the absolute values (without sign) of active energy demand and active energy supply.
65	Active energy (3L) net demand	*Net energy* is equal to *energy demand* minus *energy supply*. Because this measured value can be negative and can decrease as well as increase, it is not possible to use this measured value to generate pulses via the output contacts.
74 to 77	Reactive energy total	The sum of the absolute values (without sign) of inductive and capacitive kvarh.
82	Counter 1 / 2 / 3 / 4	Number of limit violations
83 84	Binary inputs, analog inputs	optional

3.2 Formulas and Calculation of Derived Quantities

3.2.1 Calculation of Derived Quantities

Line	Derived Quantity	Formula	Note
1	RMS value voltage, distorted waveform included	$V = \sqrt{\frac{1}{64}\sum_{\nu=1}^{64} u_\nu^2}$	
2	RMS value voltage, fundamental component U_1 only	$V_1 = \sqrt{\frac{a^2 + b^2}{2}}$	From the Fourier coefficients a and b of the fundamental component
3	RMS value current, distorted waveform included	$I = \sqrt{\frac{1}{64}\sum_{\nu=1}^{64} i_\nu^2}$	
4	RMS value voltage, fundamental component I_1 only	$I_1 = \sqrt{\frac{a^2 + b^2}{2}}$	From the Fourier coefficients a and b of the fundamental component
5	Active power P_{Std}	$P = \frac{1}{64}\sum_{\nu=1}^{64} v_\nu i_\nu$	From sample values
6	Active power P_{Four}	$P = Va_1 Ia_1 + Vb_1 Ib_1$	From the Fourier coefficients of the fundamental component
7	Active power P_{DIN}	$P = \sum_{n=1}^{21}(Va_n Ia_n + Vb_n Ib_n)$	From the Fourier coefficients of the fundamental component and from the harmonics.
8	Reactive power Q_{Std}	$Q = \frac{1}{64}\sum_{\nu=1}^{64} v_\nu i_\nu \cdot e^{-j\frac{1}{2}\pi}$	Standard up to now, additional fault for distortions[1]
9	Reactive power Q_{Four}	$Q = Va_1 Ib_1 + Vb_1 Ia_1$	
10	Reactive power Q_{DIN}	$Q_{tot} = \sum_{n=1}^{21}(Va_n Ib_n + Vb_n Ia_n)$	From the Fourier coefficients of the fundamental component
11	Apparent power S_{Std}	$S = V_{1N} \cdot I_1 + V_{2N} \cdot I_2 + V_{3N} \cdot I_3$	From the RMS values according to line 1 and 3
12	Apparent power S_{Four}	$S = \sqrt{V_{1N}^2 + V_{2N}^2 + V_{3N}^2} \cdot \sqrt{I_1^2 + I_2^2 + I_3^2}$	From the RMS values according to line 1 and 3
13	Apparent power S_{DIN}	$S = \sqrt{V_{1N}^2 + V_{2N}^2 + V_{3N}^2} \cdot \sqrt{I_1^2 + I_2^2 + I_3^2}$	From the RMS values according to line 2 and 4
14	Power factor	$\cos\varphi = \frac{\lvert P\rvert}{S}$ or $\frac{P_1}{S_{DIN}}$	No sign!
15	Power factor DIN	$\cos\varphi = \frac{\lvert P\rvert}{S_{DIN}}$	No sign!
16	Power factor cos φ	$\cos\varphi = \frac{P_1}{S_1}$	Four quadrants according to note 4
17	Phase Angle	$\varphi = \arctan\frac{Q_1}{P_1}$	From the fundamental component only!

[1] According to classic measuring devices (electrodynamic power meter)

Line	Derived Quantity	Formula	Note
18	System frequency	$f = \frac{\frac{N}{T}}{P}$	Refer to note 1
19	Active energy demand	$W = \sum_{\nu=1} P_\nu \quad for\, P > 0$	The active energy demand will be calculated every second.
20	Active energy supply	$W = \sum_{\nu=1} P_\nu \quad for\ P < 0$	The active energy supply will be calculated every second.
21	Active energy without sign	$W = \sum_{\nu=1} P_\nu$	Calculation without sign
22	Active energy net demand	$W = \sum_{\nu=1} P_\nu$	Calculation with sign
23	Asymmetrical voltage U or current I	$V = \frac{G}{M}$	Refer to note 2 Range is 0 to ∞, avoid division by 0!
24	THD voltage, current	$THD = \sqrt{\frac{M_{tot}}{M_1} - 1}$	Refer to note 3
25	Harmonics		From Fourier transformation

3.2.2 Remarks to the Measuring Quantities

Note 1

N: Nominal value of the counting pulses per period at nominal value of the system frequency

T: Nominal value of the period length of the system frequency in µs

P: Counted pulses within one period

V: Asymmetry

G: Unbalanced system

M: Balanced system

M_n: Vector of the measured quantity, U_{LN} or I_L, from Fourier transformation

Note 2

No. of Equation	Equation
1	$G = \sqrt{A^2 + B^2}$
2	$A = M_1 + M_2 \cos\left(\varphi_{12} - \frac{2}{3}\pi\right) + M_3 \cos\left(\varphi_{13} + \frac{2}{3}\pi\right)$
3	$B = M_2 \sin\left(\varphi_{12} - \frac{2}{3}\pi\right) + M_3 \sin\left(\varphi_{13} + \frac{2}{3}\pi\right)$
4	$M = \sqrt{C^2 + D^2}$
5	$C = M_1 + M_2 \cos\left(\varphi_{12} + \frac{2}{3}\pi\right) + M_3 \cos\left(\varphi_{13} - \frac{2}{3}\pi\right)$
6	$D = M_2 \sin\left(\varphi_{122} + \frac{2}{3}\pi\right) + M_3 \sin\left(\varphi_{13} - \frac{2}{3}\pi\right)$

Note 3

Derivation of the formula:

Total distortion D according to IEC 61000-2-2:

Equation No. 7:

$$D = \sqrt{\sum_{n=2}^{N} u_n^2} = \frac{1}{M_1}\sqrt{\sum_{n=2}^{N} M_n^2}$$

u_n: U_n/U_1

n Order of the harmonic

U_n Voltage of the n-th harmonic

U_1 Voltage of the fundamental component

N 40, for SIMEAS P: 21

M_n Harmonic (n-th order) of voltage or current

M_1 Fundamental component of voltage or current

It is possible to derive the result from the harmonic M_1 and the RMS value M_{ges} of the distorted measured quantity. With the root „H“ from equation 8:

Equation No. 8:

$$H = \sqrt{M_{ges}^2 - M_1^2}$$

M_{ges}: RMS value of the distorted measured quantity U or I

M_1: RMS value of the fundamental component of the measured quantity

Inserting the values into the equation results in:
Equation 9:

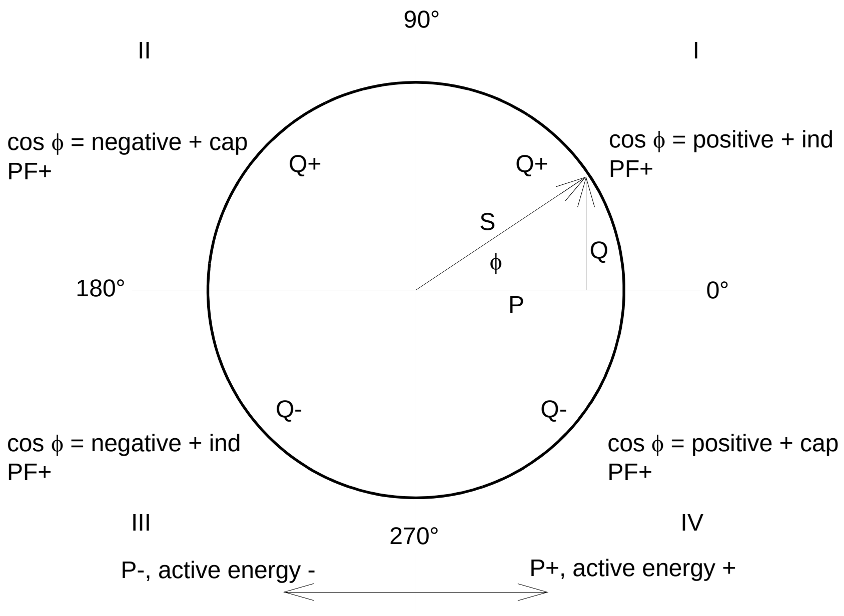
$$THD = \frac{1}{M_1} H = \frac{1}{M_1}\sqrt{M_{ges}^2 - M_1^2}$$

Inserting 1/M1 into the root results in:
Equation 10:

$$THD = \sqrt{\frac{M_{ges}^2 - M_1^2}{M_1^2}} = \sqrt{\frac{M_{ges}^2}{M_1^2} - 1}$$

Note 4

4 Quadrants



3.3 Connection Modes

3.3.1 Four-wire Three-phase Current with Any Load

Depending on the measuring method some quantities to be measured are not available. For the method according to DIN, for example the apparent power S or S_1 are available; only S_{DIN} can be calculated.

3.3.2 Single-phase AC

The measuring path for the voltage is A-N for the voltage and A for the other quantities. This applies also for the power values. The apparent power according to DIN, the reactive power Q_{tot} DIN and the asymmetry are not valid.

3.3.3 Four-wire Three-phase Current with Symmetrical Load

Current A and voltage A-N are available. You can display the same measured quantities as for Single-phase AC. For power Σ, the value calculated from U and I must be multiplied by 3. For power, power factor, cos ϕ, phase angle and energy only the sum is relevant. The measurement values Asymmetrical U or I are not available. THD and harmonics can be derived for A only.

3.3.4 Three-wire Three-phase Current with Symmetrical Load

For this connection mode, an artificial neutral point is formed via resistors. Since this internal neutral point is connected to the grounding conductor, it cannot be used here. The reactive power (Standard) can be derived from U_{32} and I_1:

Equation 11:

$$Q = \frac{\sqrt{3}}{64}\sum_{\nu=1}^{64} u_{32\nu} i_{1\nu}$$

You have to calculate u_{32} from u_{3E} - u_{2E}. To calculate the reactive power for the fundamental Q1, the adequate phasors are used. For the reactive power (Standard), sample points, which are shifted by 90°, are used for the voltage.

Equation 12:

$$P = \frac{\sqrt{3}}{64}\sum_{\nu=1}^{64} u_{32\nu} \cdot e^{-j\frac{\pi}{2}} i_{1\nu}$$

To calculate the active power of the fundamental P_1 the adequate phasors are used. The measurement values Asymmetrical U or I are not available. THD and harmonics cannot be calculated. The apparent power is the multiplication of the RMS values voltage and current, e.g.:

Equation 13:

$$S = \sqrt{3} \cdot U_{32} \cdot I_1$$

For S_1, the RMS values of the fundamental component are used; as symmetrical load is supposed S_{DIN} = S.

3.3.5 Three-wire Three-phase Current with Any Load

For this connection mode, the phase-to-ground voltages are not available. Active and reactive powers are calculated from the formulas of the two-wattmeter (Aron) circuit:

Equation 14:

$$P = \frac{1}{64}\sum_{\nu=1}^{64} u_{12\nu} i_{1\nu} + \frac{1}{64}\sum_{\nu=1}^{64} u_{23\nu} i_{3\nu}$$

This is also valid for the calculation via Fourier analysis. For the reactive power according to classic measuring devices (electro dynamic power meter), the following equation is valid:

Equation 15:

$$Q = \frac{1}{64}\sum_{\nu=1}^{64} u_{12\nu} i_{1\nu} e^{-j\frac{1}{2}\pi} + \frac{1}{64}\sum_{\nu=1}^{64} u_{23\nu} i_{3\nu} e^{-j\frac{1}{2}\pi}$$

Distortions will cause an additional fault. For the apparent power (classical method), the following equation is valid::

Equation 16:

$$S = \sqrt{3}\left(U_{12} I_1 + U_{23} I_3\right)$$

For the apparent power according to DIN calculated from the phase voltages, the following equation is valid:

Equation 17:

$$S = \sqrt{\frac{1}{3}\left(U_{12}^2 + U_{23}^2 + U_{31}^2\right)} \cdot \sqrt{I_1^2 + I_2^2 + I_3^2}$$

In both cases, current B must be calculated from the geometrical sum of the currents -A and -C. To do this, you can sum up the sample points or the Fourier coefficient.

The artificial neutral point does not allow measuring the voltage asymmetry exactly and is not realized. The measured values are only exact, if you use a four-wire net with neutral point. Often the three-wire net is used only to save the cable connection to current transformer 2. Only in this case, it would be useful to measure the asymmetry.

3.4 View of Measured Quantities and Error Limits

Table 3-3 Measured values and tolerances

Measured Values	**Measuring Path** [1]	**Menu**	**Tolerances** [2]
Voltage	L1-N, L2-N, L3-N	▼ ■ ●	±0.2 %
Voltage	L1-L2, L2-L3, L3-L1, Σ [3]	▼ ■ ●	±0.2 %
Current	L1, L2, L3, N, Σ [3]	▼ ■ ●	±0.2 %
Active power P + demand, - supply	L1, L2, L3, Σ	▼ ■ ●	±0.5 %
Reactive power Q + cap, - ind	L1, L2, L3, Σ	▼ ■ ●	±0.5 %
Apparent power S	L1, L2, L3, Σ	▼ ■ ●	±0.5 %
Power factor |cosφ| [4]	L1, L2, L3, Σ	▼ ■ ●	±0.5 %
Active power factor cosφ [4]	L1, L2, L3, Σ	▼ ■ ●	±0.5 %
Phase angle [4]	L1, L2, L3, Σ	▼ ■ ●	±2°
System frequency [5]	L1-N	▼ ■ ●	±10 mHz
Active energy demand	L1, L2, L3, Σ	▼ ■	±0.5 %
Active energy supply	L1, L2, L3, Σ	▼ ■	±0.5 %
Active energy total	L1, L2, L3, Σ	▼ ■	±0.5 %
Active energy net demand	Σ	▼ ■	±0.5 %
Reactive energy cap	L1, L2, L3, Σ	▼ ■	±0.5 %
Reactive energy ind	L1, L2, L3, Σ	▼ ■	±0.5 %
Reactive energy total	L1, L2, L3, Σ	▼ ■	±0.5 %
Apparent energy	L1, L2, L3, Σ	▼ ■	±0.5 %
Unbalance voltage	Four-wire system	▼ ■ ●	±0.5 %
Unbalance current	Four-wire system	▼ ■ ●	±0.5 %
THD voltage	L1, L2, L3	▼ ■ ●	±0.5 %
THD current	L1, L2, L3	▼ ■ ●	±0.5 %
Harmonic voltage 5., 7., 11., 13., 17. and 19. H.	L1, L2, L3	▼ ■ ●	±0.5 %
Harmonic current 5., 7., 11., 13., 17. and 19. H.	L1, L2, L3	▼ ■ ●	±0.5 %
Limit violation	Counter 1 to 4	▼ ■	
Analog input [6]	external	▼ ■	±0.5 %
Binary input [6]	external	▼ ■	

1) Phases are displayed based on the type of connection.

2) Tolerances at reference conditions (see chapter 7) are applicable from 0.1 to 1.2 x nominal range.

3) Average value of all phases.

4) Measuring beginning with 2 % of the internal apparent power in selected measurement range

5) Measuring beginning with 30 % of the input voltage L1-N

6) Optional

7) Limit values for the complete temperature range (see chapter 7) referring to: 0.1 to 1.2 x nominal range.

Symbol	Function
▼	Measured values can be displayed on measured value screens (only 7KG7750)
■	Measured values selectable over communication
●	Measured values selectable for list screens and oscilloscope (only 7KG7750)

Device Parameterization 4

Contents

The following chapters describe the device parameterization of the SIMEAS P 7KG7750 using a graphic display. The parameterization of the SIMEAS P 7KG7755 using PC software is explained in chapter 5.

4.1	Operating Notes	52
4.2	Overview of the Levels	54
4.3	Main Menu	55
4.4	Basic Settings	58
4.5	About SIMEAS	72
4.6	Reset	72
4.7	Reset Memory	73
4.8	Parameterization Screens	73
4.9	I/O Modules	75
4.10	Memory Management	75
4.11	Data Logger	76
4.12	Overflow of Measured Values	78

4.1 Operating Notes

This chapter describes all of the setting options of the SIMEAS P that are made via the front buttons.

The Main Menu (programming level 2, see chapter 4.3) can be accessed :

- from the measured values screens, the min-max values screens or the screen U, I, cos ϕ via the ENTER button,
- from the data logger: use the arrow buttons to select the Date/Time screen and press the ENTER button.

4.1.1 Button Functions

The following functions are performed via the ▼ ▲ buttons:

- Moving the cursor to the entry line,
- Scrolling through selection lists when entering settings,
- Selecting numbers when entering numerical values.

If the buttons are held down, the scrolling continues automatically. The buttons generally cycle between cursor, parameters or numbers.

The selected line, setting, or number is confirmed by pressing the ENTER button.

4.1.2 Windows Structure

Selecting ***** and pressing ENTER moves the cursor directly to the data entry field on the same line.

Selecting **> screen structure** and pressing ENTER opens a new window for additional data entry.

Selecting **< OK** and pressing ENTER confirms the settings and returns the user to the previous level.

Selecting **< Cancel** and pressing ENTER cancels the setting changes just made and returns the user to the previous level.

```
*no. screens:    10
*repeat ratio:    0Sec
*illumination:    2Min
*contrast:        5
>screen structure

<ok
<cancel
```

4.1.3 Notes on Parameterization

- The measured quantities offered for selection in the screens depend on the connection type selected.
- The numbers entered are checked for plausibility and the note: "ERR" is displayed if required. The input value is then set to the maximum value.
- If the power supply voltage is switched off during programming, the message illustrated below appears when the device is restarted. Therefore, the power supply voltage should only be switched off in level 1 (measuring screens).

Select **No** via the ▼ ▲ buttons to retain the settings as they existed prior to the loss of power supply voltage.

Choose **Yes** by pressing the ENTER button to restore the default settings.

```
      Attention!

 Parameter incorrect
        reset?

   No            Yes
(arrow)       (Enter)
```

Note

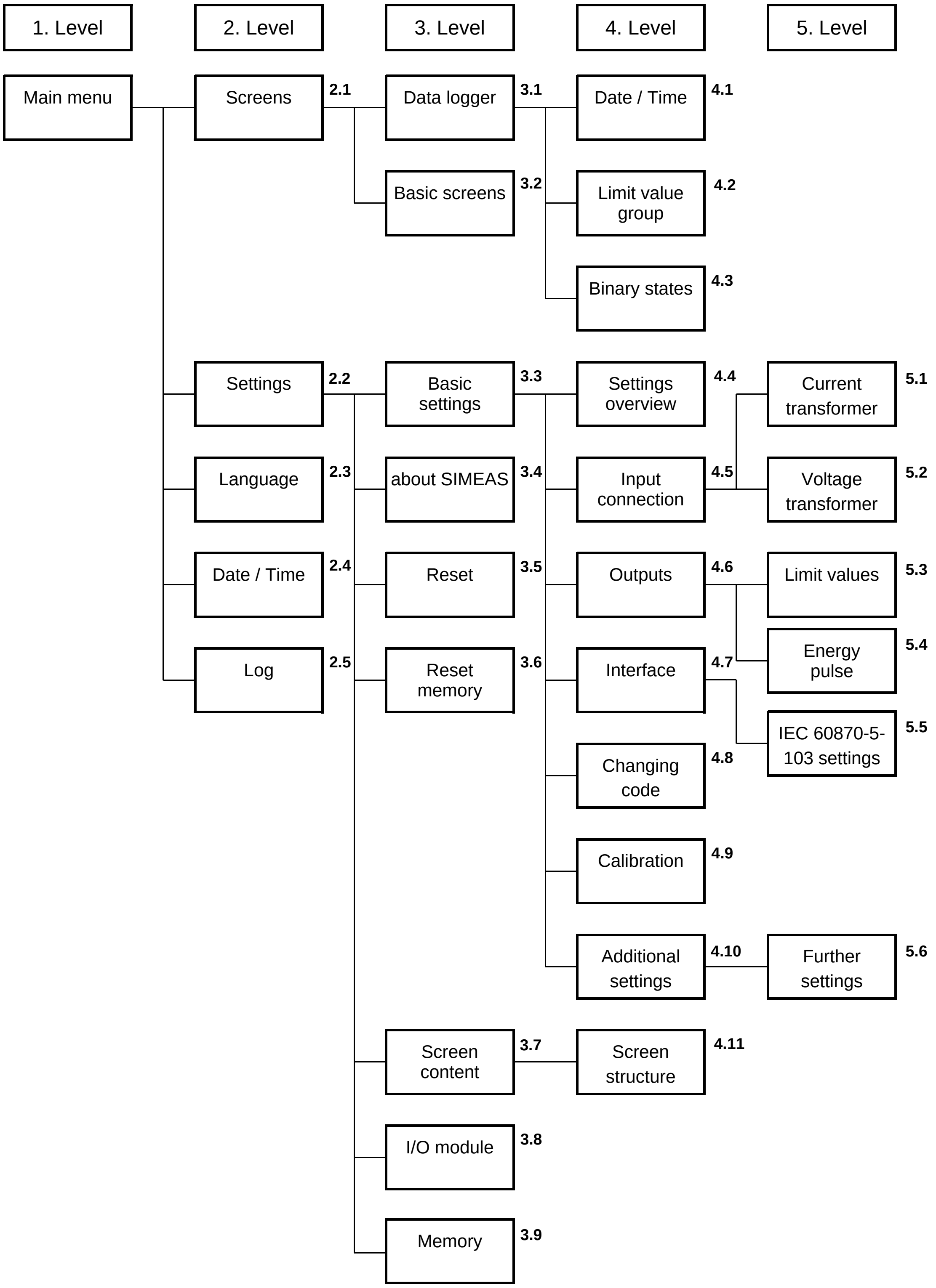
This means, that you should always leave the parameter screens completely (OK or Cancel) until the measurement screens are displayed again. This ensures that all parameters will be accepted by the device.

Note

Please check the parameters and the adjustment data afterwards, to ensure the correct function of the SIMEAS P.

If you have adjusted the device manually (refer to chapter 6), the adjustment data will not be overwritten by default settings.

4.2 Overview of the Levels



4.3 Main Menu

The main menu is used to access various submenus.

```
>screens
>settings
>language
>date/ time
>log


<close
```

4.3.1 Screens

Use the ENTER key to switch between the displays

- Main menu
- Measured value screens
- Data logger

4.3.2 Settings

The setup masks for device parameterization can be selected from the Parameters menu.

```
>basic settings
>about SIMEAS
>reset
>reset memory
>screen content
>I/O module
>memory
<close
```

4.3.3 Language

Language

Here you can select the language of the SIMEAS P.

- D = German
- GB = English

Designation

Change of the conductor designations in the screens:

- a, b, c
- L1, L2, L3

```
*language:   GB
*description:a,b,c




<ok
<cancel
```

4.3.4 Date / Time

SIMEAS P requires time information for the following functions:

- Oscilloscope
- Log entries
- Measured value memory

```
*date:  01.02.2001
*time:  10:17:57  am
*12/24h:   12

CEST: 00.00 to 00.00
binary input:BE2
<ok
<cancel
```

One binary input (optional) may be used for time synchronization via minute impulse.

The data for summer/winter time and the binary input can only be set via the PC software SIMEAS P parameterization (refer to chapter 5).

4.3.5 Log

The screen **Log** displays date and time of the most recent status changes.

```
failure          dd.mm.yy
                 hh:mm:ss
power on            .   .
                    :   :
settings            .   .
                    :   :
reset limit         .   .
                    :   :
reset average       .   .
                    :   :
reset power         .   .
                    :   :
reset osc.          .   .
                    :   :
set clock           .   .
                    :   :
reset binary        .   .
                    :   :
```

▼ ▲

4.4 Basic Settings

Here you can make the most important settings directly on the device.

```
>settings overview
>input connections
>output contacts
>interface
>change code
>calibration
>additional settings
<ok
```

4.4.1 Settings Overview

Settings Overview is where the most important settings associated with the device are displayed.

```
calc. mode:standard
 4 wire unbalanced
current range:   1.2A
voltage range:   480V
rel 1: limit value1
rel 2: limit value2
bus adr.:111
<cancel
```

4.4.2 Connection / Transformer

Input connection

As shown in chapter 1.5.4, the connection mode can be selected here.

- Single-phase AC
- Three-phase, four-wire, balanced
- Three-phase, four-wire, unbalanced
- Three-phase, three-wire, balanced
- Three-phase, three-wire, unbalanced (2 x I)
- Three-phase, three-wire, unbalanced (3 x I)

Three-wire, unbalanced can be selected either with the connection of two current transformers (standard / Aron measuring circuit) or three current transformers.

```
input connection
*three-wire
 unbalanced (3*I)
>current transformer
>voltage transformer

<ok
<cancel
```

4.4.2.1 Current Transformer

- **Yes**: Current transformers utilized (max. primary: AC 999999 A, secondary: AC 6 A)
- **No**: Current transformers not utilized

```
*current transf.: No
           A/       A
*measuring range 1.2A



<ok
<cancel
```

Measuring range

The secondary input current measuring range is selected for the SIMEAS P as follows:

- **1.2 A**: nominal input AC 1 A
- **6 A**: nominal input AC 5 A

Caution

- You must make these settings for a direct connection or for a connection with current transformers.
- The selected measuring range must be greater than the secondary rating of the current transformer!
- The accuracy of SIMEAS P (see table 3-3) is based on the selected measuring range.
- The determination of this range indicates the maximum current value that can be displayed on the device.

Note

When you change the current transformer settings, the power calculation in the device has to be reset.

Example

CT rating: 500 / 1 A

Measuring range 1.2 A:	Maximum display range:	AC 0 A to 600 A
Measuring range 6 A:	Maximum display range:	AC 0 A to 3000 A

4.4.2.2 Voltage Transformer

- Yes: Voltage transformers are utilized (max. primary: AC 1000 kV, secondary: AC 600 V)
- No: Voltage transformers are not utilized

```
*voltage transf.:No
          kV/         V
*meas. range L-L 480V



<ok
<cancel
```

Measuring range

- **132 V** nominal input AC 100/110 V
- **228 V** nominal input AC 190 V
- **480 V** nominal input AC 400 V
- **828 V** nominal input AC 690 V

Selectable measuring range L-L	Equivalent to measuring range L-N
AC 0 V to 132 V	AC 0 V to 76.2 V
AC 0 V to 228 V	AC 0 V to 132 V
AC 0 V to 480 V	AC 0 V to 276 V
AC 0 V to 828 V	AC 0 V to 480 V

Up to U_{LN} = 480 V, the SIMEAS P can be connected directly without a transformer. In three- and four-phase networks, **except for three-phase networks without neutral** (see the respective notes), the SIMEAS P can also be connected directly without a transformer up to U_{LL} = 690 V.

Caution

- You must make these settings for a direct connection or for a connection with current transformers.
- The selected measuring range must be greater than the secondary rating of the voltage transformer!
- The accuracy of SIMEAS P is based on the selected measuring range.
- The determination of this range indicates the maximum voltage value that can be displayed on the device.
- "The frequency measurement of the SIMEAS P is initiated only when the measured voltage is > 30 % of the maximum voltage of the measuring range.
- Measurements in three-phase networks without neutral in V-connection (1:1 transformer) are possible **up to** a nominal voltage of U_{LL} = 400 V. With this nominal voltage, the measuring range U_{LL} = 690 V **must** be parameterized.
- For measurements in three-phase networks without neutral in V-connection and a nominal voltage of U_{LL} = 690 V, the voltage must be transformed to $U_{LL} \leq$ 400 V. The measuring range to be parameterized is then also U_{LL} = 690 V.
- In IT networks, the SIMEAS P cannot be connected directly because the voltage is measured against the PE conductor connection and the input impedance of the device causes a leakage current against earth. The leakage current can cause tripping of the leakage protective system in IT networks. Please make sure that the maximum permissible input voltage of the SIMEAS P against earth U_{L-PE} = 480 V is not exceeded (e.g., due to an earth fault of one phase). Voltage transformers **must** be used in IT networks.

4.4.3 Outputs

Here, the user can determine the function of the programmable output contacts (potential-free electronic relays). Further contacts can be assigned in devices with I/O modules of the binary output or relay output type (option).

```
*relay1: limit value1
*relay2: rotation



<ok
<cancel
```

Selection

•	Off	Contact has no function
•	SIMEAS P is on	Contact closed if power supply voltage is present.
•	Energy pulses	If selected, a new window "Energy Pulses" appears.
•	Limit value 1	If selected, a new window "Limit Value 1" appears.
•	Limit value 2	If selected, a new window "Limit Value 2" appears.
•	Limit value 3	If selected, a new window "Limit Value 3" appears.
•	Limit value 4	If selected, a new window "Limit Value 4" appears.
•	Limit value 5	If selected, a new window "Limit Value 5" appears.
•	Limit value 6	If selected, a new window "Limit Value 6" appears.
•	Limit value 7	If selected, a new window "Limit Value 7" appears.
•	Direction of rotation	This option allows you to output the rotation direction of the voltage.

- 1: Contact activated; direction of rotation for clockwise display
  (phase sequence L1-L2-L3, clockwise rotation)
- 0: Contact deactivated; direction of rotation for anti-clockwise display
  (2 phases interchanged, anti-clockwise rotation)

4.4.3.1 Screen for Energy Pulses

```
energy pulses
*energy: WpL1 d
*value: 0.0088kWh/Imp
*pulse length:200ms


<ok
<cancel
```

Energy

Selection of an energy or other metered quantity from the table 3-1 (depends on the type of the input connection).

Value

Selection of the amount of energy required to generate a pulse.

Puls length

Can be selected from 50 ms, 100 ms, 150 ms, 200 ms to 500 ms.

Note

An explanation on power metering can be found in chapter 5.7.2.

4.4.3.2 Screen for Limit Values

```
limit value
*hysteresis:     1.0%
*pulse length:     1 s
*filter time:    1.0s
>further settings

<ok
<cancel
```

The values entered for hysteresis, pulse length and filter time are valid for all logically connected measured quantities.

Hysteresis

- Input of 0.1 % to 10 % of rated value
- Percentage refers to nominal values

Puls length

- 0.5 s, 1 s, 5 s, 10 s, 30 s, 60 s, 300 s
- ∞ (triggering for as long as a limit violation applies)

Filter time

Input of 0.0 s to 9.9 s max. (minimum time during which a limit violation must occur to launch a triggering)

Note

Limit violations are recorded reliably only from a duration of $\geq$ 1 s.

Limit values

- Selection of any measured quantity from the table 3-1 (no energy or metered quantities)
- Selection as to whether triggering should be launched when the measured quantity exceeds or drops below the threshold value (< >).
- Selection of the threshold value that initiates triggering.
- Additional measured quantities can be connected logically via "AND" or „OR". A maximum of six measured quantities are possible.

Note

You can parameterize limit value groups also in „Additional Settings“ - „Counter“ (level 4, see chapter 4.2)!

4.4.4 Communication Interface

4.4.4.1 General Settings

```
*bus address:112
*baudrate:   19200Bd
*parity:     E
*protocol:   IEC 103
>IEC 103 settings

<ok
<cancel
```

Bus addres

Input address 1 to 254

Baud rate

- Selection only for connection to a PC or Modbus. The following baud rates are allowed: 300 bit/s, 600 bit/s, 1200 bit/s, 2400 bit/s, 4800 bit/s, 9600 bit/s, 19200 bit/s, 38400 bit/s, 57600 bit/s, 115200 bit/s.
- The baud rate of the Profibus is supported automatically up to 12 Mbit/s with the selection being performed via the master station.

Note

The Baud rate is selected during parameterization (using SIMEAS P Par or the display). It can be set in the range between 300 bit/s and 115200 bit/s, for the IEC 60870-5-103 protocol, however, only in the range between 9600 bit/s and 38400 bit/s.

Parity

- Only for Modbus (N = None, E = Even, O = Odd)

Protocol

- SIMEAS P ASCII Protocol: PC RS485 (for connection to a PC via programming software)
- Profibus DP (with firmware version V3 only) <u>or</u>
  IEC 60870-5-103 (with firmware version V4 only)
- Modbus RTU
- Modbus ASCII

Note

At delivery, the following communication parameters are preset:

Address:	1
Protocol:	PC-RS485
Baud rate:	9600 bit/s
Parity:	No

4.4.4.2 IEC 60870-5-103 Settings

```
*MV range:    240%
*Harmonics:   no
*Counters:    no



<ok
<cancel
```

Measuring value range (MV range)

Parameterization of the measuring value range.

Settings:

- **120 %**
- **240 %**

Transmit Harmonic

Parameterization of the transmission of harmonic values for the harmonics as per IEC 60870-5-103 protocol.

Settings:

- **yes** Transmit
- **no** No transmit

Transmit counter values

Parameterization of the transmission of metered values (for power and pulse) as per IEC 60870-5-103 protocol.

Settings:

- **yes** Transmit
- **no** No transmit

Note

The IEC 60870-5-103 parameters *MV range, Transmission of harmonic* and *Transmission of metered values* are also offered if Modbus has been selected as a protocol. The settings, however, are then ineffective.

4.4.5 Changing the Password

```
*code1: 000000
*       off
*code2: 000000
*       off


<ok
<cancel
```

4.4.5.1 Password of Code 1

off: No function

on: Active if code 2 is active

Secured functions:

Parameterization the screens

Reset

Language / Designation

4.4.5.2 Password of Code 2

off: No function (code 1 is also deactivated)

on: Code activated

Secured functions:

Basic settings

Notes

- A password always consists of a 6-digit number.
- If you have forgotten the password, the device can also be activated by using the master password. Please contact our hotline for the master password.
- Password 1 is only active if password 2 is also activated.
- If both password 1 and password 2 are activated, password 2 can be used to access all protected functions of password 1.
- If an identical password is chosen for password 1 and password 2, all functions of password 1 and password 2 can be activated by means of a single password.
- In Level 1, a lock displayed on the status bar indicates whether the status of the device is password protected (lock closed) or unprotected (lock open).
- After a password has been programmed, a time of 1 minute elapses before it is activated in level 1 (the activation can be detected when the lock closes on the status bar).

- If the protected functions are called in the menu, a window for entering the password appears.
- If a protected setting is activated by means of a password, all other settings associated with this password are activated as well. A reactivation is required after a time of 1 minute has elapsed in level 1.

4.4.6 Calibration

See chapter 6 "Calibration".

4.4.7 Additional Settings

```
>counter1-limitvalue1
>counter2-limitvalue2
>counter3-limitvalue3
>counter4-limitvalue4
>further settings

<ok
<cancel
```

Counter 1 to 4

Counters 1 to 4 can be displayed in the screens. Limit value groups can be assigned to these counters. If a counter is selected, another window is opened for defining the limit value group (see outputs).

Note

Limit value groups can also be parameterized under **Outputs** - **Limit value group** (level 4, see chapter 4.2)!

4.4.8 Further Settings

```
*calc. mode: standard
*current direction: +
*direction of power:+
*zero point:  0.3000%
Uen:       calculation
AO settings
<ok
<cancel
```

Calculation mode

- **Standard**
- **DIN**
- **Fourier**

The calculation mode for some measured quantities can be changed here. For further information, see the chapter 3.1.

Current direction

- **+** Default setting for correct connection according to standard and back panel marking
- **-** Current direction is negated (change the current direction to avoid changing the connectors)

Direction of power

- **+** positive energy flow direction = energy demand

  negative energy flow direction = energy supply
- **-** positive energy flow direction = energy supply

  negative energy flow direction = energy demand

Zero point

The zero point suppression can be changed here.

Can be selected from 0.0 % to 10.0 % of the upper limit of the measurement range (default setting: 1 %)

Note

Due to its high precision, SIMEAS P can measure voltages and currents even without measuring values connected to the device. If you do not want this behaviour in your application, you can suppress measuring below a certain threshold.

Uen

- **Measurement** (default setting)
- **Calculation**

Uen will be calculated if terminal N is grounded (standard application).

Uen has to be measured if L2 or L3 is grounded (special application).

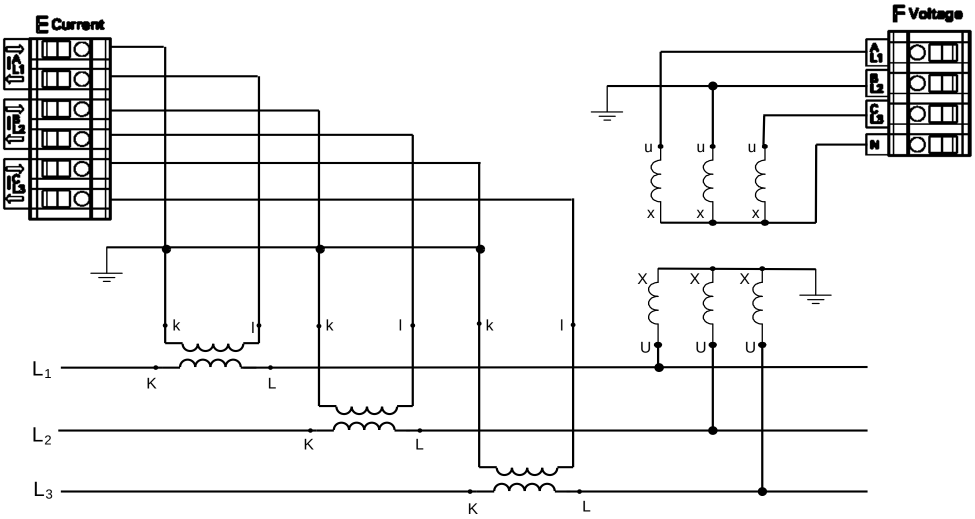


Figure 4-1 Network connection with grounded phase L2

Analog output setting (only visible in screen for devices with optional analog output module)

If the device is equipped with an optional analog output module (see table 1-2, order code D), analog outputs are configured in following screen:

```
Analog output setting
*start value:holding
*range from: -32767
*       to:    32767
*current range:0-20mA

<ok
<cancel
```

These settings allow writing the transduced measured values (range 0 mA to 20 mA) to analog outputs of analog output module via Modbus master or IE 60870-5-103 master.

Start value

- holding

  After power interruption the analog output is set to last in register saved value.

- default

  After power interruption the analog output is set to current value in register.

Range for Modbus protocol

- **from:** min. -32767
- **to:** max. 32767

Calculation:

$$\frac{AO_{fern} - from}{AO_{real} - AO_{min}} = \frac{to - from}{range_{(max - min)}}$$

Example:

from:	0
to:	1000
selected range:	4-20 mA
transmitted AO value:	500

$$\frac{500 - 0}{AO_{real} - 4} = \frac{1000 - 0}{20 - 4} = 12mA$$

Current range

- 0-20 mA
- 4-20 mA

4.5 About SIMEAS

All of the device characteristics are displayed on this window.

```
order number: 7KG7750
BF-Nr.:BF01047653
version   :03.00.06
bus-address:1
calibrated:15.09.2006
module:A

<ok
```

4.6 Reset

```
*reset device:        Y
* reset energy:       Y
* reset min-max:      Y
* reset counter:      Y


<ok
<cancel
```

- Reset of SIMEAS P
- Energy values
- Min / Mean / Max values
- Alarm counter (counter for limit violations)

4.7 Reset Memory

```
*reset power values:Y
*reset mean values: N
*reset alarm log:   Y
*reset binary log:  N
*reset oscilloscope:N

<ok
<cancel
```

The following records are deleted in the memory and restarted in the event of a reset:

- **Power values**
- **Mean values**
- **Alarm log**: states of the limit value groups
- **Binary log**: states of the binary states
- **Oscilloscope**

4.8 Parameterization Screens

```
*no. screens:     4
*repeat ratio:    0Sec
*illumination:   99Min
*contrast:        4
>screen structure

<ok
<cancel
```

The contents and display mode of the various screens are established in this window.

Number of Screens

1 to 20: The number of screens that can be selected in level 2 via the buttons ▼ ▲ .

Screen interval (repeat ratio)

0 s to 60 s

0 s: fixed screens (only selection via buttons possible)

1 s to 60 s: scrolls automatically to the next screen after 1 s to 60 s

Illumination

0 min to 99 min

0 min = Illumination off

99 min = Illumination on permanently

Contrast

0 to 9 (default setting: 4)

Screen structure

```
*screen no.:  10
*type: min-max
*1:Ua
*2:Ub
*3:Uc

<ok
<cancel
```

The contents of specific measuring screens are programmed on the "Screen Structure" window.

Screen

Selection of a specific screen among the number previously established. The contents of the screen are automatically displayed when switching from one screen to the next.

Contents

The contents of the selected screen can be established or modified here as follows:

- 3 measured values digital
- 6 measured values digital
- 3 Min - Max values
- Voltages, currents, cos ϕ, phases L1, L2, L3

If specific screen content is selected, the input fields for the corresponding characteristics are automatically displayed.

4.9 I/O Modules

```
  module  state
E analog- E =  0.0 mA
  input   E =  0.0 mA




>ok
```

This screen displays the optional I/O modules together with their current state. For devices without I/O modules the table remains empty.

4.10 Memory Management

```
memory management
*average values:20%
*power values:  20%
*oscilloscope:  20%
*limit values:  20%
*binary log:    20%
<ok
<cancel
```

You can partition the main memory of 1 MByte as required for the recording of mean values, outputs, limit violations, binary state changes and oscilloscope records.

The total of the percentages entered must reach but not exceed 100%.

Notes

- For power recording, the recording time will be calculated from the number of channels to be recorded and the period time.
- For mean values and power recording settings, you have to use the PC software SIMEAS P Parameterization (ordering number see chapter 1.2).

4.11 Data Logger

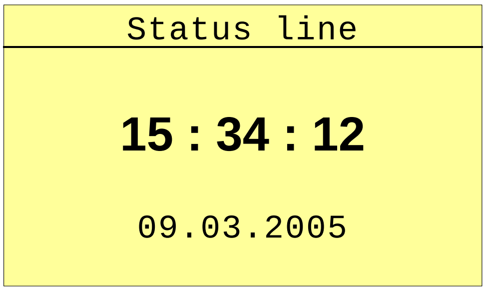
The group **Data logger** displays the following screens:

- Date and time
- Limit value group
- Binary states

To work with the group **Data logger** proceed as follows:

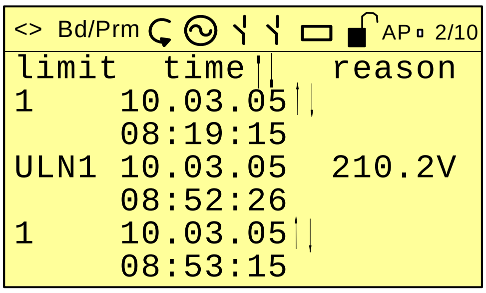
- In the **Main menu**, select **Screens** and press two times ENTER.
- Use the buttons ▼ ▲ to access the group **Data logger**.
- To leave the **Data logger**, go back to the screen **Date and Time** and press ENTER to return to the **Main menu**.

4.11.1 Data Logger Date and Time



This screen shows the current time of the SIMEAS P (to set the values refer chapter 4.3.4).

4.11.2 Data Logger Limit Violation Group



This screen displays all limit violations ordered by time. You have to read the lines from bottom to top.

Notes

- Press ENTER to activate the arrow buttons up/down to display all messages.
- Press ENTER again to deactivate this mode. This allows you to switch to the other screens via the arrow buttons up/down.
- Go back to the screen **Date and Time** and press ENTER to return to the **Main menu**.

4.11.3 Data Logger Binary States

```
     status line
binary time     state
In A-1 20.01.08  on
       10:20:10
Out1   20.01.08  on
       10:20:10
Out1   20.01.08  off
       10:21:10
```

This screen displays all changes of the binary states ordered by time. You have to read the lines from bottom to top.

Notes

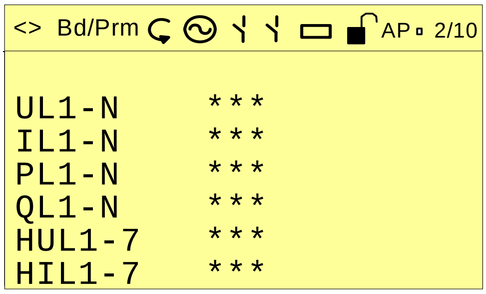
- Press ENTER to activate the arrow buttons up/down to display all messages.
- Press ENTER again to deactivate this mode. This allows you to switch to the other screens via the arrow buttons up/down.
- Go back to the screen **Date and Time** and press ENTER to return to the **Main menu**.

4.12 Overflow of Measured Values

If the measured values determined in a measurement circuit are higher than the possible values of the parameterized measuring range, a value overflow will be displayed. In addition, this value overflow is signaled via Modbus or IEC 60870-5-103 protocol.

The overflow is displayed or transmitted if the nominal AC voltage or AC current values are exceeded by 20 %.

Presentation of the measured value overflow in the display



An overflow of the measured values AC voltage and AC current, as well as the derived quantities such as active power, reactive power, harmonic, power, THD and cos ϕ is displayed by ***. The energy counting is only stopped, not reset.

Transmission of the measured value overflow using the Modbus protocol

A special Modbus register (register address 40200) has been reserved for the transmission of the measured value overflow. For detailed information, please see the *Powermeter SIMEAS P - Modbus* manual (order no. E50417-B1076-C241).

Transmission of the measured value overflow using the IEC 60870-5-103 protocol

The measured value overflow is transmitted using the IEC 60870-5-103 protocol. For detailed information, see the *Power Meter SIMEAS P 7KG7750/55 - Communication Protocol IEC 60870-5-103* manual (order no. E50417-B1000-C375).

Parameterization via PC Software 5

Content

The parameterization using a PC is described in the following chapters.

5.1	Basics	80
5.2	Overview of Parameterization	81
5.3	Date / Time Settings and Transmit	82
5.4	Dialog Window SIMEAS P	83
5.5	Basic Settings	84
5.6	Screens Setting on SIMEAS P 7KG7750	86
5.7	Input / Output Modules	89
5.8	Additionals	98
5.9	Memory Management	104
5.10	Updating the Firmware	116
5.11	Resetting Values in the Device	118
5.12	Reading the Device Memory	119
5.13	Changing the Communication Parameters	123

5.1 Basics

In order to program your SIMEAS P via the PC software SIMEAS P Parameterization you have to prepare for operation or parameterization:

Preconditions

- The device is ready to operate.
- The PC software SIMEAS P Parameterization (ordering number see chapter 1.2) is installed on your PC.
- The parameterization cable set (ordering number see chapter 1.2) or a RS485 converter is available.

Parameterization

1. Connect the device and the PC as described in the online help.
2. Set the connection parameters on the device:
   - Select the protocol "PC-RS485".
   - Select the baud rate for the connection.
3. Set the connection parameters in the PC software SIMEAS P Parameterization (**Connection** → **Setup connection**). Make sure to use the same baud rate.
4. Load the settings from the device (**Device** → **Connection configuration** → **Receive**).
5. Edit the settings in the PC software.
6. Send the new settings to the device again (**Device** → **Connection configuration** → **Send**).

Note

SIMEAS P Parameterization displays the parameters depending on the ordering number of the device.

Reading the ID from the device recognizes the device type and sets the functional scope.

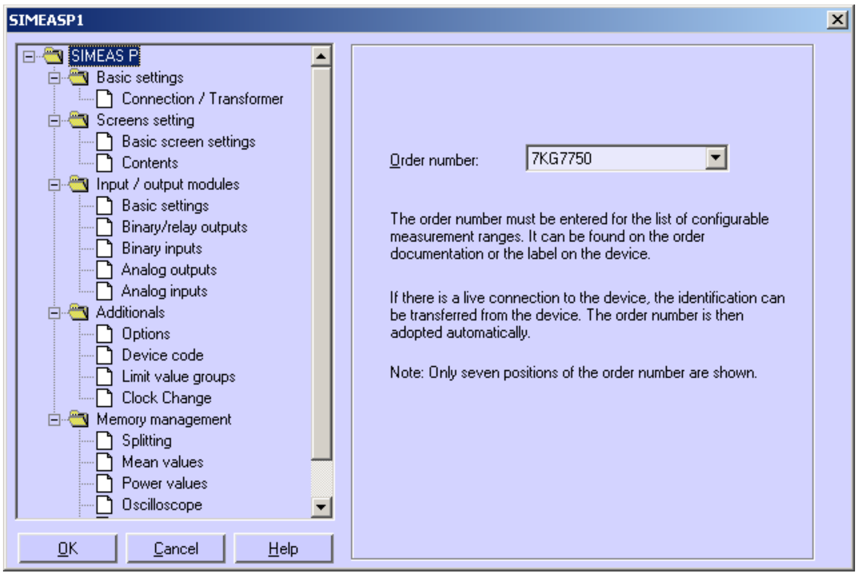
Note

All others functions of SIMEAS P Parameterization are described in the online help (key F1).

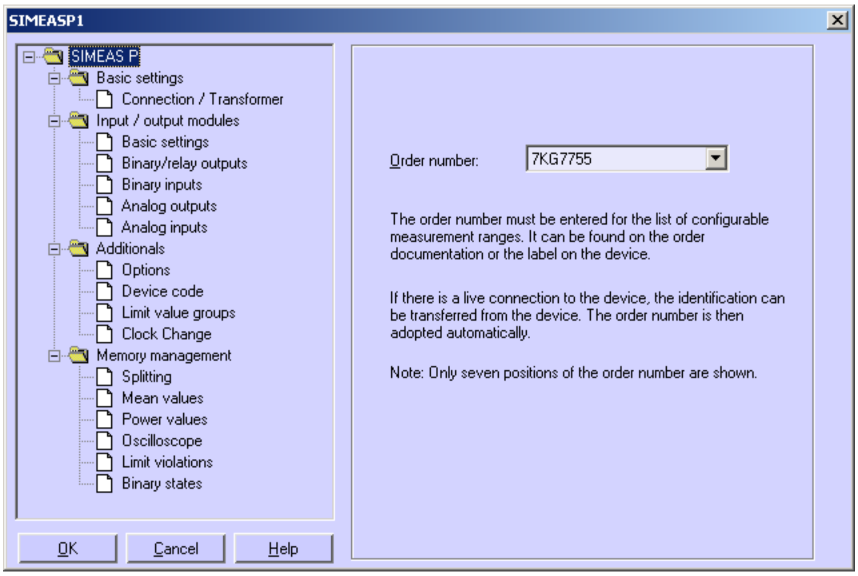
5.2 Overview of Parameterization

The following figures give an overview on all layers of the PC software SIMEAS P Parameterization depending on the device type.

5.2.1 Overview of Parameterization 7KG7750



5.2.2 Overview of Parameterization 7KG7755

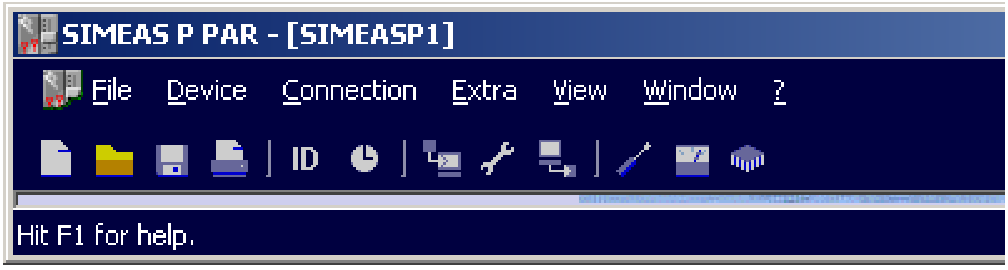


5.3 Date / Time Settings and Transmit

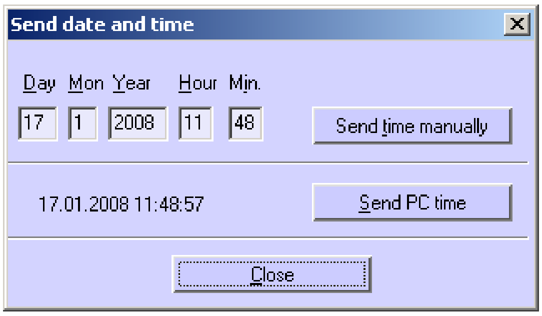
You can set the date and time of the internal clock of the SIMEAS P using the SIMEAS P Parameterization PC software. You can either accept the current PC time or define and transmit a freely selectable system time. To do this, proceed as follows:

To set the internal clock and transmit the time to a connected device, you have two options for calling up the *Send date and time* dialog window:

- Select the menu item **Device** → **Setup device clock**, or
- click the clock symbol in the toolbar.



The *Send date and time* dialog window is displayed.



Send PC time

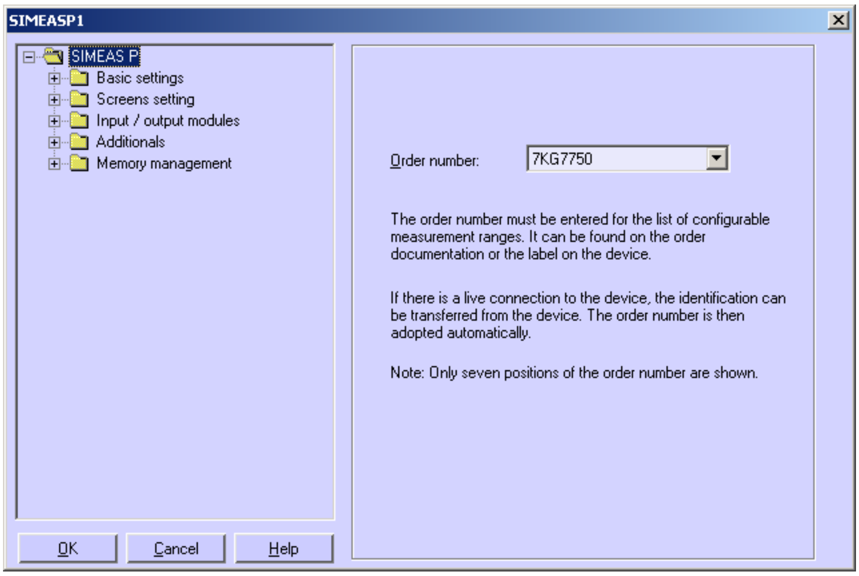
1. Click the **Send PC time** button to send the current PC time.
2. If the PC time has been transmitted correctly and accepted by the connected device, a confirmation will be displayed.
3. Click the **Close** button.

Send manual time setting

1. Change the entries in the fields **Day** to **Min** using your keyboard.
2. Then click **Send time manually**.
3. If the PC time has been transmitted correctly and accepted by the connected device, a confirmation will be displayed.
4. Click the **Close** button.

5.4 Dialog Window SIMEAS P

In this dialog window, you select the order number of the SIMEAS P device to be parameterized.

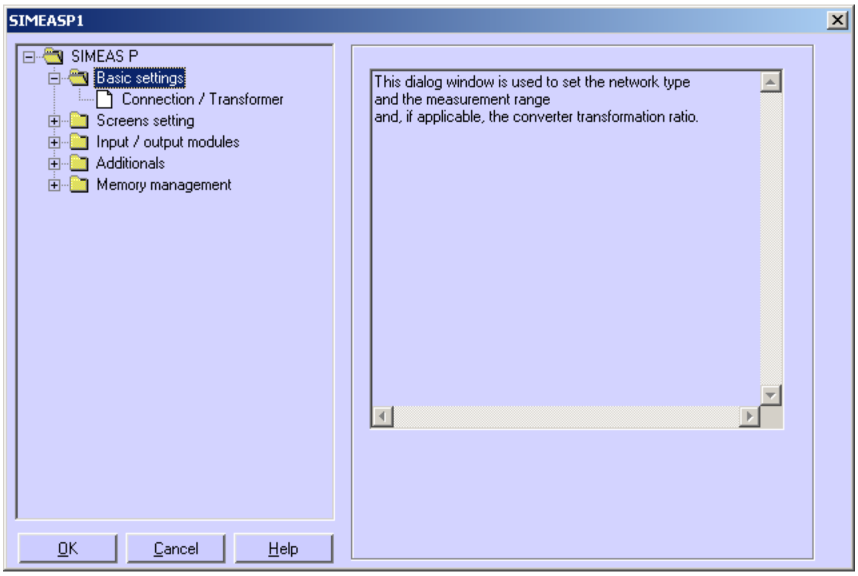


Note

SIMEAS P Parameterization displays the parameters depending on the order number of the device (see chapter 1.2). Thus, the display above may be different for your device. Reading the ID from the device recognizes the device type and sets the functional scope.

5.5 Basic Settings

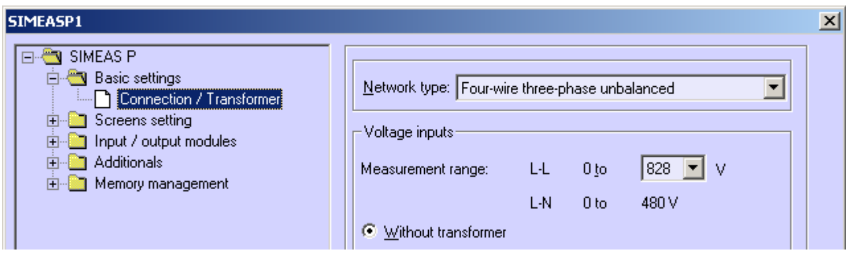
This dialog allows you to set the network type, the measuring range and the transformer ratio (optionally).



5.5.1 Connection / Transformer

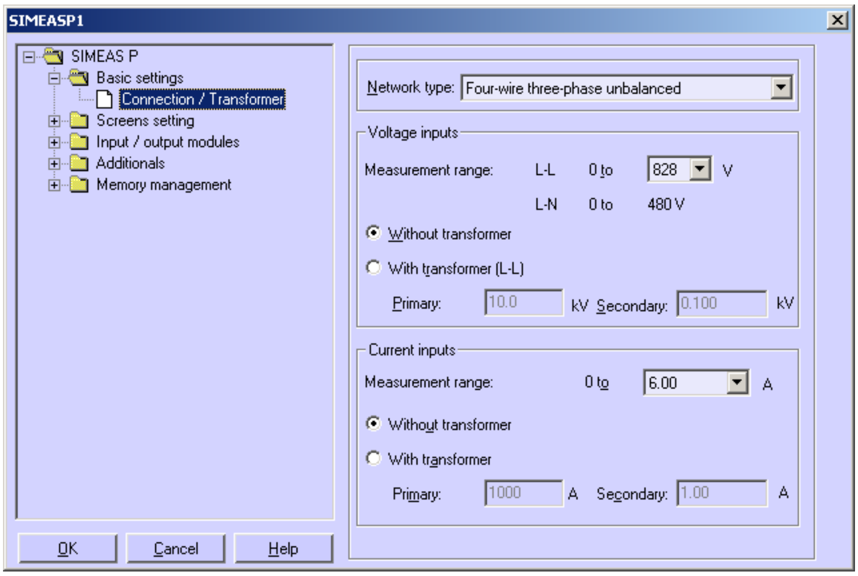
In order to adapt the SIMEAS P to the network to be measured, enter the network properties and the parameters for the current and voltage measurement inputs.

Network type



Select the relevant network type.

- Single-phase
- Three-wire three-phase balanced
- Three-wire three-phase unbalanced (2 current inputs ' Aron circuit)
- Three-wire three-phase unbalanced (3 current inputs)
- Three-phase four-wire balanced
- Three-phase four-wire, unbalanced



Voltage inputs

Measurement range

Select the maximum voltage measurement range up to which the device should display. For Single-phase or three-wire three-phase networks, both the core and the phase voltage are displayed here. The precision information for the device relates to the range selected here.

Without transformer

SIMEAS P can be operated without a voltage transformer up to a maximum of AC 690 V phase to phase.

With transformer (L-L)

If a voltage transformer is used, enter the primary and secondary data for the transformer here. The device measurement range is extrapolated internally by the factor of the transformation ratio.

Current inputs

Measurement range

Select the maximum current measurement range up to which the device should display. The precision information for the device relate to the range selected here.

Without transformer

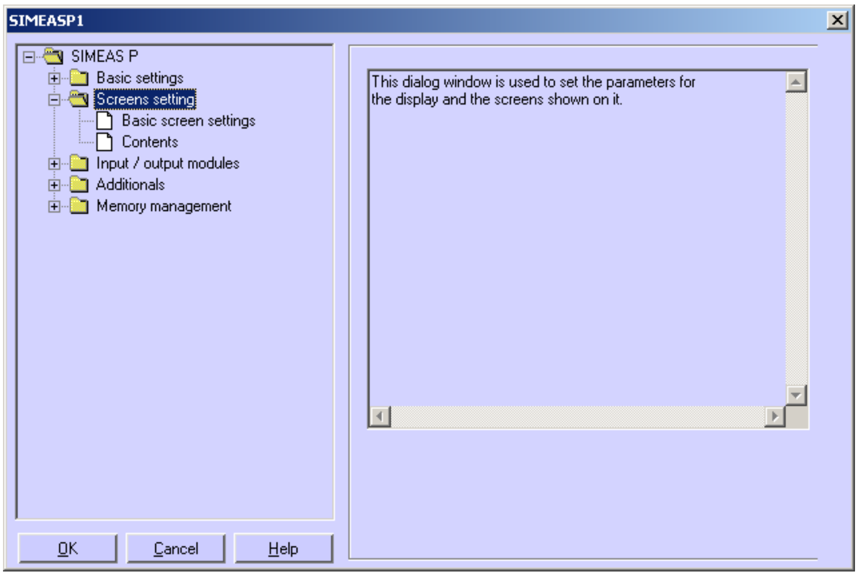
SIMEAS P can be operated without a current transformer up to a maximum of AC 6 A.

With transformer

If a current transformer is used, enter the **primary** and **secondary** data for the transformer here. The device measurement range is extrapolated internally by the factor of the transformation ratio.

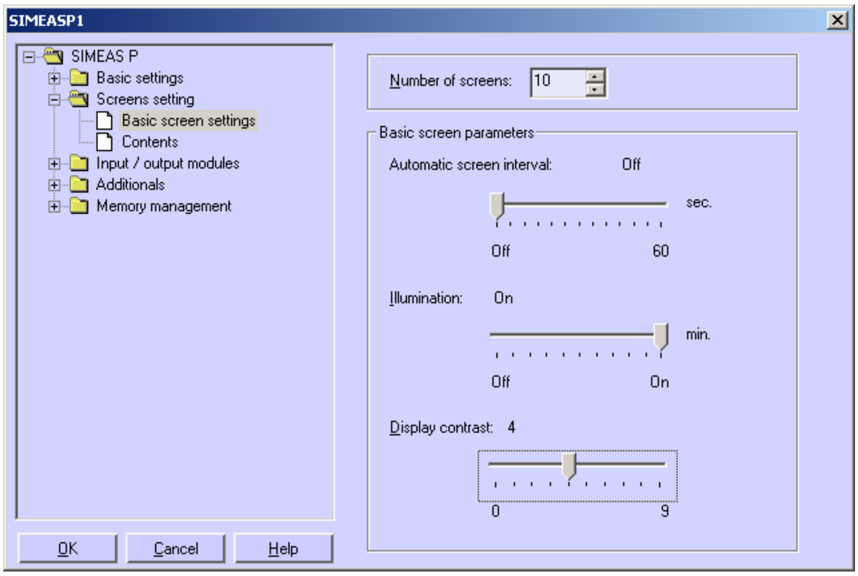
5.6 Screens Setting on SIMEAS P 7KG7750

The screens displayed in the SIMEAS P 7KG7750 (not possible with SIMEAS P 7KG7755 because no display) and their contents are defined in the following dialog windows.



5.6.1 Basic Screen Settings

Here you define fundamental properties of the display on the SIMEAS P 7KG7750.



Number of screens

Select the number of screens, which can be selected using the buttons on the front of SIMEAS P. You can enter between 1 and 20 screens.

Automatic screen interval

In SIMEAS P, you can switch between screens either manually using the buttons or automatically.

- 0 s (= **Off**): manual switching using keys
- 1 s to **60** s: automatic switching after the period set; the device then switches automatically from screen to screen on a loop.

Display illumination

You can enter the time the backlighting remains on in minutes here.

- 0 min (= **Off**): no backlighting
- 1 min to 98 min: after a button is pressed on the device, the back lighting remains on for the time set.
- 99 min (= **On**): permanent backlighting

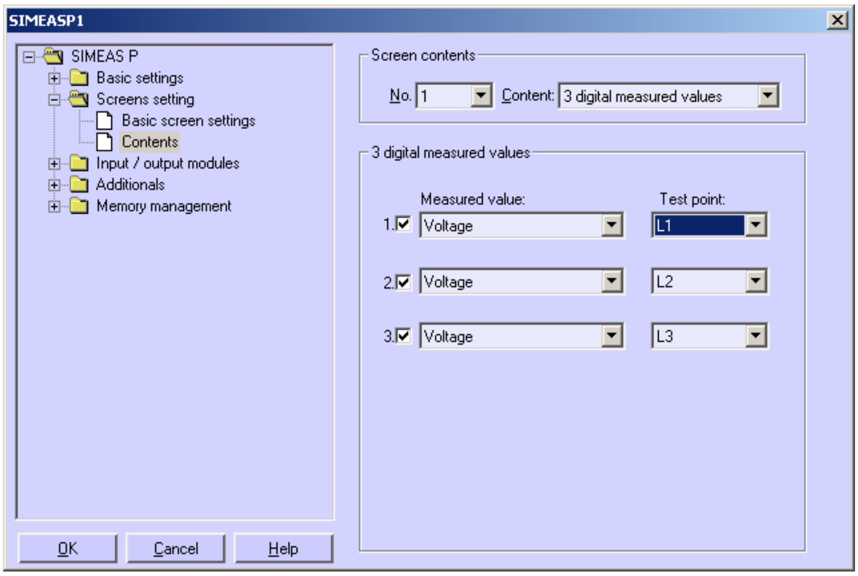
Display contrast

Here, you can adjust the contrast of the SIMEAS P display. The default value is 4.

- Input options: 0 to 9

5.6.2 Contents

Here you define the contents displayed in the individual screens.



To do this, select in field **Screen contents** the screen **No.** of the screen you wish to configure and assign it a screen type in the **Content** field. Screen types are predefined display formats for your measured values on the SIMEAS P display.

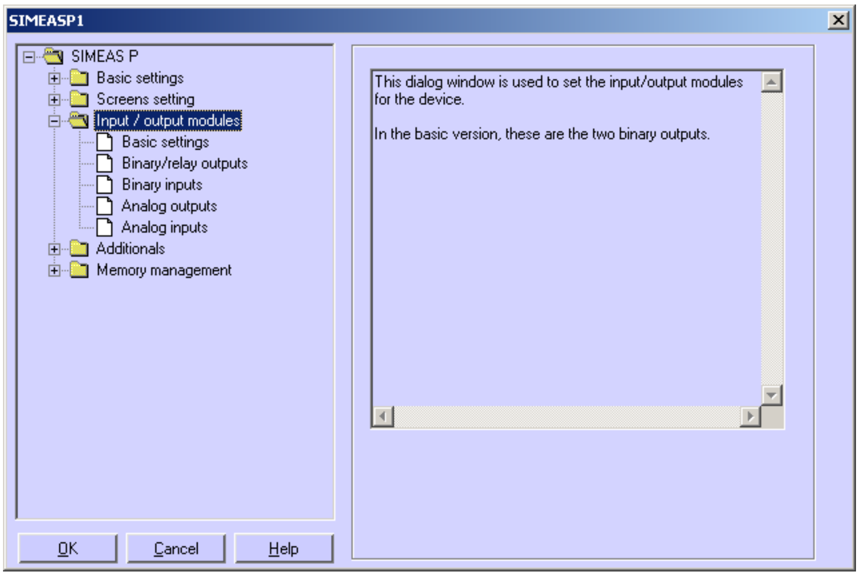
You can choose between the screen types:

- **3 Measured values digital**
- **6 Measured values digital**
- **Min-Max values**
- **U, I, cos** ϕ

For each screen type, further selection options are displayed.

- If you select **3 digital measured values**, **6 digital measured values** or **Min - Max - values**, the options are the measured values to be displayed and the measurement point.
- If you select **U, I, cos phi** no further settings are require in the basic version.

5.7 Input / Output Modules

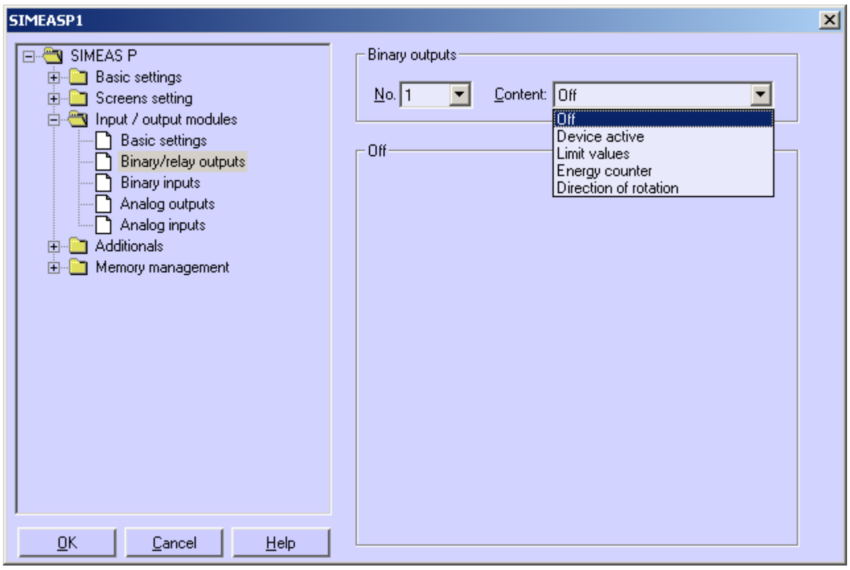


Two binary outputs are available in the device versions without I/O modules. As an option, the device has been equipped with an I/O module that is parameterized in the following dialog windows:

- *Basic settings* (see chapter 5.7.3)
- *Binary / relay outputs* (see chapter 5.7.1)
- *Binary inputs* (see chapter 5.7.6)
- *Analog outputs* (see chapter 5.7.4)
- *Analog inputs* (see chapter 5.7.5)

5.7.1 Binary / Relay Outputs

The SIMEAS P has two binary outputs. The devices are optionally equipped with a module with 3 additional relay outputs or a module with two binary outputs each.



In order to define the function of the two binary/relay outputs, select the binary output to be parameterized in field **Binary outputs** → **No.** In the **Contents** field, you can assign this binary output a function. You can select from the following options:

- **Off:** binary output with no function
- **Device active**: The SIMEAS P active function allows you to monitor whether the device is switched on (contact closed). If there is no contact, the device is switched off or broken.
- **Limit values**: Here, you can output the limit value group signals via the binary outputs. The pulse length indicates how long the binary contact is closed by means of a signal from a limit value group.
- **Energy counter**: If you assign this function to a binary output, the consumption or supply of the selected work is output as a pulse. Select a measured value and the related measurement point. Set a limit value (energy increase per pulse) for which a pulse should be triggered. The parameterizable range (minimum and maximum value) can be found by entering the max. consumer power in the field **Help**. The pulse duration can be selected in increments of 50 ms between 50 ms and 500 ms in the **Pulse** field .

  You will find a description of the energy pulse measurement in chapter 5.7.2.
- **Direction of rotation**: output the rotation direction of the voltage
  - 1: Contact activated: Direction of rotation for clockwise display (phase sequence A-B-C, clockwise rotation)
  - 0: Contact deactivated: Direction of rotation for anti-clockwise display (2 phases interchanged, anti-clockwise rotation)

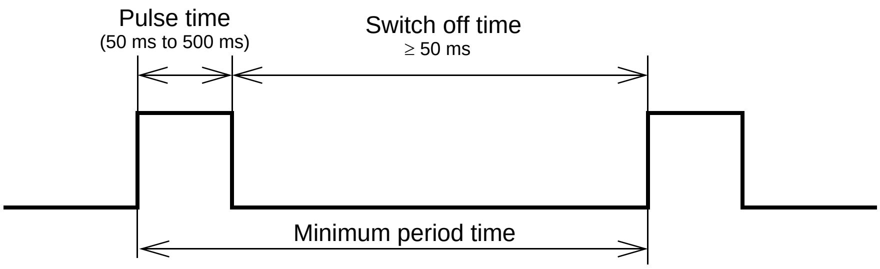
5.7.2 Information on Energy Pulse Measurement

The binary outputs of the SIMEAS P may be used to generate impulses for energy measurement: You can parameterize a specific amount of energy. When this threshold is reached, a defined pulse will be applied to the output. For energy pulse measurement, you have to adjust several settings at the device and in the parameterization software.

5.7.2.1 Parameterization via Device

Refer to chapter 4.4.3.

5.7.2.2 Pulse Time, Switch Off Time, Number of Pulses



- Pulse time (**Pulse**): Defines the "high" time of the signal at the binary output; possible values: 50 ms to 500 ms.
- Switch off time: Time during which the signal at the output of the binary contact is "low". The switch off time depends on the power measured.
- Minimum switch off time: The minimum switch off time must not be smaller than 50 ms to reach a defined switch off time.
- Number of pulses: The minimum pulse length and the minimum switch off time define the following maximum number of impulses per hour:

Pulse time (ms)	**Minimum switch off time (ms)**	**Minimum period time (ms)**	**Max. number of pulses / h**
50	≥ 50	100	36000
100	≥ 50	150	24000
150	≥ 50	200	18000
200	≥ 50	250	14400
250	≥ 50	300	12000
300	≥ 50	350	10286
350	≥ 50	400	9000
400	≥ 50	450	8000
450	≥ 50	500	7200
500	≥ 50	550	6545

5.7.2.3 Parameterization of Energy Pulses

If you want to use the binary outputs for energy measurement, you have to calculate the smallest possible input (kWh/pulse) first. Please use the following description:

1. Select the pulse length (e.g. 200 ms). Refer to the table in chapter 5.7.2.2 for the maximum number of pulses/h: 14400
2. Calculation of the maximum load to be connected:

   Single-phase circuit: Maximum load to be connected =

   (Voltage measuring range Ph-N x Transformation ratio of the voltage transformer) x (Current measuring range x Transformation ratio of the current transformer)

   e.g.: $U_{Ph\text{-}N, max}$ = 276 V, T_U = 1; I_{max} = 1.2 A, T_I = 1
   $P_{max} = U_{Ph\text{-}N, max} \times I_{max}$ = 331.2 W

   Three-phase or four-phase circuit: Maximum load to be connected = (Voltage measuring range Ph-N x Transformation ratio of the voltage transformer) x (Current measuring range x Transformation ratio of the current transformer) x 3

   e.g.: $U_{Ph\text{-}N, max}$ = 276 V, T_U = 1; I_{max} = 1.2 A, T_I = 1
   $P_{max} = (U_{Ph\text{-}N, max} \times I_{max}) \times 3$ = 993.6 W
3. Calculation of the minimum energy increase per pulse

   Depending on the pulse length and the maximum number of pulses/h the following calculation applies:

   Singl-phase circuit:

   $P_{max/W}$ / 14400 puls/h = 331.2 W / 14400 puls/h =

   0.023 Wh/puls = 0.000023 kWh/puls

   Three-phase or four-phase circuit:

   $P_{max/W}$ / 14400 puls/h = 993.6 W / 14400 puls/h =

   0.069 Wh/puls = 0.000069 kWh/puls

   For the example, the smallest energy increase is as follows:

   Singl-phase circuit: 0.000023 kWh/puls

   Three-phase or four-phase circuit: 0.000069 kWh/puls

   If you use a setting higher than these values the increase of energy will be registered correctly.

Note

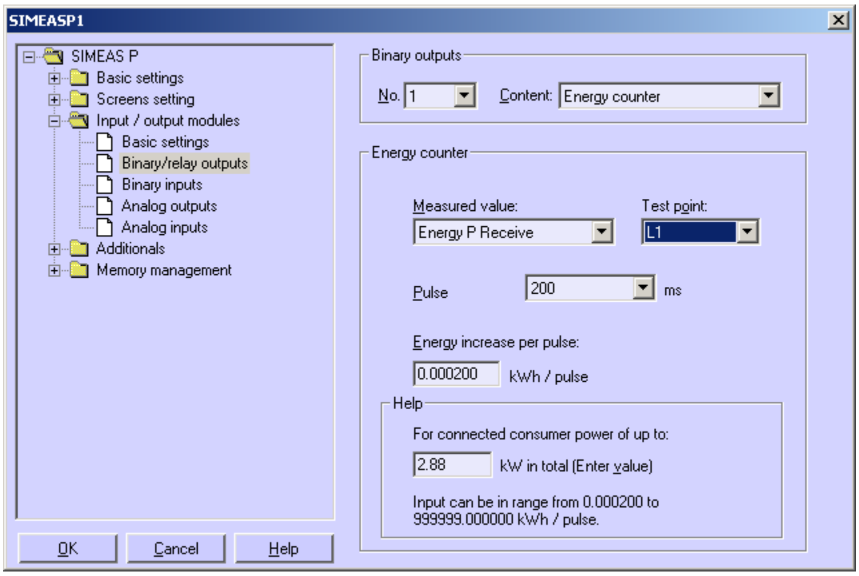
The smallest possible input values only apply if the connected load is close to the threshold of the measuring range of the device. If the connected load is smaller, the calculated values may also be smaller.

Note

A transformation ratio >1 has to be used in the calculation described above and in the parameterization of the device.

5.7.2.4 Parameterization of Energy Pulses via Parameterization Software

To parameterize energy impulses via parameterization software (refer also to chapter 5.7.1), proceed as follows:



1. Select the **Measured value** to be counted.
2. 2.Select the **Test point** for the energy measurement.
3. Select the **Pulse** length for the signal.

Note

Smallest pulse length = 50 ms.

4. Calculate the smallest energy increase per pulse. Use the description in chapter 5.7.2.3 to calculate the minimum value.

   You can use the **Help** field in the dialog window for the calculation. For this purpose, enter the connected consumer power in the **kW in total** field. Then switch over to another field of this dialog window to update the display. The smallest possible power increase per pulse for the connected consumer power you have entered is displayed in the **Help** field under **Input can be in range**.

Note

When you open the dialog for the first time, default values will be displayed. These values are derived from the connection type (single-phase, three-phase or four-phase circuit), the voltage and current range and the transformer ratios

The default values are only valid when you open the dialog for the first time!

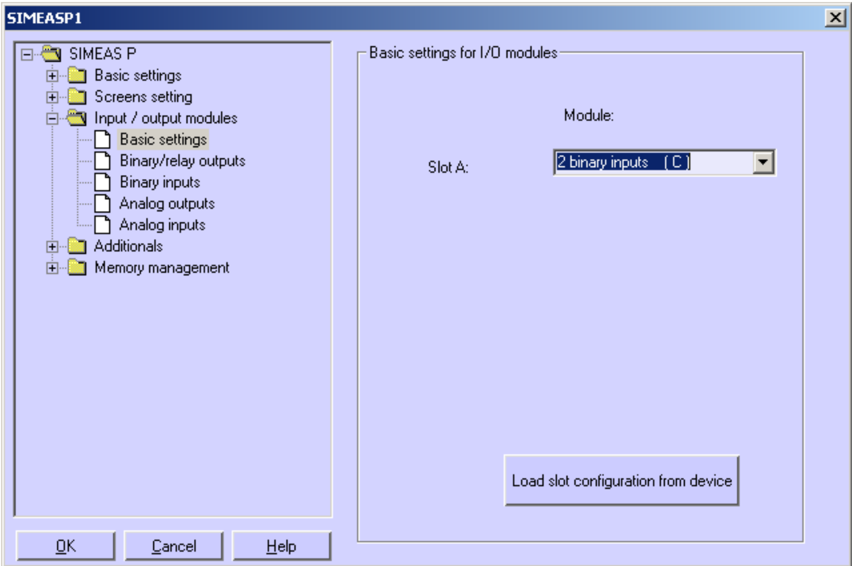
5. For the value entered in the field **Energy increase per pulse**, a pulse will be applied to the selected output each time when the given value will be reached

Note

To ensure proper energy registration, this value must not be lower than the value calculated in step 4.

5.7.3 Basic Settings

This dialog allows you to specify the I/O module (optionally) of your SIMEAS P.



There are two possibilities:

SIMEAS P is connected with PC (online)

1. Click the button **Load slot configuration** from device. The information will be loaded from the device and displayed on the screen.
2. Parameterize the I/O modules.
3. Send the new configuration to the device.

Note

This procedure ensures that the I/O modules displayed on the screen correspond to those in the device.

A parameter set is prepared for a later transmission to a SIMEAS P (offline).

1. Define slot A for the corresponding I/O module.

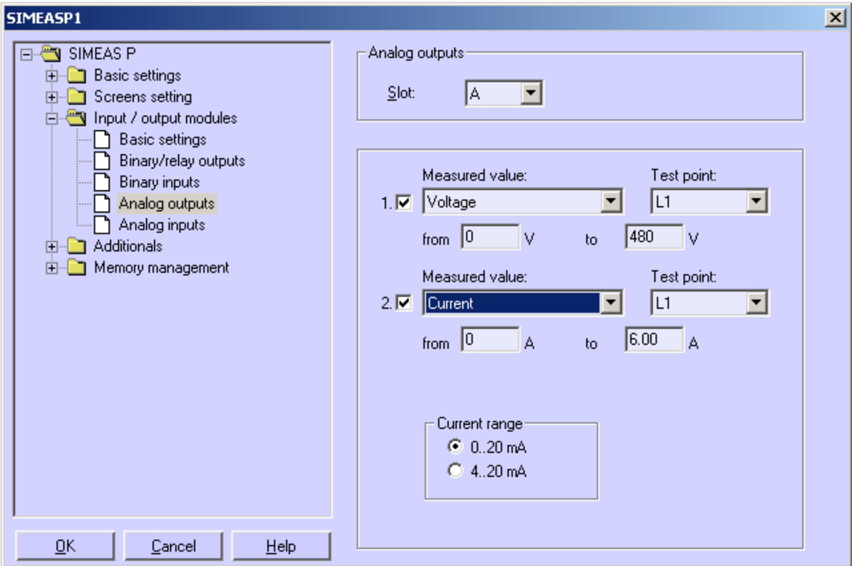
Note

These settings must correspond to the I/O modules in the device (refer to the ordering number, see chapter 1.2)!

2. Parameterize the I/O modules.
3. Send the new configuration to the device, as soon as the connection to the device has been established.

5.7.4 Analog Outputs (optional)

The analog outputs (optional) allow you to output internal measurement values as analog values in the range of 0 mA to 20 mA. This feature represents a measuring transducer.



Proceed as follows:

1. Please select **Slot A** to configure analog outputs.
2. Activate/Deactivate one or both analog outputs by ticking the corresponding check box under **1.** and/or **2.**
3. For each analog output used, choose the **Measured value** together with the **Test point** and set the signal range in the fields **from** and **to**.
4. Select the current range of the I/O module: **0..20 mA** or **4..20 mA**.

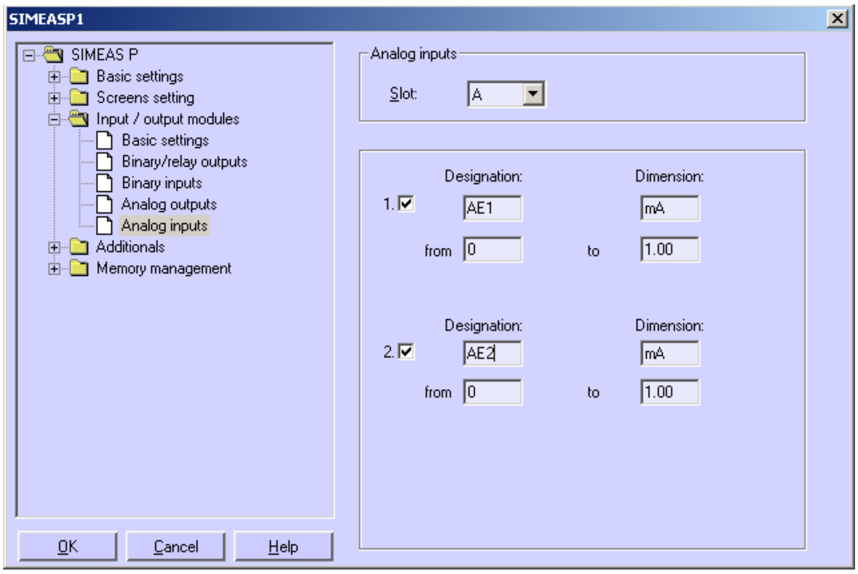
Note

The output of analog values can be controlled via Modbus, IEC 60870-5-103 or Profibus protocol. Select the output mode first in screen **further setting** (see chapter 4.4.8) in **AO settings** and choose **holding** or **default** mode in screen **Analog output settings**.

Deactivate the channel which will be controlled by communication protocol in dialog **Analog outputs**.

5.7.5 Analog Inputs (optional)

The analog inputs (optional) allow you to measure analog signals in the range of 0 mA to 20 mA.



Proceed as follows:

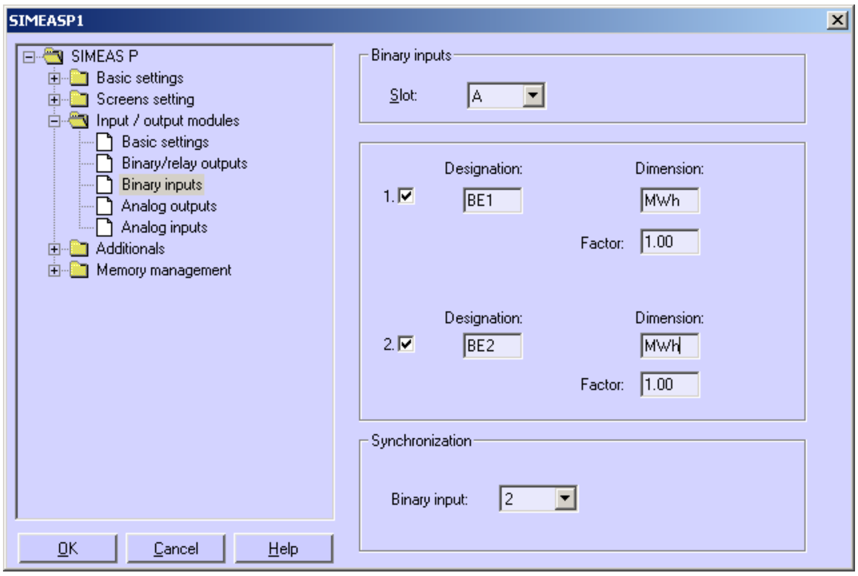
1. Activate/Deactivate one or both analog inputs by ticking the corresponding check box under **1.** and/or **2.**
2. For each input used, set the **Designation** together with the **Dimension** (max. 6 characters).
3. You define the range of values of the signal in the fields **from** and **to**.
4. The device display will be parameterized via screen contents, the supervision of limit values concerning the analog inputs via limit value groups.

Note

It is possible to save the values (together with the time information) recorded via analog inputs to the memory for mean values (see chapter 5.9.2).

5.7.6 Binary Inputs (optional)

The binary inputs (optional) can be used for static messages and impulse inputs.



Proceed as follows:

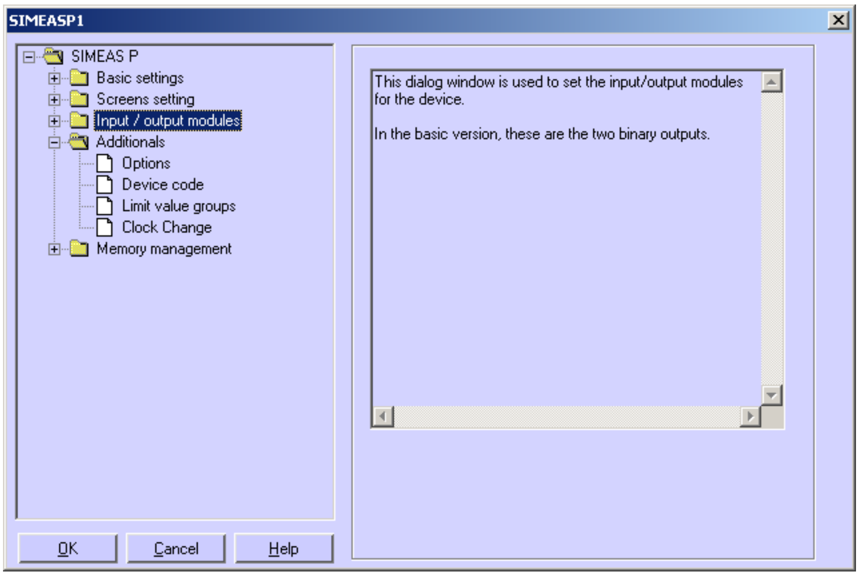
1. Activate/Deactivate one or both binary inputs by ticking the corresponding check box under **1.** and/or **2.**
2. For each input used, set the **Designation** together with the **Dimension**.
3. If you want to use the input as an external counter, you have to define the **Factor** e.g. as Energy increase per pulse (refer to chapter 5.7.2).
4. If you want to use the binary input to display binary information (0/1), 0 must be entered as a **factor**.
5. Choose the binary input to be used for time **Synchronization** via minute impulses. The device will display the designation, not the number of the **Binary input**.

Note

The designation of the binary input is displayed instead of the binary input number!

6. Analog to measured values, binary inputs may be displayed on measurement screens (see chapter 5.6.2).

5.8 Additionals



All other settings in SIMEAS P are made in the following windows.

Options

- **Regional settings**, such as device language and measured value descriptor
- Type of **power calculation**
- **Direction of current**
- **Power direction**
- **Counter assignment** of digital counter in screens
- **Zero point suppression**

Device code

Setting device codes to secure the device settings against unauthorized changes.

Limit value groups

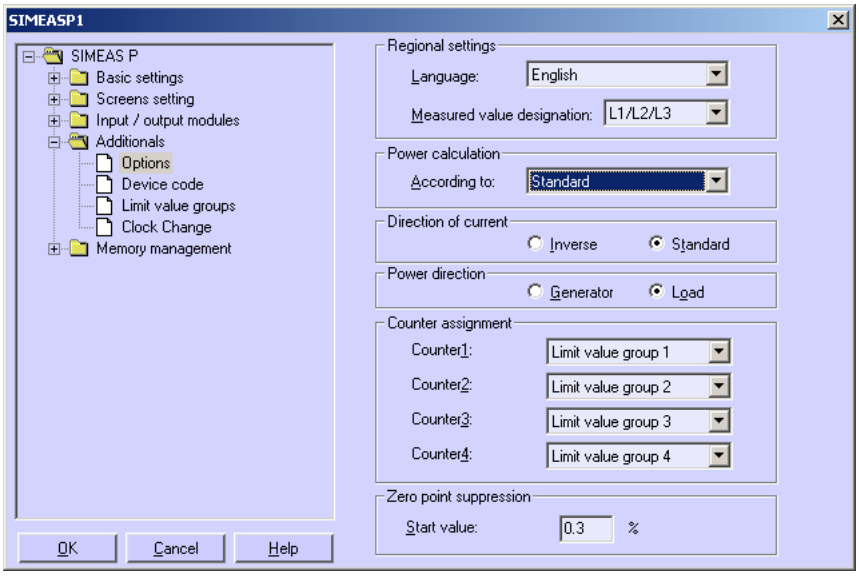
The 7 limit value groups for the device can be set here.

Clock Change

Here you can set the data for daylight saving time switchover.

5.8.1 Options

You can set more parameters for the SIMEAS P under Options.



Regional settings

- **Language**: Here, you can select what language the device display is in when you parameterize it using the device buttons.
- **Measured value designation:** The description of the conductor on device L1/L3/L3 or A/B/C can be selected here.

Power calculation

Here, you can select the type of power calculation and the calculation for current and voltage. The basic setting is standard. Settings options:

- **Standard:** All measured values are true RMS, taking all harmonics into consideration. Calculation of reactive power using methods used by traditional measuring devices. (electrodynamics power measurement)
- **DIN**: All measured values are true RMS, taking all harmonics into consideration. Customized from standard: reactive power calculation, apparent power calculation, cos ϕ and power factor, taking into consideration the new definition of apparent power in: DIN 40110-2.
- **Fourier**: All measured values calculated from the fundamental wave. Harmonics are not considered.

Direction of current

- **Standard:** Default setting for correct connection according to standard and back panel marking
- **Inverse**: Current direction is negated (change the current direction to avoid changing the connectors).

Power direction

This parameter allows you to set the operating mode of the SIMEAS P:

- **Load** (industry mode, standard)

  this means: Power positive = Energy demand

  Power negative = Energy supply

- **Generator** (Power generation mode)

  this means: Power negative = Energy demand

  Power positive = Energy supply

Counter assignment

Internal **counters 1 to 4** can be displayed in the digital measured value screens of the SIMEAS P. You can assign the four internal counters to the max. 6 **limit values groups** here.

Zero point suppression

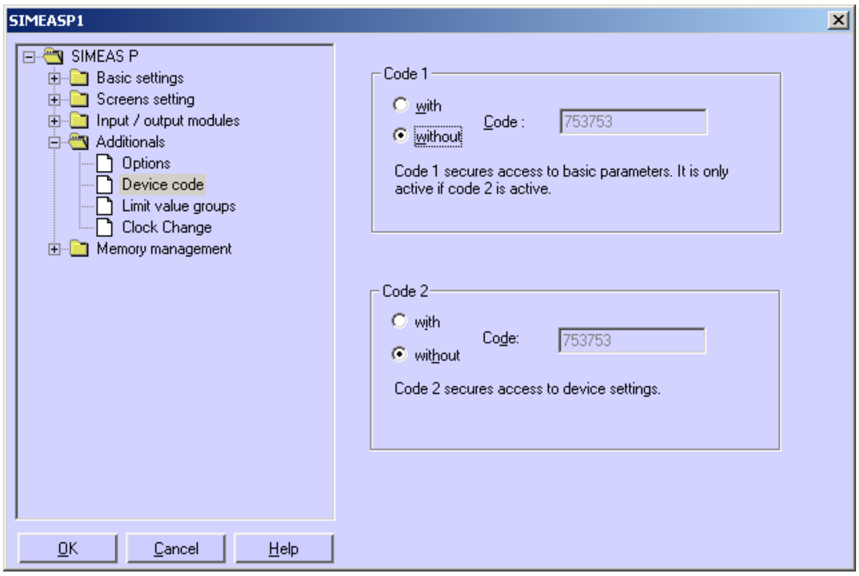
The zero suppression enables the definition of the **measuring range start** in % of the measuring range end. Can be selected from 0.0 % to 10.0 % of the upper limit of the measurement range (default setting: 1.000 %).

Note

Due to its high precision, SIMEAS P can measure voltages and currents even without measuring values connected to the device. If you do not want this behaviour in your application, you can suppress measuring below a certain threshold.

5.8.2 Device Code

Setting the device code secures the SIMEAS P against unauthorized changes.



When the code is activated, you are prompted to enter the password when you call up the parameterization menu from the buttons on the device. The relevant menu is only enabled if you enter the correct password.

Note

The software does not require a password.

Code 1

- **without**: no security
- **with**: device code 1 is only active if code 2 is activated as well.

  Functions secured: screen parameterization, reset energy min / max values and changing device language.

Code 2

- **without**: no security (code 1 also deactivated)
- **with**: code is activated

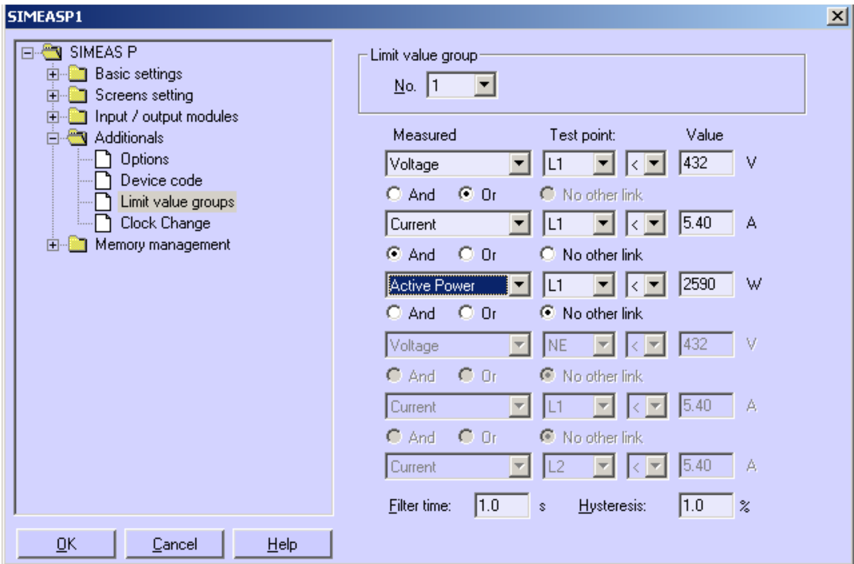
  Saved functions: basic parameters (connection / transformers, outputs, interface, change code, adjustment, other settings)

Notes:

- A password always consists of a 6-digit number.
- If you forget your password, you can activate the machine either using a master password (available from the hotline, see Foreword) or using the SIMEAS P parameterization software.
- Device code 1 is only active if code 2 is activated as well.
- If code 1 and 2 are activated, the code 2 password can also be used to unlock all the functions secured using code 1.
- If the secured parameter settings are called up in SIMEAS P, a window appears asking you to enter a password.
- If a secured parameter is unlocked by entering a password on the device, a new password prompt appears after a wait of 1 minute in level 1.

5.8.3 Limit Value Groups

In SIMEAS P, you can parameterize up to 7 limit value groups. For limit value group 7, only voltages are allowed.



Every **limit value group** provides the option to monitor whether the **measurements** exceed (**>**) or fall short of (**<**) a measured value that is entered. In each of the seven limit value groups, up to six measured quantities (no power quantities) can be **ANDed** or **ORed**.

The limit value groups set can be allocated either to binary outputs or to the internal counters. The oscilloscope can be triggered using a limit value group 1 to 6.

- Filter time: Time for which a threshold breach must remain in order to trigger an alarm. Input from 0.0 s to 9.9 s.

Note

To make sure that limit violations will be registered, enter a filter time ≥ 1 s.

- Hysteresis: Entry from 0.1 % to max. 10 %. The value relates to the nominal values for the individual measured values.

Note

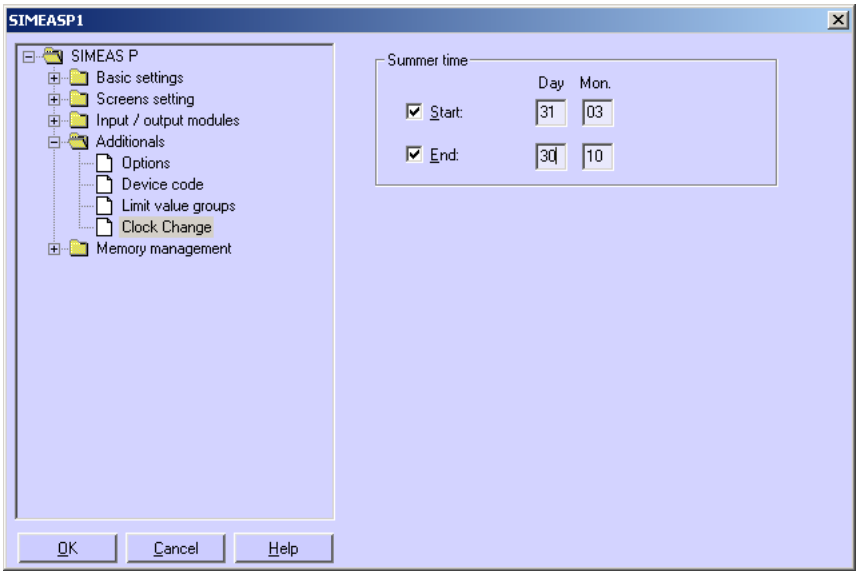
If the device provides additional analog inputs (optional), you can use external measurement signals for limit-value monitoring.

Note

Limit value group 7 allows you to monitor the measured voltages in real time and logs the measured value that caused a limit violation.

5.8.4 Clock Change

Select the date (day/month) when daylight saving time will start and end.

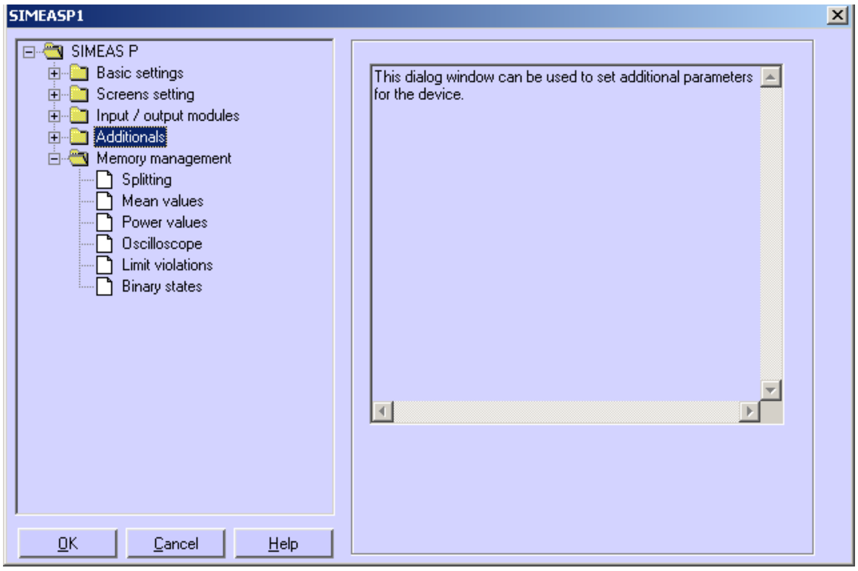


You do not have to indicate the hour since SIMEAS P considers the fact that the time change (**Day** / **Mon**.) will always take place at 2 a.m.

If you have not entered a date for start and end of the daylight saving time, the corresponding field remains grayed and SIMEAS P assumes that no time change will take place in the device. The time change will only be carried out if the corresponding date field is activated.

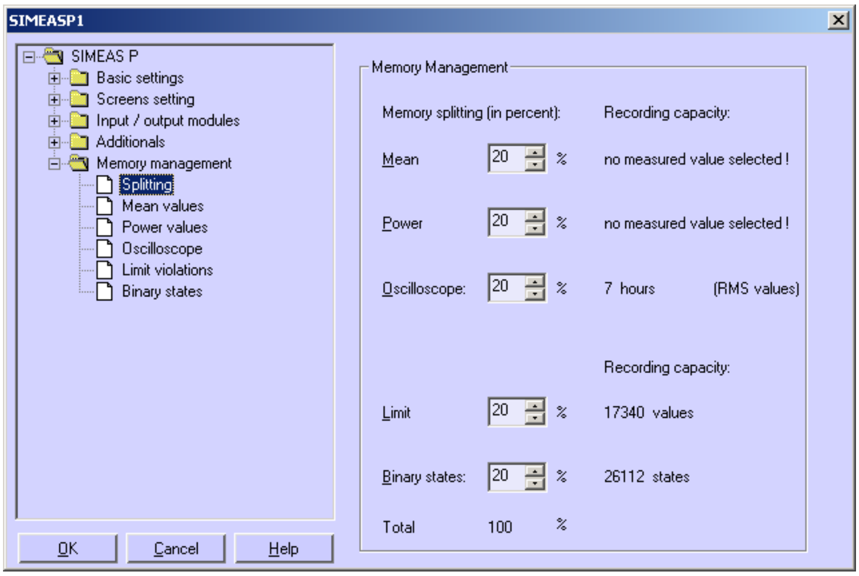
5.9 Memory Management

In the following dialog windows, you can customize the memory of SIMEAS P according to your requirements.



5.9.1 Splitting

In this dialog window you can determine how the available memory capacity will be allocated to the available functions.



Note

The indicated percentages must be in the range between 1 and 96 percent and total 100 %. Once you have entered a percent value, SIMEAS PAR displays to its right the recording time and the number of values that will be stored for this setting. The oldest values will be overwritten if you have selected Ring buffer = Yes for the recording or if overwriting is enabled by default. If you have selected Ring buffer = No, the recording will be terminated when the capacity of the associated memory area is exhausted. See the next chapters for details.

Note

The device has a memory capacity of 1 MByte (= 1048576 Bytes). The default setting ex works is 20 % of the total memory capacity for each of the five memory areas. With this memory partition, the theoretical memory capacity is 200 KBytes (exactly: 209715 Bytes) per memory area.

The recording capacities will be calculated according to the following formulas:

Note

For technical reasons (e.g., capacity for header data), the recording capacity for the individual measured values displayed in the dialog window is slightly smaller than the capacity in the examples.

Mean values

$$\boxed{t_{MAX}[h] = \frac{AllocatedMemory[Byte] * Periodtime}{((n*12)+4)Byte*3600}}$$

n: Number of channels (max. 8)

Period time: 5 s, 10 s, 15 s, 30 s, 60 s, 600 s, 900 s, 1800 s or 3600 s

Calculation example with 20 % memory size, n = 8 channels and period time = 10 s

$$t_{MAX}\,(h) = \frac{209715 \text{ Byte} * 10}{((8 * 12) + 4) \text{ Byte} * 3600} = 5.8 \text{ h}$$

Power values

$$\boxed{t_{MAX}[d] = \frac{AllocatedM\ emory[Byte] * Periodtime}{((n*4)+6)Byte*1440}}$$

n: Number of channels (max. 8)

Period time: 15 min, 30 min or 60 min

Calculation example with 20 % memory size, n = 8 channels and period time = 15 min

$$t_{MAX}\,(d) = \frac{209715 \text{ Byte} * 15}{((8 * 4) + 6) \text{ Byte} * 1440} = 60 \text{ d}$$

Oscilloscope: Instantaneous values

$$\boxed{t_{MAX}[s] = \frac{AllocatedMemory[Byte]}{64 * 16 Byte * 50}}$$

Calculation example with 20 % memory size

$$t_{MAX}\ (s) = \frac{209715\ \text{Byte}}{64 * 16\ \text{Byte} * 50} = 4{,}1\ \text{s}$$

Oscilloscop: RMS values

$$\boxed{t_{MAX}[h] = \frac{AllocatedMemory[Byte]}{8 Byte * 3600}}$$

Calculation example with 20 % memory size

$$t_{MAX}\ (h) = \frac{209715\ \text{Byte}}{8\ \text{Byte} * 3600} = 7\ \text{h}$$

Limit violations

$$\boxed{Values = \frac{AllocatedMemory[Byte]}{12 Byte}}$$

Calculation example with 20 % memory size

$$\text{Values} = \frac{209715\ \text{Byte}}{12\ \text{Byte}} = 17476$$

Binary states

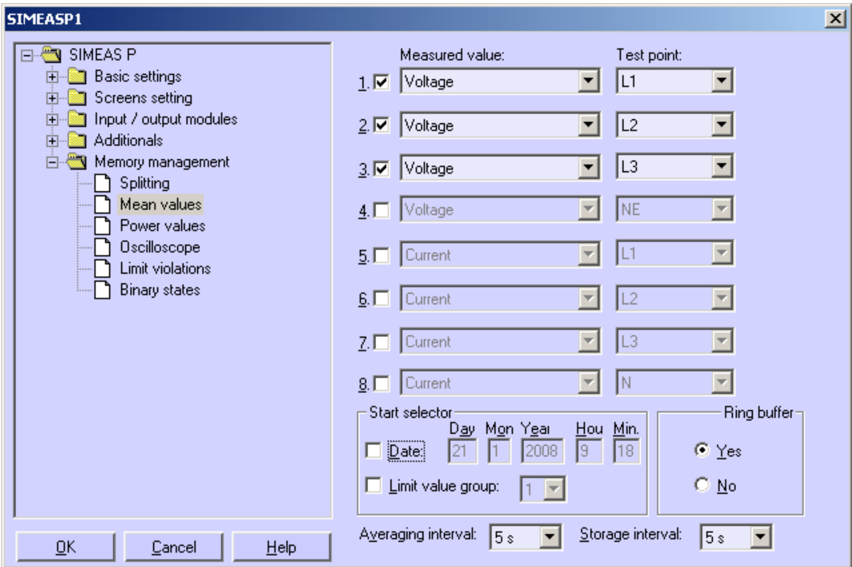
$$Values = \frac{AllocatedMemory[Byte]}{8Byte}$$

<u>Calculation example</u> with 20 % memory size

$$\text{Values} = \frac{209715 \text{ Byte}}{8 \text{ Byte}} = 26214$$

5.9.2 Mean Values

In this dialog window you can specify the settings for mean value recording.



Proceed as follows:

1. Select up to eight **Measured values** and **Test points**.
2. Select a **Date** or one of the six **Limit value group**s as **Start selector** for the average value recording. It is possible to combine Date and Limit value group as start selectors. The first of the two criteria fulfilled, will launch the recording.
3. When entering a date as **Start selector**, you must indicate a year between 2000 and 2060.
4. The **Ring buffer** mode allows you to select, if the oldest values will be overwritten (= **Yes**) or not (= **No**) when the capacity of the associated memory area is exhausted.

5. Also, you must indicate the **Averaging interval** (5 s, 10 s, 15 s, 30 s, 1 min, 5 min, 10 min, 15 min, 30 min, 60 min) and the **Storage interval** (5 s, 10 s, 15 s, 30 s, 1 min, 5 min, 10 min, 15 min, 30 min, 60 min). These parameters set the number of measured values to be used for mean value calculation and the interval for saving the values.

Note

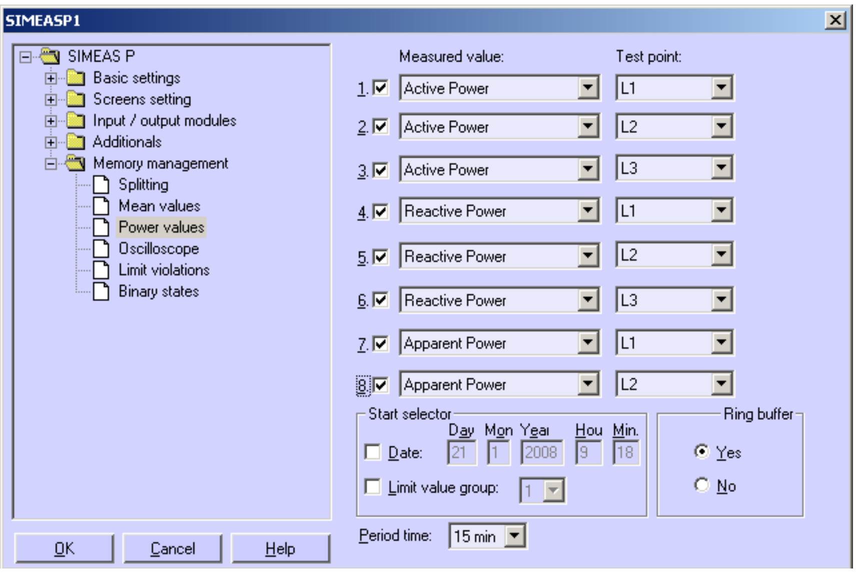
If you have entered a past start date, SIMEAS P will initiate mean value recording immediately after the setting. Manual start is not activated by configuration but can be initiated at any time.

Note

If the device provides additional analog inputs (optional), you can record external measurement signals.

5.9.3 Power Values

In this dialog window you can specify the settings for power recording.



Proceed as follows:

1. Select up to eight **Measured values** and **Test points**.
2. Select a **Date** or one of the six **Limit value groups** as **Start selector** for the power recording. It is possible to combine Date and Limit value group as start selectors. The first of the two criteria fulfilled, will launch the recording.
3. When entering a date as **Start selector**, you must indicate a year between 2000 and 2060.

Note

If you have entered a past start date, SIMEAS P will initiate mean value recording immediately after the setting. Manual start is not activated by configuration but can be initiated at any time.

4. The **Ring buffer** mode allows you to select, if the oldest values will be overwritten (= **Yes**) or not (= **No**) when the capacity of the associated memory area is exhausted.
5. Also, you must indicate the **Period time** (15 min, 30 min, 60 min).

5.9.4 Oscilloscope

- The **oscilloscope** is parameterized using SIMEAS P Par.
- Three measured quantities are always recorded.
- Normally, 30 % of the recording is allocated to pre-triggering history.
- Only one recording is possible. When initiating a new recording, the previous one is deleted.
- When triggering the oscilloscope via limit violation, the recording can also be executed in the background.
- Only the first of several limit violations that trigger a recording is recorded. Further violations are ignored.

Note

The memory range can be set by the user.

5.9.4.1 Characteristics of „Instantaneous Values“ Recording

Record length can be parameterized. The recording time to be saved in the allocated memory (see chapter 5.9.1) is calculated according to the following formula:

$$t_{MAX}[s] = \frac{AllocatedMemory[Byte]}{64*16Byte*50}$$

Sampling rate

The sampling rate is adjusted such that there are 64 samples per cycle. Therefore, the sampling rate is as follows for 50 Hz and 60 Hz respectively:

- at 50 Hz = 3.20 kHz
- at 60 Hz = 3.84 kHz

Trigger via Limit Violation

The RMS value of each half wave is calculated and tested for Max/Min violations. If a violation is detected, recording is triggered immediately. The bandwidth and filter time settings are irrelevant here.

Note

The recording type "Instantaneous value" allows to record the measurement values "current" and "voltage" only.

5.9.4.2 Characteristics of "RMS Value" Recording

- Any three measured quantities can be selected from the Table 3-1 with the exception of energy values and counters.

Recording time

Recording time can be parameterized. The recording time to be saved in the allocated memory (see chapter 5.9.1) is calculated according to the following formula:

$$t_{MAX}[h] = \frac{AllocatedMemory[Byte]}{8Byte * 3600}$$

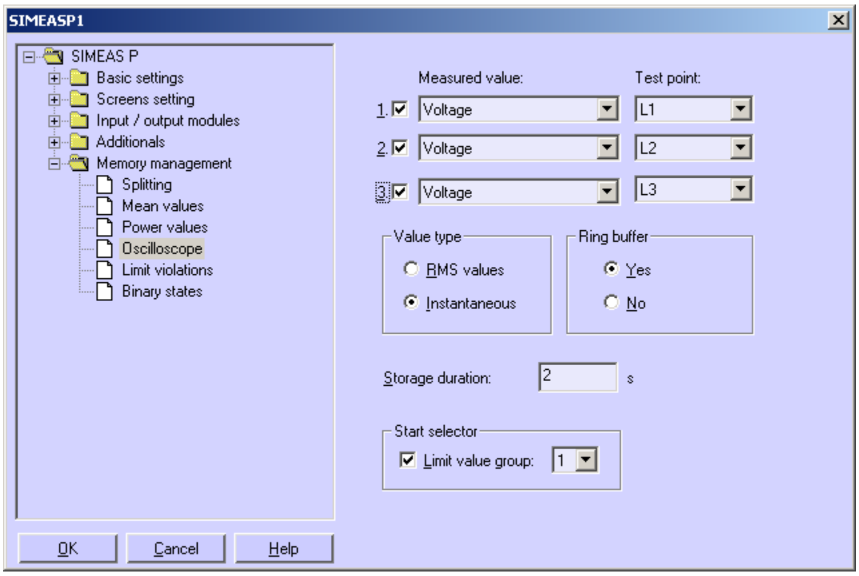
- One sample of a measured quantity is saved each second.
- Pre-trigger history is always 30 % of the selected recording time.

Note

- Since 30 % of the recording time is always allocated to pre-trigger history, the time for recording the pre-trigger history must expire before a new recording can be triggered.
- The recording type "RMS Value" does not allow to record analog inputs (optional).

5.9.5 Parameterization Oscilloscope

The oscilloscope can be set via this dialog window.



Proceed as follows:

1. Select up to three **measured quantities**: An oscilloscope recording is started via the selected **limit value group** (groups 1 to 6 are allowed).
2. Also, you must determine whether to record **Instantaneous** values or **RMS values**.

Note

When changing the value type (instantaneous or RMS), the present selection will be reset since the two types of measured values have different value ranges.

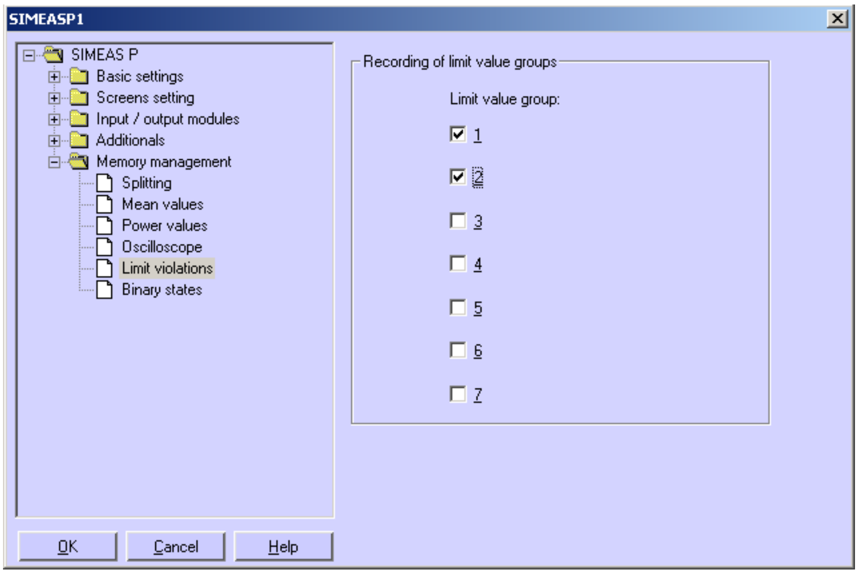
3. The **Ring buffer** mode allows you to select, if the oldest values will be overwritten (= **Yes**) or not (= **No**) when the capacity of the associated memory area is exhausted.
4. Indicate the **Storage duration** in seconds.

Note

In the submenu **Memory management** → **Splitting** you can see what storage time corresponds to the indicated percentage for oscilloscope.

5.9.6 Limit Violation

In this dialog window you can specify the limit value groups to be recorded.



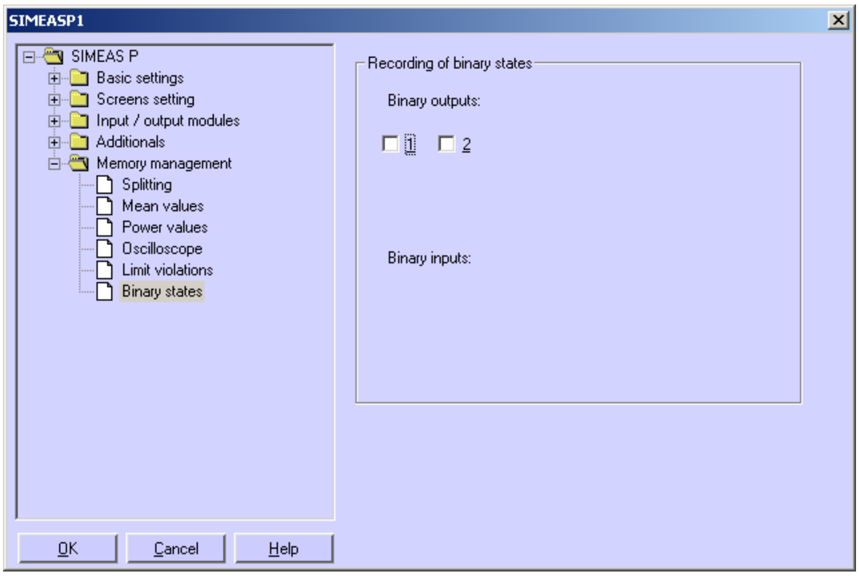
Select up to six **Limit value groups**. A violation of the specified limits will be recorded in the memory.

Note

If the memory capacity for the recording of limit violations is exhausted, data within this area will be overwritten.

5.9.7 Binary States

In this dialog window you can specify the settings for recording of binary states.

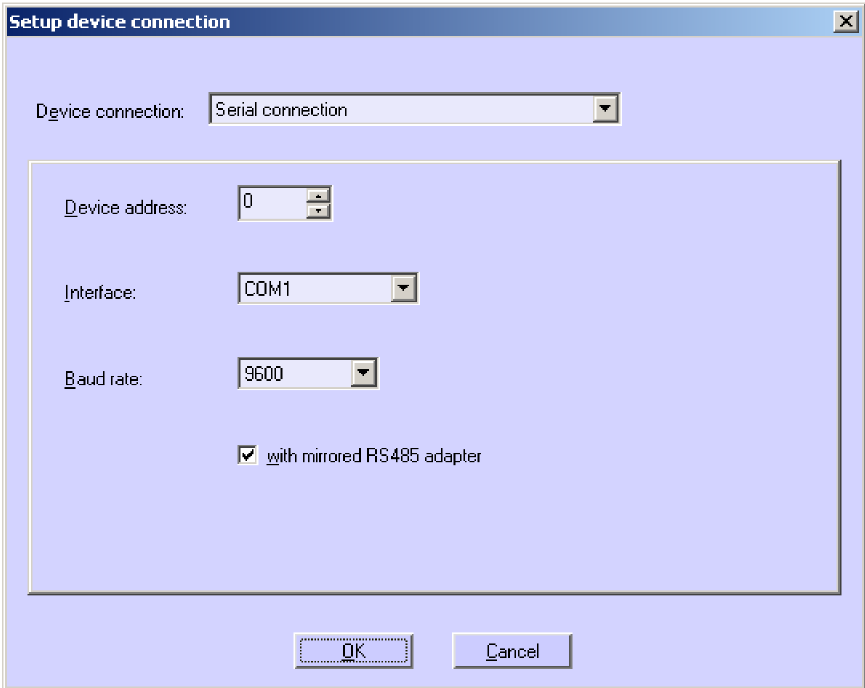


Select the **Binary outputs** to be recorded. The states of the binary outputs will then be recorded in the memory.

5.10 Updating the Firmware

Proceed as follows to update the firmware:

1. Establish a connection to the device. From the menu bar, select **Connection** → **Setup connection** and set the following parameters in the **Setup device connection** dialog:



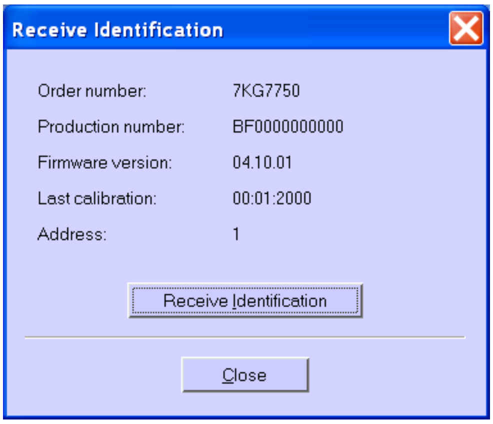
- **Device connection**: Serial connection
- **Device address**: address 0 is valid for all devices
- **Interface**: e.g. COM1
- **Baud rate**: 9600 Baud at delivery
- **depends on adapter type RS485**

Note

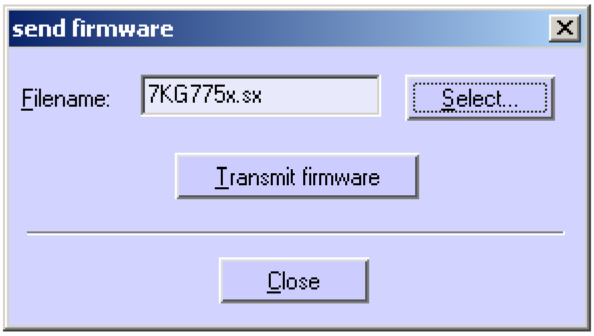
Make sure to set the same parameter values in SIMEAS P Parameterization and in the device. In the device, the serial interface must be set to "PC-RS 485".

2. Confirm by clicking **OK**.

3. Query the device identification once to check the connection. To do this, click the **ID** symbol in the toolbar.



4. Click the **Receive Identification** button to retrieve data from the device. If the configuration is correct, all lines are filled with device data. **Close** the dialog window.
5. From the menu bar, select **Device** → **Send new firmware**.
6. In the *Send firmware* dialog, enter the path to the firmware (file 7KG*.SX)



7. Click the button **Transmit firmware**. The transfer may take some minutes. Check the ID again (symbol **ID**, see item 3). The new firmware version will be displayed.

Note

A check sum allows to relate each firmware version to device types and hardware versions. This ensures that no incompatible hardware and software version are updated. In this case, the transfer will be terminated with the message "Timeout while waiting for reply from device". The original firmware in the device remains unchanged.

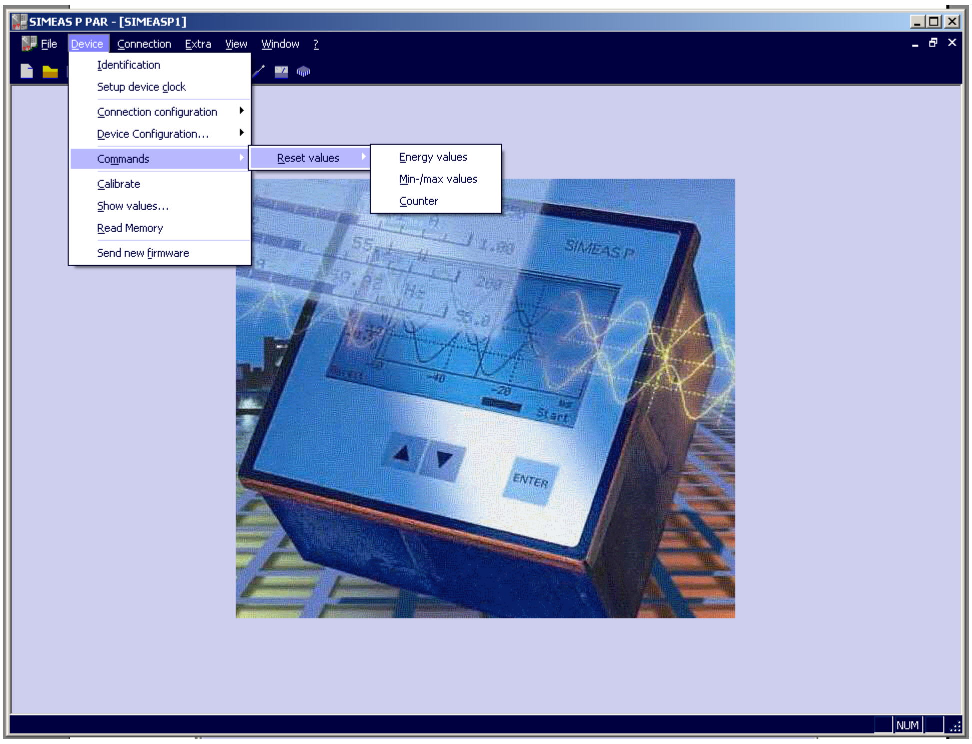
5.11 Resetting Values in the Device

SIMEAS P Parameterization allows you to reset the following values:

- Energy counter
- Counters for limit violations
- Min, aver and max values

Proceed as follows:

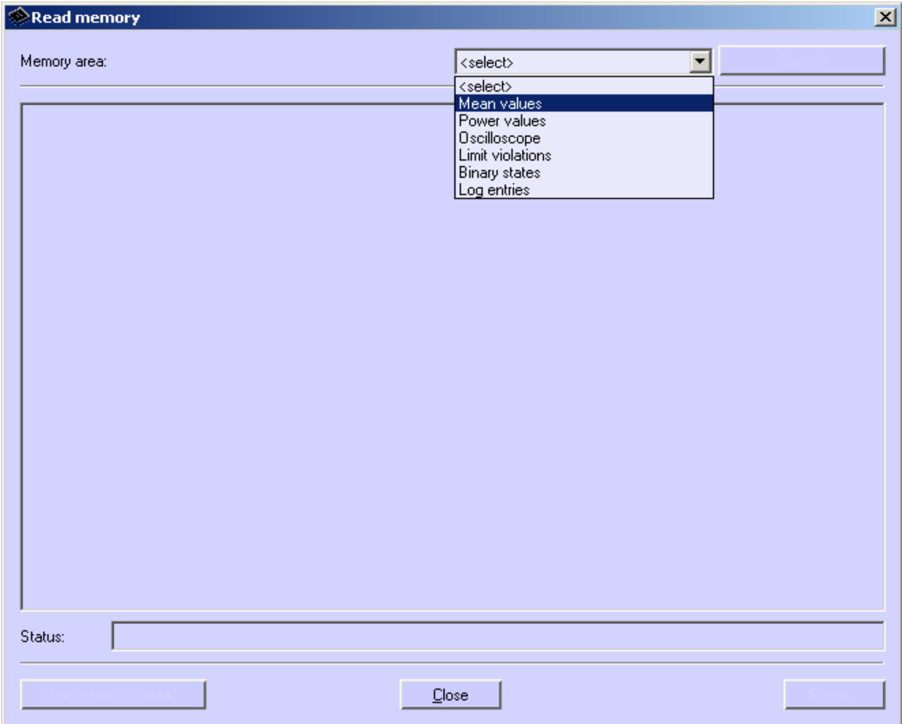
1. Establish a connection to the device. Make sure to set the same parameter values in SIMEAS P Parameterization and in the device. In the device, the serial interface must be set to "PC-RS 485".
2. From the menu bar, select **Device** → **Commands** → **Reset values** to reset the displayed items.



5.12 Reading the Device Memory

SIMEAS P Parameterization allows you read the memory content. The available memory capacity (1 MByte) can be allocated by the user to the available functions (see chapter 5.9.1).

1. From the menu bar, select **Device** → **Read Memory** to select the memory area in the *Read memory* dialog



2. Select a memory area.

5.12.1 Handling

Note

Depending on the function you have selected, different buttons are displayed. Inactive buttons are not shown.

Cancel

Click this button to interrupt the data download from the device. If a large amount of the memory is assigned to a record, the download of data may take a few minutes (at low baud rates perhaps some hours). The download progress is shown in the status line. If the download was successful or interrupted by the user, this button will be renamed to **Reload**.

Reload

Click this button to reload measured values or data from the device.

Close

Click this button to terminate the dialog window **Read memory**.

Export

Click this button to save measured values or information as CSV file (Comma separated values) or COMTRADE file (IEEE Standard Common Format for Transient Data Exchange). CSV files can be read and processed, e.g., with Excel. COMTRADE files are used for exchanging measured data as documented in the IEEE Std C37.111-1999. The standardization includes both the format for measuring files and the type of media used for the exchange of fault report, test or simulation data of power supply systems.

Delete memory area

Click this button to delete the selected memory area in the device. Optionally, you can restart the recording immediately or with the occurring of a parameterized trigger condition (mean values, power values, and limit violations only).

5.12.2 Charts / Diagrams

Diagrams and charts are coupled: By moving the measuring cursor in the diagram, the corresponding row in the chart is marked; by activating a row in the chart, the cursor in the diagram moves to the corresponding timestamp (mean values, power values, and binary states only).

5.12.3 Diagrams

In diagrams, zooming, measuring and other functions are available. Click the right mouse button in diagrams to activate the functions zoom, optimize, optimize x-axis, optimize y-axis, diagrams (fade in or blind out diagram for measured value), signals (fade in or blind out diagram for minimum, mean respectively maximum value) and copy diagrams in selectable size to the clipboard (mean values, power values, binary states, and oscilloscope data only).

5.12.4 Timestamps

All timestamps are shown in regional normal time. This avoids time gaps or overlap in data (for example, when summer time starts or ends).

5.12.5 Mean Value Record

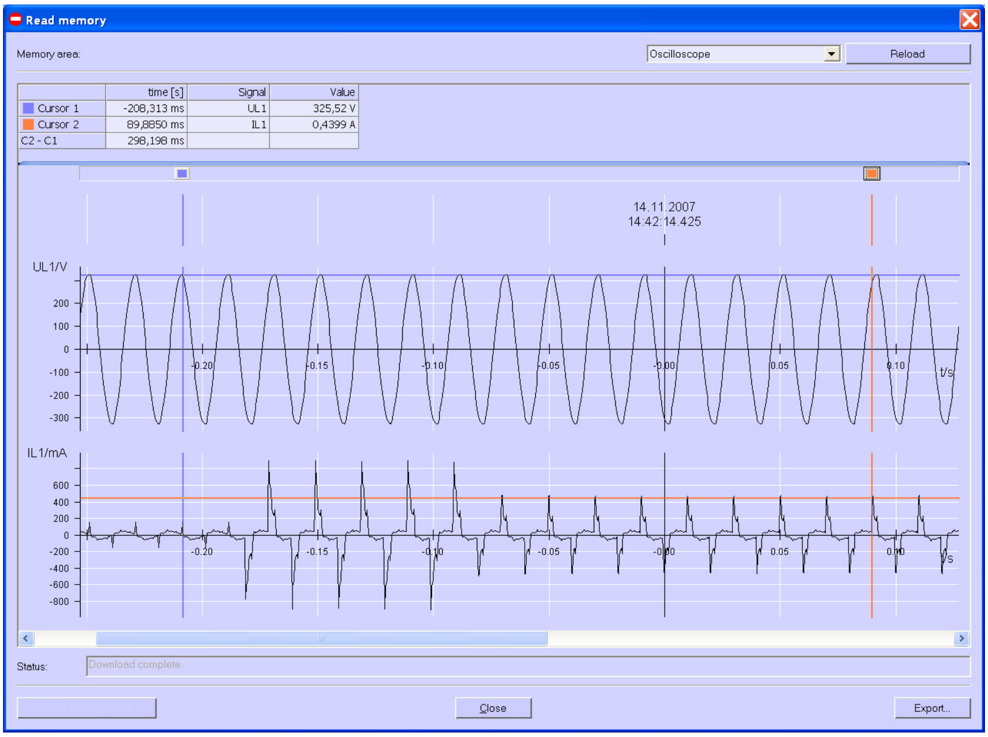
Mean values are represented in a chart and in diagrams. In the chart, you can select between minimum values, mean values and maximum values in headline. For each recorded mean value (max. 8), one column in the chart and one diagram is shown. In the diagram, the mean value and the tolerance area limited by minimum and maximum value are drawn.

5.12.6 Power Value Record

Power values are represented in a chart and in diagrams. For each recorded power value (max. 8), one column in the chart and one diagram is shown.

5.12.7 Oscilloscope

Records of oscilloscope are represented in one diagram for each value with trigger timestamp. With the two measuring cursors measurement on signals is possible. To do this, select signals in the table. Additional functions are available by pressing the right mouse button (see diagrams).



5.12.8 Limit Violation Record

Limit violations are represented in a chart. Limit violations of group 1 to 6 are shown when occurring (ON) and disappearing (OFF). For limit violation group 7, additional information is available: the signal on which the violation occurred and the measured value appeared.

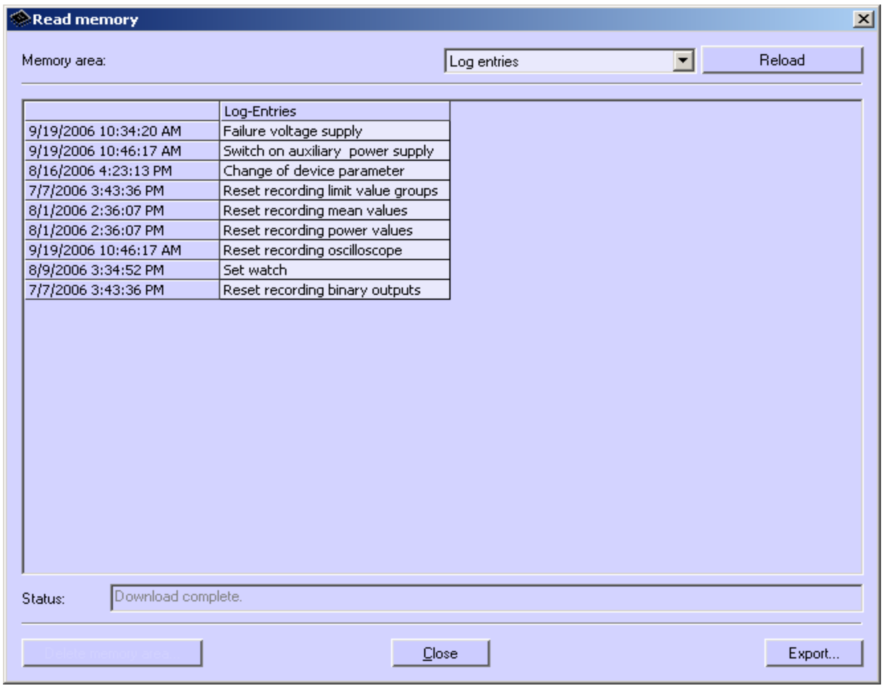
5.12.9 Binary States

Binary states are represented in a chart and in diagrams. For each recorded binary state, one column in the chart and one diagram is shown.

5.12.10 Log Entries

Log entries are represented in a chart. For each of the following entries, date and time are shown:

- Failure voltage supply
- Switch on auxiliary power supply
- Change of device parameter
- Reset recording limit value groups
- Reset recording mean values
- Reset recording power values
- Reset recording oscilloscope
- Set watch



Note

For further information on "Reading the Device Memory", refer to the online help of the PC programming software (press F1).

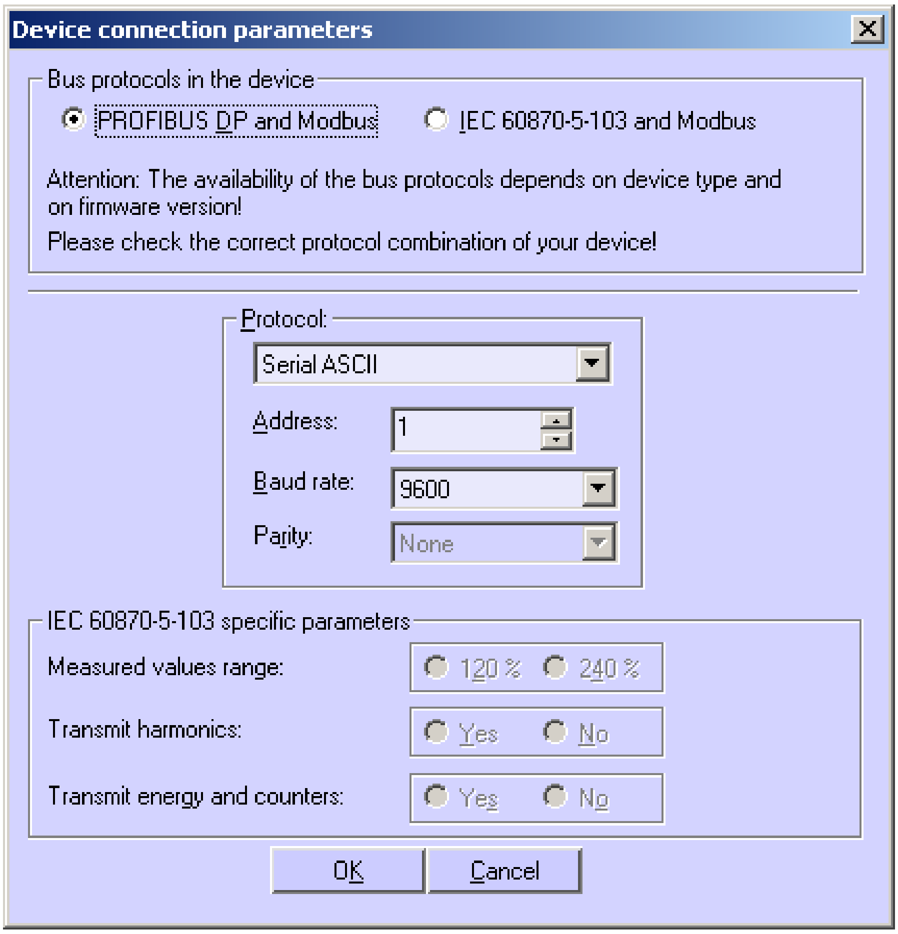
5.13 Changing the Communication Parameters

At delivery, the following communication parameters are preset:

- Address: 1
- Protocol: Serial ASCII
- Baud rate: 9600 bit/s
- Parity: No

In order to switch to another protocol, proceed as follows:

1. From the menu, select **Device** → **Connection configuration** → **Edit**. The dialog *Device connection parameters* will open.



2. Select the combination of bus protocols supported by your device in the **bus protocols in the device** field:
   - PROFIBUS DP and Modbus or
   - IEC 60870-5-103 and Modbus

Note

The bus protocols provided in your device depend on the device type and the firmware version.Therefore, check the correct bus protocol combination of your device.

3. Select the required protocol type depending on the bus protocol used:

PROFIBUS DP and Modbus	IEC 60870-5-103 and Modbus
- Serial ASCII	- Serial ASCII
- Profibus DP	- IEC 60870-5-103
- Modbus ASCII	- Modbus ASCII
- Modbus RTU	- Modbus RTU

4. Set the **Address** of the device and (if required) the **Baud rate** and the **Parity**.
5. If you have selected the IEC 60870-5-103 protocol, the following IEC 60870-5-103-specific parameters are activated, where you have to choose :
   - **Measured values range**: **120 %** or **240 %**
   - **Transmit harmonics**: **Yes** or **No**
   - **Transmit energy and counters**: **Yes** or **No**
6. Confirm your entries by clicking **OK**.
7. Select the menu item **Device**→ **Connection configuration** → **Send** to send the new setting to the device.

Note

The settings will not be activated in the device unless a hardware reset has been made.

After the device has been switched on, you have got 60 seconds to establish a connection to the parameterization tool. Once this time has elapsed, the communication protocol set will be activated automatically.

Calibration 6

Contents

The adjustment is explained in the following chapters.

6.1	Overview	126
6.2	Connection Diagrams for Adjustment	127
6.3	Procedure	128

6.1 Overview

SIMEAS P can be adjusted either directly from the device using the buttons on the front panel or by using the SIMEAS P programming software.

You can select the measurement range under **Basic Settings** → **Connection / Transformer**. Only the measurement ranges selected for current and voltage inputs can be adjusted in the Calibration menu.

Adjusting the SIMEAS P requires a single-phase adjusting device that can generate voltages and currents to an accuracy of ≤ 0.1 %, e.g. Omicron CMC 156. Adjustment frequency: 50 Hz or 60 Hz.

Note

To be able to make adjustments using the software, a connection must be established between the PC and the SIMEAS P device.

Before starting the adjustment, you should set the time in the SIMEAS P. This ensures that the last adjustment is displayed with a date in the SIMEAS P.

When connecting the adjusting outputs to the appropriate inputs, make sure that the SIMEAS P is correctly connected as per the Connection Diagrams for adjustment.

The following three elements should be adjusted during the adjustment process:

- Voltage inputs V
- Current inputs I

6.2 Connection Diagrams for Adjustment

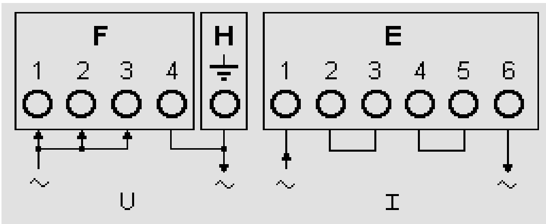
Correct adjustment is crucial to the accuracy of the measurements made by the SIMEAS P.

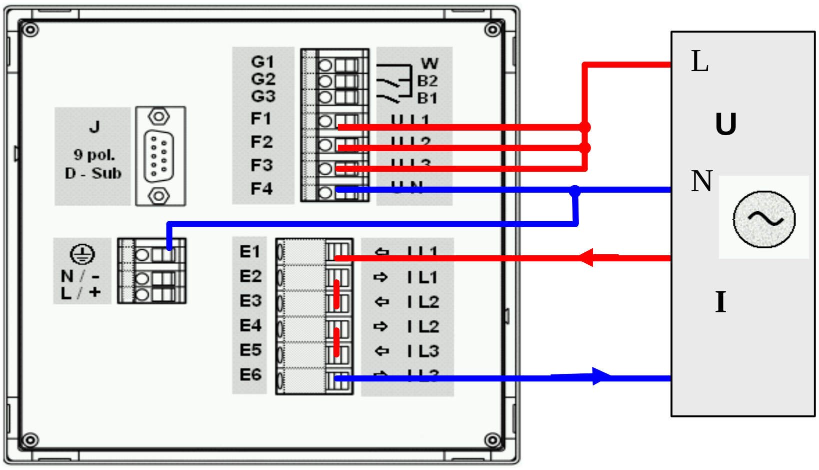
Note

The voltage and current inputs of the SIMEAS P are not compatible with polarity reversal (i.e. if phase and neutral terminals are connected incorrectly, the adjustment will not work correctly).

The following applies to the adjustment of current and voltage inputs of the SIMEAS P:

- Single-phase current and voltage connection.
- Frequency 50 Hz or 60 Hz.
- There must be no phase shift between current and voltage.
- Connect the H (ground) and F4 terminals to "N" on the adjusting device.
- The SIMEAS P must be grounded.





Note

The wiring diagram is a schematic presentation. Please refer to Fig. 1-7 for the correct pin assignment.

6.3 Procedure

- First, connect the SIMEAS P as described in chapter 6.2.
- You can adjust the device manually or via programming software

Procedure at the device

- Select **Basic settings** → **Connection / Transformer**.

  Select the range to be adjusted (e.g. AC 228 V).
- In the menu, select: Calibrate.

  A dialog window appears.
- Enter the setpoint value for adjustment voltage and adjustment current. Default setpoints are the nominal ranges of the measuring ranges set under **Connection / Transformer**. Optimal precision can be achieved by using these default setpoint values. If the default values are not available, make the appropriate changes.
- Switch the adjusting device on with the setpoints.
- Follow the instructions. SIMEAS P is readjusted.

Procedure for programming software

```
Calibration of the
selected input range.
Please follow the in-
structions in manual!
<ok
<cancel
```

- Establish the communication between device and programming software.
- In the menu, select: Calibration

  A dialog window appears.
- Select the element you wish to adjust: U or I
- Enter the setpoints for adjustment of voltage and current. The setpoints given are the nominal values of the measurement ranges set under Connection / Transformer. These preset setpoints ensure optimum precision. If the preset values are not correct, change them accordingly.
- Switch the adjusting device on with the setpoints.
- Follow the instructions. SIMEAS P is readjusted.

Technical Data 7

Contents

The following chapters include the technical data of both devices.

7.1	SIMEAS P 7KG7750	130
7.2	SIMEAS P 7KG7755	134

7.1 SIMEAS P 7KG7750

Input signals	Only for connection to AC systems
AC voltage inputs	U_I 3 voltage inputs
Max. system voltage	Y 400 /Δ 690 V
Overload	20 %
Frequency range f_i	45 Hz to 65 Hz, min. > 30 % U_{IN}
Waveform	Sinusoidal or distorted up to the 21st harmonic
Input voltage U_i	AC 100 V/110 V; AC 190 V; AC 400 V; AC 690 V (L-L)
Continuous overload capacity	1.5 x U_i
Surge withstand capability	2.0 x U_i
Input resistance (L - N)	3 phases symmetrical: 4.2 MΩ 1 phase: 8.4 MΩ
Power consumption per phase	38 mW (U_{LE} = 400 V)
AC current inputs	I_I 3 current inputs
Input current I_i	AC 1 A; AC 5 A
Maximum voltage	AC: 150 V
Continuous overload	AC 10 A
Surge withstand capability	AC 100 A for 1s
Power consumption per phase	83 µVA at 1 A ; 2.1 mVA at 5 A
Binary outputs	Internal and optional via isolated solid-state relay
Permissible voltage	AC: 230 V; DC: 250 V
Permissible current	AC/DC 100 mA continuous AC/DC 300 mA for 100 ms
Internal resistance	50 Ω
Permissible operating frequency	10 Hz
Binary inputs	(optional)
Max. input voltage	DC 300 V
Current consumption for high level	1.8 mA
Threshold voltage low	≤10 V
Threshold voltage high	≥19 V
Signal delay	Max. 3 ms
Analog inputs	(optional)
Measuring range	DC 0 mA to 20 mA
Input range	DC 0 mA to 24 mA
Input resistance	50 Ω ± 0.1 %
Accuracy	0.5 % of the measuring range limit
Analog outputs	(optional)
Output current	DC 0 mA to 20 mA
Output range	DC 0 mA to 24 mA
Max. load resistance	250 Ω
Accuracy	0.2 % (typical); max. 0.5 % of the nominal value
Relay output contacts	(optional)
Max. switching voltage	AC 270 V; DC 150 V
Max. permanent current	AC/DC 5 A
Min. permanent current	1 mA at DC 5 V
Rating (resistive)	AC 5 A / 250 V or DC 5 A /30 V
Max. response time	10 ms
Max. release time	7 ms

Display	Graphic display
Resolution Dimensions	(128 x 64) pixel 40 mm x 60 mm
Dimensions, Mass	
Dimensions Mass	96 mm x 96 mm x 90 mm approx. 0.6 kg (without I/O module) approx. 0.65 kg (with I/O module)

Over voltage category	According to IEC 61010-1
Voltage measurement V_{IN} to 400 V (L-L) V_{IN} to 690 V (L-L) Current measurement V_{IN} to 150 V Power Supply Binary outputs, binary inputs and relay outputs Analog inputs and analog outputs	 Cat III Cat II Cat III Cat II Cat II Cat III
Auxiliary power	Multi-range power supply unit AC /DC
Nominal range Total range Power consumption	DC 24 V to 250 V or AC 100 V to 230 V (45 Hz to 65 Hz) ±20 % of nominal range max. 6 W or 9 VA
Battery	
Type	VARTA CR2032

Communication interface	
Connection	9-pole D-sub. female connector
Data transfer PROFIBUS DP V1	Baud rate: 9600 bit/s to 12 Mbit/s
Data transfer IEC 60870-5-103	Baud rate: 9600 bit/s, 19200 bit/s, 38400 bit/s
Data transfer Modbus RTU/ASCII PC-RS485	Baud rate: 300 bit/s, 600 bit/s, 1200 bit/s, 3400 bit/s, 4800 bit/s, 9600 bit/s, 19200 bit/s, 38400 bit/s, 57600 bit/s, 115200 bit /s

Isolation test	**IEC/EN 61010-1**	
	Type test	Routine test, 2 s
Voltage inputs, binary outputs	AC 3.2 kV	AC 2.0 kV
Current inputs	AC 2.2 kV	AC 1.35 kV
Power supply	DC 4.9 kV	DC 3.1 kV
Serial interface	AC 700 V	AC 500 V
I/O-Module (optional)		
Binary inputs and binary/relay outputs to PG	AC 2.2 kV	AC 1.35 kV
Analog inputs and analog outputs to PG	AC 700 V	AC 500 V

Impulse voltage withstand test	IEC/EN 61010-1
Voltage inputs	5.8 kV
Current inputs	2.5 kV
Power supply	5.8 kV
Serial interface	1.31 kV
I/O-Module (optional)	
Binary inputs and binary/relay outputs to PG	1.31 kV
Analog inputs and analog outputs to PG	1.31 kV

Insulation type of inputs and outputs	
Signal inputs (current)	Reinforced, AC: max. 150 V, Cat III
Signal inputs (voltage)	Protective impedance, max. AC 600 V, Cat II or max. AC 300 V, Cat III
Power supply	Reinforced, max. AC 230 V/ max. DC 250V, Cat II
Output contacts	Reinforced, max. AC 230 V/ max. DC 250V, Cat II

Reference conditions	The stated error limits apply for reference conditions
Input current I_i	I_{iN} ± 1 %
Input voltage U_i	U_{iN} ± 1 %
Frequency f_i	45 Hz to 65 Hz
Waveform	Sinus, harmonic distortion ≤ 5 %
Ambient temperature T_A	23 °C ± 1 °C
Auxiliary voltage U_H	U_{HN} ± 1 %
Warm-up time	≥ 15 min
External fields	no

Environmental conditions	The device is designed for indoor use only
Ambient Temperature	According to IEC 60688
Operating Temperature Range	32 °F to 131 °F (0 °C to 55 °C)
Storage Temperature Range	-13 °F to 158 °F (-25 °C to 70 °C)
Max. relative humidity	80 % for temperatures up to 31 °C decrease linearly to 50 % at 40 °C
Max. altitude above sea level	2000 m
Pollution degree	2, no condensation

Additional Technical Data	
Internal fuse	Not replaceable Type T500mA/250V according IEC 60127
Internal fuse, secondary	Not replaceable Type F2A/125V according UL 248-14

Protection class according IEC 60529	
Device	
Front	IP20, IP41 or IP 65 see ordering data
Rear	IP20
Personnel protection	IP1x

Electromagnetic compatibility (EMC)	
Immunity	IEC/EN 61000-6-2 IEC/EN 60688
Emission	IEC-CISPR 11 IEC/EN 61000-6-4 Class B

Mechanical dynamic stress	
Standards	IEC/EN 60255-21 IEC/EN 60068
Vibration, sinusoidal for stationary application	IEC/EN 60255-21-1 (06.90) IEC/EN 60068-2-6 (03.95) Class 1
Vibration, sinusoidal transport	IEC/EN 60255-21-1 (06.90) IEC/EN 60068-2-6 (03.95) Class 1
Vibration on earthquake for stationary application	IEC/EN 60255-21-3 (06.90) IEC/EN 60068-2-57 (03.95) IEC/EN 60068-3-3 (03.95) Class 1
Shock, for stationary application	IEC/EN 60255-21-2 (06.90) IEC/EN 60068-2-27 (03.95) Class 1
Shock, semi-sinusoidal, transport	IEC/EN 60255-21-2 (06.90) IEC/EN 60068-2-27 (03.95) Class 1
Bump test (continuous shock), transport	IEC/EN 60255-21-2 (06.90) IEC/EN 60068-2-29 (03.95) Class 1

7.2 SIMEAS P 7KG7755

With the following exceptions, the technical data of the SIMEAS P 7KG7755 correspond to the data of the SIMEAS P 7KG7750:

The SIMEAS P 7KG7755 has no display.

Protection class according IEC/EN 60529 (VDE 0470 part 1)	
Device	IP20
Personnel protection	IP1x

SIEMENS

TM 1703 ACP

System Data Sheet

MC6-007-2.01

Introduction

Requirements

It is the purpose of automation devices to support us in the cost-effective and safe management of technical processes.

In conventional concepts, processes were monitored and controlled via remote terminal units while non-communicating local automatic controllers (e.g. relay controllers, programmable controllers, analog controllers) would handle automation. As a result, there was a multitude of different interfaces, making global monitoring nearly impossible.

Meanwhile conditions have changed from a commercial, IT-related and technological viewpoint. Cost-effectiveness has become a crucial factor of competitiveness. Consequently, this calls in almost all processes for the improved utilization of existing resources, that is, moving closer and closer toward tapping their full performance capacities. To avoid neglecting reliability requirements in this process, a greater amount of information is necessary. By that we mean more information about the process (utilization rate, state) and about the automation system itself.

Due to the technological progress, automation devices consequently have become more powerful and intelligent. All of a sudden, they are now able to assume many additional functions - starting with preprocessing tasks and up to the complete networking of all automation devices.

Thus, it was only a question of time until this intelligence could be functionally decentralized and at the same time be put to local distributed use, directly at the process. The aim of functional decentralization is the creation of

- a better clarity
- autonomous functional units, and thus
- higher availability.

The aim of local distribution and the resulting reduced number of cabling routes is the achievement of

- a reliable signal transmission
- streamlining the assembly effort
- reduction of cable materials and accessories
- down to doing without intermediate terminals.

This requires modern automation concepts giving due account to the greater expansion of the automation system, all the way up to the integration of increasingly smaller system components. In this context, the additional benefit sought in terms of cost-effectiveness and reliability is

- the reduction or avoidance of parallel interfaces between the various automation levels, and
- the improved adaptation to the process with its specific signals and functions to be accomplished through closer bonding to the primary process

This leads to the creation of non-market-sector-specific but also market-sector-specific requirements which - unlike pure programmable controller applications - reach way beyond the sole performance of process control functions and simple serial data coupling.

What is required are:

- the balanced coexistence
  - of the world of automation running periodically (equidistantly and thus time-consistently) for purposes of guaranteed reproducible reaction times and including freely definable logic, open-loop, and closed-loop control functions
  - the parameter-settable, standardized spontaneous world of telecontrol and communications
- means of communication adapted to the application and linked with consistent integral solutions
  - LAN communication via TCP/IP with intensive networking possibilities,
  - local serial couplings and remote communication options
  - high interoperability also with regard to other devices by using default communications to IEC 60870-5
  - system-consistent service functions such as real-time acquisition, test and diagnostic functions, as well as
- consistent engineering and straightforward service
  - systemwide consistent CAE tools with state-of-the-art and ergonomically advanced full-graphics user interface
  - replacement of spares without CAE tool
- high operational reliability and availability ensured by
  - modular structure and continuous system monitoring
- cost-effective adaptation to process-specific requirements
  - of signal processing (type of signals, voltage level), and the
  - use of "intelligent terminal modules"
    - for the acquisition of the process peripherals, as direct and close to the primary equipment as possible
    - to avoid costly cabling and additional intermediate terminals.

Longevity through Continuity and Innovation

Following the principle of our product development, TM 1703 ACP has high functionality and flexibility, through the implementation of innovative and reliable technologies, on the stable basis of a reliable product platform.

For this, the system concept ACP (Automation, Control and Protection) creates the technological preconditions. Balanced functionality permits the flexible combination of automation, telecontrol and communication tasks. Complemented with the scalable performance and various redundancy configurations, an optimal adaptation to the respective requirements of the process is achieved.

TM 1703 ACP is thus perfectly suitable for automation with integrated telecontrol technology as

- Telecontrol substation or central device
- Automation unit with autonomous functional groups
- Data node, station control device, front-end or gateway
- With local or remote peripherals
- For simple mounting on standard rail

TM 1703 ACP – the Forward-Looking Product

The following highlights make TM 1703 ACP to a forward-looking product:

- Non-market-sector-specific product, therefore high product stability and versatile fields of application
  - Hydroelectric power stations (turbine governor, process control)
  - Electrical energy distribution and transmission
  - Oil/Gas pipelines
  - Tunnels
- Versatile communication
  - up to 66 serial interfaces according to IEC 60870-5-101/103
  - LAN/WAN communication according to IEC 60870-5-104
  - various third-party protocols possible
- Easy engineering
  - TOOLBOX II
  - Object-orientation
  - Creation of open- and closed-loop control application programs according to IEC 61131-3
  - all engineering tasks can also be carried out remotely
- Plug & play for spare parts
  - Storage of parameters and firmware on a flash card
  - spare part exchange does not require additional loading with TOOLBOX II
- Open system architecture
  - Modular, open and technology-independent system structure
  - System-consistent further development and therefore an innovative and future-proof product
- Mechanical design
  - Assembly on 35 mm DIN rail
  - Simplified connection system in the form of the "intelligent terminal"
  - LEDs for process and operating states
- The intelligent terminal – TM 1703
  - Direct connection of actuators and sensors with wire cross-sections up to 2.5 mm²
  - Can be located remotely up to 200 m
  - Binary input/output also for 110/220 VDC

Non-Market-Sector-Specific Product, therefore High Product Stability and Versatile Fields of Application

Our philosophy: we provide basic products that can be used as is in several market sectors, and market-sector products developed out of the basic products by specific engineering, however, standardized for respective market sectors.

Advantages:

- If a customer has applications in several market sectors and fields of use, he may rest assured that the products will be able to communicate with one another and behave identically within an automation network and in relation to the user (system behavior, engineering, maintenance). Example: turbine governor and hydro process control.
- Within the application, it is possible to choose the most cost-effective product, depending on data volume and the number of communication interfaces.
- Using the same product in several market sectors also means less product diversity (no more "dedicated systems") and consequently greater versatility in use and thus enhanced product stability.

Versatile Communication Capability

With TM 1703 ACP, a variety of media can be utilized for local and remote communication. (wire connections, FO, radio, dial-up traffic, GSM, GPRS, WAN, LAN, field bus etc.)

Through the simple installation of serial interface modules, in total up to 4 communication interfaces are possible in one TM 1703 ACP, whereby a different individual protocol can be used for each interface.

For standard communication, protocols according to IEC 60870-5-101/103/104 as well as IEC 61850 are implemented. The consistent implementation of these standards guarantees a uniform addressing from the source through to the sink.

Besides the previously mentioned standard protocols, there are also a variety of third-party protocols available (DNP 3.0, Modbus etc.). Through this, the seamless integration into existing automation networks is enabled, whereby a long-term safeguarding of already effected investments is ensured.

Easy Engineering

An essential aspect in the overall economical consideration are the costs that occur for the creation, maintenance and service. For this, the reliable TOOLBOX II is used.

- Object-orientation

  The object-orientation makes it possible to also utilize the same characteristics of same-type primary-technology units and operational equipment (e.g. disconnectors, circuit breakers, feeders etc.) for the configuration. The close coupling with the design tool ensures the consistent, uniform documentation of the entire plant through to circuit diagram.

  Through this, considerable rationalization results with engineering.

- Open-loop and closed-loop control according to IEC 61131-3

  Open- and closed-loop control application programs are created by means of CAEx *plus* according to IEC 61131-3, a standard that is generally accepted and recognized in the market. As a result, the training periods are reduced considerably.

- All engineering tasks can also be carried out remotely

  All engineering tasks, from the system diagnostic through to the online test, can also be performed remotely with the TOOLBOX II. For this, a separate communication link between TOOLBOX II and TM 1703 ACP is not necessary: every available communication interface can be used. Using further automation units of the ACP 1703 product family, the TOOLBOX II can be remotely positioned over an arbitrary number of hierarchies.

The access to the engineering data is fundamentally protected by a password.

Plug & Play for Spare Parts

With the replacement of spare parts, Plug & Play becomes a reality: one needs no special tool for this, even loading is no longer necessary. Thereby, work during a service operation is reduced to a minimum.

Flash card for data storage

All data of an automation unit - such as firmware and parameters - are stored non-volatile centrally on an exchangeable flash card. With a restart of the automation unit, and also with a restart of individual modules, all necessary data are automatically transferred from the flash card to all CPUs and modules.

Consequently, with the exchange of modules, new loading is no longer required, since new modules obtain all data from the storage card.

Open System Architecture

The basis for this automation concept is a modular, open and consequently technology-independent system architecture for processing, communication and peripherals (multi-processor system, firmware).

Standardized interfaces between the individual elements again permit, even with further developments, the latest state of technology to be implemented, without having to modify the existing elements. In this way, a longevity of the product and consequently investment security and continuity can be ensured.

Every board and every module on which a firmware can run, forms together with the function-determining firmware a system element.

The adaptation to the specific requirements of the application is achieved through the individual configuration and through the loading of standard firmware and parameters. Within their defined limits, the parameters thereby not only influence the behavior of the firmware functions, but also that of the hardware functions.

With that, for all module types, all mechanical parameter settings are omitted, such as for instance the changing of jumpers or loads and thus enables not only the online change, but also a consistent documentation of the set parameters by the TOOLBOX II as well as a simplified storage.

Mechanical Design– Simple Process Interfacing

Generally, when developing the mechanical design, we focused on achieving highest ease in handling. As a result, all components of TM 1703 ACP were adapted to be mounted on a DIN rail.

An essential feature of TM 1703 ACP is its efficient and simple way of interfacing to the process signals. This is accomplished by so-called I/O modules standing out for a robust housing, reliable contacting, and sound electronics.

The I/O modules are arranged side by side on a DIN rail. Contact between them is established as soon as they engage with one another, without requiring any further manual intervention. Even so, it is still possible to replace every single module separately.

A clearly structured connection front featuring status indicator LEDs makes sure that things at the site remain clear and transparent. The structure of the terminals permits direct sensor/actuator wiring without requiring the use of intermediate terminals with wire cross-sections up to 2.5 mm^2. Modules for binary inputs and outputs up to 220 VDC open further saving potentials at the interface level.

The I/O modules may, depending on the requirements, be equipped with either an electrical or an optical bus, whereby the peripheral signals can be acquired very close to their point of origin. Consequently, wide cabling can be reduced to a minimum.

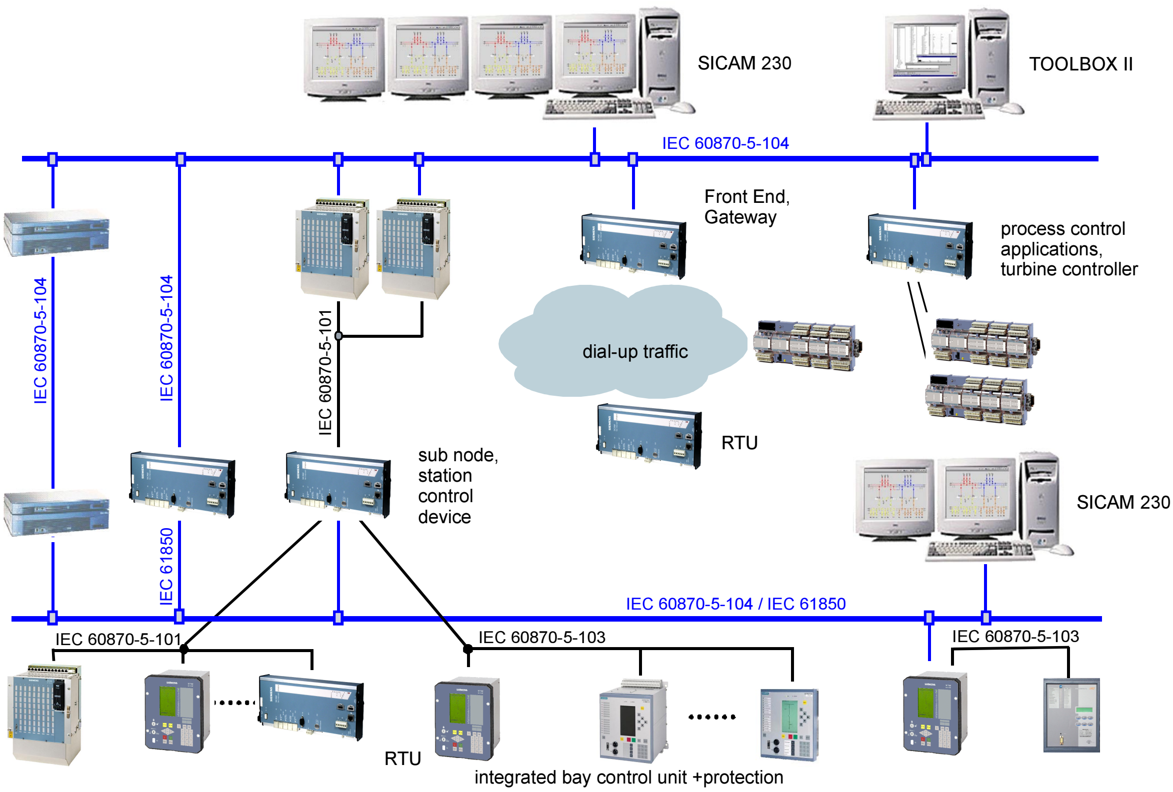
Application Overview

Introduction

Due to the modular architecture, TM 1703 ACP can be used in a variety of ways:

- Front End, Gateway
- Process control applications
- Automation applications
- Turbine governor
- Station control device
- Sub-node
- Telecontrol substation

In principle, for this all necessary functionalities are available. The actual application is defined simply through the corresponding configuration and parameterization.



Fields of Use

Front End

Due to the number of interfaces and the variety of protocols available, TM 1703 ACP is perfectly suitable for the use as front end for a process control system.

All telecontrol substations – regardless of which manufacturer and over which protocol – are connected to TM 1703 ACP. In the front end, the signal processing and adaptation takes place for the respective control system. From the perspective of the control system, there is no difference which protocol and which system behavior the substation actually has.

Process Control Applications, Automation Applications, Turbine Governor

Open- and closed-loop control application programs are created by means of CAEx *plus* according to IEC 61131-3, a standard that is generally accepted and recognized in the market.

In TM 1703 ACP, at every slot a system element can be fitted with *open-/closed-loop control function*. Through this and due to the modularity, TM 1703 ACP is suitable for many applications: from smaller automation applications through turbine governor up to complex process control applications. Naturally, all applications can also be combined.

Station Control Device, Sub-Node

The functionality of a station control device can be simply regarded as a combination of the functionality of a front end (interfacing of diverse bay devices, protective devices, processing of the data for the power system control) and the functionality of process control applications (open- and closed loop control application programs), and is therefore perfectly suited for this application. In addition, further telecontrol peripherals could also be installed in the station control device, through which telecontrol station and station control device could be united in one device.

Telecontrol Substation

For telecontrol applications there is a modular, versatile periphery available for the process data interfacing.

Especially due to the possibility of being able to remotely locate TM 1703 peripherals, TM 1703 ACP supports peripheral elements installed centrally and decentralized. Flexible communication functions also permit redundant communication and communication over stand-by transmission lines.

Naturally, arbitrary open- and closed-loop control application programs can be realized in TM 1703 ACP with CAEx *plus*, through which, at the same time and to the same degree, TM 1703 ACP can become a remote terminal unit and an automation unit in one.

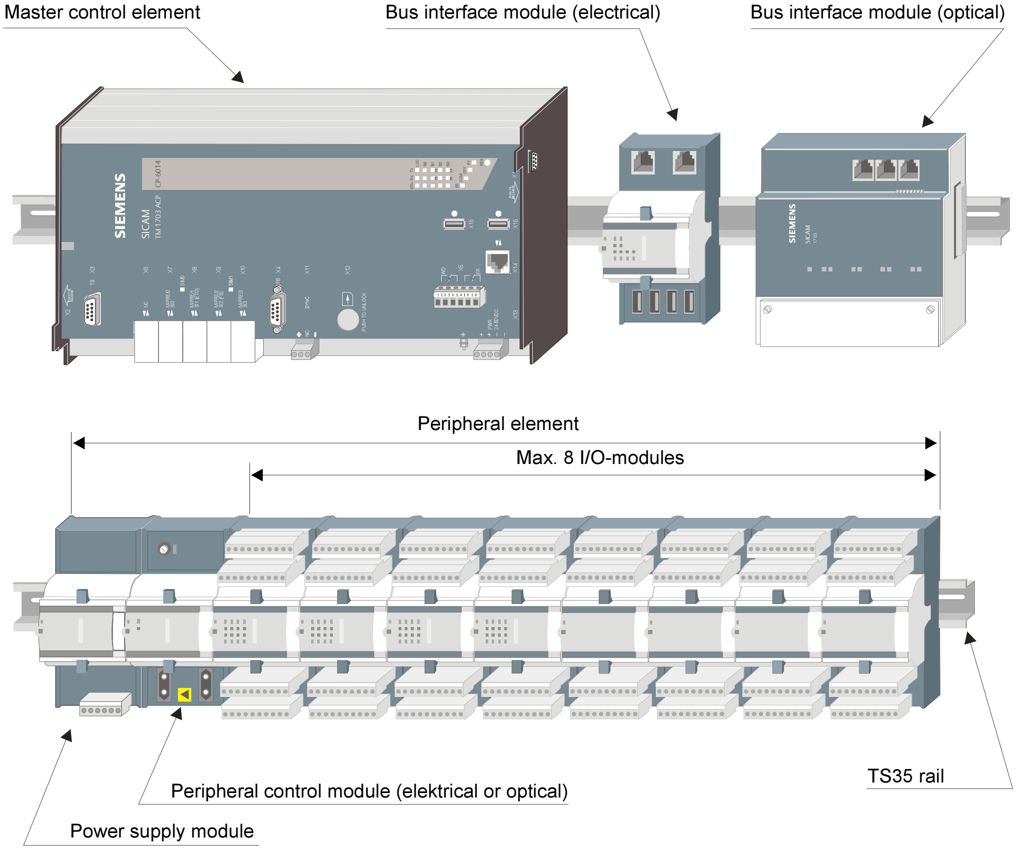
System Overview

System Architecture

Structure

TM 1703 ACP is an automation unit of the system family SICAM 1703 and is structured from the following elements:

- 1 Master control element
- Up to 4 protocol elements for the communications
  - mountable on the master control element
- Up to 16 peripheral elements
  - modular expandable and detachable
- Up to 4 businterface modules

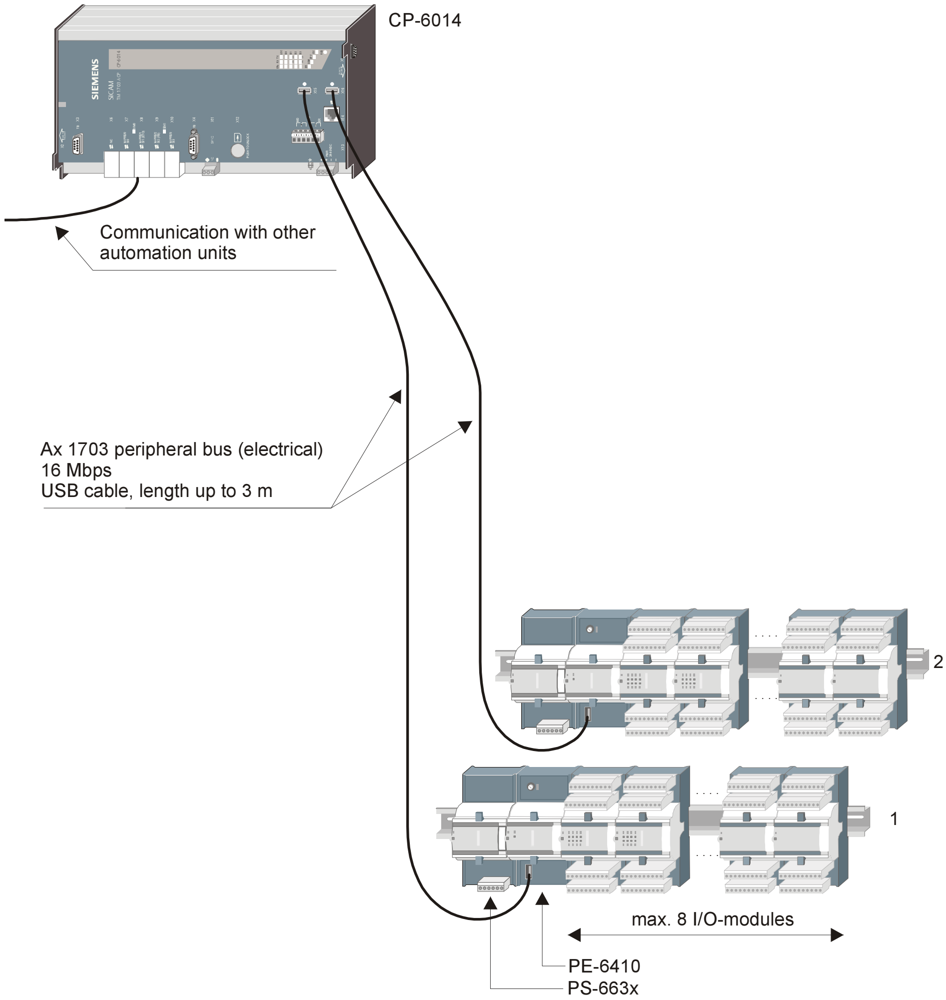


Configuration

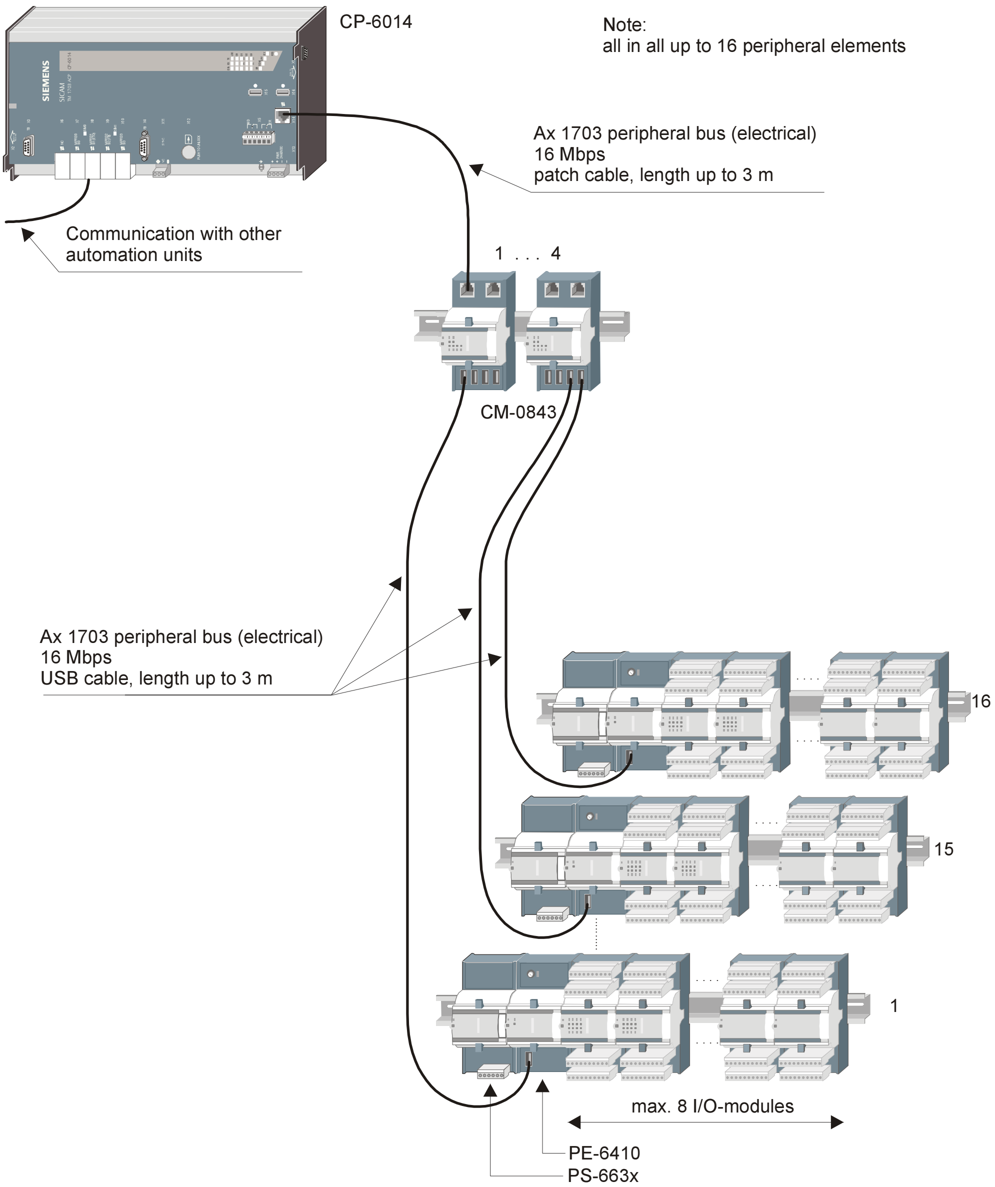
The following figures show examples for the connection of the periphery to the master control element.

Further configuration examples can be found in the manual *ACP 1703 Platforms, Configuration Automation Units and Automation Networks* (refer to Literature).

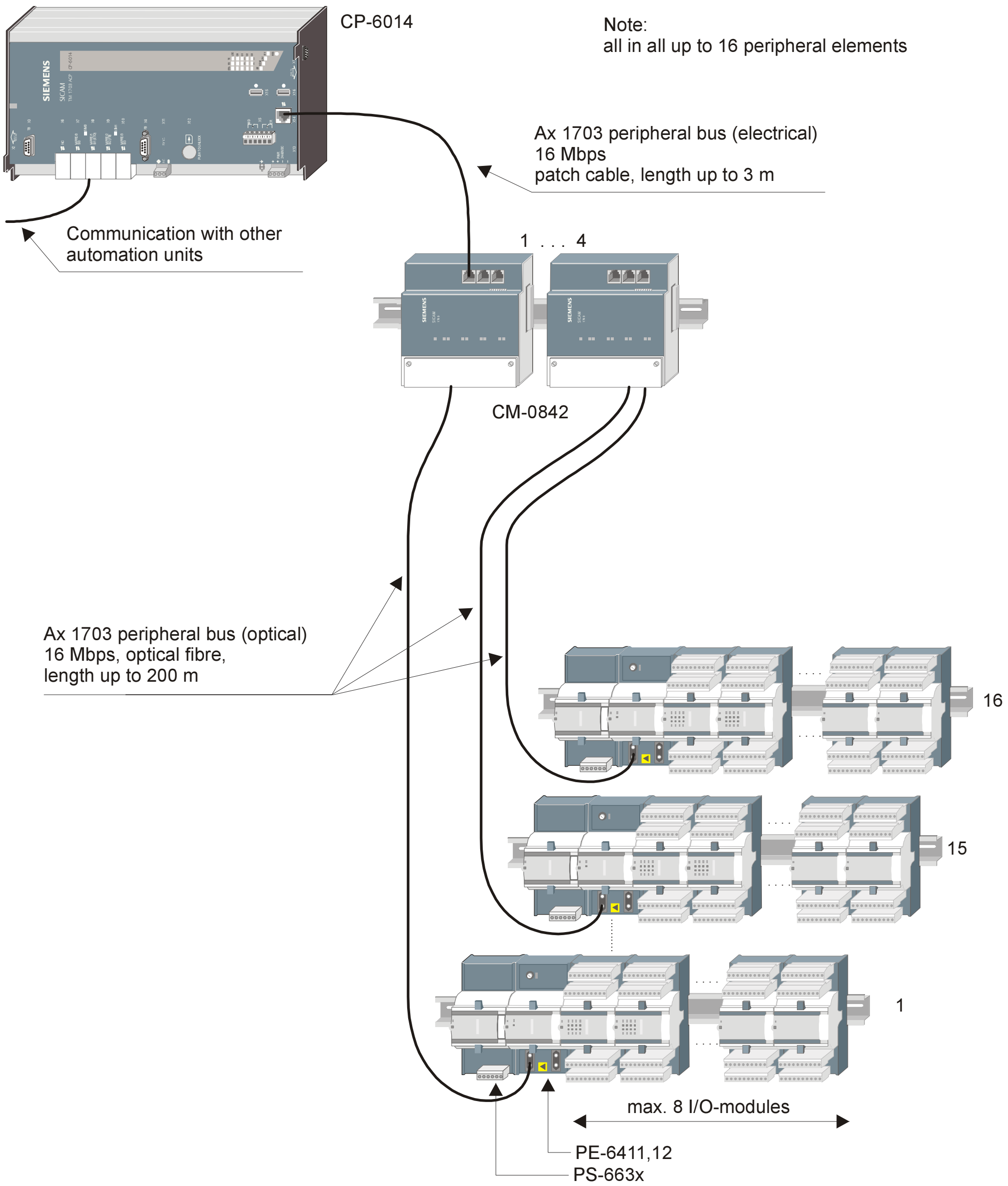
Direct electrical connection of up to 2 peripheral elements



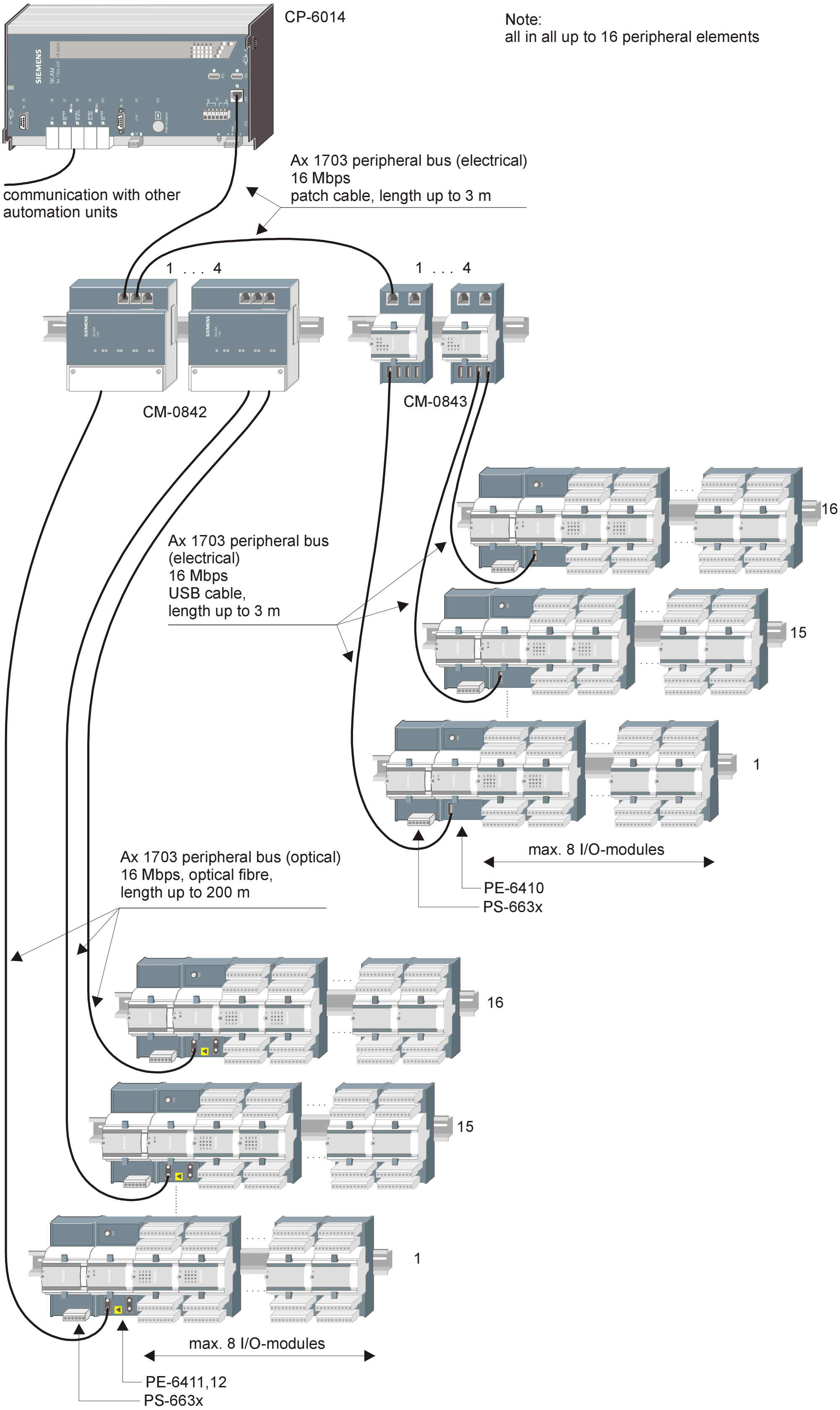
Connection of up to 16 peripheral elements via bus interface (electrical)



Connection of up to 16 peripheral elements via bus interface (optical)



Connection of up to 16 peripheral elements via bus interface (electrical and optical combined)



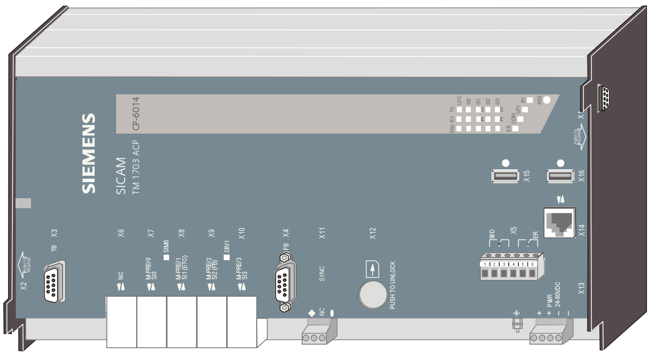
System Elements

A system element is a functional unit and consists of hardware and firmware. The firmware gives the hardware the necessary functionality.

Detailed information on a system element can be found in the relevant data sheet (refer to Literature).

Master Control Element

The master control element forms the heart of the TM 1703 ACP automation module. Process input and output is connected externally via peripheral elements. The communication interfaces can be fitted directly onto the master control element.



Functions of the master control element

- Central coordinating element for all system services and all internal and overlapping concepts
  - Time management and time synchronization via minute pulse, serial time signal (DCF77/GPS-receiver), serial communication link, NTP server over LAN/WAN
  - Data Flow Control
  - Monitoring functions
  - Diagnostic functions
  - Archiving of events
  - Communication with the engineering system TOOLBOX II
  - Storage of application data and firmware on a flash card
- Communication with installed peripheral elements via the serial Ax 1703 peripheral bus
- Execution of parameterizable telecontrol functions
- Execution of programmable open-/closed-loop control functions
- Communication with other automation units via protocol elements installable on the master control element (node function)

The master control element provides the open-/closed-loop functions and/or the parameterizable telecontrol function, and the node function for the communication via serial interfaces and LAN/WAN. Therefore, it also serves as a centrally coordinating element for all system functions and all internal and integral concepts.

This architecture ensures

- a deterministic behavior of the open-/closed-loop control function with guaranteed reaction times
- an autonomous behavior (for instance in the case of communication failure)
- the integration of the telecontrol functionality (spontaneous processing and spontaneous communication) and the open-/closed-loop control functions (periodical processing and periodical communication with the periphery) into one common automation device.

Product Overview

Type	Designation	Remarks
CP-6014/CPCX65	Processing & Communication	required
Flash Card	Flash Card 1GB	required

Protocol Element

A protocol element is used for the exchange of data – and thereby for the transmission of messages – over a communication interface to other SICAM 1703 automation units or to devices of other manufacturers, as for instance control centre systems.

A fundamental characteristic of the protocol elements is the separation of protocol-bound communication from application tasks of an automation unit:

- Each interface has its own protocol processor
  - communication has no impact on the application, and vice versa
  - each processor runs 1 communication protocol
  - various different protocols run on one and the same hardware
- Change of the communication protocol, for instance from serial to LAN, without retroactive effect to the application tasks of an automation unit
- Each automation unit can be equipped with various protocols, this allows easy implementation of data nodes and frontends.

Tasks of the protocol elements

- Handling of specifical communication protocols
- Adaption of the internal message formats to the corresponding external message formats
- Adaption of system and adressing concepts of SICAM 1703 and the devices of other manufacturers

Thereby it is distinguished between protocol elements with serial communication or with LAN/WAN communication.

Configuration

The hardware for the protocol elements is a communication interface on a Serial Interface Module (SIM) that can be mounted – directly or cascaded (SIM on SIM) – on the master control element.

A SIM has up to 2 communication interfaces. On every interface provided by the SIM, a communication protocol available for this interface can be loaded with the TOOLBOX II.

On a master control element, up to 4 communication interfaces can be used. This way, a multitude of communication options is available, as for instance:

- 4 serial interfaces
- 3 serial interfaces and 1 Ethernet interface (LAN/WAN)
- 2 serial interfaces and 1 Profibus DP interface (master)
- 2 serial, 1 Ethernet interface (LAN) and 1 Ethernet interface (WAN)

The possible configuration variants can be found in the *System Element Manual CP-6014/CPCX65* (refer to Literature).

Product Overview

Type	Designation	
SM-x551/BPPA0	Standard protocol for point-to-point traffic	optional
SM-x551/UMPMA0	Standard protocol for multi-point traffic (Master)	optional
SM-x551/UMPSA0	Standard protocol for multi-point traffic (Slave)	optional
SM-x551/SFBMA1	Standard protocol for field bus (Master)	optional
SM-x551/SFBSA1	Standard protocol for field bus (Slave)	optional
SM-x551/DIAMA0	Standard protocol for dial-up traffic (Master)	optional
SM-x551/DIASA0	Standard protocol for dial-up traffic (Slave)	optional
SM-x551/103MA0	Standard protocol for interfacing of protective devices (Master)	optional
SM-2545/DPM00	Standard protocol for Profibus DP	optional
SM-2556/ET02	Standard protocol for Ethernet TCP/IP IEC 104	optional
SM-2556/ETA2	Standard protocol for Ethernet TCP/IP IEC 104	optional
SM-2556/ET03	Standard protocol for Ethernet TCP/IP IEC 61850	optional
SM-2557/ET02	Standard protocol for Ethernet TCP/IP IEC 104	optional
SM-2557/ETA2	Standard protocol for Ethernet TCP/IP IEC 104	optional
SM-2557/ET03	Standard protocol for Ethernet TCP/IP IEC 61850	optional

Serial Communication

For serial communication are available as standard protocols:

- Point-to-point traffic
- Multi-point traffic, optionally with relay operation
- Dial-up traffic

Naturally, all standard protocols are fully based on the interoperable standard to IEC 60870-5-101/103, including

- absolutely free addressing
- single object orientation
- time Synchronization
- integrated remote maintenance functions such as
  - remote diagnostics
  - remote parameter setting
  - online test functions

Yet, there is still a whole series of other available protocols such as

- counter interfacing according to IEC 61107
- interfacing of protective devices according to IEC 60870-5-103
- Modbus RTU standard protocol
- DNP 3.0

Additional information on interfacing to non-SICAM systems and third-party protocols (subject-to-license protocols) is available on request.

LAN/WAN Communication

Today, modern automation systems are generally distributed and thus require networks to connect the various components with one another. In its systems, Siemens has for many years provided networks solutions, which link the various components with one another.

From the very beginning, great attention was paid to ensuring full integration as well as optimum availability and operational reliability. As network technology continued to become ever more refined, the product family SICAM 1703 as well has continuously been updated and upgraded to reflect the latest state of the art, without neglecting the criteria of ensuring a long system lifecycle and highest availability.

For the LAN/WAN communication, Ethernet TCP/IP accordeing to IEC 60870-5-104 or IEC 61850 can be used, which again guarantees maximum interoperability.

If TM 1703 ACP is used as a station control device, then the communication with the devices of the bay level (bay control units, protective devices) can also be established according to IEC 61850.

IEC 61850 is the standardized communication standard for substation automation which interconnects devices of the bay level and the station control level, based on Ethernet TCP/IP.

Bus Interface Module

A bus interface module serves for the connection of peripheral elements with a master control element. At each bus interface module – type dependent optical or electrical – up to 4 peripheral elements can be connected.

At a master control element, up to 4 bus interface modules can be connected via standard patch cables.

Product Overview

Type	Designation	Remarks
CM-0842	Bus Interface Ax-PE 4x optical	optional
CM-0843	Bus Interface Ax-PE 4x USB	optional

Peripheral Element

A peripheral element serves for acquisition or output of process information and performs process-oriented adaption, monitoring and processing of the process signals at each point where the signals enter or leave an automation unit.

Processing is performed by

- hardware (e.g. filter, ADC, DAC)
- firmware (e.g. smoothing of measured values, time tagging)

The peripheral elements deliver via the Ax 1703 peripheral bus

- messages with process information
- periodical information
- messages with system information (e.g. diagnostic information)

and receive

- messages with process information
- periodical information
- messages with system information (e.g. parameters)

Peripheral elements are linked with the master control element via the Ax 1703 peripheral bus. Up to 2 peripheral elements can be connected directly (via USB interfaces), up to 16 peripheral elements can be connected with usage of bus interface modules.

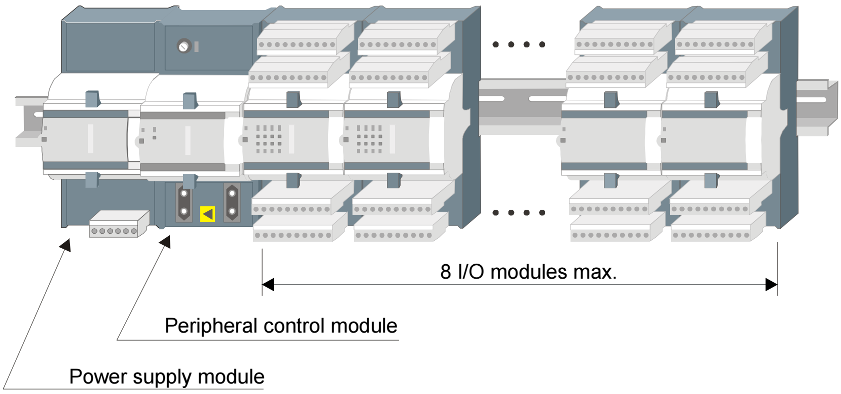
Structure of the peripheral element

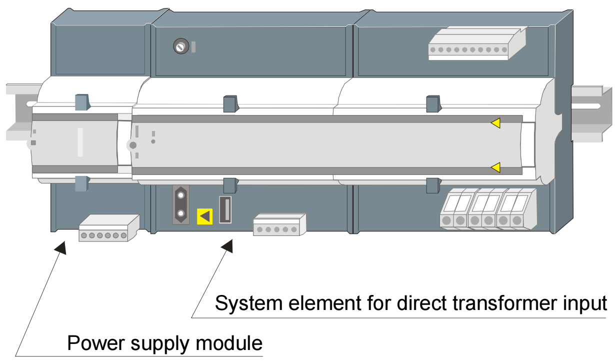
A peripheral element consists of

- 1 power supply module
- 1 peripheral control module
- up to 8 I/O modules

or

- 1 power supply module
- 1 system element for direct transformer input





Power Supply Module

A power supply module ensures the supply for the peripheral element. There are 2 types with enhanced electromagnetic compatibility available.

Product Overview

Type	Designation	Power
PS-6630	Power Supply Module 24-60 VDC (EMC+)	8.0 W
PS-6632	Power Supply Module 110-220 VDC (EMC+)	8.0 W

Peripheral Control Module

The peripheral control module is linked with the master control element or with the bus interface module by means of simple, standardized cable, thereby reducing the assembly effort required for their connection to a minimum.

Functions of the peripheral control module

- Secured data exchange with the master control element
- Secured data exchange with the connected I/O modules via the TM 1703 peripheral bus (TM bus)
- Monitoring of the connected I/O modules
- Preprocessing of the input and output signals

The communication between the I/O modules and the peripheral control module takes place via the TM bus according to the master/slave method, the I/O modules being the slaves.

Product Overview

Type	Designation	Remarks
PE-6410/USIO66	Peripheral Controller (Ax-PE bus el)	optional
PE-6411/USIO66	Peripheral Controller (1x Ax-PE bus opt)	optional
PE-6412/USIO66	Peripheral Controller (2x Ax-PE bus opt)	optional
PE-6410/TCIO66	Peripheral Controller for TC 1703 (Ax-PE bus el)	optional
PE-6411/TCIO66	Peripheral Controller for TC 1703 (Ax-PE bus opt)	optional
PE-6412/TCIO66	Peripheral Controller for TC 1703 (2xAx-PE bus opt)	optional

I/O Modules

The I/O modules are added side by side to the peripheral control module. As soon as they engage with one another, contact will be established automatically throughout the TM bus so that no additional wiring is required. Even so, every single I/O module can still be exchanged separately. The installation may be horizontally or vertically.

Removable terminals (I/O connectors) are used for the simple handling of modules when they are to be mounted or exchanged. Since the terminals carry the wiring, no connections need to be disconnected when devices are exchanged.

How many I/O modules may actually be used per peripheral element and in what order they can be used, is described in the respective data sheets.

Functions of the I/O modules

- Acquisition and output of binary and analog process signals
- Secured data exchange with the peripheral control element via the TM bus

Product Overview

Type	Designation	Remarks
DI-6100	Binary Input 2x8, 24-60 VDC	optional
DI-6101	Binary Input 2x8, 110/220 VDC	optional
DI-6102	Binary Input 2x8, 24-60 VDC 1ms	optional
DI-6103	Binary Input 2x8, 110/220 VDC 1ms	optional
DI-6104	Binary Input 2x8, 220VDC	optional
DO-6200	Binary Output Transistor 2x8, 24-60 VDC	optional
DO-6212	Binary Output Relays 8x 24-220 VDC/230 VAC	optional
DO-6220	Command Output Base Module	optional
DO-6221	Command Output Base Module with Measurement	optional
DO-6230	Command Output Relay Module	optional
AI-6300	Analog Input 2x2 ±20 mA/±10 V	optional
AI-6307	Analog Input 2x2 ±5mA	optional
AI-6308	Analog Input 2x2 ±2mA/±10V	optional
AI-6310	Analog Input 2x2 Pt100/Ni100	optional
AO-6380	Analog Output 4x ±20 mA/±10 mA/±10 V	optional
TE-6420	Speed Measurement 2x2 5 VDC/24 VDC/NAMUR	optional
TE-6430	Counting Pulse Input 2x 24…60 VDC	optional
TE-6450	Position Acquisition 2x2 SSI/RS-422	optional

System Elements for Direct Transformer Connection

TM 1703 ACP provides additional TM modules for direct transformer input. These system elements do not require a peripheral control module.

Product Overview

Type	Designation	Remarks
AI-6303/TIPS05	Direct Transformer Input (4x220 V,3x6 A)	optional
AI-6304/TIPS05	Direct Transformer Input (4x220 V,3x6 A)	optional

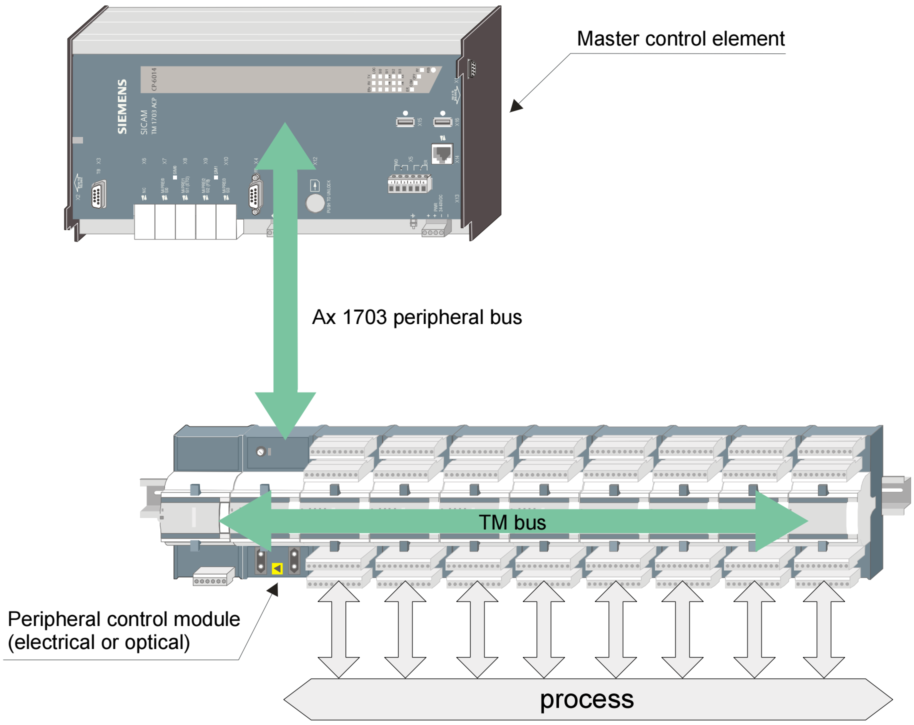
Ax 1703 Peripheral Bus

The Ax 1703 peripheral bus permits the secured (hamming distance 4), serial in-system communication between the master control element and the peripheral elements.

The Ax 1703 peripheral bus may be accessible via external connectors (optical or electrical).

Serial communication also makes it possible to locally detach individual or all peripheral elements via optical links by up to 200 m without sacrificing any of the full system functionality. Where electric links are used, standardized USB cables up to a maximum length of 3 m are used.

The communication at the Ax 1703 peripheral bus takes place according to the master/slave method, the peripheral elements being the slave and the master control element the master.



Each peripheral element represents, regardless of its

- function
- data volume
- processing

one of up to 16 possible slave participants at the Ax 1703 peripheral bus.

Addressing of the bus participants is handled for all peripheral elements via a logical peripheral board address (PBA) that can be set on the peripheral control module.

The interfaces between the system elements are memories whose contents are transmitted periodically (every 10 ms) by the Ax 1703 peripheral bus. It is defined for each system element which and how much information is transmitted.

Via the Ax 1703 peripheral bus, 2 logical channels are implemented:

- Periodical channel for the function package "Automation".

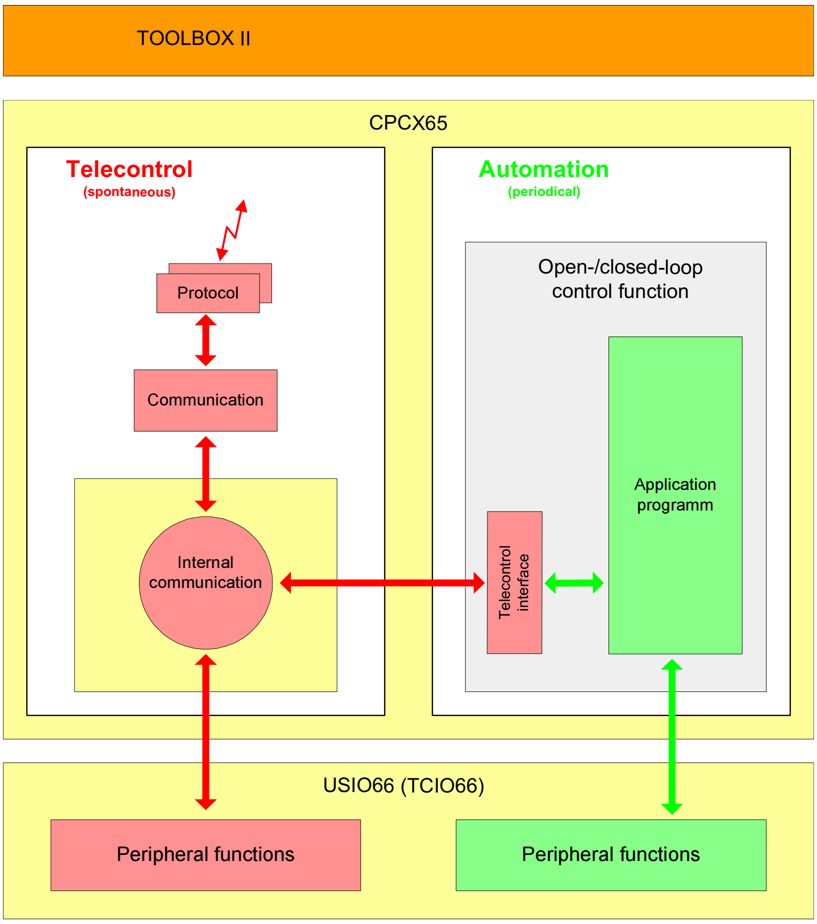
  The periodical channel permits the data exchange between the master control element and the peripheral elements in the cycle of the *open-/closed-loop control function* in the master control element. This way, non-linearized and conditioned (adapted) values are supplied to the input module of the *open-/closed-loop control function* and passed on by the *open-/closed-loop control function* to the output modules.

- Spontaneous channel for the function package "Telecontrol".

  The spontaneous channel permits the data exchange between the master control element and the peripheral elements. This way, the *messages with process information* and the *messages with system information* are transmitted in the acknowledged mode in a spontaneous time window within the acquisition and output grid.

Firmware Architecture

The specific firmwares for the individual system elements are stored within the TOOLBOX II. Firmware updates can be loaded, if necessary, easily into the respective system elements by means of the firmware loader of the TOOLBOX II.



Engineering

The costs for the creation and maintenance of automation technology plants are determined to an increasing degree by the costs for the creation and updating of the engineering data. The engineering data therefore represent major capital goods of the company, the creation and updating of which by means of a high-quality engineering system results in a considerable reduction of the indirect costs.

For this reason, Siemens places great importance on the engineering systems in its product range, and with the TOOLBOX II, thus consequently continues its policy of always providing high-quality, ergonomic products based on innovative system technology, also in the field of engineering systems.

The high demands on the easy and intuitive operability as well as on the overall ergonomics of an engineering system are satisfied by the TOOLBOX II through an operating and display technology based on the latest state of technology.

- Fully graphical user interface with easy operation and uniform "Look and Feel" (Window technology, Menus, Icons, Help System)

as well as through forward-looking conception

- Industrial standard database system ORACLE ™
- Network support (TOOLBOX II Peer Server)
- Client/Server architecture
- Standard operating systems (Windows NT, Windows 2000, Windows XP)
- Standard hardware (Personal Computer)

The TOOLBOX II constitutes an integrated overall tool

- All engineering data are stored, managed and processed – on the same hardware platform in a central database – by the same tool; a transfer of data between devices and tools is not necessary.
- Besides the entire SICAM 1703 product line, SICAM 230 is also configured by means of the TOOLBOX II.
- If an exchange of data with devices or systems of other manufacturers should be necessary, then there is a specific data interface for this available that is simple to operate, the source data management.

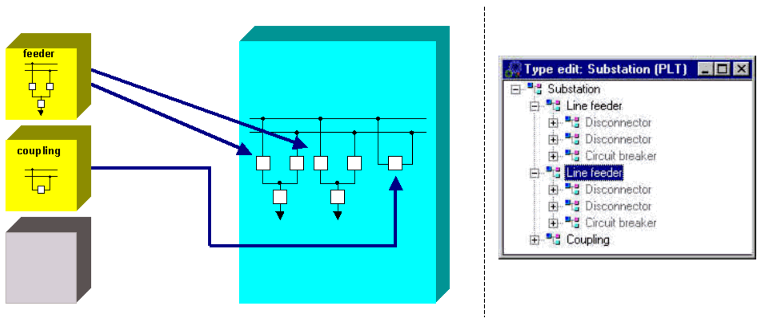
During the entire lifecycle of the plant, the TOOLBOX II comprehensively supports all phases of the plant configuration and maintenance for the entire SICAM 1703 system family. The engineering with the TOOLBOX II therefore goes far beyond conventional device parameterization and comprises the following areas:

- Data acquisition, data modeling
- Parameter setting, test and diagnostic
- Documentation
- Backup and archiving
- Maintenance

Data Acquisition, Data Modeling

The plant is at the center of the configuration procedure:

Feeders Plant OPM II View



For same type primary technology units and resources (objects), types can be modeled, which contain the characteristics of the objects. During engineering, such objects can be created identically many times very easily (one speaks of instantiation). As a result considerable savings can be achieved.

The advantages outweigh not only with the creation but also with the updating of the data for expansions and with consistent change of all same-type objects as well as with the achievable quality with regard to consistency of the engineering data.

User Programs for the Open-/Closed-Loop Control Function

User programs for the *open-/closed-loop control function* are created according to IEC 61131-3 using CAEx *plus*, a tool of the TOOLBOX II. This standard is generally accepted in the market and is recognized. Engineering according to this standard generally only requires short training periods.

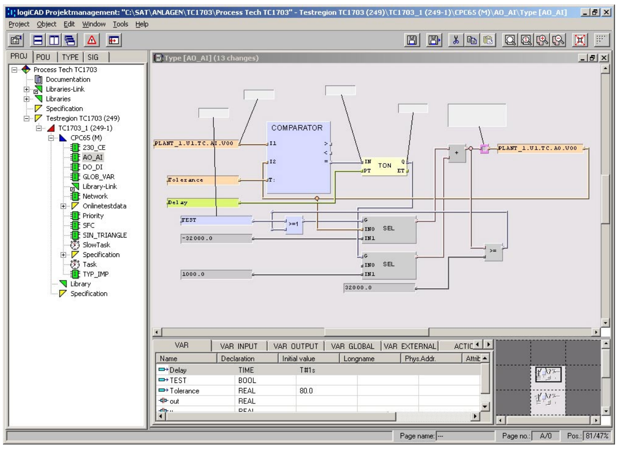
Thereby versatile applications can be easily realized:

- Logical links
- Sum commands, sum alarms
- Limit monitoring
- Bay- and station-related interlocks
- Synchronous comparison with analog of busbar
- Switchover automation, switching sequences (busbars, transformers etc.)
- Step-by-step controls
- Closed loop control (tap changer controller, turbine governor, etc.)

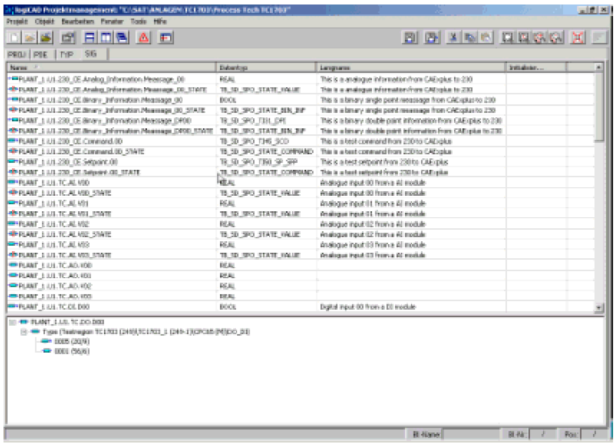
Test Functions

There are various test function available, both offline as well as online. Consequently, test and commissioning periods can be kept very short.

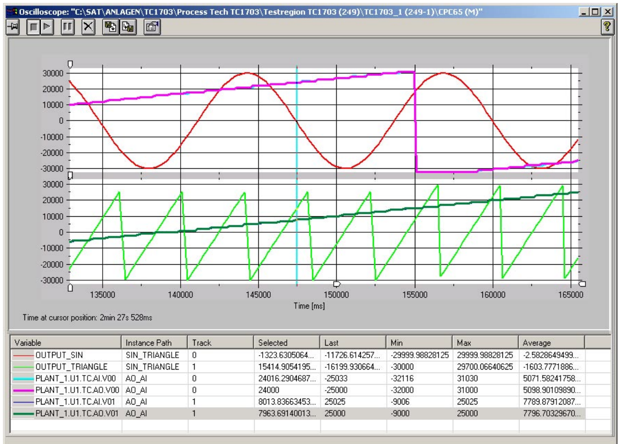
Function chart editor CAEx *plus*



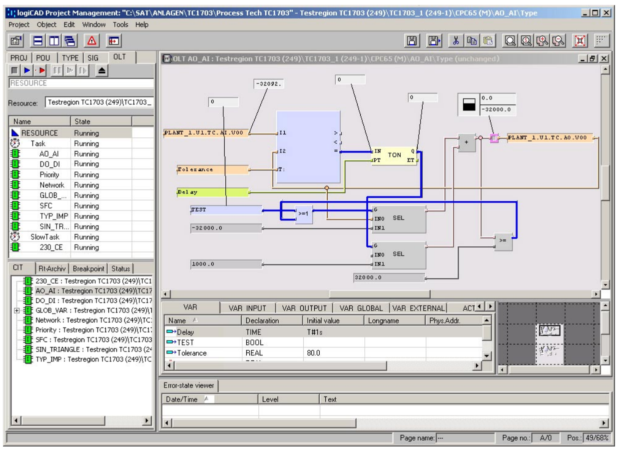
Signal list display



Test function Oscilloscope



Online test



Function Packages

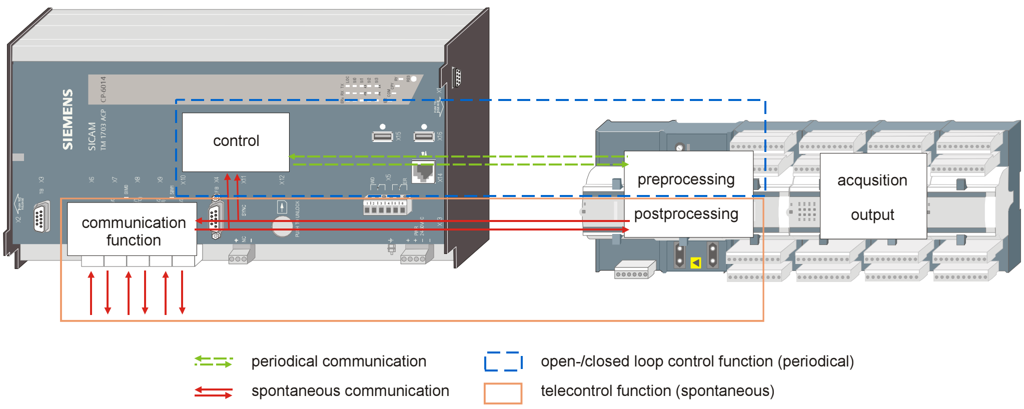
Overview

Due to the different requirements in terms of functionality, also different data flow concepts are produced.

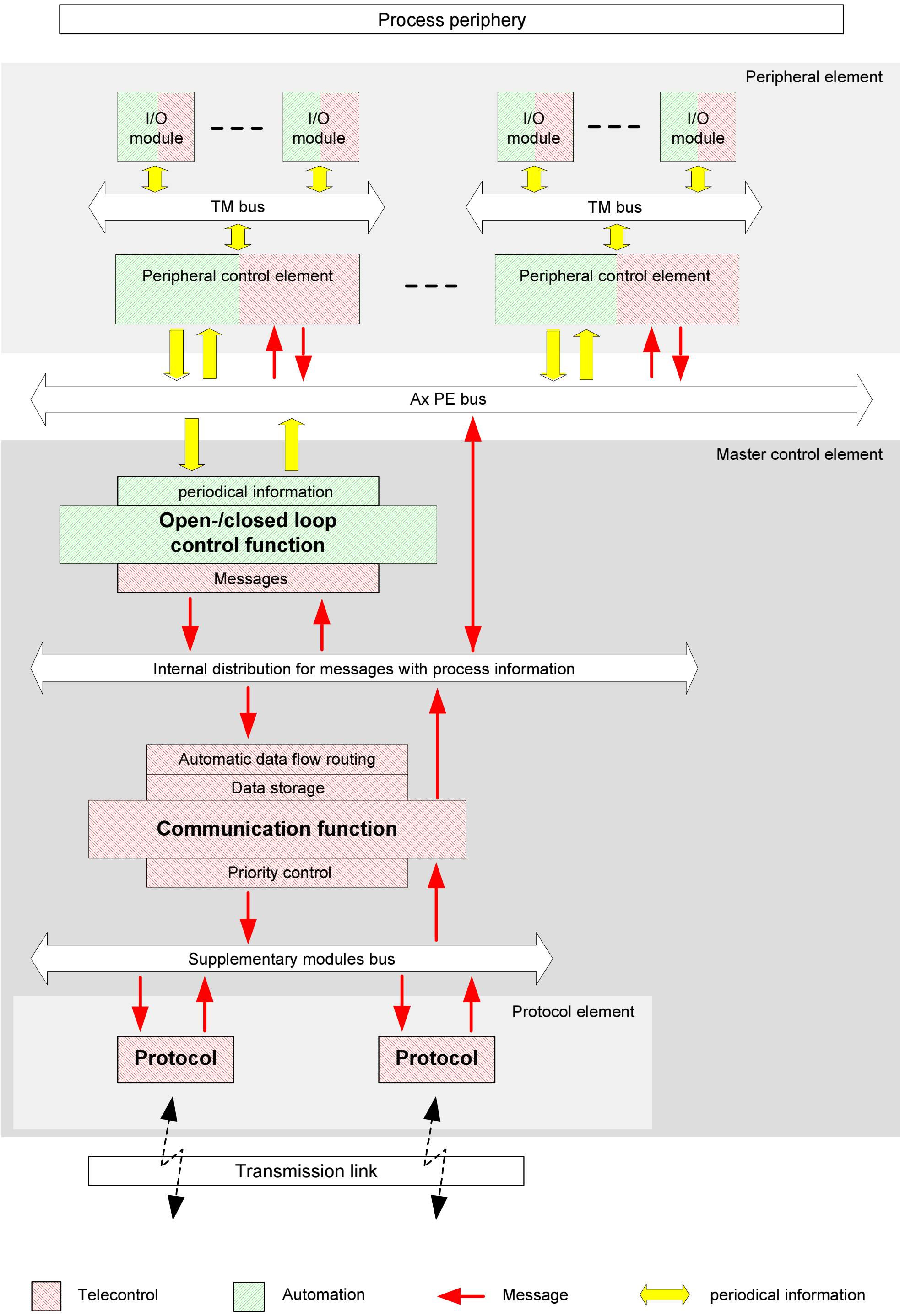
The implementation of freely definable open-/closed-loop control functions ("Automation") calls for a deterministic guaranteed reaction time. This is achieved by using the consistently periodic concept with regard to data acquisition, execution of functions, and data transfer, regardless of the number of changing signals.

For telecontrol tasks and the distribution of user data in networked plants ("Telecontrol"), the use of spontaneous transmission proves advantageous for optimizing the utilization of the in many cases limited communication bandwidth. This helps avoid constant burdening of the data sinks with unnecessary data.

While in classical programmable controller devices, the design is primarily adapted for the open-/closed-loop control functions - that is, for a periodical traffic - classical telecontrol devices in turn only prove advantageous in spontaneous data exchange. By way of the integration of both functional packages in one system, both requirements are accomplished equally well, for high-load cases they can even be mutually prioritized.



Functional Packages – Architecture



A detailed description of the function packages can be found in the document *ACP 1703 Common Functions System and Basic System Elements*.

Telecontrol

The function package Telecontrol includes the following functions:

- Process input and output on peripheral elements
- Communication with other automation units
  - Automatic data flow routing
  - Data storage
  - Priority control
- Protocol elements
- Redundant communication routes
- Communication within the automation unit
- Protocol element control and return information
- Decentralized archive

Process Input and Output on Peripheral Elements

- Acquisition of the process data
- Processing, generation and transfer of *messages with process information* via the Ax 1703 peripheral bus
- Time tag with 1 ms or 10 ms resolution, dependent on the respective I/O module
- Reception of *messages with process information* via the Ax 1703 peripheral bus
- Processing and output of the process data

Communication with Oher Automation Units

The communication function controls the transmission of messages via protocol elements to other automation units or control systems.

A protocol element is based on a serial interface module (SIM) that can be installed on a basic system element for serial, LAN/WAN and field bus communication. It supports standard protocols according to the standards IEC 60870-5-101/103/104 and a large number of protocols for the communication with third-party systems.

The communication function differentiates between transmission and receive direction.

Communication function in transmit direction

The messages to be transmitted are learned through the automatic data flow routing and stored in the data storage. The transfer of the messages from the data storage to the protocol elements takes place via a priority controller in order to optimally utilize the transmission route.

- Automatic data flow routing
- Data storage
- Priority control

Communication function in receive direction

- *Messages with process information* are distributed to all functions within the automation unit.
- *Messages with system information* are either processed directly (e.g. station interrogation) or distributed further based on their destination address (CASDU) (e.g. messages for remote maintenance).

Automatic Data Flow Routing

For the automatic data flow routing, a routing of individual process information items is not necessary. Simply only the direction (monitor direction, control direction, both directions), in which the messages are to be transmitted, is to be parameterized.

The type identification of each message provides information about the class (refer to Messages with Process Information) to which a message belongs and with which methods it is to be distributed:

- *Messages with process information in monitor direction*
  - In simple applications, the messages are distributed via an entry in the topology.
  - For more complex applications, the messages can be distributed selectively with the help of the *data flow filter*.

    For each communication interface, pass-through filters or blocking filters can be set. Since wildcards can also be used for all address attributes of the message, it is possible to control the data flow very specifically with simple means.
- *Messages with process information in control direction*
  - The messages are distributed to the destinations determined by their CASDU over interfaces that are defined in the topology. The CASDU is interpreted as destination address.

Data Storage

Messages that are intended for transmission over communication interfaces, are in principle stored chronologically in rings. There is a process image both before and after a ring. The arrangement, consisting of one ring and two process images, is called a priority channel (priority channels for transparent data do not have any process images).

Depending on the data communication mode of the protocol element over which the communication is processed, priority channels are provided for every priority of the messages to be transmitted and for every station that can be reached via the protocol element:

- Data communication mode "Multi Point" (e.g. multi-point traffic, LAN)

  One priority channel for every transmission priority, for every station and for every protocol element
- Data communication mode "Single Point"

  One priority channel for every transmission priority and for every protocol element

With regard to the data that they transport, priority channels are distinguished as follows:

- Time synchronization
- System information
- Process information in control direction
- Process information in monitor direction Priority HIGH with class 1 data
- Process information in monitor direction Priority MEDIUM with class 2 data
- Process information in monitor direction Priority LOW with class 2 data
- Transparent information

Functions for priority channels:

- State compression for measured values (can be set using parameters)

  Specifically reduces the flood of messages, that can continuously generate fluctuating measured values
- Behavior with a priority channel overload
- Behavior during a communication failure (transmit direction)
- Monitoring of the dwell time (parameter-settable) of *messages with process information in control direction*

  Messages that are stored too long in the priority channel are discarded
- Answering of station interrogations
- Behavior during failure of peripheral elements, communication interfaces etc.
- Blocking (series of information elements)

Priority Control

The priority controller has the task of selecting messages recorded in the data memories independently and individually for each interface and station and to direct the transmission of the messages via the protocol elements in accordance with their priority. This ensures, that with several information items queued at the same time, the higher-priority, highly important information is transmitted first.

The prioritization, however, does not represent an absolute priority status, but rather a measure for the distribution of the channel capacity. This ensures, that even with continuously available higher-priority data, those of lower priority can also be transmitted.

Communication within the Automation Unit

Within an automation unit, the function package Telecontrol communicates with the function package Automation via its Telecontrol Interface. The functions are described there.

Protocol Element Control and Return Information

This function is used for the user-specific influencing of the functions of the protocol elements. The main application lies with protocol elements with multi point data communication mode and especially for dial-up traffic configurations.

This function contains two separate independent parts:

- Protocol element control
  - test if stations are reachable
  - suppression of errors with intentionally switched-off stations
- Protocol element return information
  - cost control of telephone charges
  - cost-efficient utilization of the telephone line (example: command initiation only then, when a connection has already been established)

Decentralized Archive

During a communication failure, in the master control element data are stored in the decentralized archive (DEAR). After the communication fault has been rectified, the control system can read out the decentralized archive of the master control element. Through this function, a possible loss of data is prevented.

Features of DEAR:

- Reconstruction of all process-relevant data
- Transmission of the archive to the control system
  - Automatic initiation by the control system after communication fault
  - File transfer acc. to IEC 60870-5-101
- Data saving
  - Datapoint-specific (parameter-settable)
  - Number of files, memory size parameter-settable
  - Binary information, integrated totals: spontaneous
  - Measured values: definable cycle
  - Non-volatile on flash card
- Configuration acc. to IEC 60870-5-101/104 (point-to-point, multi-point traffic, dial-up traffic, Ethernet), also multi-hierarchical configurations possible
- SICAM 230 or third-party control system possible
- Reading of the archive possible via webbrowser or via the TOOLBOX II
- Front-end: AK 1703 ACP, optionally redundant

Automation

The function package Automation includes the following functions:

- Process input and –output on peripheral elements
- Telecontrol functions
  - Treatment for commands according to IEC 60870-5-101/104
  - Change monitoring and generation of messages with time tag
- *Open-/closed-loop control function*

Process Input and Output on Peripheral Elements

- Acquisition of the process data on the peripheral elements
- Processing, periodical transfer of the process information to the *open-/closed-loop control function*
- Periodical acceptance of process information from the *open-/closed-loop control function*
- Processing and output of the process data

The detailed description of these functions can be found in the document *SICAM 1703 Common Functions Peripheral Elements according to IEC 60870-5-101/104* (refer to Literature).

Open-/Closed-Loop Control Function

The *open-/closed-loop control function* is used for the management of automation tasks with the help of an application program.

The creation of the application program is carried out by the TOOLBOX II with the tool CAEx *plus* predominantly in function diagram technology according to IEC 61131-3.

The application program processes process information (so-called signals) from the peripheral elements connected to the basic system element and / or from other system elements in the automation network of the specific process-technical plant.

Process images form the interface of the application program to the outside world. We distinguish between input process images and output process images.

The exchange of the process information can take place in two ways:

- Transmission of periodical information from and to the peripheral elements connected to the basic system element via the Ax 1703 peripheral bus (Process Input and Output On Peripheral Elements)
- Transmission of spontaneous information objects from and to functions or peripheral elements within the automation unit, other open-/closed-loop control functions and other automation units or control systems with the help of the telecontrol function (Transfer of Messages with Process Information and Change Monitoring and Generation of Messages with Time Tag)

The *open-/closed-loop control function* supports 32 programs (type instances), whereby each program is assigned one of three periodical tasks. As a result, fast controls can be optimally combined with slower background processings.

The management of these three periodical tasks (Task Management) corresponds with the standard IEC 61131-3. Spontaneous tasks are not supported.

Variables, signals (input process images for spontaneous information objects) and function blocks can be saved non-volatile. That means, that after a power failure these variables and signals are immediately available again with their values before the power failure.

Telecontrol Interface

Transfer of Messages with Process Information

Reception of *messages with process information* and transfer to the open-/closed-loop control function for the purpose of further processing.

Messages with process information in monitor direction:

- Single-point information
- Double-point information
- Step position information
- Measured values
- Integrated totals
- Bitstring of 32 bit

Messages with process information in control direction:

- Single commands
- Double commands
- Regulating step commands
- Setpoint commands
- Bitstring of 32 bit

Treatment for commands according to IEC 60870-5-101/104

The treatment for commands serves for the check of the spontaneous information objects to be processed with the help of the *open-/closed loop control function* and transmission of the confirmation for:

- Pulse commands (single commands, double commands, regulating step commands)
- Setpoint values (setpoint command)
- Bitstring of 32 bit

The data transfer of the spontaneous information objects to the application program of the open-/closed-loop control function for further processing is dependent on the result of the checks.

The activation of the element or function to be controlled is the task of the application program of the open-/closed-loop control function.

For the proper operation of this function, information is required by the application program of the open-/closed-loop control function (e.g. from an interlocking logic) for the choice of a positive or negative confirmation.

The treatment for commands can be activated individually for each command via a parameter.

The treatment for pulse command comprises the following processing functions:

- Prepare command output procedure
  - formal check
  - retry suppression
  - 1-out-of-n check
  - direct command or
    select and execute command
  - control location check
  - command locking
  - system-element overlapping 1-out-of-n check
- Initiate command output procedure
  - command to application program
- Monitor pulse duration (only pulse commands)
  - command output time
  - return information monitoring
- Terminate command output procedure

Change Monitoring and Generation of Messages With Time Tag

For the generation of messages with process information, the signals in the output process images that are assigned to an element of a spontaneous information object, are monitored for change.

The change monitoring takes place in a grid of the cycle time of each task, in which the signal is assigned to a spontaneous information object.

On a change of the state in a corresponding element of the spontaneous information object, the generation of the message is initiated.

Depending on the type of signal to be monitored, different methods are applied:

- Change of the state (positive edge, positive and negative edge)
- Change of the value (according to the rules of the additive threshold value procedure)

If a spontaneous information object has been activated for transmission due to a change, a *message with process information* is generated. The time tag represents either the current time synchronous with the cycle (resolution 10 ms or multiples of 10 ms) or the time information from an assigned spontaneous information object.

Additive threshold value procedure

The additive threshold value procedure prevents an unnecessary loading of the transmission links with insignificant changes of the corresponding signal and acts only on the basic data of the spontaneous information objects with measured values.

Task Management

The *open-/closed-loop control function* manages the application programs in 3 tasks running periodically:

- "Fast Task"
- "Task"
- "Slow Task"

Coordination of the sequences of a task

- Periodical start in the selected cycle
- Input handling
- Program processing
- Output handling
- Online Test
- Real time archive

Coordination of the three tasks with each other

- "Fast Task" runs without interruption and with constant running time
- "Task" and "Slow Task" can be interrupted by higher-priority functions

Cycle time

- Within the cycle time, all programs assigned to a task (type instances) must process the input handling and the output handling for this task
- The cycle time can be set in the tool CAEx *plus* for each task.
- The cycle times of the three tasks must be different and ascending from the "Fast Task" to the "Slow Task".

Watchdog timer

This function monitors the proper sequence of each task within its set cycle time. If a task is not finished with its input handling, program processing and its output handling within this time, the next cycle for this task is omitted and a time-out is signaled.

With serious time-outs, for example due to a malfunction, the reliability of the application program becomes questionable. A time scale can be defined for such cases, the exceeding of which leads to an error message and a controlled shutdown of parts or the entire application program as well as all peripheral elements connected.

Loading the Application Program

Initial loading

The initial loading of an application program is always associated with a startup.

Loading of changes (reload)

Frequently, in the test and commissioning phase but also with the remedy of faults, changes must be carried out. Most such changes (error rectifications, expansions) to the application program can be loaded without interruption to operation. Far-reaching changes can necessitate a startup of the basic system element and consequently an interruption to operation.

In the case of a loading operation that does not necessitate any interruption to operation, all tasks of the *open-/closed-loop control function* continue to run unaffected. After successful loading, a switchover to the newly loaded application program takes place synchronous with the cycle.

Examples of changes that do not necessitate any interruption to operation:

- If after change, the function corresponds completely with that before change, in other words a change has been performed that is not noticeable from "outside"
- If only new functional parts were added, that do not affect those that already existed
- If parameters of a controller are adapted

Fundamentally however, the fault-free operation and consequently the availability of every control or controller depends on the quality of the program – in other words the measure of how free they are of formal and logical errors. The loading of error-burdened changes can always lead to interruptions to operation.

Online Test

The entire functionality of the online test applies to

- the TOOLBOX II tool "CAEx *plus* Online Test" and
- the online test function of the *open-/closed-loop control function* of the automation unit

While in the tool "CAEx *plus* Online Test", all functions of the man-machine-interface can be found, the *open-/closed-loop control function* provides functions for the execution of the operator inputs.

If for example a value is to be displayed, then the selection of the value and its display takes place in the tool "CAEx *plus* Online Test". For this purpose, the *open-/closed-loop control function* is given the task of reading out the selected value and transmit it to the TOOLBOX II.

In the following, those functions are listed that the online test function of the *open-/closed-loop control function* provides.

Display and setting of variables and signals

- Display of variables and signals
- Single setting of variables (single forcing)

  The value of a variable can change again at any time after setting, due to the function of the program
- Permanent setting of variables and signals (permanent forcing)

  In order to be able to set variables and signals permanently, a special element ("force marker") is set in the function diagram. This element contains the set value and a switch. Depending on the position of the switch, the set value and or that value is transferred, that the source that normally supplies the variable or the signal, is delivered.

Blocking and enabling of messages with process information and periodical information

The copy operation in the input-side or from the output-side process images of

- *Messages with process information*
- Periodical information

can be blocked and enabled. This can take place with the following granularity:

- Per message
- All messages
- Per periodical information
- Each peripheral element

Changing the execution status of the open-/closed-loop control function

- Perform cold start or warm start of the resource
- Start and stop controller
- Perform cold start or warm start of a task
- Task halt and continue
- Program halt and continue

Test means

The available test means are:

(a) Halting of the execution due to a trigger condition ("Breakpoint")
(b) Execution of a task in cycle steps
(c) Controlling of the recording of the cyclic archive "Real Time Archive"

For each of the functions (a) and (c) a trigger condition is defined in the tool "CAEx *plus* Online Test". A trigger conditions consists of up to conditions. The conditions of a trigger condition are combined equal-ranking with AND or OR.

A condition compares a variable with a constant value to be specified:

<table>
<tr><th>Variable of the Type</th><th>Condition</th><th colspan="4"><operator></th></tr>
<tr><td>BOOL</td><td>variable <operator> value</td><td colspan="2">=</td><td colspan="2"><></td></tr>
<tr><td>INT or REAL</td><td>variable <operator> value</td><td><</td><td>=</td><td><></td><td>></td></tr>
</table>

The trigger condition is assigned to either a task or the resource (= all tasks), depending on what one wishes to achieve:

- The function **Halt the execution due to a trigger condition** halts the task or resource, if the trigger condition is satisfied
- The function **Real Time Archive** switches over from Recording the Pre-History to Recording the Post-History, if the trigger condition is satisfied

The trigger condition is evaluated at the end of that task, to which it has been assigned; or at the end of every task, if it has been assigned to the resource.

Real time archive

The real time archive of the *open-/closed-loop control function* records variables (and signals) after every cycle, in order to make then available for display with the oscilloscope function of the TOOLBOX II tool "CAEx *plus* Online Test". Which variables are to be recorded is defined in the "CAEx *plus* Online Test". The recording can be controlled in such a way, that pre- and post-history are available for a post-mortem analysis.

For the recording of the variables there is a memory of 100,000 bytes available for each resource.

The recording can be terminated with

- An operator input in "CAEx *plus* Online Test"

  The recording is terminated, the entire memory is available as pre-history.
- A definable Trigger condition

  The real time archive switches from Recording the Pre-History to Recording the Post-History and continues to record until the memory is full. The division of the memory into pre- and post-history can be defined.

Which variables are to be recorded and at which periodicity, is determined in the "CAEx *plus* Online Test". The periodicity is determined by assigning the recording to a task. From its cycle time and the setting of how many cycles are to be omitted between the recordings, the recording times are produced and consequently the resolution of the display in the oscilloscope function:

*Resolution[ms] = cycle time[ms] of the selected task * (number of cycles to be omitted +1)*

The time period for the pre- and post-history is dependent on the number of variables to be recorded (*# of Var*) and the aforementioned *resolution*:

*Period[ms] = (100000 * resolution[ms]) / (# of Var BOOL) + 2*(# of Var INT) + 4*(# of Var REAL)*

Display status information

For each task the following information items are made available to the TOOLBOX II on request:

- The parameterized cycle time
- The current run time (in 10 µs)
- The maximum run time (in 10 µs)
- The number of time-outs that the system has registered

During the course of the interrogation, the current run time and the number of time-outs can be optionally reset.

System Services

System Services is a function package, that provides general functions and basic services in an automation unit, that other function packages require:

- Communication with the Engineering System
- Data Flow Control
- Addressing
- Time Management
- General Interrogation
- Self Test
- Failure
- Diagnosis and Signaling
- Autonomy

Communication with the Engineering System (TOOLBOX II)

For the communication between the TOOLBOX II and the automation unit, in two respects there are different variants:

- Physical connection of the TOOLBOX II with an automation unit
  - direct local via the serial Toolbox interface (TB) on the master control element
  - remote
    - serial via modems
    - Ethernet (TCP/IP) and Terminal Server (serial)
    - Ethernet (TCP/IP)

- Logical connection of the TOOLBOX II with that automation unit, that is the subject of the engineering task:
  - Local automation unit
    (that is that one, to which the physical connection exists, regardless in which of the above mentioned forms)
  - Remote automation unit
    (automation unit that can be reached via the local automation unit; consistent remote communication according to IEC 60870-5-101 or -104 is required)

With the exception of the very first initialization procedures, all tasks are possible in each of the above mentioned variants, including for example:

- Parameter setting
- Diagnostic
- Test (for example online test of an application program of the *open-/closed-loop control function*)
- Load firmware, load parameters

Data Flow Control

The data flow control is that system function which co-ordinates the communication of messages within the automation unit.

This function supports:

- *Messages with Process Information*
- *Messages with System Information*

For the tracking of messages within an automation unit the following test functions are available:

- Data Flow Test
- Message Simulation

Messages with Process Information

IEC 60870-5 distinguishes between the following classes of messages. The type identification of each message provides information about the class to which a message belongs and with which methods it is to be distributed:

- *Messages with process information in monitor direction*
  - binary information, measured values, integrated totals and bit patterns
- *Messages with process information in control direction*
  - commands, setpoint values and bit patterns

The distribution of *messages with process information* takes place by way of routing (telecontrol) or assignment (open- / closed-loop control function) based on the message address and type identification in the message.

Messages with process information, that are to be transmitted to other automation units via protocol elements, are distributed with the help of the function Automatic Data Flow Routing.

For *messages with process information* that are to reach sinks within the automation unit - such as for instance peripheral elements or the *open-/closed-loop control function* - the routing information or assignments are automatically derived from parameters from OPM-inputs (datapoint address).

Predominantly used are message formats according to IEC 60870-5-101 / 104 in the public range with the exception of user data containers. Therefore, for their part the messages are compatible and interoperable with many other manufacturers.

Within the SICAM 1703 family, when using standard protocols the messages are compatible with the system families **Ax 1703** (AK 1703, AM 1703, AMC 1703, BC 1703) and **ACP 1703** (AK 1703 ACP, TM 1703 ACP, BC 1703 ACP).

Messages with process information have a 5-stage message address. Message addresses must be parameterized at the sources, such as for instance peripheral elements or the *open-/closed-loop control function*.

Addressing of the Process Information

Each data point is addressed in the automation network according to IEC 60870-5-101/104 by means of:

CASDU 1………Common address of the ASDU, octet 1
CASDU 2………Common address of the ASDU, octet 2
IOA 1……………Information object address, octet 1
IOA 2……………Information object address, octet 2
IOA 3……………Information object address, octet 3

Messages with process information in monitor direction are source-addressed, *messages with process information in control direction* are destination-addressed.

Addressing of Automation Units and System Elements

Addressing of Automation Units

An automation unit is addressed by means of:

- Region number (0…249) and
- Component number (0…255)

Within a system-technical plant each automation unit must be unambiguously addressed. Therefore a system-technical plant may consist of up to 64.000 automation units.

Addressing of System Elements

Within an automation unit, system elements are addressed by means of numbers for:

- Basic system elements
- Peripheral elements
- Protocol elements

Time Management

It is an integral element of the time management, that each automation unit and each system element, that has a time-dependent function to fulfill, can manage a clock with corresponding accuracy and resolution. Each automation unit has a central clock, the so-called time server.

Clock

In error-free operation the clocks are set once with the *time setting* operation and then run completely autonomous without any further time setting mechanisms. Afterwards the *time synchronization* ensures, that all time servers in all automation units run synchronously.

All clocks within an automation unit are operated and synchronized by a central 10 ms clock pulse, that is generated by the time server of the automation unit with an accuracy of < 1 ms.

With a restart, all clocks begin to run unsynchronized with the value 0 hours. In other words, until the first *time setting* they have only a relative time, that is flagged with "invalid".

Time Setting and Time Synchronization

There are many options available for time setting and time synchronization:

- Direct serial connection of a DCF77 or a GPS time signal receiver
- Time setting over the communication (serial, LAN) from a master station, time synchronization by means of minute pulse of the GPS- or DCF77-receiver
- Time setting and time synchronization over a serial communication
- Time setting and time synchronization over LAN (Ethernet TCP/IP-NTP)

The system itself can provide further automation units with time over communication lines, and can perform the time synchronization with serial standard protocols.

If the external time synchronization fails, the system continues to operate based on the internal clock (free run).

Automatic Time Tag (Time Stamp)

At every point in the system where messages with process information are generated, these messages can be provided with a time tag. Resolution and accuracy of the time tag are dependent on

- the function that generates the time tag
- the system element in which this takes place.

The transfer of the data with standard protocols takes place with 7 octet time (in other words including date, with 1ms resolution) and priority-controlled.

General Interrogation

On startup and after faults in the system (communication faults, FIFO overflows), the participating automation units ensure, that the operation is resumed automatically in a coordinated manner.

This means, that the internal and external communication connections are set up (again). Under consideration of a multi-hierarchical network, all affected data and relevant system information are transmitted throughout the system from their sources though to their sinks for the purpose of updating the process images. This takes place with the initiation of a general interrogation to the corresponding part of the automation network, in which the error occurred.

Self Test

The self-test is used for the protection against inadmissible operating states. Through a series of monitoring operations, defects of the hardware used or faulty behavior of the firmware are detected.

Depending on which test is concerned, a test is performed:

- During startup and/or
- Continuously during operation

Monitoring of Hardware and Firmware

Monitoring	detects	Note
Watchdog monitoring	• Defect of the CPU used • Faulty behavior of the firmware	
IDLE monitoring	• Faulty behavior of the firmware or application program with endless loops • Excessively long firmware run times etc	
Code memory monitoring	• Defect of the storage medium used (Flash-PROM or flash card) • Undetected transmission errors when loading the program code	Checksum
Parameter memory monitoring	• Defect of the storage medium used (Flash-PROM or flash card) • Undetected transmission errors when loading the parameters	Checksum
Firmware self-monitoring	• Incorrect call parameters with system services and programming errors	
Shadow RAM	• Defect of the storage medium used (DRAM) • Defect of the DRAM refresh logic implemented	
RAM test with addressing errors check	• Defect of the storage medium used (DRAM) • Defect of the READ/WRITE equipment • Defect of the RAM in a defined area • Defect of the DRAM refresh logic implemented • Short or interruptions on the data and address bus	

Monitoring	detects	Note
Monitoring forbidden memory access	• Firmware errors	CPU exception handling
Monitoring forbidden I/O access	• Firmware errors when accessing the I/O address range • Hardware errors	CPU exception handling
Illegal Opcode	• Firmware errors with e.g. jump operations • Defect of the storage medium used (Flash-PROM) • Defect of the READ equipment • Short or interruptions on the data and address bus	CPU exception handling
Stack Overflow	• Firmware errors	• CPU exception handling • Firmware

Monitoring the Data Integrity

Monitoring	detects	Note
Messages with spontaneous information objects on internal interfaces	• Defect of the storage medium used (FIFO) • Internal communication errors	Checksum
Messages with periodical information on the Ax 1703 peripheral bus	• Communication errors on the Ax 1703 peripheral bus	• Hamming distance 4 • Horzontal and vertical parity

Failure

The system concept of failure management realized in SICAM 1703 ensures the individual marking of the data of failed parts of the system and the correct system and process behavior in the event of a fault.

For this the failure management provides:

- A system function for the failure detection (for instance for modules/system elements, communication)
- Derived from this the marking of the data points affected by the failure in the spontaneous communication with all data sinks such as
  - other automation units
  - the *open-/closed-loop control function*
  - the peripheral elements
- Periodical information that inform the *open-/closed-loop control function* which peripheral elements - and thereby which periodical information - are affected by the failure
- A parameter-settable behavior of peripheral elements with output function.

Consequently, for all data sinks (peripheral outputs, *open-/closed-loop control function*, control system) the state is available for every process information and - depending on requirements and functionality - corresponding measures can be initiated.

Diagnosis and Signaling

The diagnostic function manages the system states and error information detected by the individual functions and their monitoring operations.

It enables the display of process states, the internal system and fault information on the front panel of the modules and the local or remote diagnostic by means of the TOOLBOX II.

Each system element delivers its detected system- and error states to the master control element with supplementary information (for instance cause of error, originator description). There they are saved in tables as current and stored information. These information items can be read out and displayed in detail locally or remotely with the help of the TOOLBOX II. The stored information can be acknowledged and can thus be updated again. For the purpose of better clarity, these tables are divided into classes:

A sum information about the detailed errors is transmitted from each automation unit via the communication to the next automation units and is additionally managed there.

A TM 1703 ACP provides up to 2 relay outputs – each with normally open and normally closed contact – for signaling.

Important detail or sum information is displayed by means of LEDs on the front panels of the system elements.

Autonomy

Autonomy means, that an autonomous basic system element and its supplementary system elements (protocol and peripheral elements) continue to function unaffected during the failure of the master control unit. This behavior can be set for the basic system element by means of a parameter.

On failure of the master control unit, data points are flagged with "not topical", which

- are acquired by other system elements in the automation unit and not over the particular peripheral or protocol elements
- are acquired by other automation units that are not connected over the particular protocol elements.

After startup of the master control unit, the autonomous basic system element is synchronized without interruption to operation. Due to a general interrogation, the data points flagged with “not topical” on failure of the master control unit are updated.

Compatibility

Compatibility with the Existing SICAM 1703 Product Family

Existing plants with Ax 1703 automation units (AK 1703 (Ax-Mode), AM 1703 (Ax-Mode), AMC 1703 (Ax-Mode)) can be networked without problems with automation units described in this document, either over the serial standard communication according to IEC 69870-5-101 or via Ethernet TCP/IP according to IEC 69870-5-104.

Networking of automation units described in this document with other automation units of the ACP 1703 platforms is a standard feature and therefore supported.

Technical Specifications

General Data

Performance Characteristics

- Multi-processor solution
- Modular
- Spontaneous telecontrol function
- Combined open-/closed-loop control function (periodical)
- Online parameter-settable
- Loadable firmware
- Storage of application data and firmware on replaceable flash card
- Connection to engineering system TOOLBOX II via fiber optics
- Standard protocols according to
  - IEC 60870-5-101 (end-end, multi-point traffic, dial-up traffic)
  - IEC 60870-5-103 (protection device connection)
  - IEC 60870-5-104 (Ethernet TCP/IP)
- Third-party protocols DNP 3.0 and Modbus
- Transmission rate 50 to 38400 bps (standard baud rates)
- Spontaneous (acknowledged) transmission
- LED-signalling on the front panel of the modules

Mechanical Design

Mechanics	
Structure	Assembly system for mounting on 35 mm DIN rail • 1 Master control element – up to 2 Serial interface modules (SIM) for the communication • up to 2 Bus interface modules for connecting peripheral elements • up to 16 Peripheral elements – detached up to 3 m via USB cable, or – up to 200 m via fiber optic links
Dimensions (H x W x D)	• Master control element 155 x 306 x 75 mm • Bus interface module CM-0842 133.5 x 141 x 43 mm • Bus interface module CM-0843 131 x 63 x 73 mm • Peripheral elements PE-641x – per module 131 x 63 x 73 mm – fully equipped 131 x 630 x 73 mm • Peripheral elements AI-6303/-6304 131 x 252 x 73 mm
Weight	• Master control element approx. 1100 g • Bus interface module CM-0842 ca. 420 g • Bus interface module CM-0843 ca. 150 g • Peripheral elements PE-641x – peripheral control modules approx. 130…160 g [1)] – I/O modules approx. 225…300 g [1)] • Peripheral elements AI-6303, AI-6304
Connectors	
Connection system for peripheral signals and power supply	Plug-connectable screw terminal strips, wire cross section up to 2.5 mm²
Ax 1703 peripheral bus (TTL)	D-SUB 9-pin, female (DIN 41652)
Ax 1703 peripheral bus (TTL)	RJ45 8-pin, for connecting Cat.5 cables with up to 3 m length
Ax 1703 peripheral bus (EIA-485)	USB (A series) 4-pin, for connecting USB cables with up to 3 m length
TOOLBOX II (TB)	D-SUB 9-pin, female (DIN 41652)
Fieldbus (FB): Profibus DP	D-SUB 9-pin, female (DIN 41652)
Connector(s) for serial interfaces (LOC [2)], SI0, SI1/ET0, SI2/FB, SI3)	5x RJ45 8-pin
Connector for modem power supply or synchronization	D-SUB 9-pin, female (DIN 41652) (left side of the device)
Protection against contact, foreign objects and water	
Protection type according to IEC 60529	• Terminal modules IP40 – for the belonging terminals IP20 • CP-6014 from the front IP40 – for the belonging terminals from behind IP20
Protection against electric shock	
Protection class according to IEC 61140	Class II

1) dependent on type

2) currently not implemented

Ambient Conditions

Electrical Environmental Conditions

System Properties

Factor	Value	Testing standard	Product standard	Class
Immunity against discharge of static electricity (ESD)	8 kV-A 6 kV-C	IEC 61000-4-2	IEC 60870-2-1	3
			IEC 60255-22-2	3
Immunity against electromagnetic fields	10 V/m	IEC 61000-4-3	IEC 60870-2-1	2
			IEC 60255-22-3	3
Immunity against electromagnetic fields GSM 900 MHz	10 V/m	ENV 50204	IEC 61000-6-2	
Radio interference voltage approx. peak value	79/73 dBµV	CISPR22	IEC 60870-2-1	A
			CISPR22	A
Radio interference voltage mean value	66/60 dBµV	CISPR22	IEC 60870-2-1	A
			CISPR22	A
Radio interference field strength (10 m)	40/47 dBµV	CISPR22	IEC 60870-2-1	A
			CISPR22	A
Immunity against 50 Hz magnetic fields	100 A/m	IEC 61000-4-8	IEC 60870-2-1	4
Immunity against induced HF voltage	10 V	IEC 61000-4-6	IEC 61000-6-2	

The characteristics required according to the standards IEC 61000-6-2 and IEC 61000-6-4 are covered by the values listed above.

Power Supply Master Control Element

Factor	Value	Testing standard	Product standard	Class
Voltage tolerance DC	+30/-20%	IEC 60870-2-1	IEC 60870-2-1	DC3
			IEC 60654-2	>DC3
Voltage ripple DC	≤ 5%	IEC 60870-2-1	IEC 60870-2-1	VR3
			IEC 60255-11	
Interruption time	≤ 10 ms	IEC 61000-4-11	IEC 60870-2-1	1
			IEC 60255-11	
Dielectric test $V_N \leq 60$ V (SELV circuit)	1.5 kV_{rms}	IEC 60255-5	IEC 60870-2-1	>VW2
			IEC 60255-5	
Impulse voltage 1.2/50 µs $V_N \leq 60$ V common	2.5 kVs	IEC 60255-5	IEC 60870-2-1	>VW3
			IEC 60255-5	
Oscillatory waves common	2.5 kVs	IEC 61000-4-12	IEC 60870-2-1	3
			IEC 60255-22-1	3
Oscillatory waves normal	1.0 kVs	IEC 61000-4-12	IEC 60870-2-1	2
			IEC 60255-22-1	3
Fast transient burst common	2.0 kVs	IEC 61000-4-4	IEC 60870-2-1	3
			IEC 60255-22-4	3
Surge 1.2/50 µs common	2.0 kVs	IEC 61000-4-5	IEC 60870-2-1	3
			IEC 60255-22-5	
Surge 1.2/50 µs normal	2.0 kVs	IEC 61000-4-5	IEC 60870-2-1	4
			IEC 60255-22-5	
Surge 100/1300 µs normal	1.3 U_N	IEC 61000-4-1	IEC 60870-2-1	

Power Supply Peripheral Element

Factor	Value	Testing standard	Product standard	Class
Voltage tolerance DC	+30/-20%	IEC 60870-2-1	IEC 60870-2-1	DC3
			IEC 60654-2	>DC3
Voltage ripple DC	≤ 5%	IEC 60870-2-1	IEC 60870-2-1	VR3
			IEC 60654-2	
Interruption time	≤ 50 ms	IEC 61000-4-11	IEC 60870-2-1	>1
			IEC 60255-11	
Dielectric test $V_N \leq 60$ V (SELV circuit)	2.5 kV_{rms}	IEC 60255-5	IEC 60870-2-1	VW3
			IEC 60255-5	
Dielectric test 60 V < $V_N \leq$125 V against SELV circuits	2.5 kV_{rms}	IEC 60255-5	IEC 60950-1	VW3
Dielectric test 125 V < $V_N \leq$ 230 V against SELV circuits	3.0 kV_{rms}	IEC 60255-5	IEC 60950-1	>VW3
Impulse voltage 1.2/50 µs $V_N \leq 60$ V common	5.0 kVs	IEC 60255-5	IEC 60870-2-1	VW3
			IEC 60255-5	
Impulse voltage 1.2/50 µs 60 V < $V_N \leq$ 125 V common	5.0 kVs	IEC 60255-5	IEC 60870-2-1	VW3
			IEC 60255-5	
Impulse voltage 1.2/50 µs 125 V < $V_N \leq$ 230 V common	5.0 kVs	IEC 60255-5	IEC 60870-2-1	VW3
			IEC 60255-5	
Oscillatory waves common	2.5 kVs	IEC 61000-4-12	IEC 60870-2-1	3
			IEC 60255-22-1	3
Oscillatory waves normal	2.5 kVs	IEC 61000-4-12	IEC 60870-2-1	>3
			IEC 60255-22-1	3
Fast transient source of radio noise common	4.0 kVs	IEC 61000-4-4 *)	IEC 60870-2-1	4
			IEC 60255-22-4	3
Impulse voltage 1.2/50 µs common	4.0 kVs	IEC 61000-4-5	IEC 60870-2-1	4
Impulse voltage 1.2/50 µs normal	4.0 kVs	IEC 61000-4-5	IEC 60870-2-1	>4
Impulse voltage 100/1300 µs normal	1.3 U_N	IEC 61000-4-1	IEC 60870-2-1	
Starting current	S1	IEC 60870-4	IEC 60870-4	S1

*) directly connected

Digital and Analog Standard I/Os

Factor	Value	Testing standard	Product standard	Class
Dielectric test $V_N \leq 60$ V (SELV circuit)	1.5 kV_{rms}	IEC 60255-5	IEC 60870-2-1	>VW2
			IEC 60255-5	
Dielectric test 60 V < V_N ≤125 V against SELV circuits *)	2.0 kV_{rms}	IEC 60255-5	IEC 60950-1	
Dielectric test 125 V < V_N ≤ 230 V against SELV circuits *)	3.0 kV_{rms}	IEC 60255-5	IEC 60950-1	
Impulse voltage 1.2/50 µs $V_N \leq 60$ V common	2.5 kVs	IEC 60255-5	IEC 60870-2-1	>VW2
			IEC 60255-5	
Impulse voltage 1.2/50 µs 60 V < V_N ≤ 125 V common	2.5 kVs	IEC 60255-5	IEC 60870-2-1	>VW2
			IEC 60255-5	
Impulse voltage 1.2/50 µs 125 V < V_N ≤ 230 V common	2.5 kVs	IEC 60255-5	IEC 60870-2-1	VW3
			IEC 60255-5	
Oscillatory waves common	2.5 kVs	IEC 61000-4-12	IEC 60870-2-1	3
			IEC 60255-22-1	3
Oscillatory waves normal	1.0 kVs	IEC 61000-4-12	IEC 60870-2-1	>2
			IEC 60255-22-1	3
Fast transient burst common	2.0 kV	IEC 61000-4-4	IEC 60870-2-1	3
			IEC 60255-22-4	4
Surge voltage 1.2/50 µs common	2.0 kVs	IEC 61000-4-5 *)	IEC 60870-2-1	3
			IEC 60255-22-5	
Surge voltage 1.2/50 µs normal	2.0 kVs	IEC 61000-4-5	IEC 60870-2-1	4
			IEC 60255-22-5	

*) restriction with usage of TE-6420

Usage of TE-6420

If sensor and TE-6420 reside within a cabinet, the signal lines to the sensor must be carried out shielded and massed both ways (cabinet feeding, potential equalization of sensor).

With usage of third-party supplied sensors, the signal lines as well as the power supply of the sensor must be directed in shielded cables. The power supply may be directed max. 1 m unshielded between power supply module and terminal. The corresponding power supply module may be used exclusively for the sensor feeding, a usage for other plant parts is not allowed.

Direct Current and Voltage Inputs

Factor	Value	Testing standard	Product standard	Class
Dielectric test $V_N \leq 60$ V (SELV circuit)	2.5 kV_{rms}	IEC 60255-5	IEC 60870-2-1	VW3
			IEC 60255-5	
Dielectric test 60 V < V_N ≤125 V against SELV circuits	2.5 kV_{rms}	IEC 60255-5	IEC 60950-1	VW3
Dielectric test 125 V < V_N ≤ 230 V against SELV circuits	3.0 kV_{rms}	IEC 60255-5	IEC 60950-1	>VW3
Impulse voltage 1.2/50 µs $V_N \leq 60$ V common	5.0 kVs	IEC 60255-5	IEC 60870-2-1	VW3
			IEC 60255-5	
Impulse voltage 1.2/50 µs 60 V < V_N ≤ 125 V common	5.0 kVs	IEC 60255-5	IEC 60870-2-1	VW3
			IEC 60255-5	
Impulse voltage 1.2/50 µs 125 V < V_N ≤ 230 V common	5.0 kVs	IEC 60255-5	IEC 60870-2-1	VW3
			IEC 60255-5	
Oscillatory waves common	2.5 kVs	IEC 61000-4-12	IEC 60870-2-1	3
			IEC 60255-22-1	3
Oscillatory waves normal	2.5 kVs	IEC 61000-4-12	IEC 60870-2-1	>3
			IEC 60255-22-1	3
Fast transient burst common	4.0 kV	IEC 61000-4-4	IEC 60870-2-1	4
			IEC 60255-22-4	4
Surge voltage 1.2/50 µs common	4.0 kVs	IEC 61000-4-5	IEC 60870-2-1	4
			IEC 60255-22-5	
Surge voltage 1.2/50 µs normal	4.0 kVs	IEC 61000-4-5	IEC 60870-2-1	>4
			IEC 60255-22-5	

Telecommunication Lines V.23

The listed values are valid for screened and twisted-pair cables.

Factor	Value	Testing standard	Product standard	Class
Dielectric test	1.5 kV_{rms}	IEC 60950-1	IEC 60950-1	>VW2
Impulse voltage 1.2/50 µs common	2.5 kVs	IEC 60255-5	IEC 60870-2-1	>VW2
			IEC 60255-5	
Impulse voltage 1.2/50 µs normal	2.5 kVs	IEC 60255-5	IEC 60870-2-1	>VW2
			IEC 60255-5	
Oscillatory waves common	1.0 kVs	IEC 61000-4-12	IEC 60870-2-1	2
			IEC 60255-22-1	3
Fast transient burst common	2.0 kV	IEC 61000-4-4	IEC 60870-2-1	3
			IEC 60255-22-4	4
Surge voltage 10/700 µs common	2.5 kVs	IEC 60950-1	IEC 60950-1	
Surge voltage 10/700 µs normal	1.0 kVs	IEC 60950-1		
Noise immunity against technical line frequencies 50/60 Hz	10 V/100 V	IEC 61000-4-16	IEC 60870-2-1	

Fieldbus Communication

The listed values are valid for a distance ≤ 100 m for screened twisted-pair cables.

Factor	Value	Testing standard	Product standard	Class
Dielectric test	1.5 kV_{rms}	IEC 60255-5	IEC 60870-2-1	>VW2
			IEC 60255-5	
Impulse voltage 1.2/50 µs common	2.5 kVs	IEC 60255-5	IEC 60870-2-1	>VW3
			IEC 60255-5	
Oscillatory waves common	2.5 kVs	IEC 61000-4-12	IEC 60870-2-1	3
			IEC 60255-22-1	3
Fast transient burst common	2.0 kV	IEC 61000-4-4	IEC 60870-2-1	3
			IEC 60255-22-4	>4
Surge voltage 1.2/50 µs common	2.0 kVs	IEC 61000-4-5	IEC 60870-2-1	3
			IEC 60255-22-5	

Local Communication V.24/V.28

The listed values are valid for a distance ≤ 30 m for screened lines.

Factor	Value	Testing standard	Product standard	Class
Dielectric test	1.5 kV_{rms}	IEC 60255-5	IEC 60870-2-1	>VW2
			IEC 60255-5	
Impulse voltage 1.2/50 µs common	2.5 kVs	IEC 60255-5	IEC 60870-2-1	>VW3
			IEC 60255-5	
Fast transient burst common	2.0 kV	IEC 61000-4-4	IEC 60870-2-1	3
			IEC 60255-22-4	4

LAN Communication 10/100Base-T

The listed values are valid for a distance ≤ 100 m for Cat.5 cables.

Factor	Value	Testing standard	Product standard	Class
Dielectric test	1.5 kV_{rms}	IEC 60255-5	IEC 60870-2-1	>VW2
			IEC 60255-5	
Impulse voltage 1.2/50 µs common	2.5 kVs	IEC 60255-5	IEC 60870-2-1	>VW3
			IEC 60255-5	
Fast transient burst common	2.0 kV	IEC 61000-4-4	IEC 60870-2-1	3
			IEC 60255-22-4	4

Internal Interface Ax Bus

The listed values are valid for a distance ≤ 3 m screened.

Factor	Value	Testing standard	Product standard	Class
Dielectric test	1.5 kV_{rms}	IEC 60255-5	IEC 60870-2-1	>VW2
			IEC 60255-5	
Impulse voltage 1.2/50 µs common	2.5 kVs	IEC 60255-5	IEC 60870-2-1	>VW3
			IEC 60255-5	
Fast transient burst common	2.0 kV	IEC 61000-4-4	IEC 60870-2-1	3
			IEC 60255-22-4	4

Mechanical Environmental Conditions

Factor	Value	Testing standard	Product standard	Class
Harmonic sinusoidal				
Oscillation 1…9 Hz	3.5 mm	IEC 60068-2-6	IEC 60870-2-2	$>B_M$
Oscillation 9..200 Hz	10 m/s²			
Oscillation 200…500 Hz	15 m/s²			
Oscillation 10…150 Hz	10 m/s²	IEC 60068-2-6	IEC 60255-21-1	1
Shock semi-sinusoidal				
Shock 11 ms	100 m/s²	IEC 60068-2-27	IEC 60870-2-2	B_M
Shock 11 ms	15 g	IEC 60068-2-27	IEC 60255-21-2	1
Continuous shock semi-sinusoidal				
Continuous shock 16 ms	10 g	IEC 60068-2-29	IEC 60255-21-2	1
Seismic harmonic sinusoidal				
Oscillation 1…8 Hz (horizontal)	±3.5 mm	IEC 60068-3-3	IEC 60255-21-3	1
Oscillation 1…8 Hz (vertical)	±1.5 mm			
Oscillation 8…35 Hz (horizontal)	1 g			
Oscillation 8…35 Hz (vertical)	0.5 g			

The above listed values cover or exceed the required seismic loading according to IEC 60870-2-2 Cl.S3 and IEC 60255-21-3 Cl.1. The values apply in operation and for storage.

Attention

The master control element CP-6014 must be mounted with the shock proved mounting part TC6-213--, MLFB-Nr. 6MF13130GC130AA1 on the DIN rail, if the above listed values must be observed.

Transport

- The permitted mechanical stress during transport depends on the transport packaging.
- The device packaging is not a transport packaging.

Climatic Environmental Conditions

This class is intended for indoor locations with temperature control and a wide range of relative humidity. The humidity is not controlled.

The devices can be exposed to sun and heat. They can be exposed as well to air flow caused by draught in buildings, e.g. by open windows or influences of technical processes. Condensation water, precipitations, water and icing do not occur.

Bedewing is possible for a short time (e.g. during the course of maintenance tasks).

Heating and cooling is used to maintain the necessary conditions, especially in case of great differences between indoor and outdoor climate.

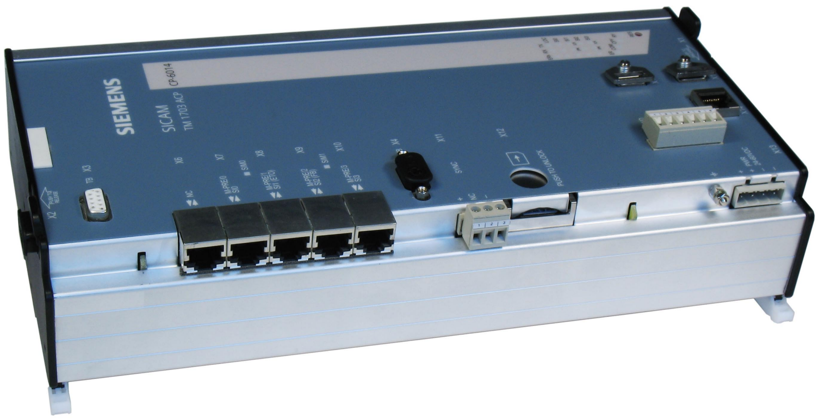
The conditions of this class normally occur in living and working areas, e.g. in production rooms for electronic and electrotechnical products, telecontrol rooms, storage rooms for valuable and sensible devices.

Factor	Value	Testing standard	Product standard	Class
Minimum air temperature	-25°C	IEC 60068-2-1	IEC 60870-2-2	C2
			IEC 60654-1	C2
Maximum air temperature	70°C	IEC 60068-2-2	IEC 60870-2-2	C3
			IEC 60654-1	C3
Temperature gradient	≤ 30°C/h		IEC 60870-2-2	C2
			IEC 60654-1	C2
Relative air humidity	5…95%		IEC 60870-2-2	C2
			IEC 60654-1	C2
Absolute air humidity	≤ 29 g/m^3		IEC 60870-2-2	C2
			IEC 60654-1	C2
Dry heat	70°C 4 days	IEC 60068-2-2		
Damp heat	40°C 4 days	IEC 60068-2-78		
Air pressure	70…106 kPa	IEC 61000-4-5	IEC 60870-2-2	C2
			IEC 60654-1	C2
Storage and transport temperature	-30…+85°C			
Component ambient temperature	max. +85°C			

Mechanical Design and Installation

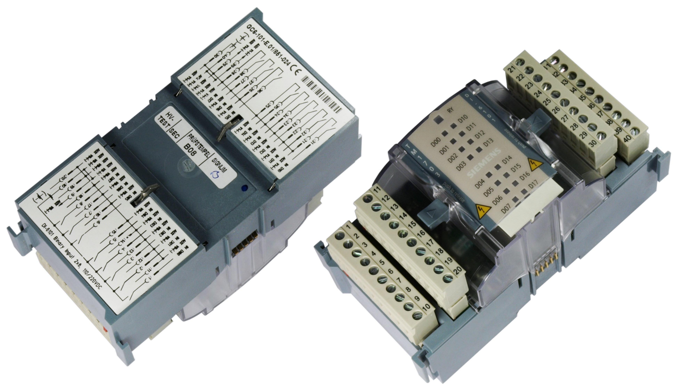
TM Modules

The terminal modules of the system TM 1703 ACP are provide a compact housing for the mounting on a TS35 rail (DIN rail) according to european standard EN 50022.



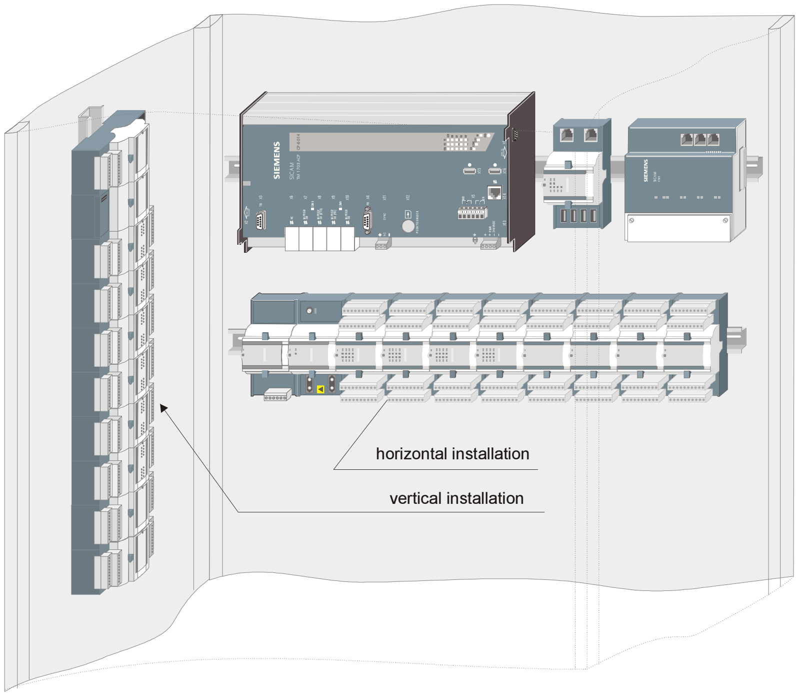
Master Control Module attached on DIN rail

I/O modules with printed connecting diagrams (examples)



Mounting Location and Space Requirements

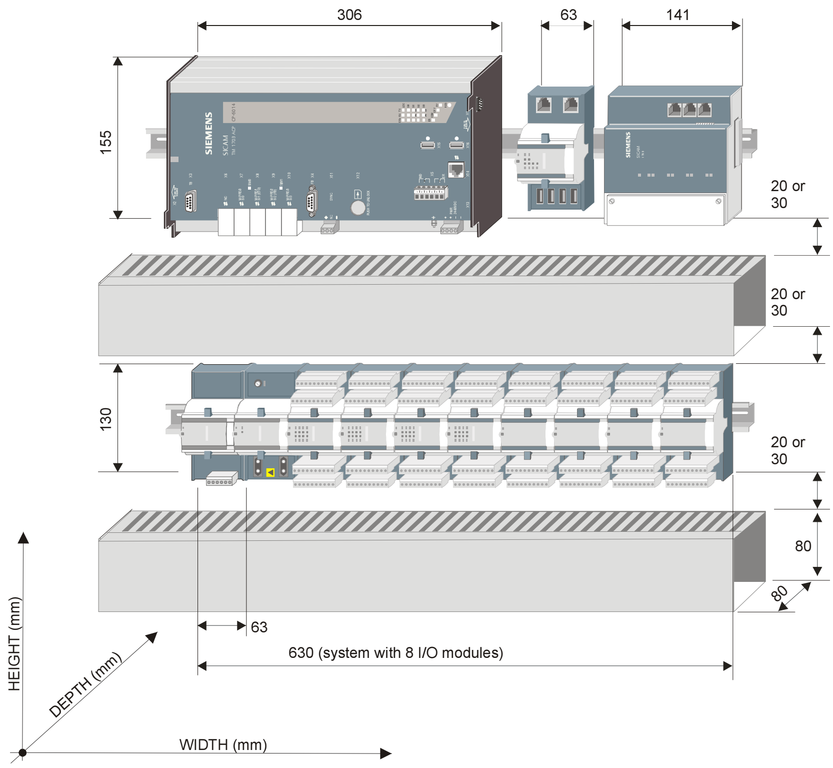
The modules of the system TM 1703 ACP are designed for the installation in a cabinet, rack or on the wall. The mounting is possible horizontally or vertically.



The space requirements depend basically on the mounting position.

With vertical installation, an end bracket must be considered at the respective lower end of the modules (10 mm).

The height results from the module size, the size of the cable ducts used and their distance to the modules (20 mm without, and 30 mm with lead labeling).

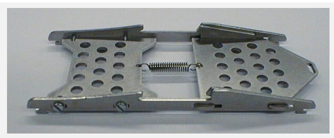


Ordering Information

Master Control Module

Designation	Item number / MLFB
CP-6014 Master Control Module	GC6-014 6MF11130GA140AA0

Shock proved mounting part for Master Control Module



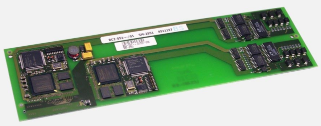
Bezeichnung	Sachnummer / MLFB
TC6-213 Shock proved mounting part CP-x003, 6014	TC6-213 6MF13130GC130AA0

Interface Modules

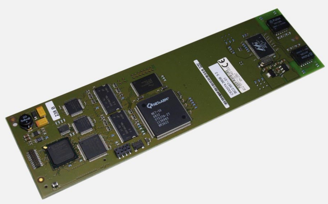
Fieldbus Interface Processor (FIP)

Designation	Item number / MLFB
SM-2545 Profibus Interface (Master)	BA2-545 6MF10110CF450AA0

Serial Interface Processor (SIP)

	Designation	Item number / MLFB
	SM-2551 Serial Interface Processor 2 Interfaces	BC2-551 6MF10130CF510AA0
	SM-0551 Serial Interface Processor 1 Interface (can be equipped on SM-2556)	BC0-551 6MF10130AF510AA0

Network Interface Processor (NIP)

	Designation	Item number / MLFB
	SM-2556 Ethernet 10/100TX + 1 Interface (optional)	BC2-556 6MF10130CF560AA0
	SM-2557 Ethernet 100TX 2 Interfaces	BC2-557 6MF10130CF570AA0

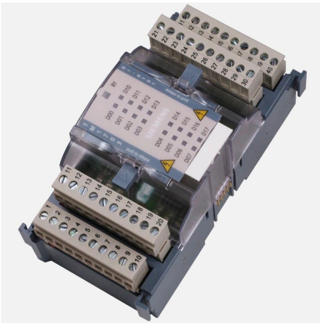
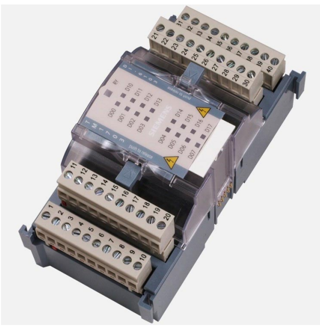
Power Supply for Peripheral Elements

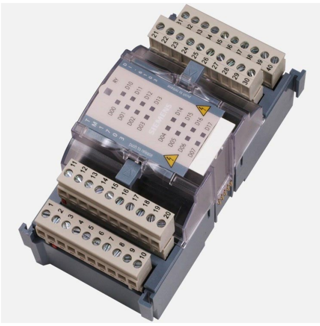
	Designation	Item number / MLFB
	PS-6630 Power Supply 24…60 VDC EMC+	GC6-630 6MF11130GG300AA0
	PS-6632 Power Supply 110…220 VDC EMC+	GC6-632 6MF11130GG320AA0

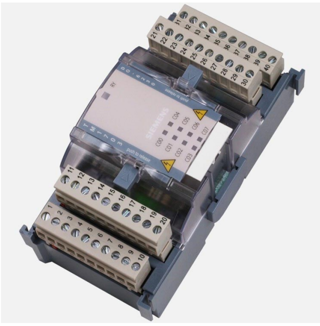
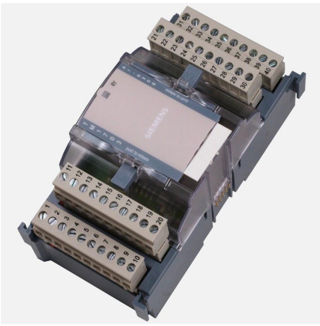
Peripheral Control Modules

	Designation	Item number / MLFB
	PE-6410 Peripheral Controller 1x Ax PE bus electrical	GC6-410 6MF11130GE100AA0
	PE-6411 Peripheral Controller 1x Ax PE bus optical	GC6-411 6MF11130GE110AA0
	PE-6412 Peripheral Control Module 2x Ax PE bus optical	GC6-412 6MF11130GE120AA0

I/O Modules

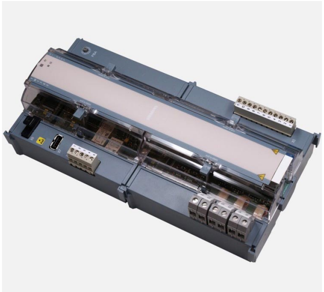
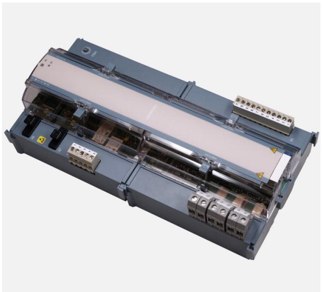
	Designation	Item number / MLFB
	DI-6100 Binary Input 2x8, 24…60 VDC	GC6-100 6MF11130GB000AA0
	DI-6101 Binary Input 2x8, 110/220 VDC	GC6-101 6MF11130GB010AA0
	DI-6102 Binary Input 2x8, 24…60 VDC 1 ms	GC6-102 6MF11130GB020AA0
	DI-6103 Binary Input 2x8, 110/220 VDC 1 ms	GC6-103 6MF11130GB030AA0

	Designation	Item number / MLFB
	DI-6104 Binary Input 2x8, 110/220 VDC 1 ms	GC6-104 6MF11130GB040AA0
	DO-6200 Binary Output Transistor 2x8, 24…60 VDC	GC6-200 6MF11130GC000AA0
	DO-6212 Binary Output Relays 8x 24…220 VDC/230 VAC	GC6-212 6MF11130GC200AA0
	DO-6220 Command Output Base Module	GC6-220 6MF11130GC200AA0
	DO-6221 Command Output Base Module with Measurement	GC6-221 6MF11130GC210AA0

	Designation	Item number / MLFB
	DO-6230 Command Output Relay Module	GC6-230 6MF11130GC300AA0
	AI-6300 Analog Input 2x2 ±20 mA/±10 V	GC6-300 6MF11130GD000AA0
	AI-6307 Analog Input 2x2 ±5 mA/±10 V	GC6-307 6MF11130GD070AA0
	AI-6308 Analog Input 2x2 ±2 mA/±10 V	GC6-308 6MF11130GD080AA0
	AI-6310 Analog Input 2x2 Pt100/Ni100	GC6-310 6MF11130GD100AA0

	Designation	Item number / MLFB
	AO-6380 Analog Output 4x ±20 mA/±10 mA/±10 V	GC6-380 6MF11130GD800AA0
	TE-6420 Speed Measurement 2x2 5 VDC/24 VDC/NAMUR	GC6-420 6MF11130GE200AA0
	TE-6430 Counting Pulse Inp. 2x24…60 VDC	GC6-430 6MF11130GE300AA0
	TE-6450 Position Acquisition 2x2 SSI/RS-422	GC6-450 6MF11130GE500AA0

Peripheral Elements with Direct Transformer Input

	AI-6303/TIPS05 Direct Transformer Input (4x220 V, 3x6 A) Ax PE bus electrical + optical	GC6-303 6MF11130GD030AA0
	AI-6304/TIPS05 Direct Transformer Input (4x220V,3x6 A) 2x Ax PE bus optical	GC6-304 6MF11130GD040AA0

Bus Interface Modules

	Designation	Item number / MLFB
	CM-0843 Ax 1703 Bus Interface electrical	GA0-843 6MF11110AJ430AA0
	CM-0842 Ax 1703 Bus Interface 4x optical	GA0-842 6MF11110AJ420AA0

Literature

Folder TM 1703 ACP	MC6-003-2
Folder TOOLBOX II	M30-001-3
SICAM 1703 Common Functions Peripheral Elements according to IEC 60870-5-101/104	DC0-011-2
ACP 1703 Common Functions System and Basic System Elements	DC0-015-2
ACP 1703 Platforms Configuration Automation Units and Automation Networks	DC0-021-2
SICAM TM 1703 I/O Modules	DC6-041-2
Data Sheet PS-663x	MC6-027-2
Data Sheet CP-6014/CPCX65	MC6-033-2
Data Sheet SM-2545/DPM00	MC0-007-2
Data Sheet SM-x551/PROTOCOL	MC0-003-2
Data Sheet SM-25x4/ET02	MC0-005-2
Data Sheet SM-25xx/ETA2	MC0-047-2
Data Sheet SM-25x6/ET03	MC0-037-2
Data Sheet SM-25x6/PROTOCOL	MC0-029-2
Data Sheet PE-641x/USIO66	MC6-031-2
Data Sheet PE-641x/TCIO66	MC6-036-2
Data Sheet AI-630x/TIPS05	MC6-025-2
Data Sheet CM-0842	MC0-021-2
Data Sheet CM-0843	MC0-023-2

Document Label SIC1703-DSTM1703ACP-ENG_V2.01
Version.Revision 2.01
Release date 22.04.2011

SIEMENS

SICAM 1703

TM 1703 emic

System Description

Preface, Table of Contents	
Introduction	1
Application Overview	2
System Overview	3
Function Packages	4
Overview of the I/O Modules	5
Overview of the Protocol Elements	6
Technical Specification Total System	7
Technical Specification of the Modules	8
Order Information	A

MC6-049-2.01

Note

Please take notice of the notes and warnings for your safety in the preface.

Document Label	SIC1703-HBTM1703EMICSB-ENG_V2.01
Version.Revision	2.01
Release date	2011-08-12

Preface

This document is applicable for the following product:

- TM 1703 emic

Purpose of this manual

This manual describes the characteristics and functions of the system TM 1703 emic.

It contains

- Fields of application and advantages of the system
- Configuration possibilities
- Functional overviews
- Technical specifications
- Order information

Target Group

The document you are reading right now is addressed to users, who are in charge of the following engineering tasks:

- Evaluation of the suitability of the system
- Evaluation of the module specifications
- Evaluation of quotation criteria, such as technical specifications of the system or environmental conditions
- Conceptual activities, such as design and configuration

Recommendations for Third-Party Products

Siemens does neither receive liability nor warranty for recommendations which are given or implied by this manual. For the correct and intended use of the respective product the associated technical descriptions must be paid attention to in any case.

References to Third-Party Web Sites

Siemens is not responsible for the contents of third-party websites mentioned in this document, as well as the correctness of the publications and links. For all product information the respective manufacturer is responsible.

Placement into the Information Landscape

Document name	Item number
Folder TM 1703 emic	MC6-041-2
TM 1703 emic User Manual	DC6-051-2
Folder TOOLBOX II	M30-001-3
SICAM 1703 IEC 60870-5-101/104 Interoperability	DC0-013-2
SICAM 1703 IEC 60870-5-103 Interoperability	DC0-026-2
SICAM 1703 TG800 Interoperability	DC0-041-2
SICAM 1703 DNP3 Interoperability	DC0-046-2
SICAM 1703 MODBUS Interoperability	DC0-073-2
Ax 1703 IEC 60870-5-101/104 Interoperability	DA0-046-2
Data Sheet CM-0819	MC0-043-2
Data Sheet CM-0821	MC0-031-2
Data Sheet CM-0822	MC0-033-2
Data Sheet CM-0823	MC0-035-2
Data Sheet CM-0827	MA0-025-2

Further Support

For more information, please contact our Customer Support Center:
Phone: +49 (0)180 524 70 00
Fax: +49 (0)180 524 24 71
(charges depending on provider)
e-mail: support.energy@siemens.com

The Siemens Power Academy offers a comprehensive program of professional training events in the fields of power generation, distribution and transmission.

Main training centers are:

Nuremberg, Germany (Head Office)
Mr. Armin Hilgraf
Phone: +49 911 433 7415
Fax: +49 911 433 5482
power-academy.ptd@siemens.com

Vienna, Austria
Ms. Monika Schuecker
Phone: +43 51707 31143
Fax: +43 51707 55243
power-academy.at@siemens.com

Schenectady, NY, USA
Ms. Renee W. Devine
Phone: +1 518 395 5005
Fax: +1 518 346 2777
pti-edpro.ptd@siemens.com

Hebburn, United Kingdom
Mr. Phil Letouze
Phone: +44 1914 953449
Fax: +44 1914 953693
pti-training.stdl.uk@siemens.com

Notes on Safety

This manual does not constitute a complete catalog of all safety measures required for operating the equipment (module, device) in question because special operating conditions might require additional measures. However, it does contain notes that must be adhered to for your own personal safety and to avoid damage to property. These notes are highlighted with a warning triangle and different keywords indicating different degrees of danger.

Danger

means that death, serious bodily injury or considerable property damage **will** occur, if the appropriate precautionary measures are not carried out.

Warning

means that death, serious bodily injury or considerable property damage **can** occur, if the appropriate precautionary measures are not carried out.

Caution

means that minor bodily injury or property damage could occur, if the appropriate precautionary measures are not carried out.

Hint

is important information about the product, the handling of the product or the respective part of the documentation, to which special attention is to be given.

Qualified Personnel

Commissioning and operation of the equipment (module, device) described in this manual must be performed by qualified personnel only. As used in the safety notes contained in this manual, qualified personnel are those persons who are authorized to commission, release, ground, and tag devices, systems, and electrical circuits in accordance with safety standards.

Use as Prescribed

The equipment (device, module) must not be used for any other purposes than those described in the Catalog and the Technical Description. If it is used together with third-party devices and components, these must be recommended or approved by Siemens.

Correct and safe operation of the product requires adequate transportation, storage, installation, and mounting as well as appropriate use and maintenance.

During operation of electrical equipment, it is unavoidable that certain parts of this equipment will carry dangerous voltages. Severe injury or damage to property can occur if the appropriate measures are not taken:

- Before making any connections at all, ground the equipment at the PE terminal.
- Hazardous voltages can be present on all switching components connected to the power supply.
- Even after the supply voltage has been disconnected, hazardous voltages can still be present in the equipment (capacitor storage).
- Equipment with current transformer circuits must not be operated while open.
- The limit values indicated in the manual or the operating instructions must not be exceeded; that also applies to testing and commissioning.

Consider obligatory the safety rules for the accomplishment of works at electrical plants:

1. Switch off electricity all-pole and on all sides!
2. Ensure that electricity cannot be switched on again!
3. Double check that no electrical current is flowing!
4. Discharge, ground, short circuit!
5. Cover or otherwise isolate components that are still electrically active!

Table of Contents

1 Introduction 13

1.1 Requirements 14
1.2 Solution Description 16
1.2.1 Non-Market-Sector-Specific Product, hence High Product Stability and Versatile Fields of Use 17
1.2.2 Open System Architecture 17
1.2.3 Versatile Communication 17
1.2.3.1 Serial Communication 18
1.2.3.2 LAN/WAN Communication 18
1.2.4 Easy Engineering 19
1.2.4.1 Integrated Webserver for Simple Applications 19
1.2.4.2 TOOLBOX II 20
1.2.5 Mechanical Design 22
1.2.6 Plug and Play for Spares 23
1.2.7 Compatibility 23

2 Application Overview 25

2.1 Introduction 26
2.2 Fields of Use 27
2.2.1 Front End, Gateway 27
2.2.2 Process Control Applications, Automation Applications 27
2.2.3 Station Control Device, Sub-Node 27
2.2.4 Telecontrol Substation 27

3 System Overview 29

3.1 Mechanical Structure 30
3.2 Architecture 31
3.2.1 Power Supply Module 31
3.2.2 Master Control Element 32
3.2.3 Peripheral Element 34
3.2.3.1 I/O Modules 34
3.2.3.2 TM 1703 Peripheral Bus 36
3.2.4 Protocol Elements 37
3.2.4.1 Supported Protocols 37
3.3 Communication 38
3.3.1 Interfaces 38
3.3.2 Configurations 39
3.3.3 Transmission Facilities 40
3.3.4 Installation of External Communication Connections 41
3.3.4.1 Serial Communication 41

3.3.4.1.1 Multi-Point Traffic via Leased Line Modem and VFT Channel Modem41
3.3.4.1.2 Multi-Point Traffic via Glass Fibre Optic and Star Connection........... 42
3.3.4.1.3 Dial-up Traffic Analog with Westermo TD-36 and External Supply ... 42
3.3.4.1.4 Dial-up Traffic ISDN with Westermo IDW-90 and External Supply.... 43
3.3.4.1.5 Dial-up Traffic GSM... 43
3.3.4.1.6 GPRS 44
3.3.4.2 Ethernet Communication (LAN/WAN) 44
3.4 Engineering.. 45

4 Function Packages 47

4.1 Overview... 48
4.2 System Services 49
4.2.1 Communication with the Engineering System (TOOLBOX II)...................... 49
4.2.2 Integrated Webserver 50
4.2.3 Data Flow Control 50
4.2.3.1 Messages with Process Information... 50
4.2.4 Addressing.. 51
4.2.4.1 Addressing of Automation Units 51
4.2.4.2 Addressing of Process Information 51
4.2.5 Real-Time Concept... 52
4.2.6 General Interrogation.. 52
4.2.7 Monitoring Functions 52
4.2.8 Failure Management... 53
4.2.9 Diagnosis and Signaling 53
4.2.10 Storage of Application Data.. 54
4.2.11 Storage of Firmware 54
4.2.12 Autonomy.. 54
4.3 Telecontrol 55
4.3.1 Communication with other Stations 55
4.3.1.1 Protocol Elements 55
4.3.1.2 Automatic or Selective Data Flow Routing 56
4.3.1.3 Data Storage 56
4.3.1.4 Priority Control... 57
4.3.2 Communication within the Automation Unit.. 57
4.3.3 Protocol Element Control and Return Information.. 57
4.3.4 Decentralized Archive.. 58
4.3.5 Process Data Input and Output 58
4.4 Automation.. 59
4.4.1 Telecontrol Interface 59
4.4.1.1 Transfer of Messages with Process Information 59
4.4.1.1.1 Treatment for commands according to IEC 60870-101/104 59
4.4.1.2 Change Monitoring and Generation of Messages with Time Tag........... 60
4.4.2 Open-/Closed-Loop Control Function... 61
4.4.2.1 Non-Volatile Storage 61
4.4.2.2 Task Management.. 61

4.4.2.3 Loading the Application Program 62
4.4.2.4 Diagnosis 62
4.4.3 Process Data Input and Output 63

5 Overview of the Peripheral Functions 65

5.1 Common 66
5.2 Acquisition and Preprocessing 67
5.2.1 DI-6100 ,DI-6101, DI-6104 67
5.2.2 DI-6102, DI-6103 68
5.2.3 AI-6300, AI-6307, AI-6308 69
5.2.4 AI-6310 69
5.2.5 TE-6430 70
5.3 Postprocessing and Output 71
5.3.1 DO-6200 71
5.3.2 DO-6212 72
5.3.3 DO-6220, DO-6221, DO-6230 73
5.3.4 AO-6380 74
5.3.5 Further Functions 74

6 Overview of the Protocol Elements 75

6.1 Standard Protocols 76
6.1.1 UMPxT0 76
6.1.1.1 Features and Functions 76
6.1.1.2 Operating Modes 77
6.1.1.3 Configuration 78
6.1.2 DIAST0 80
6.1.2.1 Features and Functions 80
6.1.2.2 Operating Modes 81
6.1.2.3 Configuration 81
6.1.3 103MT0 82
6.1.3.1 Features and Functions 82
6.1.3.2 Operating Modes 83
6.1.3.3 Configuration 83
6.1.4 BPPT0 84
6.1.4.1 Features and Functions 84
6.1.4.2 Operating Modes 84
6.1.4.3 Configuration 85
6.1.5 ETT0 86
6.1.5.1 Features and Functions 86
6.1.5.2 Operating Modes 86
6.1.5.3 Configuration 87
6.2 Third-Party Protocols 88
6.2.1 UMPMT1 88
6.2.1.1 Features and Functions 88
6.2.1.2 Operating Modes 90

6.2.1.3 Configuration ... 90
6.2.2 MODMT0 ... 91
6.2.2.1 Features and Functions ... 91
6.2.2.2 Operating Modes ... 91
6.2.2.3 Configuration ... 92
6.2.3 DNPST0 ... 93
6.2.3.1 Features and Functions ... 93
6.2.3.2 Operating Modes ... 93
6.2.3.3 Configuration ... 94
6.2.4 ST1ST0 ... 95
6.2.4.1 Features and Functions ... 95
6.2.4.2 Operating Modes ... 95
6.2.4.3 Configuration ... 96
6.2.5 TG8ST0 ... 97
6.2.5.1 Features and Functions ... 97
6.2.5.2 Operating Modes ... 97
6.2.5.3 Configuration ... 98
6.2.6 SMST0 ... 99
6.2.6.1 Features and Functions ... 99
6.2.6.2 Operating Modes ... 99
6.2.6.3 Configuration ... 100
6.2.6.3.1 Printer control ... 100
6.2.6.3.2 SMS alert and control ... 100

7 Technical Specifications Total System ... 101

7.1 General Specification ... 102
7.1.1 Performance characteristics ... 102
7.1.2 Mechanical Design ... 103
7.2 Ambient Conditions ... 104
7.2.1 Electrical Environmental Conditions ... 104
7.2.1.2 System Properties ... 104
7.2.1.3 Power Supply ... 105
7.2.1.4 Digital And Analog I/Os ... 106
7.2.1.5 Communication LAN/WAN ... 106
7.2.1.6 Communication EIA-485 ... 107
7.2.1.7 Communication EIA-232 ... 107
7.2.2 Mechanical Environmental Conditions ... 108
7.2.3 Climatic Environmental Conditions ... 109

8 Technical Specification of the Modules ... 111

8.1 Power Supply Modules ... 112
8.1.1 PS-6630 ... 112
8.1.2 PS-6632 ... 113
8.2 Master Control Module ... 114
8.2.1 CP-6010 ... 114

8.3 I/O Modules ... 116
8.3.1 DI-6100 ... 116
8.3.2 DI-6101 ... 116
8.3.3 DI-6102 ... 117
8.3.4 DI-6103 ... 117
8.3.5 DI-6104 ... 118
8.3.6 DO-6200 ... 119
8.3.7 DO-6212 ... 120
8.3.8 DO-6220 ... 121
8.3.9 DO-6221 ... 122
8.3.10 DO-6230 ... 123
8.3.11 AI-6300 ... 124
8.3.12 AI-6307 ... 125
8.3.13 AI-6308 ... 126
8.3.14 AI-6310 ... 127
8.3.15 AO-6380 ... 128
8.3.16 TE-6430 ... 129

A. Order Information ... 131

A.1. Power Supply Modules ... 132
A.2. Master Control Module ... 132
A.3. I/O Modules ... 133
A.4. Interface Modules ... 136
A.5. Accessories ... 137
A.5.1. Proprietary Modems ... 137
A.5.2. Recommended Modems (Third-Party Devices) ... 138
A.5.3. Cables and Plugs ... 139
A.5.4. Recommanded Upstream Power Supply Units ... 140
A.5.5. SD Card ... 141
A.5.6. Various Incidentials ... 141
A.6. Engineering Tools ... 143

1 Introduction

Contents

1.1 Requirements 14
1.2 Solution Description.. 16

1.1 Requirements

It is the purpose of automation devices to support us in the cost-effective and safe management of technical processes.

In conventional concepts, processes were monitored and controlled via remote terminal units while non-communicating local automatic controllers (for instance relay controllers, programmable controllers, analog controllers) would handle automation. As a result, there was a multitude of different interfaces, making global monitoring nearly impossible.

Meanwhile conditions have changed from a commercial, IT-related and technological viewpoint. Cost-effectiveness has become a crucial factor of competitiveness. Consequently, this calls in almost all processes for the improved utilization of existing resources, that is, moving closer and closer toward tapping their full performance capacities. To avoid neglecting reliability requirements in this process, a greater amount of information is necessary. By that we mean more information about the process (utilization rate, state) and about the automation system itself.

Due to the technological progress, automation devices consequently have become more powerful and intelligent. All of a sudden, they are now able to assume many additional functions - starting with preprocessing tasks and up to the complete networking of all automation devices.

Thus, it was only a question of time until this intelligence could be functionally decentralized and at the same time be put to local distributed use, directly at the process. The aim of the functional decentralization is the creation of

- a better clarity
- autonomous functional units, and thus
- a higher availability.

The aim of the local distribution and the resulting reduced number of cabling routes is the obtainment of a

- reliable signal transmission
- simplification of the assembly effort
- reduction of cable materials and accessories
- saving of the intermediate terminals.

This requires modern automation concepts giving due account to the greater expansion of the automation system, all the way up to the integration of increasingly smaller system components. The additional benefit sought in terms of cost-effectiveness and reliability is

- the reduction or avoidance of parallel interfaces between the various automation levels, and
- the improved adaptation to the process with its specific signals and functions to be accomplished through closer bonding to the primary process.

This leads to the creation of non-market-sector-specific but also market-sector-specific requirements which - unlike pure programmable controller applications - reach way beyond the sole performance of process control functions and simple serial data coupling.

What is required are:

- The balanced coexistence of
  - the world of automation running periodically (equidistantly and thus time-consistently) for purposes of guaranteed reproducible reaction times and including freely definable logic operation, open-loop, and closed-loop control tasks, and
  - the parameter-settable, standardized spontaneous world of telecontrol and communications
- Communication functions adapted to the application and linked with consistent integral solutions, this means
  - LAN communication via TCP/IP with intensive networking possibilities
  - local serial couplings and remote communication options
  - high interoperability also with regard to other devices by using default communications to IEC 60870-5
  - system-consistent service functions such as real-time acquisition, test and diagnostic functions
- Consistent engineering and straightforward service
  - systemwide consistent CAE tools with state-of-the-art and ergonomically advanced full-graphics user interface
  - replacement of spares without CAE tool
- High operational reliability and availability ensured by
  - modular structure and continuous system monitoring
- Cost-effective adaptation to process-specific requirements
  - of signal processing (type of signals, voltage level), and the
  - use of "intelligent terminal modules" for the
    - acquisition of the process peripherals, as direct and close to the primary equipment as possible
    - avoidance of costly cabling and additional intermediate terminals

1.2 Solution Description

As a result of the steady further development of the tried and tested SICAM 1703 system family - the system for integrated automation networks - TM 1703 emic is ideally suited for both automation functions and telecontrol functions with the direct interfacing of peripherals without intermediate terminals.

The following key factors make TM 1703 emic a trendsetter product:

- Non-market-sector-specific product, hence high product stability and versatile fields of use
  - Hydroelectric power plants (process control)
  - Distribution and transmission of electrical energy
  - Local network control
  - Oil/gas pipelines
  - Traffic (tunnel, railways)
- Versatile communication
  - Consistent communication to IEC 60870–5–101/104
  - Various third-party protocols
- Easy engineering
  - Integrated webserver for engineering, diagnosisand test
  - Process engineering and object orientation in engineering process
  - Networkability and shared-work operations
  - Consistent data management
  - Use of standards
- Plug & play for spares
  - Storing of parameters and firmware on a flash card
  - Components can be exchanged without requiring an additional loading of parameters
- Open system architecture
  - System-consistent further development and thus an innovative and future-proof product
  - Modular, open, and not technology-dependent system structure
- Mechanical design
  - Can be mounted on DIN rail
  - Simplified connection system by way of the "intelligent terminal"
  - Leds for process and operating states
- Compatibility to the system family SICAM 1703

1.2.1 Non-Market-Sector-Specific Product, hence High Product Stability and Versatile Fields of Use

Our philosophy: we provide basic products that can be used as is in several market sectors, and market-sector products developed out of the basic products by specific engineering, however, standardized for respective market sectors.

Advantages:

- If a customer has applications in several market sectors and fields of use, he may rest assured that the products will be able to communicate with one another and behave identically within an automation network and in relation to the user (system behavior, engineering, maintenance).
- Within the application, it is possible to choose the most cost-effective product, depending on data volume and the number of communication interfaces.
- Using the same product in several market sectors also means less product diversity (no more "dedicated systems") and consequently greater versatility in use and thus enhanced product stability.
- By means of this basic system philosophy the stockkeeping for spare parts can be reduced since one system is placeable for various applications, and therefore is only once in the depot.

1.2.2 Open System Architecture

The basis for this automation concept is a modular, open, and thus non-technology-dependent system architecture for processing, communication, and peripherals (single-processor system, firmware).

The adaptation to the specific needs of the application is accomplished by relying on an individual hardware configuration and by loading standard firmware and parameters. The parameters influence, within their defined limits, not only the behavior of the firmware functions, but also that of the hardware functions. As a result, mechanical parameterizations such as the changing of jumpers or loads are no longer necessary on any of the module types. This permits not only online reconfiguration but also the gapless documentation of set parameters by the engineering system, as well as simplified inventory management.

1.2.3 Versatile Communication

To be able to communicate with as many systems as possible, Siemens decided to not only *use* standard protocols defined by the IEC, but also *get actively involved in defining them*. TM 1703 emic communicates both externally and internally in conformity with these standards, to ensure a maximum interoperability.

Therefore, the application configurations can be very versatile: they start with smallest applications as for instance local transformer controllers, up to a networked plant.

1.2.3.1 Serial Communication

For serial communication standard protocols are available:

- Point-to-point traffic
- Multi-point traffic, optionally with relay operation
- Dialup traffic

Naturally, all standard protocols are fully based on the interoperable standard to IEC 60870-5-101 including

- fully free addressing
- single object orientation
- file transfer
- time synchronization
- integrated remote maintenance functions such as
  - remote diagnostics
  - remote parameter setting
  - online test functions

Still there are further protocols available, such as:

- Interfacing of protective devices acc. to IEC 60870–5-103
- Modbus master
- DNP 3.0 slave

1.2.3.2 LAN/WAN Communication

Today, modern automation systems are generally distributed and thus require networks to connect the various components with one another.

For many years Siemens provides networks and puts thereby highest attention on complete integration as well as optimum availability and operational reliability. As network technology continued to become ever more refined, the networks, as well, have continuously been updated and upgraded to reflect the latest state of the art without neglecting the criteria of ensuring a long system lifecycle and highest availability.

For the LAN/WAN communication, the protocol Ethernet TCP/IP according to the standard IEC 60870-5-104 is available.

1.2.4 Easy Engineering

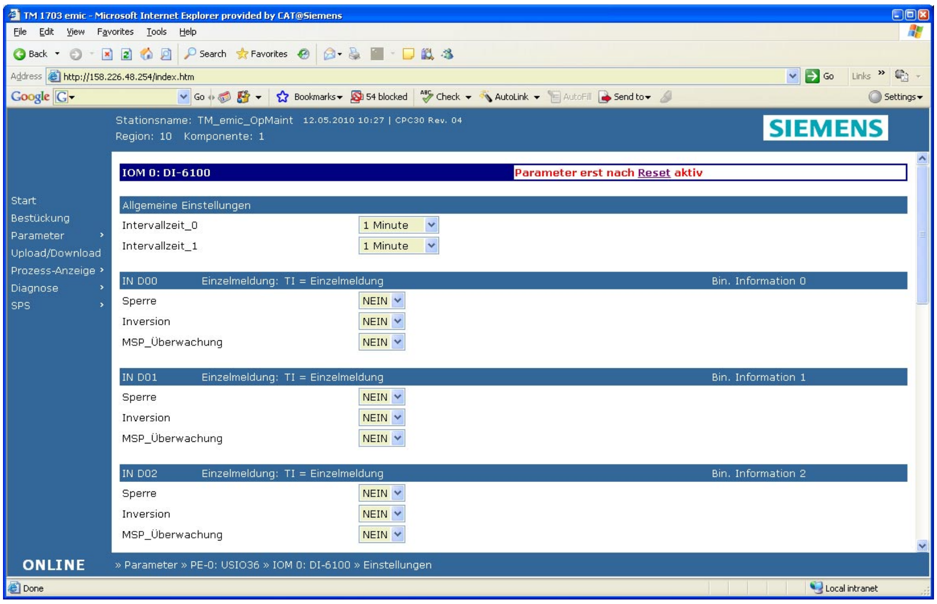
With growing pressure on costs in virtually all processes, there is an increasing need to also automate smaller stations to make better and more reliable use of existing equipment.

Modern, high-performance automation systems allow the integration of smaller stations to provide universal and reliable management of complex processes. But smaller stations are also being equipped with greater functionality because of the increased demand for more information.

From simple monitoring activities to control functions and the integration of additional equipment, modern systems need to offer a wide range of functionality.

1.2.4.1 Integrated Webserver for Simple Applications

Keeping the engineering process as simple as possible was a top priority. TM 1703 emic provides a web server for configuration, diagnosis and testing, so that no special tools or additional licenses are needed.

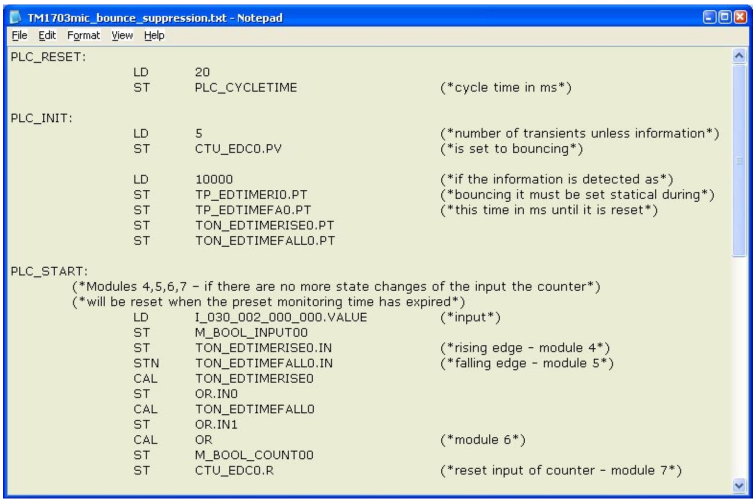


The tool is already integrated in TM 1703 emic and is operated with a standard web browser (*Microsoft ® Internet Explorer* of a standard PC).

When configuring via web browser, there are some restrictions in the engineering options. You can find more details thereto in section 3.4, Engineering.

Implementation of Application Programs

Simple application programs can be created with each text editor as instruction list (IL), based on the standard IEC 61131-3. Via the web browser, the instruction list can be uploaded into the automation unit for execution.




```
PLC_RESET:
        LD      20
        ST      PLC_CYCLETIME                (*cycle time in ms*)

PLC_INIT:
        LD      5                            (*number of transients unless information*)
        ST      CTU_EDC0.PV                  (*is set to bouncing*)

        LD      10000                        (*if the information is detected as*)
        ST      TP_EDTIMERI0.PT              (*bouncing it must be set statical during*)
        ST      TP_EDTIMEFA0.PT              (*this time in ms until it is reset*)
        ST      TON_EDTIMERISE0.PT
        ST      TON_EDTIMEFALL0.PT

PLC_START:
    (*Modules 4,5,6,7 - if there are no more state changes of the input the counter*)
    (*will be reset when the preset monitoring time has expired*)
        LD      I_030_002_000_000.VALUE      (*input*)
        ST      M_BOOL_INPUT00
        ST      TON_EDTIMERISE0.IN           (*rising edge - module 4*)
        STN     TON_EDTIMEFALL0.IN           (*falling edge - module 5*)
        CAL     TON_EDTIMERISE0
        ST      OR.IN0
        CAL     TON_EDTIMEFALL0
        ST      OR.IN1
        CAL     OR                           (*module 6*)
        ST      M_BOOL_COUNT00
        ST      CTU_EDC0.R                   (*reset input of counter - module 7*)
```

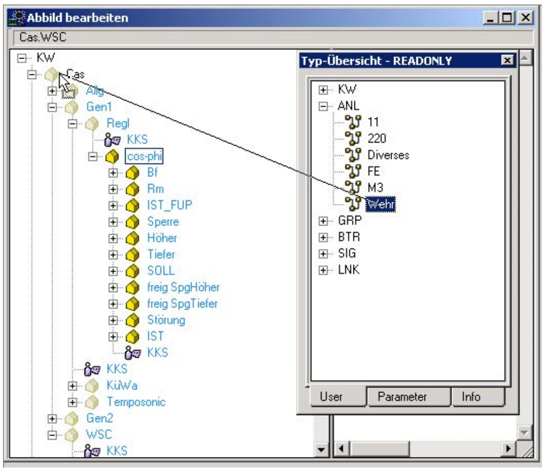
1.2.4.2 TOOLBOX II

Of course TM 1703 emic supports also the TOOLBOX II, the integrated engineering system for the entire SICAM 1703 family. This comprises all stages of plant configuration and maintenance, this means data collection, configuring, parameter setting, expanding, changing, testing, system diagnosis, and documentation.

Object Orientation

The introduction of object orientation allows project engineers to describe real units and pieces of equipment in the configuration process (circuit breakers, feeders, etc.).

They can take advantage of these structural advantages especially in cases where systems are constituted of a plurality of primary units and pieces of equipment of equal type (for example a transformer substation). This yields enormous streamlining effects for the engineering process.



Consistent Data Management

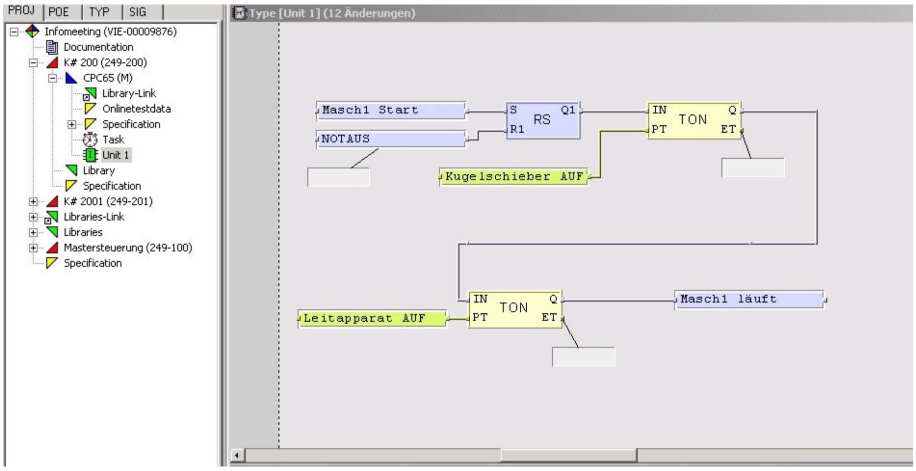
TOOLBOX II stores all information in one central database. Once a piece of information has been entered, it will immediately and always be available in its latest updated form to all tools of TOOLBOX II and to all people working on a project.

Networkability and shared-work operations

This reaches from stand-alone terminal solutions all the way to complex network solutions. In networks, several engineers may work on one or more projects at the same time. Whether on a standalone terminal or in a network, always the same TOOLBOX II is used.

Function Diagrams for the Realization of Application Programs

When configuring via the TOOLBOX II, application programs (*open-/closed-loop control function*) can be created as function diagram (FUD) with the tool CAEx *plus*. Optionally, also an existing instruction list can be imported into the TOOLBOX II.

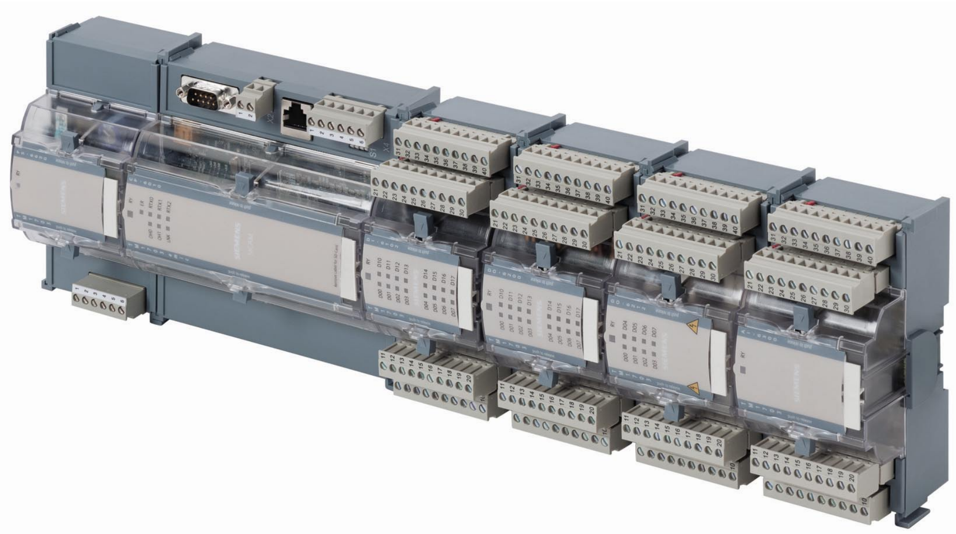


In view of its conformity with IEC 61131-3, CAEx *plus* grants the user access to a well-established and generally acknowledged standard. This helps shorten staff training times considerably.

By means of the available standard-conformal module libraries and standard-conformal data types, the engineering becomes more transparent and is possible with high application quality.

1.2.5 Mechanical Design

Generally, when developing the mechanical design, we focused on achieving highest ease in handling. As a result, all components of TM 1703 emic were adapted to be mounted on a DIN rail.



A key feature of TM 1703 emic is the efficient and simple way of interfacing the process signals. This is accomplished by so-called I/O modules standing out for a robust housing, reliable contacting, and sound electronics.

The I/O modules are added side by side to the central master control module. Contact is established as soon as they engage with one another, without requiring any further manual intervention. Thereby every single I/O module can be replaced separately and be mounted on a DIN rail. It may be installed horizontally or vertically.

A clearly structured connection front featuring status indicator LEDs makes sure that things at the site remain clear and transparent. The structure of the terminals permits direct sensor/actuator wiring without requiring the use of intermediate terminals.

Wherethrough the peripheral signals can be acquired very close to their point of origin, a wide cabling can be reduced to a minimum.

1.2.6 Plug and Play for Spares

With the replacement of spare parts, plug & play becomes a reality: no special tool is required for this, even loading is no longer necessary. Thereby, work during a service operation is reduced to a minimum.

All data of an automation unit - such as firmware and parameters - are stored centrally on an exchangeable SD card in a non-volatile manner. Upon the restart of the automation unit, but also upon the restart of individual modules, all required data are automatically transferred from the SD card to all CPUs and modules.

Thus, when modules are exchanged, no subsequent loading process will be required, as new modules receive all their data from the memory card.

When using the TOOLBOX II, the engineering data is stored in a data base, and can be written offline on the SD card. With commissioning the SD card must be only put into the corresponding automation unit.

With commissioning or in case of maintenance, the engineering data can be loaded also online into the automation unit. In this case, the master control element stores the data on the equipped SD card.

1.2.7 Compatibility

TM 1703 emic is in the range of IEC 60870-5-101/103/104, when using standard protocols, compatible with the entire SICAM 1703 system family (AK 1703 ACP, TM 1703 ACP, BC 1703 ACP, TM 1703 mic).

The function diagram (FUD) is compatible with the entire system family SICAM 1703, with restrictions due to the system limit (Memory).

2 Application Overview

Contents

2.1 Introduction 26

2.2 Fields of Use 27

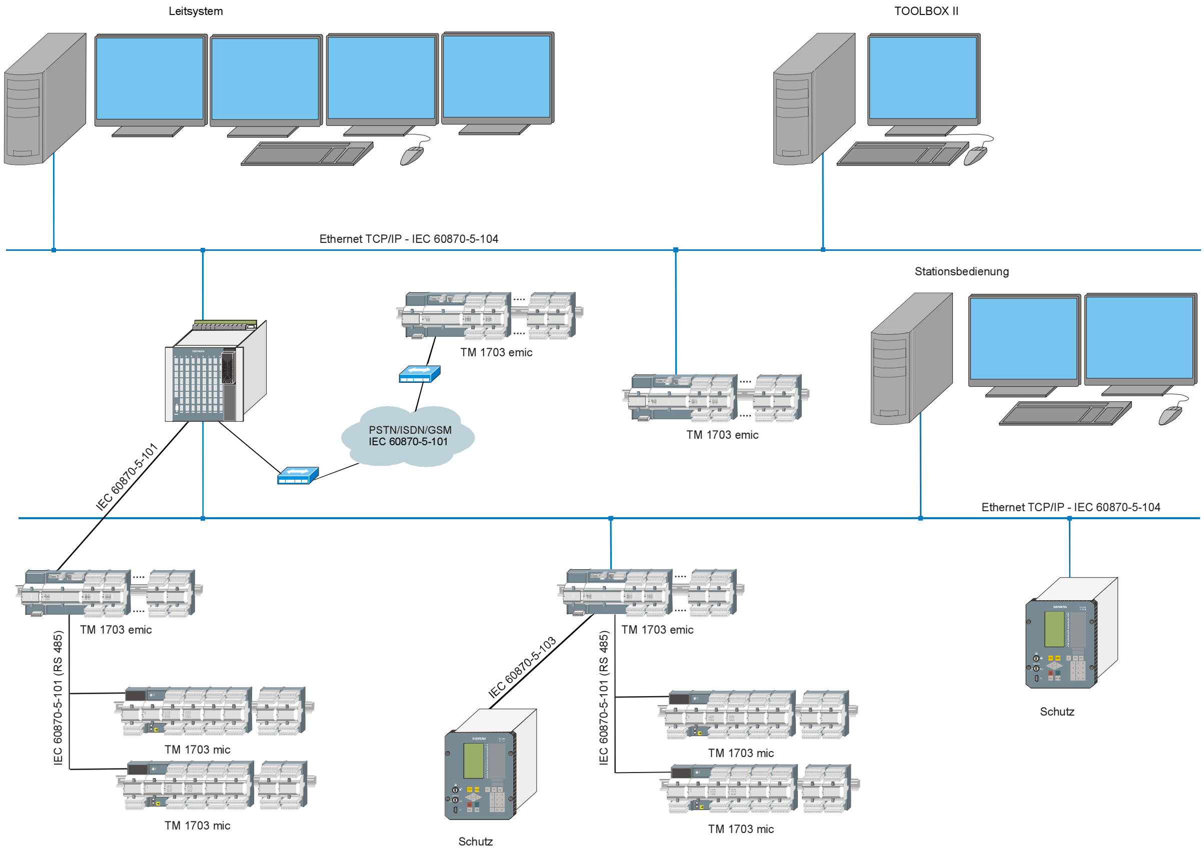
2.1 Introduction

Due to the modular architecture, TM 1703 emic can be used in a variety of ways:

- Front end, gateway
- Process control applications, automation applications
- Station control device, sub-node
- Telecontrol substation

In principle, for this all necessary functionalities are available. The actual application is defined simply through the corresponding configuration and parameterization.

Example for a Networked Plant (System Family SICAM 1703)



Note

Please consider the performance features of the systems and of its components in chapter 7, Technical Specifications Total System, and chapter 6, Overview of the Protocol Elements.

2.2 Fields of Use

2.2.1 Front End, Gateway

Due to the number of interfaces and the variety of protocols available, TM 1703 emic is perfectly suitable for the use as front end for a process control system.

All telecontrol substations – regardless of which manufacturer and over which protocol – are connected to TM 1703 emic. In the front end, the signal processing and adaptation takes place for the respective control system. From the perspective of the control system, there is no difference which protocol and which system behavior the substation actually has.

2.2.2 Process Control Applications, Automation Applications

Open- and closed-loop control application programs are created by means of CAEx *plus* according to IEC 61131-3, a standard that is generally accepted and recognized in the market.

In TM 1703 emic, depending on requirement, various peripheral modules can be connected. Through this and due to the modularity, TM 1703 emic is suitable for many applications: from smaller automation applications up to complex process control applications. Naturally, all applications can also be combined.

2.2.3 Station Control Device, Sub-Node

The functionality of a station control device can be simply regarded as a combination of the functionality of a front end (interfacing of diverse bay devices, protective devices, processing of the data for the power system control) and the functionality of process control applications (open- and closed loop control application programs), and is therefore perfectly suited for this application. In addition, further telecontrol peripherals could also be installed in the station control device, through which telecontrol station and station control device could be united in one device.

2.2.4 Telecontrol Substation

For telecontrol applications there is a modular, versatile periphery available for the process data interfacing.

Naturally, arbitrary open- and closed-loop control application programs can be realized in TM 1703 emic with CAEx *plus*, through which, at the same time and to the same degree, TM 1703 emic can become a remote terminal unit and an automation unit in one.

3 System Overview

Contents

3.1 Mechanical Structure 30
3.2 Architecture 31
3.3 Communication 38
3.4 Engineering 45

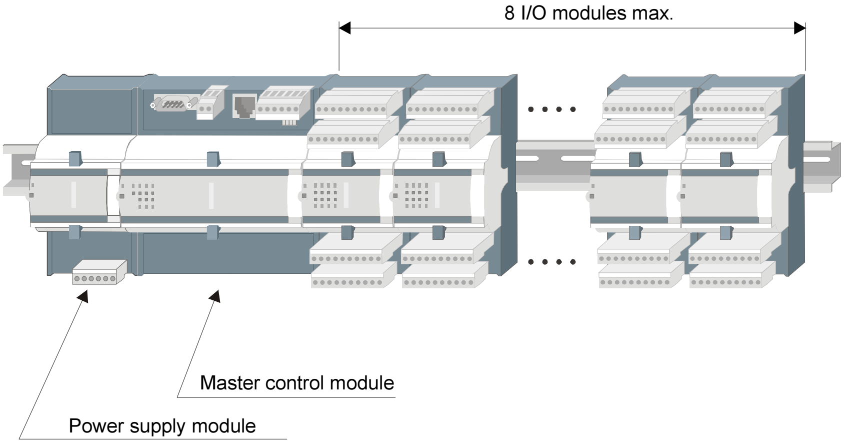
3.1 Mechanical Structure

TM 1703 emic is an automation device of the system family SICAM 1703. Installation takes place on a DIN rail (TS35) that is mounted horizontally or vertically on a vertical standing rack.

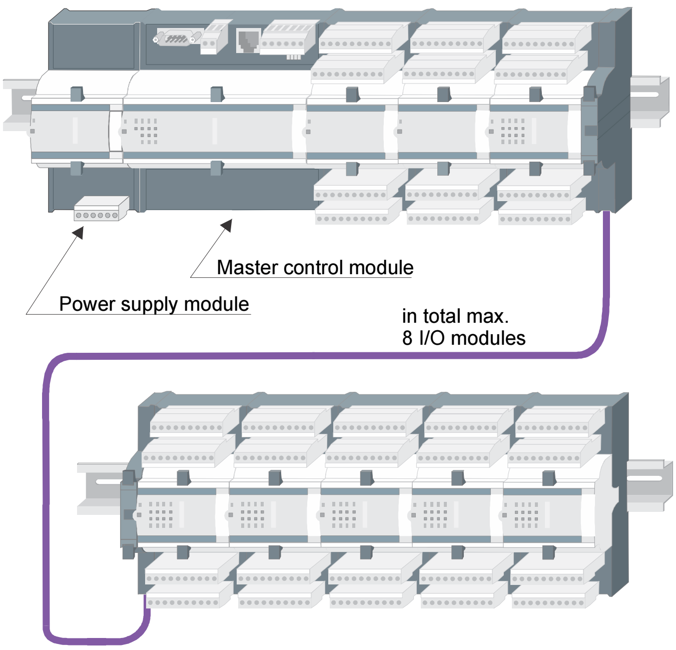
The sequence of modules from left to right or top to bottom is prescribed as follows:

- 1 power supply module
- 1 master control module
- optionally up to 8 I/O modules (dependent on power consumption)

Standard Arrangement



2-Line Structure



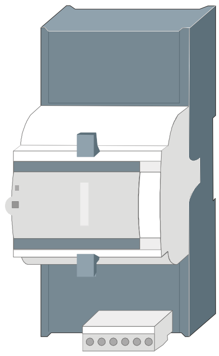
For the installation under reduced space conditions the I/O modules can be arranged also in 2 lines.

The connection of the both lines takes place via a special cable (CM-6810).

3.2 Architecture

3.2.1 Power Supply Module

The supply of TM 1703 emic is carried out by a power supply module.



The power supply module provides the operating voltage for the master control module and for the optional I/O modules.

It provides also the operating voltage for the transmission equipment for multi-point traffic and dial-up traffic.

Features

- Installation on DIN rail
- Input voltage
  - PS-6630: 24…60 VDC
  - PS-6632: 110…220 VDC
- System voltage output U1 5.1 VDC, max. 8 W
- System voltage output U2, switchable
  - 5.2 VDC, max. 2.5 W or
  - 10 VDC, max. 2.,5 W
- Environmental conditions with enhanced electromagnetic compatibility
- Withdrawable srew terminals
- Function display via LED
- Monitoring of the output voltage
- Parallel connection for redundance (not for purpose of power enhancement)

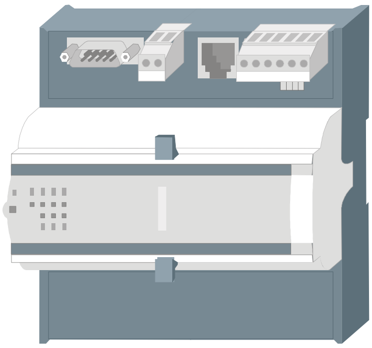
Product Overview

Type	Designation
PS-6630	Power supply module 24…60 VDC (EMC+)
PS-6632	Power supply module 110…220 VDC (EMC+)

3.2.2 Master Control Element

The master control element is the heart of the system TM 1703 emic.

The hardware of the master control element is the master control module, and its functionality is provided by means of a loadable and parameter-settable firmware.



On the master control module reside the interfaces for the communication (serial and Ethernet), as well as a status display.

The master control element provides the parameter-settable *telecontrol function* and the *open-/closed-loop function*, as well as the node function for the communication. Additionally, it serves as centrally coordinating element for all *system services* and all internal and integral concepts.

This architecture ensures

- an autonomous behavior (for instance in the case of communication failure)
- the integration of the *telecontrol function* (spontaneous processing and spontaneous communication) and the *open-/closed-loop control function* (periodical processing and periodical communication with the periphery) into one common automation device
- a deterministic behavior of the *open-/closed-loop control function* with guaranteed reaction times

Furthermore, the master control element is able to store events in an archive (DEAR) in case of a communication fault. After elimination of the fault the superior control system can demand the archive of the master control element. By means of this function, a possible data loss will be prevented.

Features

- Installation on DIN rail
- Interfaces for the communication
  - Ethernet (TCP/IP) for LAN/WAN Verbindungen nach IEC 60870-5-104
  - EIA-232 for multi-point traffic or dial-up traffic according to IEC 60870-5-101 with supply for an external transmission facility
  - EIA-485 with externally accessible configuration switch
- Data Node functionality
  - Organization of the data flow from and to the communication interfaces
- Main focus in telecontrol
  - Parameter-settable telecontrol functionality
  - Parameter-settable communication protocols
  - Time management and time synchronization
- Automation
  - Freely programmable open-loop and closed-loop control tasks
- Expandable with up to 8 I/O modules (input and output of process signals)
- Loadable firmware
- Storage of the parameters and application program on SD card
- Decentralized archive (DEAR) for the avoidance of data loss during communication fault
- Engineering, diagnosis and test via TOOLBOX II
- Integrated webserver for the optional engineering via web browser
- Function and error display
- Power supply 24 VDC…220 VDC (depending on power supply module)

Product Overview

Type	Designation
CP-6010	Master control module
CPC30	Firmware *central processing and communication*
SD card	Memory card for parameters and firmware

3.2.3 Peripheral Element

The optional peripheral element serves for the acquisition or output of process signals. It performs the process-compliant adaptation, monitoring and processing of the process signals at each point of entrance or exit of the system.

The hardware for the peripheral element is integrated on the master control module, and its functionality is provided by means of a loadable and parameter-settable firmware.

Features

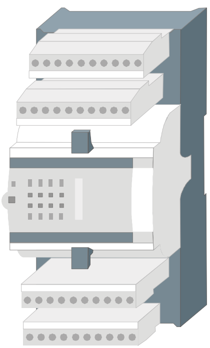
- Support of up to 8 I/O modules
- Acquisition and preprocessing of process data according to IEC 60870-5-101/104 with and without time tag
  - Single-point and double-point information items
  - Count pulses
  - Actual values
- Postprocessing and output of process data according to IEC 60870-5-101/104
  - Single-point information items
  - Single-point and double-point commands
  - Setpoint commands
- Secured data exchange between the I/O modules and the master control element via the TM bus
- Supervision of the I/O modules and failure processing
- Fault display

Product Overview

Type	Designation
USIO36	Firmware *universal signal input and output*

3.2.3.1 I/O Modules

The optional I/O modules support the peripheral element with the input and output of process data.



The connection of the process signals (I/Os) happens by means of removable screw terminals. The screw terminals are enclosed with each I/O module.

When modules are exchanged no connections need to be detached, since the screw terminals carry the wiring. Thereby the assembly effort required for the connection is reduced to a minimum.

Further, a status display resides on the I/O modules.

Features

- Installation on DIN rail
- Acquisition of process signals and preprocessing by means of hardware
  - binary inputs
  - analog inputs (currents, voltages, temperatures)
- Output of process signals and postprocessing by means of hardware
  - binary outputs
  - analog outputs (currents and voltages)
- Preprocessing or postprocessing by hardware
- Status display for binary signals
- Function display

Product Overview

Type	Designation
DI-6100	Binary input 2x8, 24…60 VDC
DI-6101	Binary input 2x8, 110/220 VDC
DI-6102	Binary input 2x8, 24…60 VDC 1 ms
DI-6103	Binary input 2x8, 110/220 VDC 1 ms
DI-6104	Binary input 2x8, 220 VDC
DO-6200	Binary output transistor 2x8, 24…60 VDC
DO-6212	Binary output relays 8x 24…220 VDC/230 VAC
DO-6220	Command out basic module *)
DO-6221	Command out basic module measurement *)
DO-6230	Command output relay module
AI-6300	Analog input 2x2 ±20 mA/±10 V
AI-6307	Analog input 2x2 ±2.5 mA/±5 mA/±10 V
AI-6308	Analog input 2x2 ±1 mA/±2 mA/±10 V
AI-6310	Analog input 2x2 Pt100/Ni100
AO-6380	Analog output 4x ±20 mA/±10 mA/±10 V
TE-6430	Counter input 2x 24…60 VDC

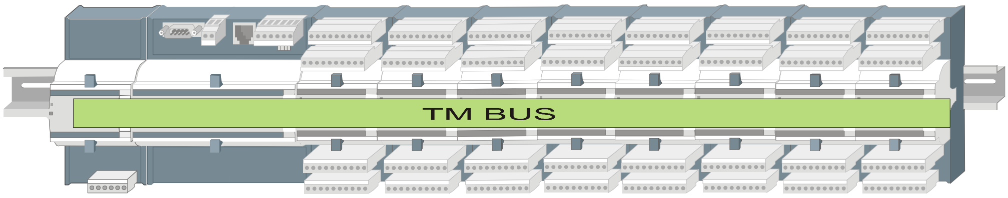
*) checked command output combined with maximum 7 pcs. DO-6230

3.2.3.2 TM 1703 Peripheral Bus

The master control element communicates with the I/O modules via the TM 1703 peripheral bus (TM bus), and via those with the process.

By arranging the various modules side by side, contact will be established automatically throughout the TM bus so that no additional wiring is required.

Each module is individually replaceable.



The TM 1703 peripheral bus (TM bus) permits the secured serial, in-system communication between the master control element and the I/O modules.

The communication at the TM bus takes place according to the master-slave method, the I/O modules being slaves and the master control element the master.

Addressing of the bus participants is handled for all I/O modules automatically according to the sequence of the hardware configuration.

The interfaces between the master control element and the I/O modules are memories whose contents are transmitted periodically (every 10 ms) by the TM bus. It is defined for each I/O module which and how much information is transmitted.

Two logical channels are established via the TM bus:

- 1 periodical channel for the *open-/closed-loop control function*
- 1 spontaneous channel for the spontaneous *telecontrol function* including communication.

The periodical channel permits the data exchange between the master control element and the I/O modules in the cycle of the *open-/closed-loop control function* in the master control element. This way, non-linearized and conditioned (adapted) values are supplied to the input module of the *open-/closed-loop control function* and passed on by the *open-/closed-loop control function* to the output modules.

The spontaneous channel permits the data exchange between the master control element and the I/O modules. This way, the spontaneous messages are transmitted in the acknowledged mode in a spontaneous time window within the acquisition and output grid.

The I/O modules are checked via the TM bus cyclically upon function. An error is recognized after maximally 200 ms. The "RY" LED on the relevant I/O modul goes out.

3.2.4 Protocol Elements

A protocol element serve for the exchange of data – and thus for the transmission of messages – via a communication interface to other automation units or process control systems.

The hardware for the protocol elements is integrated on the master control module, and their functionality is provided by means of loadable and parameter-settable firmwares.

Via the communication interfaces the master control element is able to communicate with an arbitrary superior or subordinate automation unit in multi-point traffic or dial-up traffic (with the aid of an external transmission facility), or via LAN/WAN.

3.2.4.1 Supported Protocols

TM 1703 emic supports the following protocols and interfaces.

Type	Designation	Standard	Interface
Standard protocols			
UMPMT0	Multi-point traffic Master	IEC 60870-5-101	EIA-232, EIA-485
UMPST0	Multi-point traffic Slave	IEC 60870-5-101	EIA-232, EIA-485
DIAST0	Dial-up traffic Slave *)	IEC 60870-5-101	EIA-232
103MT0	Protective device interfacing Master	IEC 60870-5-103	EIA-232, EIA-485
BPPT0	Point-to-point traffic	IEC 60870-5-101	EIA-232
ETT0	Ethernet TCP/IP	IEC 60870-5-104	LAN
Third-party protocols			
UMPMT1	Multi-point traffic Master (AMIS)	IEC 60870-5-101	EIA-232, EIA-485
MODMT0	Gould Modbus Master	*Modbus*	EIA-232, EIA-485
DNPST0	DNP3 Multi-point traffic Slave	DNP 3.0	EIA-232, EIA-485
ST1ST0	Siemens SINAUT-ST1 Multi-point traffic Slave	*Siemens*	EIA-232, EIA-485
TG8ST0	L&G Telegyr 800 Multi-point traffic Slave	*Telegyr*	EIA-232, EIA-485
SMST0	ASCII protocol for SMS alerting	*AT-Hayes/Siemens*	EIA-232
PCBST0	SK 1703 Multi-point traffic Slave *)	*Siemens*	EIA-232, EIA-485
RP5UT1	ABB RP570/571 Multi-point traffic Slave	*ABB*	EIA-232, EIA-485

*) not configurable via web browser

EIA-232 can be configured via the connectors X1 or X2, LAN only via X1, and EIA-485 only via X3.

You can find more information on the protocols in chapter 7, Technical Specifications Total System.

Additional information on interfacing to third-party systems and further protocols is available on request.

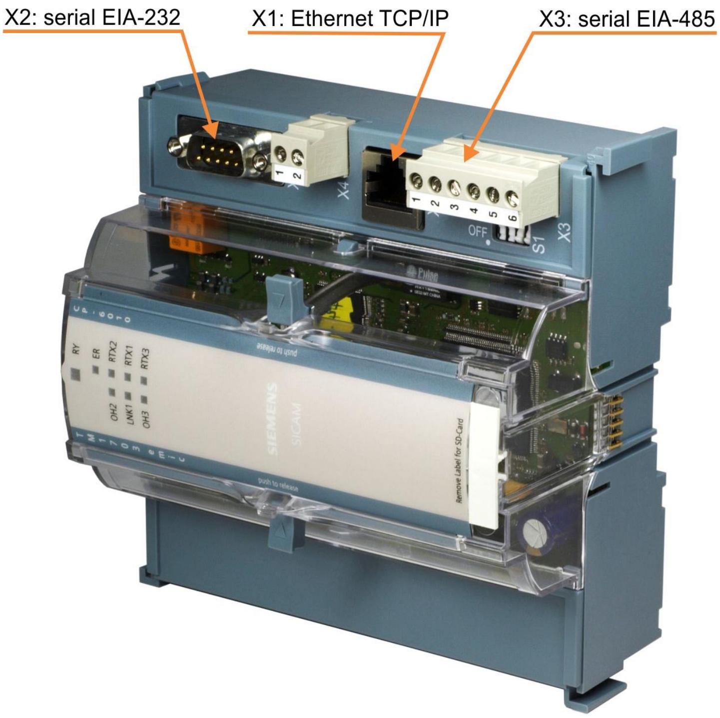
3.3 Communication

3.3.1 Interfaces

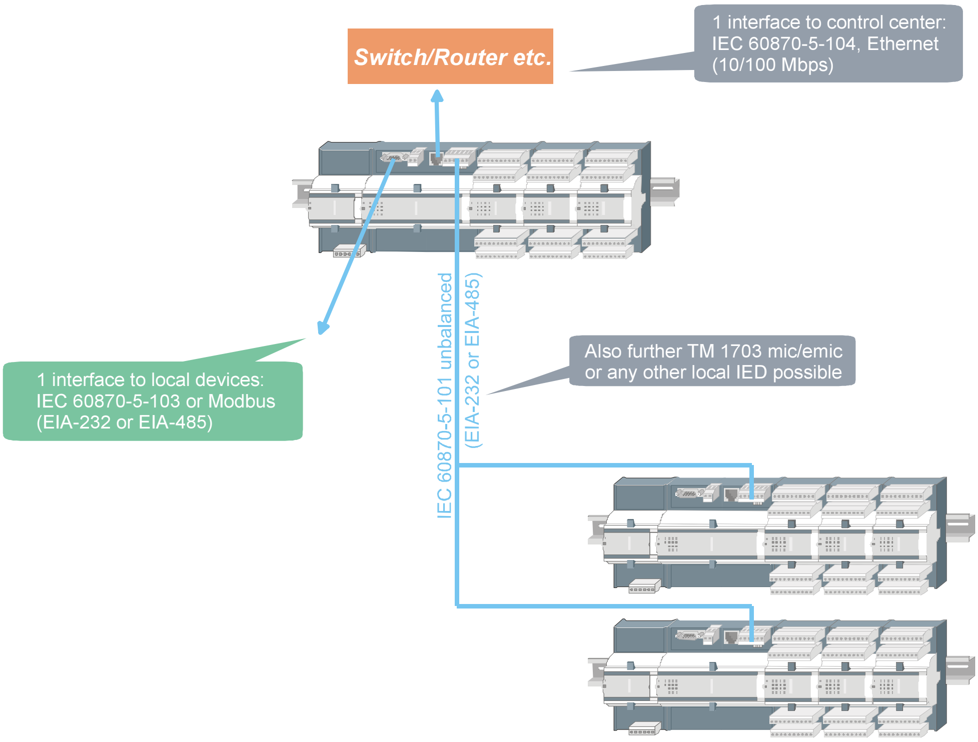
The master control element provides 3 interfaces for a multitude of communication possibilities:

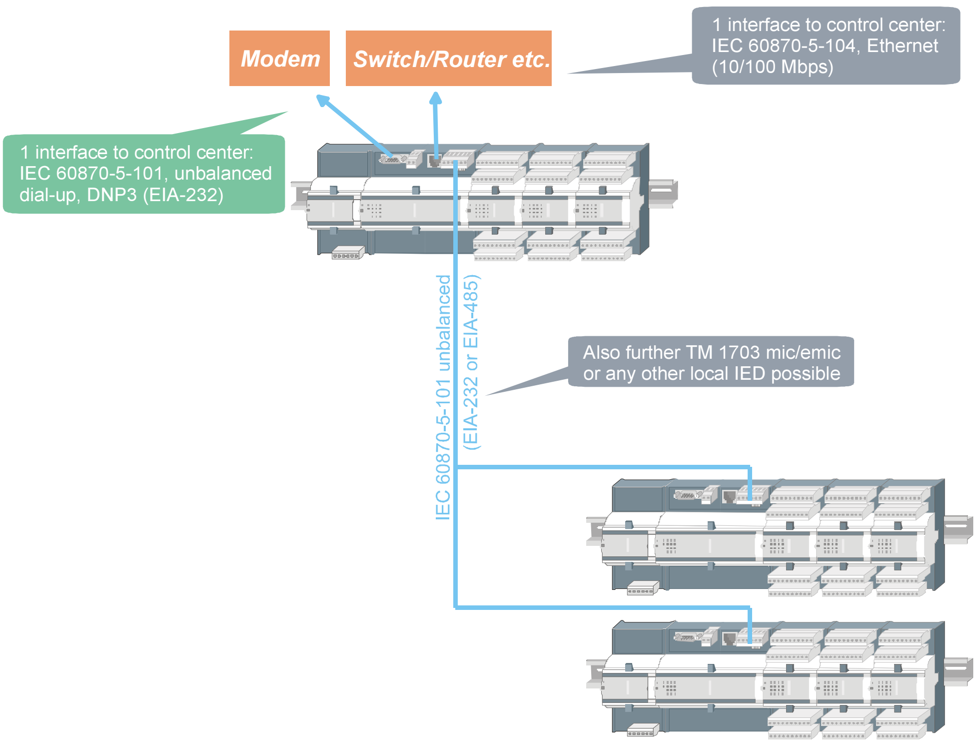
- serial according to standard EIA-232
- serial according to standard EIA-485
- Ethernet TCP/IP (LAN/WAN)

All interfaces can be operated simultaneously.



3.3.2 Configurations





3.3.3 Transmission Facilities

TM 1703 emic supports the following transmission facilities:

Traffic type	Transmission facility	Protocol
Multi-point traffic	CE-0700 V.23 Leased line modem [1)]	UMPMT0, ST1ST0, TG8ST0, UMPMT1
	CE-0701 VFT Channel modem [1)]	UMPMT0, ST1ST0, TG8ST0, UMPMT1
	CM-0819 Converter EIA-232/EIA-485	103MT0, MODMT0
	CM-0821 Field bus interface ring (3x FO, 1x el.)	UMPMT0, UMPST0, MODMT0, 103MT0
	CM-0822 Field bus interface star (4x FO)	UMPMT0, UMPST0, MODMT0, 103MT0
	CM-0823 Field bus interface ring (3x FO, 1x EIA-485)	UMPMT0, UMPST0, MODMT0, 103MT0
	CM-0827 Fiberoptical interface (el.-FO)	UMPMT0, UMPST0, MODMT0, 103MT0
	Westermo TD-23 (analog) [2)]	UMPMT0, UMPST0
	TP Radio WDM 8000	UMPST0, UMPMT1
	SATELLINE 2ASxE	UMPMT0, UMPST0
	Radio digital	UMPMT0, UMPST0, ST1ST0, TG8ST0, UMPMT1
	Radio analog	UMPMT0, UMPST0, ST1ST0, TG8ST0, UMPMT1
	Direct connection	UMPMT0, UMPST0,103MT0, ST1ST0, TG8ST0, BPPT0, MODMT0, UMPMT1
Dial-up traffic	Westermo TD-36 (analog)	DIAST0
	Westermo IDW-90 (ISDN)	DIAST0
	Cinterion MC52iT (GSM 900/1800 MHz) [3) 4)]	DIAST0
GPRS	Siemens MD741-1 (GPRS) [4)]	ETT0
	Dr. Neuhaus Tainy EMOD-V2-IO (GPRS) [4)]	ETT0
	Dr. Neuhaus Tainy EMOD-L1-IO (GPRS) [4) 5)]	ETT0
Ethernet		ETT0

1) supply 5 V via modem cable TM 1703 emic for CE-070x

2) provides EIA-232 and EIA-485 interface

3) supply 10 V via modem cable TM 1703 emic for MC52iT-Modem

4) transmission of SMS (notifications) possible

5) without IP sec. VPN tunnel

3.3.4 Installation of External Communication Connections

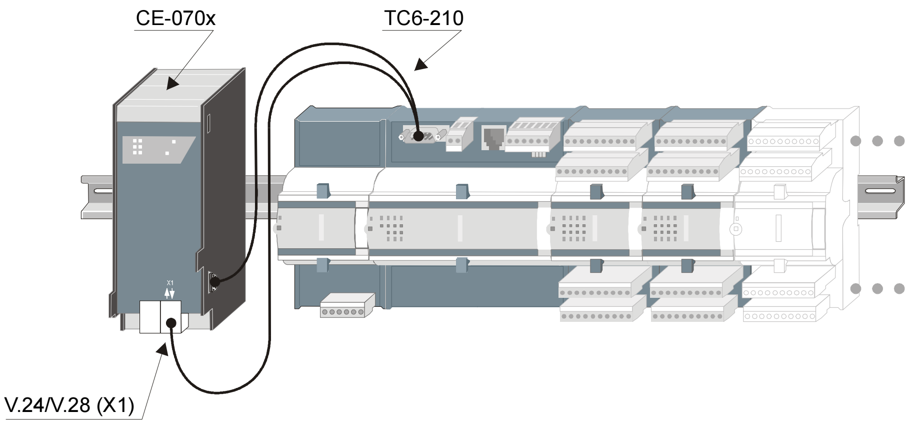
This section shows, how the various methods of communication can be realized by means of the standard modems and cables.

Note

Communication cables are, if possible, to be installed separately from the supply and peripheral cables.

3.3.4.1 Serial Communication

3.3.4.1.1 Multi-Point Traffic via Leased Line Modem and VFT Channel Modem

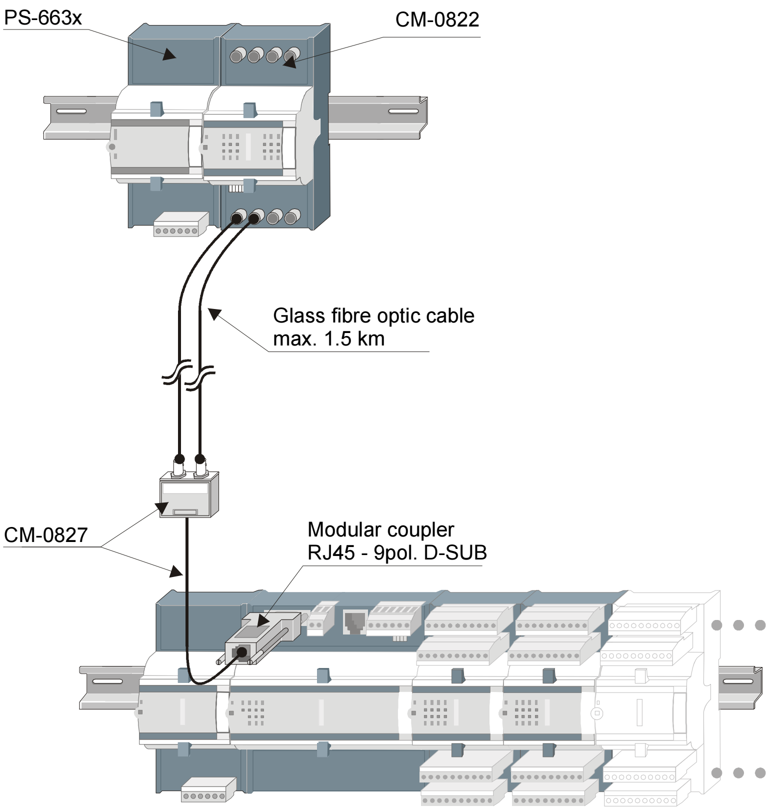


Note

Consider the power consumption of the modem when using this configuration (power supply of CE-070x via CP-6010).

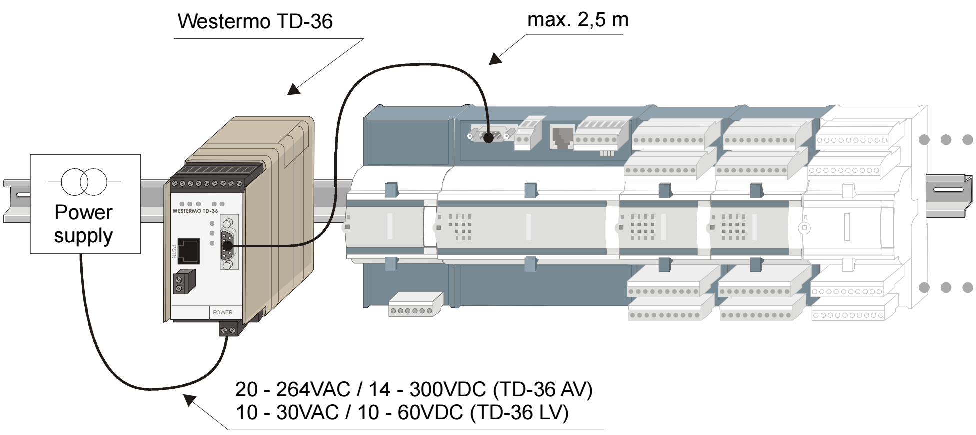
Order information for the transmission facility and cables see appendix A.4, Interface Modules.

3.3.4.1.2 Multi-Point Traffic via Glass Fibre Optic and Star Connection



Order information for the transmission facility and cables see appendix A.4, Interface Modules.

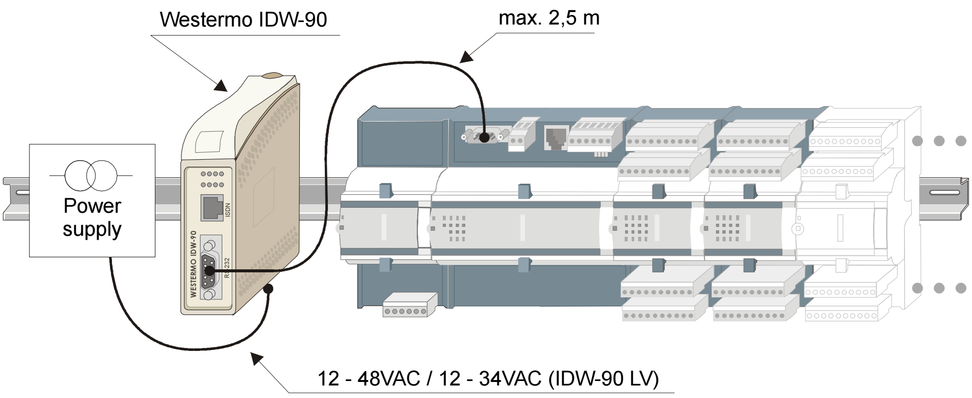
3.3.4.1.3 Dial-up Traffic Analog with Westermo TD-36 and External Supply



Order information for the transmission facility and cables see appendix A.4, Interface Modules.

You can find a diagram for the modem cable in the *TM 1703 emic User's Guide, chapter "Installation",section "Cables for External Communication Links"*.

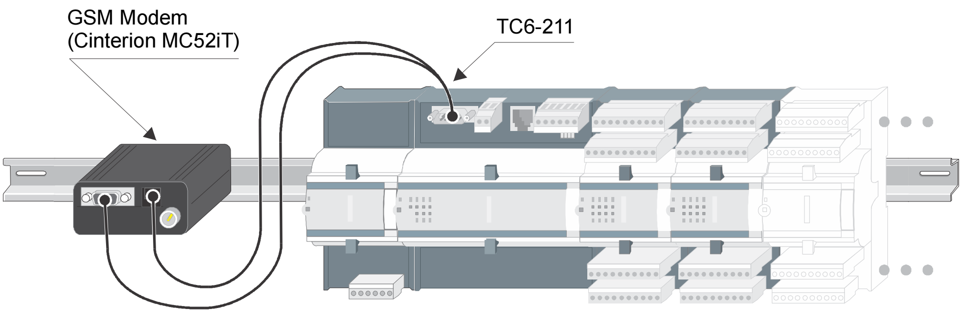
3.3.4.1.4 Dial-up Traffic ISDN with Westermo IDW-90 and External Supply



Order information for the transmission facility and cables see appendix A.4, Interface Modules.

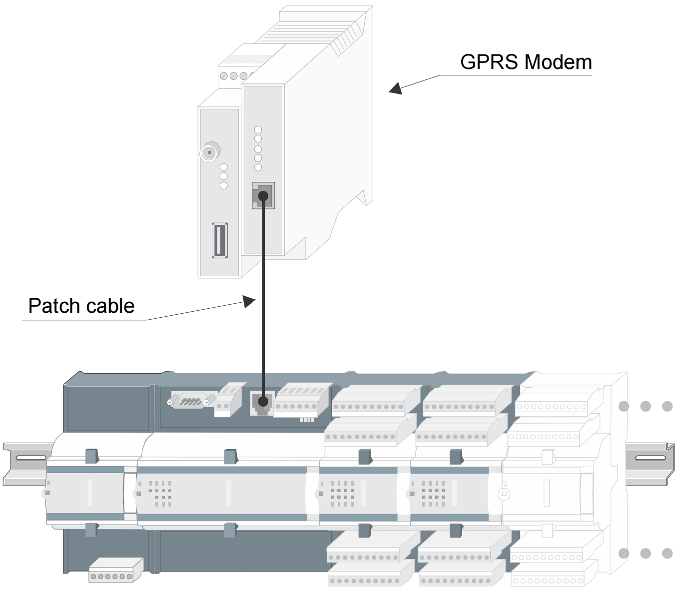
You can find a diagram for the modem cable in the *TM 1703 emic User's Guide, chapter "Installation",section "Cables for External Communication Links"*.

3.3.4.1.5 Dial-up Traffic GSM



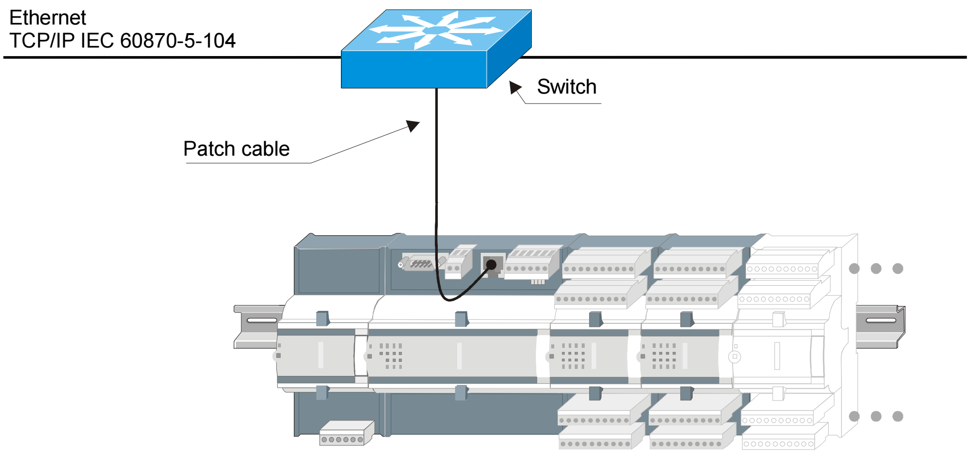
Order information for the transmission facility and cables see appendix A.4, Interface Modules.

3.3.4.1.6 GPRS



Order information for the transmission facility and cables see appendix A.4, Interface Modules.

3.3.4.2 Ethernet Communication (LAN/WAN)



Note

Depending whether a connection is done inside or outside of cabinets, differenttypes of patch cables must be used.

You can find details on connections above 10 m in the manual *ACP 1703 Platforms Configuration Automation Units and Automation Networks, appendix A; section "Electrical Connection, Cable longer than 10 m"*.

3.4 Engineering

Engineering, diagnosis, test takes place alternatively via

- TOOLBOX II (as of Version 4.10 SP2)
- Web browser (Microsoft ® *Internet Explorer* as of Version 6)

The engineering data and firmwares are stored on a SD-Karte. Therefore, for replacing defect modules no tool is needed.

Differences in the Engineering

	TOOLBOX II 	**Web browser** 
License required	yes	no
Interfacing	• directly via direct cable (EIA-232) • remotely via Toolbox cable and further SICAM 1703 automation units • Ethernet	• directly via direct cable (EIA-232) • Ethernet
Engineering mode	parameterization offline, subsequently transform parameters and load into target system	parameterization online in the target system
Remote maintenance	yes	no
Protocols	• standard protocols • third-party protocols	• not all third-party protocols supported
Peripheral functions	like TM 1703 ACP, except TE modules	like TM 1703 ACP, except TE modules • without expert parameters • not all third-party protocols via web available
Process-technical parameterization	like TM 1703 ACP	• no data points from/to basic system element possible *) • no automatic protocol parameterization
Application program	• instruction list • function chart (CAEx *plus*) based on IEC 61131-3, with restrictions	• instruction list based on IEC 61131-3, with restrictions
Test functions	yes (except CAEx *plus* online test)	with restrictions
Diagnosis	yes	with restrictions
Sum diagnosis information	yes	only via instruction list
Extras		initialization program necessary (*webemic.exe*)

*) no messages for detailed diagnostics, sum diagnostics, communication control, protocol control and –return information, special application output and –input, special function AMIS

4 Function Packages

Contents

4.1 Overview 48
4.2 System Services 49
4.3 Telecontrol 55
4.4 Automation 59

4.1 Overview

Due to the different requirements in terms of functionality, also different data flow concepts are produced.

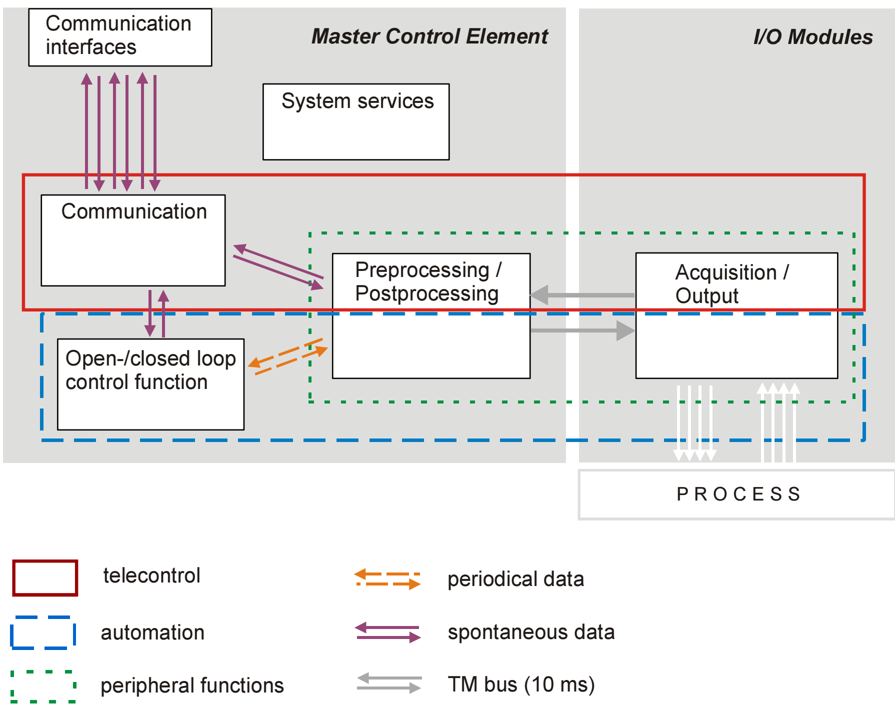
The implementation of freely definable open-/closed-loop control functions (*Automation*) calls for a deterministic guaranteed reaction time. This is achieved by using the consistently periodic concept with regard to data acquisition, execution of functions, and data transfer, regardless of the number of changing signals.

For telecontrol tasks and the distribution of user data in networked plants (*Telecontrol*), the use of spontaneous transmission proves advantageous for optimizing the utilization of the in many cases limited communication bandwidth. This helps avoid constant burdening of the data sinks with unnecessary data.

While in classical programmable controller devices, the design is primarily adapted for the open-/closed-loop functions - that is, for a periodical data exchange - classical telecontrol devices in turn prove advantageous in spontaneous data exchange. TM 1703 emic complies equally well with both requirements. For high-load cases they can even be mutually prioritized.

The optional configurable I/O modules serve as interface to the process. The input/output and processing of the process signals is performed by means of the *Peripheral Functions*.

Data flow



The subsequently listed functions are described in detail in the manual *"ACP 1703 Common Functions System and Basic System Elements"*.

4.2 System Services

The function package *System Services* provides general functions and basic services that are required by other function packages. It contains

- Communication with the engineering system
- Integrated webserver
- Data flow control
- Addressing
- Real-time concept
- General interrogation
- Monitoring functions
- Failure management
- Diagnosis and signaling
- Autonomy
- Storage of application data
- Storage of firmware

4.2.1 Communication with the Engineering System (TOOLBOX II)

For the communication between the TOOLBOX II and TM 1703 emic, there exist different variants:

- Physical connection
  - Directly by means of a direct cable (EIA-232 interface)
  - Remotely
    - Serial remote communication link via modems (EIA-232 or EIA-485 interface)
- Logical connection of the TOOLBOX II with that automation unit, that is the subject of the engineering task:
  - Local automation unit
    (that is that one, to which the physical connection exists, regardless in which of the above mentioned forms)
  - Remote automation unit
    (automation unit that can be reached via the local automation unit; consistent remote communication according to IEC 60870-5-101 or -104 is required)

Except for first-time initialization processes, all tasks are possible in each of the variants listed above:

- Parameter setting
- Diagnostic
- Test
- Load firmware, load parameters

4.2.2 Integrated Webserver

For simple engineering tasks a webserver resides on the master control element. The webserver provides the menus for the engineering and maintenance designed as websites. The engineering takes place online via the *Microsoft ® Internet Explorer*.

The following functions are supported:

- Configuration of peripheral element and protocol elements
- System-technical parameter-setting (parameter management consistent with the TOOLBOX II)
- Diagnosis
- Process display, process simulation
- Load backup file, save backup file
- Application program handling (IL)
  - Configuration
  - Load code
  - Delete code
  - Diagnosis

4.2.3 Data Flow Control

The data flow control is that system function which coordinates the communication of messages within the automation unit.

This function supports:

- *Messages with Process Information*
- *Messages with System Information*

For the tracking of messages within an automation unit the following test functions are available:

- Data Flow Test
- Message Simulation

4.2.3.1 Messages with Process Information

IEC 60870-5 distinguishes between the following classes of messages. The type identification of each message provides information about the class to which a message belongs and with which methods it is to be distributed:

- *Messages with process information* in monitor direction
  - binary information, measured values, integrated totals and bit patterns
- *Messages with process information* in control direction
  - commands, setpoint values and bit patterns

The distribution of *messages with process information* takes place by way of routing (*telecontrol function*) or assignment (*open/closed-loop control function*) based on the message address and type identification in the message.

Messages with process information, that are to be transmitted to other automation units via protocol elements, are distributed with the help of the function Automatic Data Flow Routing.

For *messages with process information* that are to reach sinks within the automation unit (I/O modules, *open-/closed-loop control function*) the routing information or as-signments are automatically derived from parameters (datapoint address).

Predominantly used are message formats according to IEC 60870-5-101/104 in the public range with the exception of user data containers. Therefore, for their part the messages are compatible and interoperable with many other manufacturers.

Within the SICAM 1703 family, when using standard protocols the messages are compatible with the system families **Ax 1703** (AK 1703, AM 1703, AMC 1703, BC 1703) and **ACP 1703** (AK 1703 ACP, TM 1703 ACP, BC 1703 ACP).

Messages with process information have a 5-stage message address. Message addresses must be parameterized at the sources (I/O modules, *open-/closed-loop control function*).

4.2.4 Addressing

4.2.4.1 Addressing of Automation Units

Each TM 1703 emic forms an automation unit and is addressed with

- Region number (0…249)
- Component number (0…255)

Within a system-technical plant, the automation unit must be uniquely addressed, which makes the maximum size of a system-technical plant 64.000 automation units.

4.2.4.2 Addressing of Process Information

Addressing and the structure of the process information to be passed on by TM 1703 emic are consistent with the IEC 60870-5-101/104 standard. Therefore, the information is in turn compatible and interoperable with many other vendors.

In the automation network, each data point is addressed by means of

CASDU 1………Common address of ASDU, octet 1
CASDU 2………Common address of ASDU, octet 2
IOA 1……………Information object address, octet 1
IOA 2……………Information object address, octet 2
IOA 3……………Information object address, octet 3
TI………………..Type identification

4.2.5 Real-Time Concept

Generally, TM 1703 emic automatically supports time tagging for all data. On the master control element resides the central clock of the automation unit.

For time management and synchronization, the following possibilities are available:

- Time setting and synchronization via serial communication
- Time setting and synchronization via LAN/WAN (NTP server)
- Management of the own clock with a resolution of 10 ms

Time tagging takes place automatically at each point in the system where spontaneous data originates. Data is transferred priority-controlled, in standard protocols with 7 octet date and time with resolution of 1 ms or 10 ms (depending on the respective I/O module).

TM 1703 emic itself can in turn provide time to further automation units via communication lines and handle time synchronization in serial standard protocols.

4.2.6 General Interrogation

During startup and after errors in the system (communication errors, FIFO overflow events), the automation units involved ensure that operations are resumed automatically in a coordinated manner.

This means that the communication connection is established and all data concerned as well as relevant system information are transferred from their source all the way to their sink, in order to update the process images throughout the system (taking a multi-hierarchical network into account). This is done by prompting a general interrogation of the respective portion of the automation network where the error has occurred.

4.2.7 Monitoring Functions

Monitoring of an automation unit

- Functionality of the processor and of the memories (periodical test of the program, data, and parameter memories, as well as watchdog function)
- Internal communication capability (periodical internal test messages with monitoring function)
- Data integrity (internally secured data transmission with parity, plausibility check at the internal interfaces, identification of data of failing modules)
- Information loss due to a buffer overflow
- Correctness of internal workflow sequences

Monitoring of system environment

- Plausibility of process states
- Plausibility of process sequences
- Availability of process circuits

Monitoring of communication

- Functionality (periodical call messages with monitoring function, monitoring of transmission quality)
- Data integrity (secured transmission, identification through failure of data concerned)

4.2.8 Failure Management

The failure management system concept implemented in SICAM 1703 ensures the individual identification of data of failing system components and the correct system and process behavior in disturbance events. For this purpose, the failure management function includes

- a system function for failure detection (for instance for modules, communication)
- derived therefrom a system signaling in the form of status information in spontaneous messages and in the form of special data points for the open-loop and closed loop control function
- a parameter-settable behavior of peripheral elements with output function.

This way, the state for each process information is available at all data sinks (peripheral outputs, *open-/closed-loop control function*, process control system), and it is possible - depending on the requirement and functionality - to elicit an appropriate counterreaction therefrom.

4.2.9 Diagnosis and Signaling

The diagnostics function manages the system states and error information detected by the various functions and their watchdogs. It permits the indication of process states, of the internal system and fault information on module front panels, and the local or remote diagnosis.

Each I/O module supplies its detected system and error states together with additional information (for instance cause of error, originator description) to the master control element. There, they are filed in tables as current and saved information. This information can be retrieved and displayed in detail locally and from remote locations. The saved information can be acknowledged and can therefore be updated again. For the sake of better clarity, these tables are divided into various classes.

Each TM 1703 emic transmits a sum information about the detailed errors via the communication to the closest automation units, where it is managed.

Important detailed and sum information is indicated by means of LEDs at the module front panels.

4.2.10 Storage of Application Data

With engineering via the TOOLBOX II, application data are stored in a data base on the engineering PC. From there they can be loaded into a target system, or else be written on a suitable SD card.

With engineering via the web browser, application data are written directly on the SD card in the target system.

The application data of a project created via the web browser can be saved in a file on the engineering PC. With the aid of the program *WEBemic* this data can be written on a suitable SD card (for instance for the duplication of a project).

After putting a written SD card into a target system, the target system transfers changed or added data into ist main memory during a subsequent startup.

4.2.11 Storage of Firmware

Current firmware revisions for TM 1703 emic can be loaded as binary files

- online into a target system with an equipped SD card
- offline through storage on a suitable SD card

In both cases, the master control element with the equipped SD card unpackes the corresponding files and stores the firmwares in the main memory during startup.

4.2.12 Autonomy

This system concept ensures that, if central parts succumb to a failure, as much of the functionality as possible will remain intact. Each TM 1703 emic is capable of functioning autonomously – this means, it will continue carrying out its defined local function even where the entire communication is disturbed.

In such events, the system invariably ensures that the failure is detected and signaled. Based thereon, a functional behavior may be defined, if necessary, that is adapted to the disturbance event at hand.

4.3 Telecontrol

The function package *Telecontrol* includes the following functions:

- Communication with other stations via selectable protocols
  - Protocol elements
  - Automatic or selective data flow routing
  - Data storage
  - Priority control
  - Monitoring of the communication links upon failure
- Communication within the Automation Unit
- Protocol element control and return information
- Archiving of events (DEAR)
- Process data input and output

Note

The listed functions are described in detail in the document *ACP 1703 Common Functions System and Basic System Elements*.

4.3.1 Communication with other Stations

4.3.1.1 Protocol Elements

The communication function controls the transmission of messages via protocol elements to other automation units or control systems.

A protocol element is based on hardware integrated in the master control element for serial or LAN/WAN communication, and supports protocols according to IEC 60870-5-101/103/104, as well as various protocols for the communication with third-party systems.

Communication in transmit direction

- The messages to be transmitted are learned through the automatic data flow routing and stored in the data storage
- The transfer of the messages from the data storage to the protocol elements takes place via a priority control in order to optimally utilize the transmission route

Communication in receive direction

- *Messages with process information* are distributed to all functions within the automation unit
- *Messages with system information* are either processed directly (example: station interrogation) or distributed further based on their destination address (CASDU) (example: messages for remote maintenance)

4.3.1.2 Automatic or Selective Data Flow Routing

For the data flow routing, a routing of individual process information items is not necessary. Simply only the direction (monitor direction, control direction, both directions) in which the messages are to be transmitted must be parameterized.

The type identification of each message provides information about the class (refer to Messages with Process Information) to which a message belongs and with which methods it is to be distributed:

- *Messages with process information* in monitor direction
  - For simple applications, the messages can be distributed via an entry in the topology
  - For more complex applications, the messages can be distributed selectively by means of data flow filters

    For each communication interface, pass-through filters or blocking filters can be set; since wildcards can also be used for all address attributes of the message, it is possible to control the data flow very specifically with simple means
- *Messages with process information* in control direction
  - The messages are distributed to the destinations determined by their CASDU over interfaces that are defined in the topology; the CASDU is interpreted as destination address

4.3.1.3 Data Storage

The messages that are intended for transmission over communication interfaces, are in principle stored chronologically in rings. There is a process image both before and after a ring. The arrangement, consisting of one ring and two process images, is called a priority channel (priority channels for transparent data do not have any process images).

Depending on the data communication mode of the protocol element over which the communication is processed, priority channels are provided for every priority of the messages to be transmitted and for every station that can be reached via the protocol element:

- Data communication mode "multi-point" (e.g. multi-point traffic, LAN)

  One priority channel for every transmission priority, for every station and for every protocol element
- Data communication mode "single-point"

  One priority channel for every transmission priority and for every protocol element

With regard to the data that they transport, priority channels are distinguished as follows:

- Time synchronization
- System information
- Process information in control direction
- Process information in monitor direction priority HIGH with class 1 data
- Process information in monitor direction priority MEDIUM with class 2 data
- Process information in monitor direction priority LOW with class 2 data
- Transparent information

Functions for priority channels:

- State compression for measured values (can be set using parameters)

  Specifically reduces the flood of messages, that can continuously generate fluctuating measured values
- Behavior with a priority channel overload
- Behavior during a communication failure (transmit direction)
- Monitoring of the dwell time (parameter-settable) of *messages with process information* in control direction

  Messages that are stored too long in the priority channel are discarded
- Answering of station interrogations
- Behavior during failure of peripheral elements, communication interfaces etc.
- Blocking (series of information elements)

4.3.1.4 Priority Control

The priority controller has the task of selecting messages recorded in the data memories independently and individually for each interface and station, and to direct the transmission of the messages via the protocol elements in accordance with their priority. This ensures that with simultaneous existence of several active information items, the higher-priority, highly important information is transmitted first.

The prioritization does not however represent an absolute priority status, but rather a measure for dividing up the channel capacity. This ensures that even with continuously available higher-priority data, those of lower priority can also be transmitted.

4.3.2 Communication within the Automation Unit

Within the automation unit, the function package *Telecontrol* communicates with the function package *Automation* via its Telecontrol Interface. The function is described there.

4.3.3 Protocol Element Control and Return Information

This function is used for the user-specific influencing of the functions of the protocol elements. The main application lies with protocol elements with multi-point data communication mode and especially for dial-up traffic configurations.

This function contains two separate independent parts:

- Protocol element control
  - Test if stations are reachable
  - Suppression of errors with intentionally switched-off stations
- Protocol element return information
  - Cost control of telephone charges
  - Cost-efficient utilization of the telephone line

    (for instance command initiation only if a connection has already been established)

4.3.4 Decentralized Archive

The decentralized archive serves for the reconstruction of events after communication faults.

- Reconstruction of all process-relevant data during a communication fault
- Transmission of the archive to the control system
  - Automatic initiation by the control system
  - File transfer acc. to IEC 60870-5-101, section 7.4.11
- Data saving
  - Datapoint-specific (parameter-settable)
  - Number of files, memory size parameter-settable
  - Spontaneous for binary information items and integrated totals
  - Definable cycle for measured values
  - Non-volatile on flash card
- Configuration acc. to IEC 60870-5-101/104 (point-to-point, multi-point traffic, dial-up traffic, Ethernet), also multi-hierarchical configurations possible
- Also multi-hierarchical configurations are possible
- Reading of the archive via web browser or via TOOLBOX II possible
- Front-end: AK 1703 ACP, optionally redundant
- Supported by SICAM 230 (also third-party control system possible)
  - Update of the archive in the control system
  - Own status marking
  - Automatic subsequent billing of
    - Counter differencies
    - Secondary values
    - Mean values and extreme values

4.3.5 Process Data Input and Output

The process data input and output comprises

- Acquisition and preprocessing of the process data from the process image of the I/O modules
- Generation and spontaneous transfer of *messages with process information* to the communication for further processing

  therein included are

  - time information (resolution 1 ms or 10 ms, dependent on the respective I/O module)
  - processed input signals
    - change-monitored conditioned values
    - change-monitored derived information
- Spontaneous reception of *messages with process information* from the communication
- Postprocessing and forwarding of the process data for the output via I/O modules

4.4 Automation

The function package *Automation* contains the following functions:

- Telecontrol interface
  - Reception of messages with process information
    - Handling of commands according to IEC 60870-5-101/104
  - Change management and generation of messages with time tag
- *Open-/closed-loop control function*
- Process data input and output

4.4.1 Telecontrol Interface

4.4.1.1 Transfer of Messages with Process Information

Reception of *messages with process information* and transfer to the *open-/closed-loop control function* for the purpose of further processing.

Messages with process information in monitor direction:

- Single-point information, double-point information, step position information
- Measured values
- Integrated totals
- Bitstring of 32 bit

Messages with process information in control direction:

- Single commands, double commands, regulating step commands
- Setpoint commands
- Bitstring of 32 bit

4.4.1.1.1 Treatment for commands according to IEC 60870-101/104

The treatment for commands serves for the check of the spontaneous information objects to be processed with the help of the open-/closed loop control function and transmission of the confirmation for:

- Pulse commands (single commands, double commands, regulating step commands)
- Setpoint values (setpoint command)
- Bitstring of 32 bit

The data transfer of the spontaneous information objects to the *open-/closed-loop control function* for further processing is dependent on the result of the checks.

The activation of the element or function to be controlled is the task of the *open-/closed-loop control function*.

For the proper operation of this function, information is required by the *open-/closed-loop control function* (e.g. from an interlocking logic) for the choice of a posi-tive or negative confirmation.

The treatment for commands can be activated individually for each command via a parameter.

The treatment for pulse command comprises the following processing functions:

- Prepare command output procedure
  - Formal check
  - Retry suppression
  - 1 out of n check
  - Direct command or
  - Select and execute command
  - Control location check
  - Command locking
  - System-element overlapping 1-out-of-n check
- Initiate command output procedure
  - Command to application program
- Monitor pulse duration (only pulse commands)
  - Command output time
  - Return information monitoring
- Terminate command output procedure

4.4.1.2 Change Monitoring and Generation of Messages with Time Tag

For the generation of *messages with process information*, the signals in the output process images that are assigned to an element of a spontaneous information object, are monitored for change.

The change monitoring takes place in the grid of the cycle time of the *open-/closed-loop control function*, in which the signal is assigned to a spontaneous information object.

On a change of the state in a corresponding element of the spontaneous information object, the generation of the message is initiated.

Depending on the type of signal to be monitored, different methods are applied:

- Change of the state (positive edge, positive and negative edge)
- Change of the value (according to the rules of the additive threshold value procedure)

If a spontaneous information object has been activated for transmission due to a change, a message with process information is generated. The time tag corresponds either cycle-synchronous with the current time (resolution corresponds with the cycle time) or the time information from an assigned spontaneous information object.

Additive threshold value procedure

The additive threshold value procedure prevents an unnecessary loading of the transmission links with insignificant changes of the corresponding signal and acts only on the basic data of the spontaneous information objects with measured values.

4.4.2 Open-/Closed-Loop Control Function

The *open-/closed-loop control function* is used for the management of automation tasks with the help of a freely programmable application program.

The creation of the application program is carried out by the TOOLBOX II with the tool CAEx *plus* predominantly in function diagram technology according to IEC 1131-3. Alternatively, the application program can be created as instruction list with an ASCII editor.

The application program processes process information (so-called signals) from the connected I/O modules and/or from other system elements in the automation network of the specific process-technical plant.

Process images form the interface of the application program to the outside world. It is distinguished between input process images and output process images.

The exchange of the process information can take place in two ways:

- Transmission of periodical information objects from and to the peripheral element (process data input and output)
- Transmission of spontaneous information objects from and to functions within the automation unit, other automation units or control systems via the telecontrol interface

4.4.2.1 Non-Volatile Storage

Variables, signals (input process images for spontaneous information objects) and function blocks can be saved non-volatile. That means, that after a power failure these variables and signals are immediately available again with their values before the power failure.

4.4.2.2 Task Management

The open-/closed-loop control function manages the application program in a periodically running task.

Coordination of the sequences of a task

- Periodical start in the selected cycle
- Programmable single-run upon change of a signal from the communication or from the I/O modules (no hardware interrupt)
- Input handling
- Program processing
- Output handling

Cycle Time

- Within the cycle time, the application programs must process the input handling and the output handling
- The cycle time can be set in the application program

Watchdog Timer

This function monitors the proper sequence of the task within its set cycle time. If the task is not finished with its input handling, program processing and its output handling within this time, the next cycle for this task is omitted and a time-out is signaled.

With serious time-outs, for example due to a malfunction, the reliability of the application program becomes questionable. A time scale can be defined for such cases, the exceeding of which leads to an error message and a controlled shutdown of parts or the entire application program as well as all peripheral elements connected.

4.4.2.3 Loading the Application Program

The initial loading of an application program is always associated with a startup.

Fundamentally however, the fault-free operation and consequently the availability of every control or controller depends on the quality of the program – in other words the measure of how free they are of formal and logical errors. The loading of error-burdened changes can always lead to interruptions to operation.

4.4.2.4 Diagnosis

The following information is provided on request:

- Parameterized cycle time
- Current run time
- Maximum run time
- used memory space
- Errors upon code generation (compiler errors)

4.4.3 Process Data Input and Output

The peripheral functions comprise the process signal input and output.

- Acquisition and preprocessing of the process data from the process image of the I/O modules
- Periodical transfer of the process information to the *open-/closed-loop control function* therein included are - depending on the respective I/O module -
  - Non-linearized values of the input signals
  - Processed input signals as not change-monitored conditioned values
  - Processed input signals as change-monitored conditioned values
  - For processing, operations-relevant error information of the processed input signals (for instance "measured value faulty")
- Periodical reception of the process information from the *open-/closed-loop control function* therein included are - depending on the respective I/O module -
  - Derived information items
  - Processing results
  - Operations-relevant error information (for instance “command output fault”)
- Postprocessing and forwarding of the process data for the output via I/O modules

5 Overview of the Peripheral Functions

Contents

5.1 Common 66
5.2 Acquisition and Preprocessing 67
5.3 Postprocessing and Output 71

5.1 Common

The peripheral functions are responsible for the process data input and output via I/O modules and take place partially by

- hardware (example: filter, ADC, 1-out-of-n check, DAC)
- firmware (example: smoothing of measured values, time tagging)

The peripheral functions are specific for each I/O module.

Common Functions

- Supervision of the I/O module, failure handling
- Signaling via lighted display

Functions for Telecontrol and Automation

- Acquisition and preprocessing of process data
  - Transmission of spontaneous process information to the *telecontrol function* for further distribution
  - Transmission of periodical process information to the *open-/closed-loop control function* for further processing
  - Transmission of system information (example: diagnosis data)
- Postprocessing and output of process data
  - Reception of spontaneous process information from the *telecontrol function*
  - Reception of periodical process information from the *open-/closed-loop control function*
  - Reception of system information (example: parameters)

Note

The functions and the belonging mode of action are described in detail in the manual *SICAM 1703 Common Functions Peripheral Elements according to IEC 60870 5 101/104*.

In the following listing, footnotes are used to specify the effect of the functions in detail.

[f] **Telecontrol**
the function affects process information which is **spontaneously** transmitted

[f1] **Telecontrol**
the function delivers (acquisition) **spontaneously** transmitted process information or is controlled by such information (output); partly, periodically transmitted information is also created/required

[a] **Automation**
the function affects process information which is **periodically** transmitted

5.2 Acquisition and Preprocessing

5.2.1 DI-6100 ,DI-6101, DI-6104

- **Single-point information**
  - Acquisition with a resolution of 10 ms [t]
  - Update every 10 ms [a] (in the cycle of the *open-/closed-loop control function*, if larger)
  - Revision [ta]
  - Power monitoring [ta]
  - Inversion [ta]
  - Firmware filter [t]
  - Bounce suppression [t]
  - Determination of the cause of transmission [t]
  - Spontaneous transmission of changes [t]
  - Periodical transmission [a]
- **Double-point information**
  - Acquisition with a resolution of 10 ms [t]
  - Update every 10 ms [a] (in the cycle of the *open-/closed-loop control function*, if larger)
  - Revision [ta]
  - Power monitoring [ta]
  - Inversion [ta]
  - Firmware filter [t]
  - Bounce suppression [t]
  - Monitoring intermediate and faulty positions [t]
  - Determination of the cause of transmission [t]
  - Reporting switching operations in progress [t]
  - Breaker tripping detection [t]
  - Breaker tripping suppression during auto-reclose [t]
  - Spontaneous transmission of changes [t]
  - Periodical transmission [a]
- **Integrated totals via count pulses [t1]**
  - Acquisition by firmware with a maximum count frequency of 20 Hz
    - Pulse length/pause >20 ms/>20 ms
    - Revision
    - Power monitoring
    - Inversion
    - Pulse counting
  - Counter value formation
    - Count pulse evaluation
    - Set counter
  - Formation of integrated totals
    - Counter request
    - Interval control
    - Freezed absolute value
    - Freezed relative value
  - Not power-fail safe
  - Integrated total transmission according to iec 60870-5-101
  - Spontaneous transmission

5.2.2 DI-6102, DI-6103

- **Single-point information**
  - Acquisition with a resolution of 1 ms [t]
  - Update every 10 ms [a] (in the cycle of the *open-/closed-loop control function*, if larger)
  - Revision [ta]
  - Power monitoring [ta]
  - Inversion [ta]
  - Firmware filter [t]
  - Bounce suppression [t]
  - Determination of the cause of transmission [t]
  - Spontaneous transmission of changes [t]
  - Periodical transmission [a]
- **Double-point information**
  - Acquisition with a resolution of 1 ms [t]
  - Update every 10 ms [a] (in the cycle of the *open-/closed-loop control function*, if larger)
  - Revision [ta]
  - Power monitoring [ta]
  - Inversion [ta]
  - Firmware filter [t]
  - Bounce suppression [t]
  - Monitoring intermediate and faulty positions [t]
  - Determination of the cause of transmission [t]
  - Reporting switching operations in progress [t]
  - Breaker tripping detection [t]
  - Breaker tripping suppression during auto-reclose [t]
  - Spontaneous transmission of changes [t]
  - Periodical transmission [a]
- **Integrated totals via count pulses [t1]**
  - Acquisition by firmware with a maximum count frequency of 20 Hz
    - Pulse length/pause >2 ms/>2 ms
    - Revision
    - Power monitoring
    - Inversion
    - Pulse counting
  - Counter value formation
    - Count pulse evaluation
    - Set counter
  - Formation of integrated totals
    - Counter request
    - Interval control
    - Freezed absolute value
    - Freezed relative value
  - Not power-fail safe
  - Integrated total transmission according to IEC 60870-5-101
  - Spontaneous transmission

5.2.3 AI-6300, AI-6307, AI-6308

- **Currents and voltages**
  - Settable acquistion grid n*100 ms [t]
  - Measurement range settable with a resloution of [t]
    - 12 Bit + sign at ±20 mA/±10 V
    - Shrinking the range results in decreasing resolution
  - Revision [t]
  - Noise rejection [t]
  - Automatic calibration [t]
  - Smoothing [t]
  - Adaptation [t]
    - Linear (normalized, technologically scaled or short floating point)
    - Suppression of zero range
    - Plausibility check
  - Change monitoring [t]
  - Spontaneous transmission of changes [t]

5.2.4 AI-6310

- **Temperatures [t1]**
  - Acquisition of resistance thermometers via analog inputs of a SM-0571
  - Connection of the resistance thermometers: 2-, 3-, or 4-wire technique
  - Update every 400 ms
  - Settable measuring range when transferring temperatures
    (a) Pt100: -50…+350°C / -58…+662°f / (≈80.31…229.67 Ω)
    (b) Pt100: -100…+700°C / -148…+1292°f / (≈60.25…345.13 Ω)
    (c) Ni100: -60…+250°C / -76…+482°f / (≈74.18…295.52 Ω)
  - Settable measuring range when transferring resistance values
    (a) Pt100:   0…230 Ω
    (b) Pt100:   0…346 Ω
    (c) Ni100:   0…346 Ω
  - Resolution when transferring temperatures
    (a) Pt100: 0.20°C / 0.36°f / (90 mΩ)
    (b) Pt100: 0.35°C / 0.63°f / (130 mΩ)
    (c) Ni100: 0.35°C / 0.63°f / (130 mΩ)
  - Resolution when transferring when transferring resistance values
    (a) Pt100:   90 mΩ
    (b) Pt100:   130 mΩ
    (c) Ni100:   130 mΩ
  - Revision
  - Noise rejection
  - Automatic calibration
  - Calibration for 2-wire technique
  - Smoothing
  - Adaptation
    - Temperature value (°C, °F), conversion using implemented curves
    - Resistance (Ω)
  - Change monitoring
  - Spontaneous transmission of changes

5.2.5 TE-6430

- **Integrated totals via counting pulses**
  - 2 counting pulse inputs or
  - 1 counting pulse input and 1 transfer input
  - Inputs are galvanically insulated from logic circles and ground
  - Inputs are not galvanically insulated from each other
  - Input voltage range from 24 up to 60 V
  - Inputs are secured by means of EMC filter and protector equipment
  - The autonomous operable functions of the module are operated buffered, thus counting function and counts remain correct also over a voltage failure from up to 72 hours
  - Spontaneous transmission *f*

5.3 Postprocessing and Output

5.3.1 DO-6200

- **Pulse commands** *t1*
  - Checked output of pulse commands
    - 1-pole
  - Single, double and regulating step commands
  - Command output (OC)
  - Application functions and procedures according to IEC 60870-5-101/104
    - Formal check
    - Direct command
    - Select and execute command ("select/execute")
  - Retry suppression
  - 1-out-of-n check
  - Control location check
  - Command locking
  - Synchronization
  - Revision
  - Command output time
    - Settable
    - Dependent on the process
  - Return information monitoring
  - Command prolongation
  - Switching sequences
  - Command output for the auto-reclose function
  - If outputs of the module are used for pulse commands, no outputs of the same module can be used for binary information output
- Binary information output
  - Selectable behavior on communication failure *ta* (deactivation or retention)
  - Deactivation on module failure *ta*
  - Spontaneous transmission *t* or
  - Periodical transmission *a*
  - If outputs of the module are used for binary information output, no outputs of the same module can be used for pulse commands

5.3.2 DO-6212

- **Pulse commands** [t1]
  - Checked output of pulse commands
    - 1-pole, 1½-pole, 2-pole
    - Cannot be mixed
  - Single, double and regulating step commands
  - Command output (OC)
  - Application functions and procedures according to IEC 60870-5-101/104
    - Formal check
    - Direct command
    - Select and execute command ("select/execute")
  - Retry suppression
  - 1-out-of-n check
  - Control location check
  - Command locking
  - Synchronization
  - Revision
  - Command output time
    - Settable
    - Dependent on the process
  - Return information monitoring
  - Command prolongation
  - Switching sequences
  - Command output for the auto-reclose function
  - If outputs of the module are used for pulse commands, no outputs of the same module can be used for binary information output
- **Binary information output**
  - Selectable behavior on communication failure [ta] (deactivation or retention)
  - Deactivation on module failure [ta]
  - Spontaneous transmission [t] or
  - Periodical transmission [a]
  - If outputs of the module are used for binary information output, no outputs of the same module can be used for pulse commands

5.3.3 DO-6220, DO-6221, DO-6230

- **Pulse commands** *t1*
  - Checked output of pulse commands
    - 1-pole, 1½-pole, 2-pole
    - Cannot be mixed on one module
  - Single, double and regulating step commands
  - Application functions and procedures according to IEC 60870-5-101/104
    - Formal check
    - Direct command
    - Select and execute command ("select/execute")
  - Control location check
  - Retry suppression
  - 1-out-of-n check
  - Command locking
  - Synchronization
  - Revision
  - DO-6220 - command output according to IC1
    - Idle check
    - Selective activation check
  - DO-6221 - command output according to RC1
    - Idle check
    - Selective activation check
    - Resistance check
    - Current flow information
    - Earth fault check
    - Interference voltage check
  - Command output time
    - Settable
    - Dependent on the process
  - Return information monitoring
  - Command prolongation
  - Periodical control circuit check
  - Switching sequences
  - Monitoring of command output sequence to prevent incorrect outputs
  - Command initionation for auto-reclose
  - Activation of command contactors with or without series-break contacts (with DO-6221)

5.3.4 AO-6380

- **Setpoint values by means of currents and voltages**
  - Output via analog outputs of a SM-0572 *ta*
  - Output range settable with a resloution of *ta*
    - 15 bits + sign at ±20 mA/±10 V
    - Shrinking the range results in decreasing resolution
  - Application functions and procedures according to IEC 60870-5-101/104 *ta*
    - Formal check
    - Direct command
    - Select and execute command ("select/execute")
  - Adaptation *t*
    - Linear (normalized, technologically scaled or short floating point) *t*
  - Selectable behavior on communication failure and module failure *ta*
    (keep value, output substitute value)
  - Spontaneous transmission *t* or
  - Periodical transmission *a*

5.3.5 Further Functions

- **Return information to pulse command assignment**
  - Settable assignment
    - For messages and pulse commands, which are acquired or output on the peripheral element
  - Predefined assignment
    - For messages and pulse commands, which are acquired or output on the peripheral element

6 Overview of the Protocol Elements

Contents

6.1 Standard Protocols 76
6.2 Third-Party Protocols..88

6.1 Standard Protocols

6.1.1 UMPxT0

6.1.1.1 Features and Functions

Communication of a central station with one or more remote stations.

- Unbalanced multi-point traffic according to IEC 60870-5-101
  UMPMT0 is controlling station, UPMST0 is controlled station
  - Supported functionality according to documents *SICAM 1703 IEC 60870-5-101/104 Interoperability* and *Ax 1703 IEC 60870-5-101/104 Interoperability*
  - Data acquisition by polling (station interrogation)
  - Acquisition of events (transmission of data ready to be sent)
  - General interrogation, outstation interrogation
  - Clock synchronization
    - Cyclic, can be set in a minute grid; at least 1x per minute
  - Command transmission
    - Set control location, control location check
  - Transmission of integrated totals
  - Acquisition of transmission delay (for the correction of time synchronisation)
- Standby transmission line over the public telephone network (PSTN)
- Data transmission using time slot radio
- Co-ordination of several masters
- Optimized parameters for selected transmission facilities
- Functions for supporting redundant communication routes
- Special functions

Communication of a central station with one or more remote stations (relay operation).

- Unbalanced multi-point traffic in relay operation mode (with routing) based on IEC 60870-5-101
  UMPMT0 is controlling station, UPMST0 is controlled station
  - Supported functionality according to documents *SICAM 1703 IEC 60870-5-101/104 Interoperability* and *Ax 1703 IEC 60870-5-101/104 Interoperability*
  - Data acquisition by polling (station interrogation)
  - Acquisition of events (transmission of data ready to be sent)
  - General interrogation, outstation interrogation
  - Clock synchronization
    - Cyclic, can be set in a minutes grid
  - Command transmission
    - Set control location, control location check
  - Transmission of integrated totals
  - Acquisition of transmission delay (for the correction of time synchronisation)
- Standby transmission line over the public telephone network (PSTN)
- Data transmission in relay operation mode (multi-point traffic with routing)
- Co-ordination of several masters
- Optimized parameters for selected transmission facilities
- Functions for supporting redundant communication routes
- Special functions

Note

The above mentioned functions are described in detail in the document *ACP 1703 • Ax 1703 Common Functions Protocol Elements*, section *"Multi-Point Traffic (UMP)"*.

6.1.1.2 Operating Modes

Standard operating mode	Extras *)	Interface signals X2
Unbalanced interchange circuit V.24/V.28 V.28 asynchronous	–	RXD, TXD, CTS, RTS, DCD, DTR, DSR/+5V, GND
Optional operating mode	**Extras *)**	**Interface signals X2**
Balanced interface EIA-485 V.11 asynchronous	CM-0829 CM-0819	RXD, TXD, CTS, RTS, DCD, DTR, DSR/+5V, GND
Optical interface (multimode fibre optic) Ring	CM-0821	RXD, TXD, CTS, RTS, DCD, DTR, DSR/+5V, GND
Optional operating mode	**Extras *)**	**Interface signals X3**
Balanced interface EIA-485 V.11 asynchronous	–	TXD+, TXD- (2-wire) TXD+/RXD+, TXD-/RXD-, RXD+, RXD- (4-wire)

*) extras are optional facilities

Note

Details about realization of various operation modes are given in the documents *TM 1703 emic User Manual* and *ACP 1703 Platforms - Configuration*.

6.1.1.3 Configuration

For the communication infrastructure, additional suitable transmission facilities and/or network components may be needed.

Own Station (Central Station)

System	System Element	Protocol element	Remarks
TM 1703 emic	CP-6010/CPC30	UMPMT0	

Remote Station (Substation)

System	System Element	Protocol element	Remarks
AK 1703 ACP	CP-2010/CPC25 CP-2017/PCCX25	SM-2551/UMPSA0 SM-0551/UMPSA0	
BC 1703 ACP	CP-5014/CPCX55	SM-2551/UMPSA0 SM-0551/UMPSA0	
TM 1703 ACP	CP-6014/CPCX65	SM-2551/UMPSA0 SM-0551/UMPSA0	
TM 1703 emic	CP-6010/CPC30	UMPST0	
TM 1703 mic	CP-6040/CPC60	✓	
Third-party system	–	–	acc. to *ACP 1703 IEC 60870-5-101/104 Interoperability* or *Ax 1703 IEC 60870-5-101/104 Interoperability*

Own Station (Substation)

System	System Element	Protocol element	Remarks
TM 1703 emic	CP-6010/CPC30	UMPST0	

Remote Station (Central Station)

System	System Element	Protocol element	Remarks
AK 1703 ACP	CP-2010/CPC25 CP-2017/PCCX25	SM-2551/UMPMA0 SM-0551/UMPMA0	
BC 1703 ACP	CP-5014/CPCX55	SM-2551/UMPMA0 SM-0551/UMPMA0	
TM 1703 ACP	CP-6014/CPCX65	SM-2551/UMPMA0 SM-0551/UMPMA0	
TM 1703 emic	CP-6010/CPC30	UMPMT0	
TM 1703 mic	CP-6040/CPC60	✓	
Third-party system	–	–	acc. to *ACP 1703 IEC 60870-5-101/104 Interoperability* or *Ax 1703 IEC 60870-5-101/104 Interoperability*

6.1.2 DIAST0

6.1.2.1 Features and Functions

Communication of a central station with up to 100 remote stations.

- Unbalanced dial-up traffic based on IEC 60870-5-101
  DIAST0 is controlled station, DIAMxx is controlling station
- Controlling connection establishment and disconnection
  - Connection establishment spontaneously and cyclically,
    controlling station ⬄ controlled station
    - Establishing a connection cyclically at a settable interval (monitoring cycle)
      - for transmission of low-priority data
      - for monitoring the station availability
      - for clock synchronization
  - Controlling connection establishment by means of modem commands
    - AT Hayes, V.25bis, X.20, X.28
    - Arbitrary main telephone number of a telephone network (PSTN)
  - Access control (LOGIN with password) in the private range of IEC 60870-5-101
  - Disconnection control in the private range of IEC 60870-5-101
- Communication when a connection is established according to
  unbalanced multi-point (dial-up traffic) based on IEC 60870-5-101
  - Data acquisition by polling (station interrogation)
  - Acquisition of events (transmission of data ready to be sent)
  - General interrogation, outstation interrogation
  - Clock synchronization
    - Each time a connection has been established
    - When a connection is established, one time per minute
  - Command transmission
  - Transmission of integrated totals
- Co-ordination of several masters in "multi-master operation" (availability and data throughput)
  - The controlling station can simultaneously establish connections to different controlled stations
- Standby transmission line(s) by means of standby telephone numbers of the same or another (PSTN) telephone network
- Multi-hierarchical configurations
- Optimized parameters for selected transmission facilities
- Toll-saving transmission strategies
- Having a telephone set connected in parallel
- Functions for supporting redundant communication routes

Note

The above mentioned functions are described in detail in the document *ACP 1703 • Ax 1703 Common Functions Protocol Elements*, section "*Dial-Up Traffic (DIA)*".

6.1.2.2 Operating Modes

Interface	Extras *)	Interface signals X2
Unbalanced interchange circuit V.24/V.28 V.28 asynchronous	Modem (GSM, PSTN, TETRA, ISDN)	TXD, RXD, GND, RTS, DTR, DSR/+5V, DCD

*) extras are optional facilities

Note

Details about realization of various operation modes are given in the documents *TM 1703 emic User Manual* and *ACP 1703 Platforms - Configuration*.

6.1.2.3 Configuration

For the communication infrastructure, additional suitable transmission facilities and/or network components may be needed.

Own Station (Substation)

System	System Element	Protocol Element	Remarks
TM 1703 emic	CP-6010/CPC30	DIAST0	

Remote Station (Central Station)

System	System Element	Protocol Element	Remarks
AK 1703 ACP	CP-2010/CPC25 CP-2017/PCCX25	SM-2551/DIAMA0 SM-0551/DIAMA0	
BC 1703 ACP	CP-5014/CPCX55	SM-2551/DIAMA0 SM-0551/DIAMA0	
TM 1703 ACP	CP-6014/CPCX65	SM-2551/DIAMA0 SM-0551/DIAMA0	

6.1.3 103MT0

6.1.3.1 Features and Functions

Communication between one central station and up to 25 protective devices, considering the maximum number of data points (= 500) which are processable in the system.

- Unbalanced multi-point traffic according to IEC 60870-5-103

  103MT0 is controlling station, 103Sxx (protective device) is controlled station
  - Supported functionality according to document *SICAM 1703 IEC 60870-5-103 Interoperability*
  - Data acquisition by polling (station interrogation)
  - Acquisition of events (transmission of data ready to be sent)
  - General interrogation, outstation interrogation
  - Clock synchronization
    - Cyclic, can be set in a seconds grid
  - Command transmission
    - Set control location, control location check
  - File transfer
    - Disturbance records to SICAM DISTO
    - Disturbance records to control centre systems according to IEC 60870-5-101/104
  - Generic functions
  - Acquisition of transmission delay (for the correction of time synchronisation)
- Resetting the short-circuit location values
- Measured value change monitoring
- Monitoring intermediate and faulty positions of double-point information
- Transmission of parameters and diagnostic information for Reyrolle protection equipment (Embedded REYDISP)
- Optimized parameters for selected transmission facilities
- Functions for supporting redundant communication routes
- Special functions

Note

The above mentioned functions are described in detail in the document *ACP 1703 • Ax 1703 Common Functions Protocol Elements*, section "*Interfaces of Protective Devices (103)*".

6.1.3.2 Operating Modes

Standard operating mode	Extras *)	Interface signals X2
Unbalanced interchange circuit V.24/V.28 V.28 asynchronous	–	RXD, TXD, CTS, RTS, DCD, DTR, DSR/+5V, GND
Optional operating mode	**Extras *)**	**Interface signals X2**
Balanced interface EIA-485 V.11 asynchronous	CM-0829 CM-0819	RXD, TXD, CTS, RTS, DCD, DTR, DSR/+5V, GND
Optical interface (multimode fibre optic) Ring	CM-0821	RXD, TXD, CTS, RTS, DCD, DTR, DSR/+5V, GND
Optional operating mode	**Extras *)**	**Interface signals X3**
Balanced interface EIA-485 V.11 asynchronous	–	TXD+, TXD- (2-wire) TXD+/RXD+, TXD-/RXD-, RXD+, RXD- (4-wire)

*) extras are optional facilities

Note

Details about realization of various operation modes are given in the documents *TM 1703 emic User Manual* and *ACP 1703 Platforms - Configuration*.

6.1.3.3 Configuration

For the communication infrastructure, additional suitable transmission facilities and/or network components may be needed.

Own Station (Central Station)

System	System Element	Protocol Element	Remarks
TM 1703 emic	CP-6010/CPC30	103MT0	

Remote Station (Substation; e.g. protictive device, power meter)

System	System Element	Protocol Element	Remarks
BC 1703 ACP	CP-5014/CPCX55	SM-2551/103SA0 SM-0551/103SA0	electrical
		local serial interface	optical
Third-party system	–	–	acc. to *SICAM 1703 IEC 60870-5-103 Interoperability* or *Ax 1703 IEC 60870-5-103 Interoperability*

6.1.4 BPPT0

6.1.4.1 Features and Functions

Communication with a remote station.

- Balanced point-to-point traffic according to IEC 60870-5-101
  - Supported functionality according to documents *SICAM 1703 IEC 60870-5-101/104 Interoperability* and *Ax 1703 IEC 60870-5-101/104 Interoperability*
  - Acquisition of events (transmission of data ready to be sent)
  - General interrogation, outstation interrogation
  - Clock synchronization
    - Cyclic, at least 1x per minute
  - Command transmission
    - Set control location, control location check
  - Transmission of integrated totals
  - Acquisition of transmission delay (for the correction of time synchronization)
- Optimized parameters for selected transmission facilities
- Functions for supporting redundant communication routes
- Special functions

Note

The above mentioned functions are described in detail in the document *ACP 1703 • Ax 1703 Common Functions Protocol Elements*, chapter *"Point-to-Point Traffic (BPP)"*.

6.1.4.2 Operating Modes

Standard operating mode	**Extras *)**	**Interface signals X2**
Unbalanced interchange circuit V.24/V.28 V.28 asynchronous	–	RXD, TXD, CTS, RTS, DCD, DTR, DSR/+5V, GND
Optional operating mode	**Extras *)**	**Interface signals X2**
Balanced interface EIA-485 V.11 asynchronous	CM-0829 CM-0819	RXD, TXD, CTS, RTS, DCD, DTR, DSR/+5V, GND
Optical interface (multimode fibre optic) Ring	CM-0821	RXD, TXD, CTS, RTS, DCD, DTR, DSR/+5V, GND
Optional operating mode	**Extras *)**	**Interface signals X3**
Balanced interface EIA-485 V.11 asynchronous	–	TXD+, TXD- (2-wire) TXD+/RXD+, TXD-/RXD-, RXD+, RXD- (4-wire)

*) extras are optional facilities

Note

Details about realization of various operation modes are given in the documents *TM 1703 emic User Manual* and *ACP 1703 Platforms - Configuration*.

6.1.4.3 Configuration

For the communication infrastructure, additional suitable transmission facilities and/or network components may be needed.

Own Station (Substation)

System	System element	Protocol element	Remarks
TM 1703 emic	CP-6010/CPC30	BPPT0	

Remote Station (Central Station)

System	System element	Protocol element	Remarks
AK 1703 ACP	CP-2010/CPC25 CP-2017/PCCX25	SM-2551/BPPA0 SM-0551/BPPA0	
BC 1703 ACP	CP-5014/CPCX55	SM-2551/BPPA0 SM-0551/BPPA0	
TM 1703 ACP	CP-6014/CPCX65	SM-2551/BPPA0 SM-0551/BPPA0	
Third-party system	–	–	Acc. to *SICAM 1703 IEC 60870-5-101/104 Inter-operability* or Ax *1703 IEC 60870-5-101/104 Inter-operability*

6.1.5 ETT0

6.1.5.1 Features and Functions

Communication of a station with one remote station (up to 4 remote stations in case of synchonous connections).

- LAN/WAN communication via Ethernet TCP/IP according to IEC 60870-5-104
  - Supported functionality according to document *ACP 1703 IEC 60870-5-101/104 Interoperability, chapter "Interoperability for TM 1703 emic"*
  - Acquisition of events (transmission of data ready to be sent)
  - General Interrogation
  - Clock synchronization
  - Command transmission
    - Supervision of maximum transport delay in control direction (command received too late)
  - Transmission of integrated totals
- Clock synchronization
  - SNTP (Simple Network Time Protocol)
  - Up to 4 different SNTP servers can be interrogated (redundancy)
  - Cyclic, can be set in a seconds grid; self-adapting
- Functions for supporting redundant communication routes
  - Synchronous redundant connections (proprietary function)

Note

The above mentioned functions are described in detail in the document *ACP 1703 • Ax 1703 Common Functions Protocol Elements*, section "*LAN Communication (104)*".

6.1.5.2 Operating Modes

Operating mode	Extras *)	Interface signals X1
Electrical Ethernet interface (twisted pair) LAN	–	TXD+, TXD-, RXD+, RXD-

*) extras are optional facilities

Note

Details about realization of various operation modes are given in the documents *TM 1703 emic User Manual* and *ACP 1703 Platforms - Configuration*.

6.1.5.3 Configuration

For the communication infrastructure, additional suitable transmission facilities and/or network components may be needed.

Own Station (Substation)

System	System Element	Protocol Element	Remarks
TM 1703 emic	CP-6010/CPC30	ETT0	

Remote Station (Central Station)

System	System Element	Protocol Element	Remarks
AK 1703 ACP	CP-2010/CPC25 CP-2017/PCCX25	SM-2556/ET02 SM-2556/ETA2 SM-2557/ET02 SM-2557/ETA2	
BC 1703 ACP	CP-5014/CPCX55	SM-2556/ET02 SM-2556/ETA2 SM-2557/ET02 SM-2557/ETA2	
TM 1703 ACP	CP-6014/CPCX65	SM-2556/ET02 SM-2556/ETA2 SM-2557/ET02 SM-2557/ETA2	only IEC 60870-5-104 via Ethernet 10Base-TX
Third-party system	–	–	Acc. to *SICAM 1703 IEC 60870-5-101/104 Interoperability, chapter "Interoperability for TM 1703 emic"*

6.2 Third-Party Protocols

6.2.1 UMPMT1

6.2.1.1 Features and Functions

Communication of a central station with one or more remote stations (multi-point master).

- Unbalanced multi-point traffic according to IEC 60870-5-101
  UMPMT1 is controlling station, UPMSxx is controlled station
  - Supported functionality according to documents *SICAM 1703 IEC 60870-5-101/104 Interoperability* and *Ax 1703 IEC 60870-5-101/104 Interoperability*
  - Data acquisition by polling (station interrogation)
  - Acquisition of events (transmission of data ready to be sent)
  - General interrogation, outstation interrogation
  - Clock synchronization
    - Cyclic, can be set in a minute grid; at least 1x per minute
  - Command transmission
    - Set control location, control location check
  - Transmission of integrated totals
  - Acquisition of transmission delay (for the correction of time synchronisation)
- Standby transmission line over the public telephone network (PSTN)
- Data transmission using time slot radio
- Co-ordination of several masters
- AMIS special functions
  - Diagnosis module for AMIS DC
  - Optimized BROADCAST handling with acknowledgement
  - Optimized Parameters for TP-Radio Modem
  - Firmware loading for TP-Radio Modem
  - Reception level from TP-Radio as process data
  - Dwell time for BROADCAST telegrams at power outage
  - Statistic information (retry slaves)
- Optimized parameters for selected transmission facilities
- Functions for supporting redundant communication routes
- Special functions

Communication of a central station with one or more remote stations (relay operation).

- Unbalanced multi-point in relay operation mode (with routing) based on IEC 60870-5-101 UMPMT1 is controlling station, UPMSxx is controlled station
  - Supported functionality according to documents *SICAM 1703 IEC 60870-5-101/104 Interoperability* and *Ax 1703 IEC 60870-5-101/104 Interoperability*
  - Data acquisition by polling (station interrogation)
  - Acquisition of events (transmission of data ready to be sent)
  - General interrogation, outstation interrogation
  - Clock synchronization
    - Cyclic, can be set in a minutes grid
  - Command transmission
    - Set control location, control location check
  - Transmission of integrated totals
  - Acquisition of transmission delay (for the correction of time synchronisation)
- Standby transmission line over the public telephone network (PSTN)
- Data transmission in relay operation mode (multi-point traffic with routing)
- Co-ordination of several masters
- AMIS special functions (substation only)
  - Diagnosis module for AMIS DC
  - Optimized BROADCAST handling with acknowledgement
  - Optimized Parameters for TP-Radio Modem
  - Firmware loading for TP-Radio Modem
  - Dwell time for BROADCAST telegrams at power outage
- Optimized parameters for selected transmission facilities
- Functions for supporting redundant communication routes
- Special functions

Note

The above mentioned functions are described in detail in the document *ACP 1703 • Ax 1703 Common Functions Protocol Elements*, section *"Multi-Point Traffic (UMP)", exception: AMIS special functions..*

6.2.1.2 Operating Modes

Standard operating mode	Extras *)	Interface signals X2
Unbalanced interchange circuit V.24/V.28 V.28 asynchronous	–	RXD, TXD, CTS, RTS, DCD, DTR, DSR/+5V, GND
Optional operating mode	**Extras *)**	**Interface signals X2**
Balanced interface EIA-485 V.11 asynchronous	CM-0829 CM-0819	RXD, TXD, CTS, RTS, DCD, DTR, DSR/+5V, GND
Optical interface (multimode fibre optic) Ring	CM-0821	RXD, TXD, CTS, RTS, DCD, DTR, DSR/+5V, GND
Optional operating mode	**Extras *)**	**Interface signals X3**
Balanced interface EIA-485 V.11 asynchronous	–	TXD+, TXD- (2-wire) TXD+/RXD+, TXD-/RXD-, RXD+, RXD- (4-wire)

*) extras are optional facilities

Note

Details about realization of various operation modes are given in the documents *TM 1703 emic User Manual* and *ACP 1703 Platforms - Configuration*.

6.2.1.3 Configuration

For the communication infrastructure, additional suitable transmission facilities and/or network components may be needed.

Own Station (Central Station)

System	System Element	Protocol element	Remarks
TM 1703 emic	CP-6010/CPC30	UMPMT1	

Remote Station (Substation)

System	System Element	Protocol element	Remarks
AMIS DC	CP-3410/CPC30 CP-3411/CPC30	UMPST0	

6.2.2 MODMT0

6.2.2.1 Features and Functions

Communication between one central station and up to 100 remote stations (MODBUS)

- Unbalanced multi-point traffic according Modicon MODBUS
  MODMT0 is controlling station, MODSxx is controlled station
  - Supported functionality according to document *SICAM 1703 MODBUS Interoperability, chapter "Interoperability of SICAM 1703 using serial MODBUS unbalanced Master"*
  - Data acquisition by polling (station interrogation, register interrogation)
  - Acquisition of events (transmission of data ready to be sent, Event-Queue)
  - General interrogation, outstation interrogation
  - Command transmission
  - Transmission of integrated totals
- Optimized parameters for selected transmission facilities
- Functions for supporting redundant communication routes
- Special functions

Note

The above mentioned functions are described in detail in the document *ACP 1703 ▪ Ax 1703 Common Functions MODBUS*.

6.2.2.2 Operating Modes

Standard operating mode	**Extras *)**	**Interface signals X2**
Unbalanced interchange circuit V.24/V.28 V.28 asynchronous	–	RXD, TXD, CTS, RTS, DCD, DTR, DSR/+5V, GND
Optional operating mode	**Extras *)**	**Interface signals X2**
Balanced interface EIA-485 V.11 asynchronous	CM-0829 CM-0819	RXD, TXD, CTS, RTS, DCD, DTR, DSR/+5V, GND
Optional operating mode	**Extras *)**	**Interface signals X3**
Balanced interface EIA-485 V.11 asynchronous	–	TXD+, TXD- (2-wire) TXD+/RXD+, TXD-/RXD-, RXD+, RXD- (4-wire)

*) extras are optional facilities

Note

Details about realization of various operation modes are given in the documents *TM 1703 emic User Manual* and *ACP 1703 Platforms - Configuration*.

6.2.2.3 Configuration

For the communication infrastructure, additional suitable transmission facilities and/or network components may be needed.

Own Station (Central Station)

System	System Element	Protocol Element	Remarks
TM 1703 emic	CP-6003/CPC10	MODMT0	

Remote Station (Substation)

System	System Element	Protocol Element	Remarks
AK 1703 ACP	CP-2010/CPC25 CP-2017/PCCX25	SM-2551/MODSA0 SM-0551/MODSA0	
BC 1703 ACP	CP-5014/CPCX55	SM-2551/MODSA0 SM-0551/MODSA0	
TM 1703 ACP	CP-6014/CPCX65	SM-2551/MODSA0 SM-0551/MODSA0	
Third-party system	–	–	Acc. to *SICAM 1703 MODBUS Interoperability*

6.2.3 DNPST0

6.2.3.1 Features and Functions

Communication with one central station (DNP3 Slave).

- Unbalanced multi-point traffic according DNP3
  DNPST0 is controlled station, DNPMxx is controlling station
  - Supported functionality according to document *SICAM 1703 DNP3 Interoperability, chapter "Interoperability of SICAM 1703 for DNP3 Slave (serial) using DNPS"*
  - Data acquisition by polling (station interrogation, register interrogation)
  - Acquisition of events (transmission of data ready to be sent, Event-Queue)
  - General interrogation, outstation interrogation
  - Command transmission
  - Transmission of integrated totals
- Optimized parameters for selected transmission facilities
- Functions for supporting redundant communication routes
- Special functions

6.2.3.2 Operating Modes

Standard operating mode	**Extras *)**	**Interface signals X2**
Unbalanced interchange circuit V.24/V.28 V.28 asynchronous	–	RXD, TXD, CTS, RTS, DCD, DTR, DSR/+5V, GND
Optional operating mode	**Extras *)**	**Interface signals X2**
Balanced interface EIA-485 V.11 asynchronous	CM-0829 CM-0819	RXD, TXD, CTS, RTS, DCD, DTR, DSR/+5V, GND
Optical interface (multimode fibre optic) Ring	CM-0821	RXD, TXD, CTS, RTS, DCD, DTR, DSR/+5V, GND
Optional operating mode	**Extras *)**	**Interface signals X3**
Balanced interface EIA-485 V.11 asynchronous	–	TXD+, TXD- (2-wire) TXD+/RXD+, TXD-/RXD-, RXD+, RXD- (4-wire)

*) extras are optional facilities

Note

Details about realization of various operation modes are given in the documents *TM 1703 emic User Manual* and *ACP 1703 Platforms - Configuration*.

6.2.3.3 Configuration

For the communication infrastructure, additional suitable transmission facilities and/or network components may be needed.

Own Station (Substation)

System	System Element	Protocol Element	Remarks
TM 1703 emic	CP-6010/CPC30	DNPST0	

Remote Station (Central Station)

System	System Element	Protocol Element	Remarks
AK 1703 ACP	CP-2010/CPC25 CP-2017/PCCX25	SM-2551/DNPMA0 SM-0551/DNPMA0	
BC 1703 ACP	CP-5014/CPCX55	SM-2551/DNPMA0 SM-0551/DNPMA0	
TM 1703 ACP	CP-6014/CPCX65	SM-2551/DNPMA0 SM-0551/DNPMA0	
Third-party system	–	–	Acc. to *SICAM 1703 DNP3 Interoperability*

6.2.4 ST1ST0

6.2.4.1 Features and Functions

Communication of a central station with one or more remote stations (Siemens SINAUT ST1).

- Unbalanced multi-point traffic according to Siemens SINAUT ST1 (TIM 11)
  ST1ST0 is substation
  - Supported functionality according to *Siemens SINAUT ST1 (TIM 11)* Protocol definition (with restrictions)
  - Data acquisition by polling (station interrogation)
  - Acquisition of events (transmission of data ready to be sent)
  - General interrogation, substation interrogation
  - Command transmission
  - Transmission of integrated totals
- Optimized parameters for selected transmission facilities
- Message conversion IEC60870-5-101 <-> Siemens SINAUT ST1 (TIM11)

Note

The above mentioned functions are described in detail in the document *ACP 1703 ▪ Ax 1703 Common Functions SIEMENS SINAUT-ST1 GV-S*.

6.2.4.2 Operating Modes

Standard operating mode	**Extras *)**	**Interface signals X2**
Unbalanced interchange circuit V.24/V.28 V.28 asynchronous	–	RXD, TXD, CTS, RTS, DCD, DTR, DSR/+5V, GND
Optional operating mode	**Extras *)**	**Interface signals X2**
Balanced interface EIA-485 V.11 asynchronous	CM-0829 CM-0819	RXD, TXD, CTS, RTS, DCD, DTR, DSR/+5V, GND
Optional operating mode	**Extras *)**	**Interface signals X3**
Balanced interface EIA-485 V.11 asynchronous	–	TXD+, TXD- (2-wire) TXD+/RXD+, TXD-/RXD-, RXD+, RXD- (4-wire)

*) extras are optional facilities

Note

Details about realization of various operation modes are given in the documents *TM 1703 emic User Manual*.

6.2.4.3 Configuration

For the communication infrastructure, additional suitable transmission facilities and/or network components may be needed.

Own Station (Substation)

System	System Element	Protocol Element	Remarks
TM 1703 emic	CP-6010/CPC30	ST1SA0	

Remote Station (Central Station)

System	System Element	Protocol Element	Remarks
AK 1703 ACP	CP-2010/CPC25 CP-2017/PCCX25	SM-2551/ST1MA0 SM-0551/ST1MA0	
BC 1703 ACP	CP-5014/CPCX55	SM-2551/ST1MA0 SM-0551/ST1MA0	
TM 1703 ACP	CP-6014/CPCX65	SM-2551/ST1MA0 SM-0551/ST1MA0	
Third-party system	–	–	acc. to *Siemens SINAUT ST1 (TIM11) Interoperability*

6.2.5 TG8ST0

6.2.5.1 Features and Functions

Communication of a central station with one or more remote stations (L&G TG800).

- Unbalanced multi-point traffic according to L&G TG800
  TG8ST0 is controlled station, TG8Mxx is controlling station
  - Supported functionality according to document *SICAM 1703 Interoperability TG800*
  - Data acquisition by polling (station interrogation)
  - Acquisition of events (transmission of data ready to be sent)
  - General interrogation, remote station interrogation
  - Clock synchronization
    - Cyclic, can be set in a minute grid; at least 1x per minute.
  - Command transmission
  - Transmission of integrated totals
- Spontaneous-mode radio transmission
- Optimized parameters for selected transmission facilities
- Functions for supporting redundant communication routes

Note

The above mentioned functions are described in detail in the document *ACP 1703 ▪ Ax 1703 Common Functions Landis & Gyr TELEGYR 800 GV-S*.

6.2.5.2 Operating Modes

Standard operating mode	**Extras *)**	**Interface signals X2**
Unbalanced interchange circuit V.24/V.28 V.28 asynchronous	–	RXD, TXD, CTS, RTS, DCD, DTR, DSR/+5V, GND
Optional operating mode	**Extras *)**	**Interface signals X2**
Balanced interface EIA-485 V.11 asynchronous	CM-0829 CM-0819	RXD, TXD, CTS, RTS, DCD, DTR, DSR/+5V, GND
Optical interface (multimode fibre optic) Ring	CM-0821	RXD, TXD, CTS, RTS, DCD, DTR, DSR/+5V, GND
Optional operating mode	**Extras *)**	**Interface signals X3**
Balanced interface EIA-485 V.11 asynchronous	–	TXD+, TXD- (2-wire) TXD+/RXD+, TXD-/RXD-, RXD+, RXD- (4-wire)

*) extras are optional facilities

Note

Details about realization of various operation modes are given in the documents *TM 1703 emic User Manual* and *ACP 1703 Platforms - Configuration*.

6.2.5.3 Configuration

For the communication infrastructure, additional suitable transmission facilities and/or network components may be needed.

Own Station (Substation)

System	System Element	Protocol Element	Remarks
TM 1703 emic	CP-6010/CPC30	TG8ST0	

Remote Station (Central Station)

System	System Element	Protocol Element	Remarks
AK 1703 ACP	CP-2010/CPC25 CP-2017/PCCX25	SM-2551/TG8MA0 SM-0551/TG8MA0	
BC 1703 ACP	CP-5014/CPCX55	SM-2551/TG8MA0 SM-0551/TG8MA0	
TM 1703 ACP	CP-6014/CPCX65	SM-2551/TG8MA0 SM-0551/TG8MA0	
Third-party system	–	–	Acc. to *SICAM 1703 TG800 Interoperability*

6.2.6 SMST0

6.2.6.1 Features and Functions

Printer logging (ASCII) and SMS alert/control.

- Printer logging
  - Logging on a serial printer (ASCII)
- SMS-alert
  - Send binary information with SMS
    - Aquisition time in SMS text
  - Send command with SMS
  - Member adminstration
  - Modem control with AT-Hayes commands
- SMS control
  - Receive command with SMS
    - Command delay supervision for SMS commands
  - Member administration
  - Modem control with AT-Hayes commands

6.2.6.2 Operating Modes

Standard Operation Mode	Extras *)	Interface signals X2
Unbalanced interchange circuit V.24/V.28 V.28 asynchronous	–	RXD, TXD, CTS, RTS, DCD, DTR, DSR/+5V, GND

*) extras are optional facilities

Note

Details about realization of various operation modes are given in the documents *TM 1703 emic User Manual*.

6.2.6.3 Configuration

For the communication infrastructure, additional suitable transmission facilities and/or network components may be needed.

6.2.6.3.1 Printer control

Own Station

System	System Element	Protocol Element	Remarks
TM 1703 emic	CP-6010/CPC30	SMST0	

Remote Station

System	System Element	Protocol Element	Remarks
Third-party system	–	–	Serial printers (for printed protocols)

6.2.6.3.2 SMS alert and control

Own Station

System	System Element	Protocol Element	Remarks
TM 1703 emic	CP-6010/CPC30	SMST0	

Remote Station

System	System Element	Protocol Element	Remarks
AK 1703 ACP	CP-2010/CPC25 CP-2017/PCCX25	SM-2551/SMSA0 SM-0551/SMSA0	
BC 1703 ACP	CP-5014/CPCX55	SM-2551/SMSA0 SM-0551/SMSA0	
TM 1703 ACP	CP-6014/CPCX65	SM-2551/SMSA0 SM-0551/SMSA0	
TM 1703 emic	CP-6010/CPC30	SMST0	
AMIS DC	CP-341x/CPC30	SMST0	
Third-party system	–	–	• Mobile phone (SMS alert/control) • Third-party system (SMS alert/control)

7 Technical Specifications Total System

Contents

7.1 General Specification 102

7.2 Ambient Conditions 104

7.1 General Specification

7.1.1 Performance characteristics

- Modular structured system
- Single processor solution
- Combined automation and telecontrol function
- Online parameter-settable
- Loadable firmware
- Saving of firmware and application data on replaceable SIM Card
- Communication via 3 interfaces possible (EIA-232, EIA-485, Ethernet)
- Manifold protocols for the communication
  - with subordinate or superior automation units according to IEC 60870-5-101 (multi-point traffic, dial-up traffic, point-to-point traffic)
  - with local devices according to IEC 60870-5-103 (protection device connection)
  - with the control system alternatively according to IEC 60870-5-104 (Ethernet TCP/IP) or according to IEC 60870-5-101 (dial-up traffic)
- Further protocols, such as
  - SMS alerting
  - Modbus Master
  - DNP 3.0 Slave
- Spontaneous (acknowledged) transmission
- LED-signalling on the front panel of the modules

7.1.2 Mechanical Design

Mechanics	
Structure	Assembly system for mounting on 35 mm DIN rail • 1 power supply unit • 1 master control element • Up to 8 I/O modules
Dimensions (HxWxD)	• Power supply module 131 x 63 x 73 mm • Master control element 131 x 126 x 73 mm • Per I/O module 131 x 63 x 73 mm • Fully equipped 131 x 693 x 73 mm + 2 x 3.7 mm
Weight	• Power supply module approx. 200…230 g *) • Master control element approx. 280 g • I/O modules approx. 225…300 g *)
Connectors	
Connection system for peripheral signals and power supply	Removeable screw terminals, wire cross section up to 2.5 mm²
Ethernet/LAN communication	RJ45 socket connector 8-pole, for connecting Cat.5 cable
EIA-232 communication	D-SUB 9-pole, male, with additional supply input for external transmission facility
EIA-485 communication	Removable screw terminal 6-pole with additional configuration switch
Supply for external data communi-cations equipment	Removable screw terminal 2-pole for connecting an auxiliary voltage
Protection against contact, foreign objects and water	
Protection type acc. to IEC 60529	• Terminal modules IP40 – the belonging terminals IP20
Protection against electric shock	
Protection class acc. to IEC 61140	Class II

*) depending on type

7.2 Ambient Conditions

7.2.1 Electrical Environmental Conditions

7.2.1.2 System Properties

Factor	Value	Testing standard	Product standard	Class
Immunity against discharge of static electricity (ESD)	8 kV-A 6 kV-C	IEC 61000-4-2	IEC 60870-2-1	3
			IEC 60255-22-2	3
Immunity against electromagnetic fields 80 MHz…2.7 GHz	10 V/m 80% AM	IEC 61000-4-3	IEC 60870-2-1	3
			IEC 60255-22-3	3
Immunity against electromagnetic fields GSM 900 MHz	10 V/m	IEC 61000-4-3	IEC 61000-6-2	
Radio interference voltage approx. peak value	79/73 dBµV	CISPR22	IEC 60870-2-1	A
			CISPR22	A
Radio interference voltage mean value	66/60 dBµV	CISPR22	IEC 60870-2-1	A
			CISPR22	A
Radio interference field strength (10 m)	40/47 dBµV	CISPR22	IEC 60870-2-1	A
			CISPR22	A
Immunity against 50 Hz magnetic fields	30 A/m	IEC 61000-4-8	IEC 60870-2-1	3
Immunity against pulse-shaped magnetic fields	1000 A/m	IEC 61000-4-9	IEC 60870-2-1	
Immunity against induced HF voltage	10 V	IEC 61000-4-6	IEC 61000-6-2	

The characteristics required according to the standards IEC 61000-6-2 and IEC 61000-6-4 are covered by the values listed above.

7.2.1.3 Power Supply

Factor	Value	Testing standard	Product standard	Class
Voltage tolerance DC	+30/-20%	IEC 60870-2-1	IEC 60870-2-1	DC3
			IEC 60654-2	>DC3
Voltage ripple DC	≤ 5%	IEC 60870-2-1	IEC 60870-2-1	VR3
			IEC 60654-2	
Interruption time	≤ 50 ms	IEC 61000-4-11	IEC 60870-2-1	>1
			IEC 60255-11	
Dielectric test U_N ≤ 60 V (SELV circuit)	2.5 kVeff	IEC 60255-5	IEC 60870-2-1	VW3
			IEC 60255-5	
Dielectric test 60 V < U_N ≤125 V against SELV-circuits	2.5 kVeff	IEC 60255-5	IEC 60950-1	VW3
			IEC 60950-1	
Dielectric test 125 V < U_N ≤ 230 V against SELV-circuits	3.0 kVeff	IEC 60255-5	IEC 60950-1	>VW3
			IEC 60950-1	
HF test common	2.5 kVs	IEC 61000-4-12	IEC 60870-2-1	3
			IEC 60255-22-1	3
HF test normal	2.5 kVs	IEC 61000-4-12	IEC 60870-2-1	>3
			IEC 60255-22-1	3
Fast transient source of radio noise common	4.0 kVs	IEC 61000-4-4 *)	IEC 60870-2-1	4
			IEC 60255-22-4	3
Impulse voltage 1.2/50 µs common	4.0 kVs	IEC 61000-4-5	IEC 60870-2-1	4
Impulse voltage 1.2/50 µs normal	4.0 kVs	IEC 61000-4-5	IEC 60870-2-1	>4
Impulse voltage 100/1300 µs normal	1.3 U_N	IEC 61000-4-1	IEC 60870-2-1	
Starting current	S1	IEC 60870-4	IEC 60870-4	S1

*) directly connected

7.2.1.4 Digital And Analog I/Os

Factor	Value	Testing standard	Product standard	Class
Dielectric test UN ≤ 60 V (SELV circuit)	1.5 kV_{rms}	IEC 60255-5	IEC 60870-2-1	
			IEC 60255-5	
Impulse voltage 1.2/50 µs common	2.5 kVs	IEC 60255-5	IEC 60870-2-1	
			IEC 60255-5	
Impulse voltage 1.2/50 µs normal	2.5 kVs	IEC 60255-5	IEC 60870-2-1	
			IEC 60255-5	
HF test common	2.5 kVs	IEC 61000-4-12	IEC 60870-2-1	
			IEC 60255-22-1	
HF test normal	1.0 kVs	IEC 61000-4-12	IEC 60870-2-1	
			IEC 60255-22-1	
Fast transient burst common	2.0 kV	IEC 61000-4-4	IEC 60870-2-1	
			IEC 60255-22-4	
Surge voltage 1.2/50 µs common	2.0 kVs	IEC 61000-4-5	IEC 60870-2-1	
			IEC 60255-22-5	
Surge voltage 1.2/50 µs normal	2.0 kVs	IEC 61000-4-5	IEC 60870-2-1	
			IEC 60255-22-5	

7.2.1.5 Communication LAN/WAN

The listed values are valid for a distance ≤ 100 m cat.5 cable.

Factor	Value	Testing standard	Product standard	Class
Dielectric test UN ≤ 60 V (SELV circuit)	1.5 kV_{rms}	IEC 60255-5	IEC 60870-2-1	
			IEC 60255-5	
Impulse voltage 1.2/50 µs common	2.5 kVs	IEC 60255-5	IEC 60870-2-1	
			IEC 60255-5	
HF test common	1.0 kVs	IEC 61000-4-12	IEC 60870-2-1	
			IEC 60255-22-1	
HF test normal	1.0 kVs	IEC 61000-4-12	IEC 60870-2-1	
			IEC 60255-22-1	
Fast transient burst common	2.0 kV	IEC 61000-4-4	IEC 60870-2-1	
			IEC 60255-22-4	
Surge voltage 1.2/50 µs common	2.0 kVs	IEC 61000-4-5	IEC 60870-2-1	
			IEC 60255-22-5	

7.2.1.6 Communication EIA-485

The listed values are valid for a distance ≤30 m screened.

Factor	Value	Testing standard	Product standard	Class
Dielectric test UN ≤ 60 V (SELV circuit)	1.5 kV_{rms}	IEC 60255-5	IEC 60870-2-1	
			IEC 60255-5	
Impulse voltage 1.2/50 µs common	2.5 kVs	IEC 60255-5	IEC 60870-2-1	
			IEC 60255-5	
HF test common	1.0 kVs	IEC 61000-4-12	IEC 60870-2-1	
			IEC 60255-22-1	
HF test normal	1.0 kVs	IEC 61000-4-12	IEC 60870-2-1	
			IEC 60255-22-1	
Fast transient burst common	2.0 kV	IEC 61000-4-4	IEC 60870-2-1	
			IEC 60255-22-4	
Surge voltage 1.2/50 µs common	2.0 kVs	IEC 61000-4-5	IEC 60870-2-1	
			IEC 60255-22-5	

7.2.1.7 Communication EIA-232

The serial interface X2 is designed only for distances ≤ 2.5 m. Thus this interface does not need to show an immunity. The immunity is assumed by the external data communications equipment.

You can find the electrical ambient conditions of data transmission equipment in the related data sheets.

7.2.2 Mechanical Environmental Conditions

Factor	Value	Testing standard	Product standard	Class
Harmonic sinusoidal				
Oscillation 1…9 Hz Oscillation 9..200 Hz Oscillation 200…500 Hz	3.0 mm 10 m/s² 15 m/s²	IEC 60068-2-6	IEC 60870-2-2	Bm
Oscillation 10…60 Hz Oscillation 60…150 Hz	±0.35 mm 0.5 g	IEC 60068-2-6	IEC 60255-21-1	1
Shock semi-sinusoidal				
Shock 11 ms	5 g	IEC 60068-2-27	IEC 60255-21-2	1
Shock 11 ms	100 m/s²	IEC 60068-2-27	IEC 60870-2-2	Bm
Continuous shock semi-sinusoidal				
Permanent shock 16 ms	10 g	IEC 60068-2-29	IEC 60255-21-2	1
Seismic harmonic sinusoidal				
Oscillation 1…8 Hz (horizontal) Oscillation 1…8 Hz (vertical) Oscillation 8…35 Hz (horizontal) Oscillation 8…35 Hz (vertical)	±3.5 mm ±1.5 mm 1 g 0.5 g	IEC 60068-3-3	IEC 60255-21-3	1

The above listed values cover or exceed the required seismic loading according to IEC 60870-2-2 Cl.S3 and IEC 60255-21-3 Cl.1. The values apply in operation and for storage.

Transport

- The permitted mechanical stresses during transport depend on the transport packaging.
- The device packaging is not a transport packaging.

7.2.3 Climatic Environmental Conditions

The listed values apply for use in open-air cabinets for bay devices. Condensation is not permissible.

The devices can be exposed to sun and heat. They can be exposed as well to air flow caused by draught in buildings, for instance by open windows or influences of technical processes. Condensation water, precipitations, water and icing do not occur.

Bedewing is possible for a short time (for instance during the course of maintenance tasks).

Heating and cooling is used to maintain the necessary conditions, especially in case of great differences between indoor and outdoor climate.

The conditions of this class normally occur in living and working areas, for instance in production rooms for electronic and electrotechnical products, telecontrol rooms, storage rooms for valuable and sensible devices.

Factor	Value	Testing standard	Product standard	Class
Minimum air temperature	-25°C	IEC 60068-2-1	IEC 60870-2-2	C1
			IEC 60654-1	C1
Maximum air temperature	70°C	IEC 60068-2-2	IEC 60870-2-2	C2
			IEC 60654-1	C2
Temperature gradient	≤ 30°C/h		IEC 60870-2-2	C2
			IEC 60654-1	C2
Relative air humidity	5…95%		IEC 60870-2-2	C1
			IEC 60654-1	C1
Absolute air humidity	≤ 29 g/m^3		IEC 60870-2-2	C2
			IEC 60654-1	C2
Dry heat	70°C 4 days	IEC 60068-2-2		
Damp heat	40°C 4 days	IEC 60068-2-78		
Air pressure	70-106 kPa	IEC 61000-4-5	IEC 60870-2-2	C2
			IEC 60654-1	C2
Storage and transport temperature	-30…+85°C			
Component ambient temperature	up to +85°C			

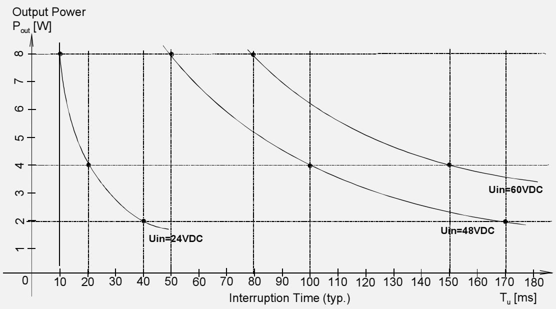
8 Technical Specification of the Modules

Contents

8.1 Power Supply Modules 112
8.2 Master Control Module 114
8.3 I/O Modules 116

8.1 Power Supply Modules

8.1.1 PS-6630

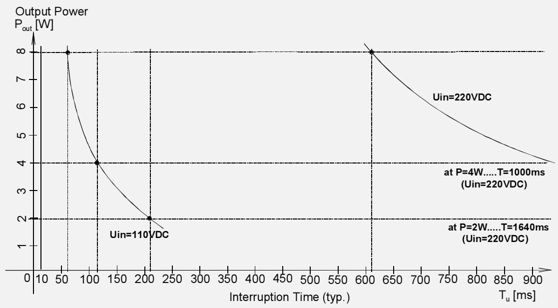
Power supply	
	• Environmental conditions according to EMC+ • Parallel connectable for redundancy (not to increase power) • Potential-free fault output (with power supply failure relay contact is open) • Function indication via LED
Operating voltage	18…78 VDC (supplied via terminals)
Output voltages system-internal for external modem 1)	 U1 5.15 VDC ±2% U2 5.1…5.4 VDC switchable 9…10 VDC 2)
Output power P_{U1}	$P_{U1\ min}$ 8.0 W – 1.25 $P_{U2\ max}$ $P_{U1\ max}$ 8.0 W (at P_{U2} = 0 W)
Output power P_{U2}	$P_{U2\ max}$ 2.5 W
Output total power	$P_{U1+U2\ max}$ 8.0 W $P_{U1+U2\ peak}$ 9.0 W
Efficiency	$\eta_{U1} = P_{U1}/P_{in}$ approx. 65% $\eta_{U2} = P_{U2}/P_{in}$ approx. 60%
Power consumption $P_{in} = P_{U1}/\eta_{U1} + P_{U2}/\eta_{U2}$	$P_{in\ max}$ 12.3 W $P_{in\ peak}$ 13.8 W
Inrush peak current	8 A at 18 VDC 600 µs 40 A at 78 VDC 600 µs
Guaranteed interruption time	
Reverse voltage protection	Yes
Overload protection	No 3)
Short-circuit protection	No 3)
Fault output max. switching voltage max. output current max. short-time current	 350 VAC, VDC 120 mA permanent (on resistance 35 Ω) 350 mA for 10 ms
Mechanics	
Terminals	Removable screw terminals for direct conductor assembly cross-section up to 2.5 mm²
Dimensions	131x63x73 mm (LxWxH, dimensions w/o DIN rail)
Weight	Approx. 200 g

1) via DTR circuit of the serial interface of CP-6010

2) switching to the higher voltage is induced exclusively by CP-6010/CPC30 and depends on its parameter setting (without switching, only the lower voltage is available)

3) internal fuse is blown (change by authorized personnel only)

8.1.2 PS-6632

Power supply	
	• Environmental conditions according to EMC+ • Parallel connectable for redundancy (not to increase power) • Potential-free fault output (with power supply failure relay contact is open) • Function indication via LED
Operating voltage	82…275 VDC (supplied via terminals)
Output voltages system-internal for external modem [1]	 U1 5.15 VDC ±2% U2 5.1…5.4 VDC switchable 9…10 VDC [2]
Output power P_{U1}	$P_{U1\ min}$ 8.0 W – 1.25 $P_{U2\ max}$ $P_{U1\ max}$ 8.0 W (at P_{U2} = 0 W)
Output power P_{U2}	$P_{U2\ max}$ 2.5 W
Output total power	$P_{U1+U2\ max}$ 8.0 W $P_{U1+U2\ peak}$ 9.0 W
Efficiency	$\eta_{U1} = P_{U1}/P_{in}$ approx. 65% $\eta_{U2} = P_{U2}/P_{in}$ approx. 60%
Power consumption $P_{in} = P_{U1}/\eta_{U1} + P_{U2}/\eta_{U2}$	$P_{in\ max}$ 12.3 W $P_{in\ peak}$ 13.8 W
Inrush peak current	25 A at 90 VDC 500 µs 80 A at 230 VDC 500 µs
Guaranteed interruption time	
Reverse voltage protection	Yes
Overload protection	No [3]
Short-circuit protection	No [3]
Fault output max. switching voltage max. output current max. short-time current	 350 VAC, VDC 120 mA permanent (on resistance 35 Ω) 350 mA for 10 ms
Mechanics	
Terminals	Removable screw terminals for direct conductor assembly cross-section up to 2.5 mm²
Dimensions	131x63x73 mm (LxWxH, dimensions w/o DIN rail)
Weight	Approx. 230 g

[1] via DTR circuit of the serial interface of CP-6010

[2] switching to the higher voltage is induced exclusively by CP-6010/CPC30 and depends on its parameter setting (without switching, only the lower voltage is available)

[3] internal fuse is blown (change by authorized personnel only)

8.2 Master Control Module

8.2.1 CP-6010

Processor and Memory	
Processor	Blackfin BF531
Clock pulse frequency	Core clock approx. 400 MHz System clock approx. 133 MHz
CPU clock pulse accuracy	3,5 p/min
Free run accuracy	12,6 ms/h
Program memory	Flash-PROM 2 MB (parallel connected)
Main memory	SDRAM 8 MB
Local non-volatile memory	FRAM 64 KBit (serial connected)
Changeable non-volatile memory	SD card up to 2 GB
Max. number of data points	500 (sum of process images over all 3 interfaces)
Memory for application program	128 kB, thereof 4 kB temporary memory for variables
Number of variables for application program	512 variables possible, thereof 256 Bytes non-volatile (variables: BOOL = 1 Bit, DINT = 4 Byte, REAL = 4 Byte)
Program sampling	• cyclically 10…2000 ms (settable raster 1 ms) • spontaneous (settable; run not based on interrupt)
Acquisition raster of I/O modules	10 ms
Decentralized archive	Recording raster for measured values 1, 2, 3, 5, 10, **15**, 30, 60 min, settable
	max. message length of a segment 1…200 Byte, settable
	Memory configuration, settable 10 files of 1000 records each (= 10000 records) 20 files of 500 records each (= 10000 records) 50 files of 400 records each (= 20000 records) 80 files of 450 records each (= 36000 records) 100 files of 100 records each (= 10000 records) 100 files of 25 records each (= 2500 records) 200 files of 50 records each (= 10000 records) 200 files of 25 records each (= 5000 records)
Communication	
Ethernet/LAN interface	• Ethernet acc. to IEEE 802.3 (10Base-T or 100Base-TX) • Galvanically insulated • ESD protection • Message transmission acc. to IEC 60870-5-104 • Transmission rate 10 Mbit/s or 100 Mbit/s • Half duplex or full duplex • Auto-MDI • Time synchronization via NTP server • Sub station function • Line length 0…100 m

Communication		
serial interface		• Unbalanced interchange circuit EIA-232 (level acc. to V.28) • Galvanically not insulated • ESD protection • Message transmission acc. to IEC 60870-5-101/-103 • Transmission rate up to 19,2 kBit/s (depending on modem) • Time synchronization
serial interface		• Balanced interchange circuit EIA-485 • Galvanically insulated • ESD protection • Message transmission acc. to IEC 60870-5-101/-103 • Transmission rate up to 115,2 kBit/s (depending on modem)
Power supply		
Power supply via TM bus		Input: 5.1 VDC, looped-through to max. 8 I/O modules Power consumption 1.2 W
Internal operating voltage		TM bus voltage 5 V 3.3 VDC Core voltage 0.8…1.2 VDC, regulated by CPU
Modem supply		Alternatively one of the following voltages: • De-energized (for reset of modem) • 5 VDC (PS-663x) • 10 VDC (PS-663x) • Supply via connection X4 (e.g. 12 VDC/2.5 A for TP radio modem) Wiring dimensioned for 30 VDCmax, 9 VDCmin, 3 Amax • Voltage range operation 12 V: 9…15 VDC Voltage range operation 24 V: 18…30 VDC
Mechanics and Connectors		
Ethernet/LAN interface	X1	RJ45 socket connector 8-pole (IEC 603.7)
EIA-232 interface	X2	Connection D-SUB 9-pole, male (DIN 41652)
EIA-485 interface	X3	Screw terminal 6-pole with shield interception
Supply for external data communications equipment	X4	Screw terminal 2-pole
TM bus	X5	Connection 5-pole to power supply module
TM bus	X6	Connection 5-pole to I/O modules
Configuration switch	S1	DIP switch for the configuration of X3 • 4-wire, no termination resistance • 4-wire, with termination resistance • 2-wire, no termination resistance • 2-wire, with termination resistance
Dimensions		131x126x73 mm (L x W x H, dimensions w/o DIN rail)
Weight		Approx. 280 g

8.3 I/O Modules

8.3.1 DI-6100

Binary inputs	
16 binary inputs	• 2 groups with 8 inputs each • Galvanically insulated • Each group has a common return of selectable polarity • Function display and status display of the inputs via LED
Filter time	1 dedicated input 2 ms All other inputs 3 ms
Nominal voltages	24/48/60 VDC
Operating points	Logical 0 ≤ 12 V Logical 1 ≥ 16 V
Rated current	1.0…1.5 mA at 18…78 V
Input circuits	18…78 VDC (operated by means of an external voltage)
Power supply	
Operating voltage	4.7…5.1 VDC, 170 mW (picked off at the TM bus)
Mechanics and Connectors	
Terminals	Removable screw terminals (grid size 5.08)
Dimensions	131x63x73 mm (LxWxH, dimensions w/o DIN rail)
Weight	Approx. 225 g

8.3.2 DI-6101

Binary inputs	
16 binary inputs	• 2 groups with 8 inputs each • Galvanically insulated • Each group has a common return of selectable polarity • Function display and status display of the inputs via LED
Filter time	1 dedicated input 2 ms All other inputs 3 ms
Nominal voltages	110/220 VDC
Operating points	Logical 0 ≤ 55 V Logical 1 ≥ 82.5 V
Rated current	1.0…1.7 mA at 82…250 V
Input circuits	82…250 VDC (operated by means of an external voltage)
Power supply	
Operating voltage	4.7…5.1 VDC, 170 mW (picked off at the TM bus)
Mechanics and Connectors	
Terminals	Removable screw terminals (grid size 5.08)
Dimensions	131x63x73 mm (LxWxH, dimensions w/o DIN rail)
Weight	Approx. 225 g

8.3.3 DI-6102

Binary inputs	
16 binary inputs	• 2 groups with 8 inputs each • Galvanically insulated • Each group has a common return of selectable polarity • Function display and status display of the inputs via LED
Filter time	1 dedicated input 2 ms All other inputs 3 ms
Nominal voltages	24/48/60 VDC
Operating points	Logical 0 ≤ 12 V Logical 1 ≥ 16 V
Rated current	1.0…1.5 mA at 18…78 V
Input circuits	18…78 VDC (operated by means of an external voltage)
Power supply	
Operating voltage	4.7…5.1 VDC, 170 mW (picked off at the TM bus)
Mechanics and Connectors	
Terminals	Removable screw terminals (grid size 5.08)
Dimensions	131x63x73 mm (LxWxH, dimensions w/o DIN rail)
Weight	Approx. 225 g

8.3.4 DI-6103

Binary inputs	
16 binary inputs	• 2 groups with 8 inputs each • Galvanically insulated • Each group has a common return of selectable polarity • Function display and status display of the inputs via LED
Filter time	1 dedicated input 2 ms All other inputs 3 ms
Nominal voltages	110/220 VDC
Operating points	Logical 0 ≤ 55 V Logical 1 ≥ 82.5 V
Rated current	1.0…1.7 mA at 82…250 V
Input circuits	82…250 VDC (operated by means of an external voltage)
Power supply	
Operating voltage	4.7…5.1 VDC, 170 mW (picked off at the TM bus)
Mechanics and Connectors	
Terminals	Removable screw terminals (grid size 5.08)
Dimensions	131x63x73 mm (LxWxH, dimensions w/o DIN rail)
Weight	Approx. 225 g

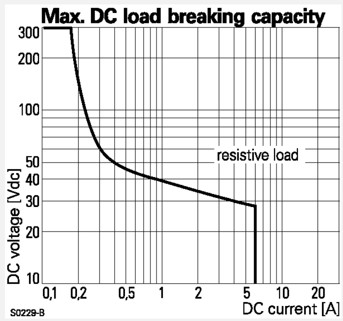
8.3.5 DI-6104

Binary inputs	
16 binary inputs	• 2 groups with 8 inputs each • Galvanically insulated • Each group has a common return of selectable polarity • Function display and status display of the inputs via LED
Filter time	1 dedicated input 2 ms All other inputs 3 ms
Nominal voltages	220 VDC
Operating points	Logical 0 ≤ 110 V Logical 1 ≥ 165 V
Rated current	1.1…1.5 mA at 165…250V
Input circuits	165…250 VDC (operated by means of an external voltage)
Power supply	
Operating voltage	4.7…5.1 VDC, 170 mW (picked off at the TM bus)
Mechanics and Connectors	
Terminals	Removable screw terminals (grid size 5.08)
Dimensions	131x63x73 mm (LxWxH, dimensions w/o DIN rail)
Weight	Approx. 225 g

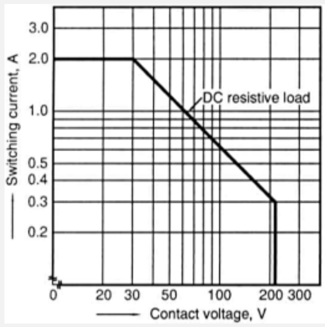
8.3.6 DO-6200

Binary outputs	
16 binary outputs (transistor)	• 2 groups with 8 outputs each • Galvanically insulated via optocoupler • Each group has a common return • All outputs are permanently short-circuit proof • Respectively 2 outputs are parallel connectable for purpose of enhancement of the switching capacity • No reaction on other outputs in case of short-circuit of an output • Function display and status display of the outputs via LED
Nominal switching voltage	24/48/60 VDC
Nominal current (resistive load)	Due to thermal loading capacity of the module: • 0.25 A at 24, 48, and 60 VDC (for each output, if 16 outputs are active at the same time) • 0.35 A when connecting 2 outputs in parallel (for each pair ot outputs, if 8 pairs of outputs are active at the same time)
Maximum continuous current	Due to electrical ratings of the transistor switch: • 0.9 A at 18…78 VDC (only 1 output active)
Nominal switching capacity (resistive load, U_N)	• 6 W at 24 VDC when connecting in parallel 8.4 W • 12 W at 48 VDC when connecting in parallel 16.8 W • 15 W at 60 VDC when connecting in parallel 21 W
Maximum switching capacity	70.2 W at 78 VDC
Overload proof	No
Proof against continued short-circuit	10 A current limitation (if the current limitation operates, current is cut off after 10 µs) Cyclic reclosing: break time 300 µs make time 10 µs
Switching cycles	Unlimited
Switching frequency	Max. 100 Hz
Output circuit voltage drop	< 0.5 V at 0.25 A
Dynamic withstand capability	• Capacitive load max. 100 nF at 60V • Inductive load $\tau \leq 500$ ms (with external recovery diode arbitrary) • Lines $Z \geq 100\ \Omega$, line length up to 3 km • Lamps $I_N \leq 150$ mA ($I_{ON} \leq 1.8$ A)
Output circuits	18…78 VDC (operated by means of an external voltage)
Power supply	
Operating voltage	4.7…5.1 VDC, 600 mW (picked off at the TM bus)
Mechanics and Connectors	
Terminals	Removable screw terminals (grid size 5.08)
Dimensions	131x63x73 mm (LxWxH, dimensions w/o DIN rail)
Weight	Approx. 260 g

8.3.7 DO-6212

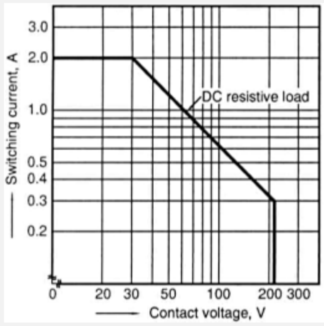
Binary outputs	
8 binary outputs (relay)	• 8 outputs, potential-free • Galvanically insulated • Outputs can be used for switching of direct voltage or also alternating voltage • Function display and status display of the outputs via LED
Nominal voltage	• 24/48/60/110/220 VDC • 110/230 VAC
Maximum continuous current	• 2 A • 5 A for 1 minute
Switching capacity	DC voltage • Min. 50 mW at 5 VDC • Max. acc. to diagram  AC voltage • Max. 1250 VA 5 A/250 VAC, resistive load • Max. 500 VA 2 A/250 VAC, cosφ = 0.4
Switching cycles	• $3x10^4$
Output circuits	Max. 250 VDC/253 VAC (operated by means of an external voltage)
Power supply	
Operating voltage	4.7…5.1 VDC, 800 mW (picked off at the TM bus)
Mechanics and Connectors	
Terminals	Removable screw terminals (grid size 5.08)
Dimensions	131x63x73 mm (LxWxH, dimensions w/o DIN rail)
Weight	Approx. 265 g

8.3.8 DO-6220

Binary outputs	
2 Impulse outputs	• 1 output contact and 1 group contact for commands • Output and group relay • Galvanically insulated • Command output with internal checks (IC1) • Function display and status display of the outputs via LED
Nominal switching voltage	24/48/60/110 VDC
Switching capacity	• Min. 10 µA 10 m VDC • Max. 60 W  max. switch. capacity / switching voltage / max. switch. current 48 W / 24 VDC / 2 A *) 57 W / 48 VDC / 1.2 A 60 W / 60 VDC / 1 A 55 W / 110 VDC / 0.5 A
Overload proof	No
Proof against continued short-circuit	10 A current limitation (if the current limitation operates, current is cut off after 10 µs) Cyclic reclosing: break time 300 µs make time 10 µs
Switching cycles	• Mechanical: 10^8 • Electrical: 10^5 (0.5 A, 110 VDC) 5×10^5 (1 A, 30 VDC) 10^5 (2 A, 30 VDC)
Switching frequency	max. 100 Hz
Output circuit voltage drop	< 0.5 V at 0.25 A
Dynamic withstand capability	• Capacitive load max. 100 nF at 60 V • Inductive load $\tau \leq$ 500 ms (with external recovery diode arbitrary) • Lines $Z \geq 100\ \Omega$, line length up to 3 km • Lamps $I_N \leq$ 150 mA ($I_{ON} \leq$ 1.8 A)
Output circuits	18 VDC…143 VDC (operated by means of an external voltage)
Power supply	
Operating voltage	5 VDC ± 5%, 560 mW (picked off at the TM bus)
Mechanics and Connectors	
Terminals	Removable screw terminals (grid size 5.08)
Dimensions	131x63x73 mm (LxWxH, dimensions w/o DIN rail)
Weight	Approx. 220 g

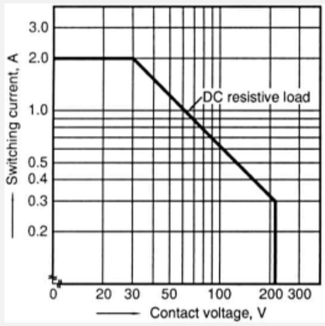
*) for module DO-6220 with version "--" the following reduced values are valid: 29 W/24 VDC/1.2 A

8.3.9 DO-6221

Binary outputs	
2 pulse outputs	• 1 output contact and 1 group contact for commands • Output and group relay • Galvanically insulated • Resistance check (RC1) • Function display and status display of the outputs via LED
Nominal switching voltage	24/48/60/110 VDC
Switching capacity	• Min. 10 µA 10 m VDC • Max. 60 W  max. switch. capacity / switching voltage / max. switch. current 48 W / 24 VDC / 2 A *) 57 W / 48 VDC / 1.2 A 60 W / 60 VDC / 1 A 55 W / 110 VDC / 0.5 A
Overload proof	Yes
Proof against continued short-circuit	10 A current limitation (if the current limitation operates, current is cut off after 10 µs) Cyclic reclosing: break time 300 µs make time 10 µs
Switching cycles	• Mechanical: 10^8 • Electrical: 10^5 (0.5 A, 110 VDC) 5×10^5 (1 A, 30 VDC) 10^5 (2 A, 30 VDC)
Switching frequency	Max. 100 Hz
Output circuit voltage drop	< 0.5 V at 0.25 A
Dynamic withstand capability	• Capacitive load max. 100 nF at 60V • Inductive load $\tau \leq$ 500 ms (with external recovery diode arbitrary) • Lines $Z \geq 100\ \Omega$, line length up to 3 km • Lamps $I_N \leq$ 150 mA ($I_{ON} \leq$ 1.8 A)
Output circuits	18…143 VDC (operated by means of an external voltage)
Power supply	
Operating voltage	5 VDC ± 5%, 1380 mW (picked off at the TM bus)
Mechanics and Connectors	
Terminals	Removable screw terminals (grid size 5.08)
Dimensions	131x63x73 mm (LxWxH, dimensions w/o DIN rail)
Weight	Approx. 230 g

*) for module DO-6221 with version "--" the following reduced values are valid: 29 W/24 VDC/1.2 A

8.3.10 DO-6230

<table>
<tr><th colspan="2">Binary outputs</th></tr>
<tr><td>16 binary outputs</td><td>• 2 groups with 8 outputs each
− 8 impulse commands (2-pole) or
− 16 impulse commands (1- pole or 1½- pole)
• Galvanically insulated
• Each group has a common return
• Function display and status display of the outputs via LED</td></tr>
<tr><td>Nominal switching voltage</td><td>24/48/60/110 VDC</td></tr>
<tr><td>Switching capacity</td><td>• Min. 10 µA 10 m VDC
• Max. 60 W


<table>
<tr><th>max. switch. capacity</th><th>switching voltage</th><th>max. switch. current</th></tr>
<tr><td>48 W</td><td>24 VDC</td><td>2 A *)</td></tr>
<tr><td>57 W</td><td>48 VDC</td><td>1.2 A</td></tr>
<tr><td>60 W</td><td>60 VDC</td><td>1 A</td></tr>
<tr><td>55 W</td><td>110 VDC</td><td>0.5 A</td></tr>
</table></td></tr>
<tr><td>Overload proof</td><td>No</td></tr>
<tr><td>Proof against continued short-circuit</td><td>No</td></tr>
<tr><td>Switching cycles</td><td>Mechanical: 10^8
Electrical: 10^5 (0.5 A, 110 VDC)
5×10^5 (1 A, 30 VDC)
10^5 (2 A, 30 VDC)</td></tr>
<tr><td>Switching frequency</td><td>Max. 100 Hz</td></tr>
<tr><td>Output circuit voltage drop</td><td>< 0.5 V at 0.25 A</td></tr>
<tr><td>Dynamic withstand capability</td><td>• Capacitive load max. 100 nF at 60V
• Inductive $\tau \leq 500$ ms (any with external free-wheeling diode)
• Lines $Z \geq 100\ \Omega$, line length up to 3 km
• Lamps $I_N \leq 150$ mA ($I_{ON} \leq 1.8$ A)</td></tr>
<tr><td>Output circuits</td><td>18…143 VDC (operated by means of an external voltage)</td></tr>
<tr><th colspan="2">Power supply</th></tr>
<tr><td>Operating voltage</td><td>5 VDC ± 5%, 130 mW (picked off at the TM bus)</td></tr>
<tr><th colspan="2">Mechanics and Connectors</th></tr>
<tr><td>Terminals</td><td>Removable screw terminals (grid size 5.08)</td></tr>
<tr><td>Dimensions</td><td>131x63x73 mm (LxWxH, dimensions w/o DIN rail)</td></tr>
<tr><td>Weight</td><td>Approx. 170 g</td></tr>
</table>

*) if the command output base modules DO-6220 or DO-6221 with version “--“ are used, the following reduced values are valid: 29 W/24 VDC/1.2 A

8.3.11 AI-6300

Analog inputs	
4 analog inputs	• Acquisition of currents and voltages • 2 groups with 2 inputs each • Groups are galvanically insulated from one another • Voltage between 2 inputs of a group max. 4 VDC • Function display via LED
Measuring ranges	• Current measurement -20…0…+20 mA • Voltage measurement -10…0…+10 V • Overrange typ. 2%
Resolution	0.013% at ±20 mA 0.025% at ±10 V
Accuracy	0.15% at 25°C 0.4% at 0…50°C 0.5% at –20…70°C
Input impedance	122.5 Ω at ±20 mA 11.3 kΩ at ±10 V
Common mode rejection	
Current inputs	Min. 70 dB (10 Hz…1 MHz) Min. 90 dB (10 Hz…500 Hz)
Voltage inputs	Min. 73 dB (10 Hz…1 MHz) Min. 90 dB (10 Hz…500 Hz)
Series mode rejection	
Current inputs	0 dB (10 Hz…7.5 kHz) +20 dB/decade (7.5 kHz…1 MHz)
Voltage inputs	0 dB (10 Hz…7.5 kHz) +20 dB/decade (7.5 kHz…1 MHz)
Input circuits	External sensors, auxiliary voltage 18 VDC…78 VDC (operated by means of an external voltage)
Power supply	
Operating voltage	4.7…5.1 VDC, max. 480 mW (picked off at the TM bus)
Mechanics and Connectors	
Terminals	Removable screw terminals (grid size 5.08)
Dimensions	131x63x73 mm (LxWxH, dimensions w/o DIN rail)
Weight	Approx. 225 g

8.3.12 AI-6307

Analog inputs	
4 analog inputs	• Acquisition of currents and voltages • 2 groups with 2 inputs each • Groups are galvanically insulated from one another • Voltage between 2 inputs of a group max. 4 VDC • Function display via LED
Measuring ranges	• Current measurement -5…0…+5 mA -2.5…0…+2.5 mA • Voltage measurement -10…0…+10 V • Overrange typ. 2%
Resolution	0.013% at ±5 mA 0.026% at ±2.5 mA 0.025% bei ±10 V
Accuracy	0.15% at 25°C 0.4% at 0…50°C 0.5% at –20…70°C
Input impedance	490 Ω at ±5 mA 11.3 kΩ at ±10 V
Common mode rejection	
Current inputs	min. 70 dB (10 Hz…1 MHz) min. 90 dB (10 Hz…500 Hz)
Voltage inputs	min. 73 dB (10 Hz…1 MHz) min. 90 dB (10 Hz…500 Hz)
Series mode rejection	
Current inputs	0 dB (10 Hz…7.5 kHz) +20 dB/decade (7.5 kHz…1 MHz)
Voltage inputs	0 dB (10 Hz…7.5 kHz) +20 dB/decade (7.5 kHz…1 MHz)
Input circuits	External sensors, auxiliary voltage 18…78 VDC (operated by means of an external voltage)
Power supply	
Operating voltage	4.7…5.1 VDC, max. 480 mW (picked off at the TM bus)
Mechanics and Connectors	
Terminals	Removable screw terminals (grid size 5.08)
Dimensions	131x63x73 mm (LxWxH, dimensions w/o DIN rail)
Weight	Approx. 225 g

8.3.13 AI-6308

Analog inputs	
4 analog inputs	• Acquisition of currents and voltages • 2 groups with 2 inputs each • Groups are galvanically insulated from one another • Voltage between 2 inputs of a group max. 4 VDC • Function display via LED
Measuring ranges	• Current measurement -2…0…+2 mA -1…0…+1 mA • Voltage measurement -10…0…+10 V • Overrange typ. 1.7%
Resolution	0.013% at ±2 mA 0.026% at ±1 mA 0.025% at ±10 V
Accuracy	0.15% at 25°C 0.4% at 0…50°C 0.5% at –20…70°C
Input impedance	1225 Ω at ±2 mA 11.4 kΩ at ±10 V
Input circuits	External sensors, auxiliary voltage 18 VDC…78 VDC (operated by means of an external voltage)
Power supply	
Operating voltage	4.7…5.1 VDC, max. 480 mW (picked off at the TM bus)
Mechanics and Connectors	
Terminals	Removable screw terminals (grid size 5.08)
Dimensions	131x63x73 mm (LxWxH, dimensions w/o DIN rail)
Weight	Approx. 225 g

8.3.14 AI-6310

Analog inputs	
4 analog inputs	• Acquisition of temperatures • 2 groups with 2 inputs each • Groups are galvanically insulated from one another • For each input a current source is assigned for the resistance measurement • Voltage between 2 inputs of a group max. 20 VDC • Function display via LED
Measuring range	• Resistance measurement 50…400 Ω (Pt100, Ni100) (2-, 3- and 4-wire technology) • Overrange typ. 20%
Input impedance	ca. 2 MΩ
Resolution	11 mΩ
Noise rejection	16⅔ Hz, 50 Hz, 60 Hz settable for each group
Conversion time	Noise rejection for 50 Hz 120 ms Noise rejection for 60 Hz 100 ms Noise rejection for 16⅔ Hz 180 ms
Accuracy	0.19% at 25°C 0.21% at 0…50°C 0.4% at -20…70°C (due to the measuring method there is no dependence on the accuracy of the constant-current source)
Reference current	2 mA
Connecting line impedance	Sum of go-and-return line max. 40 Ω
Common mode rejection	16⅔ Hz, 50 Hz, 60 Hz…20 kHz > 100 dB 10 Hz…1 MHz > 70 dB
Series mode rejection	16⅔ Hz, 50 Hz, 60 Hz > 100 dB
Input circuits	Operated by means of an internal voltage (constant-current source)
Current outputs	
4 current outputs (constant-current source)	• 2.0 mA • galvanically insulated
Power supply	
Operating voltage	4.7…5.1 VDC, max. 450 mW (picked off at the TM bus)
Mechanics and Connectors	
Terminals	Removable screw terminals (grid size 5.08)
Dimensions	131x63x73 mm (LxWxH, dimensions w/o DIN rail)
Weight	Approx. 235 g

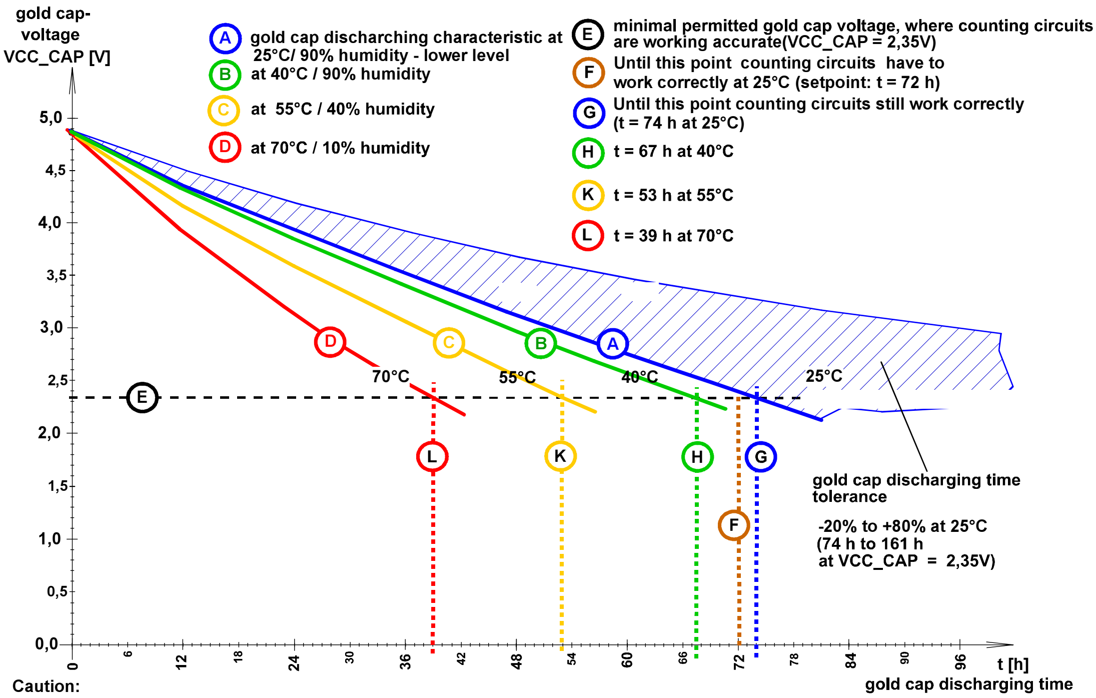
8.3.15 AO-6380

Analoge outputs	
4 analog outputs	• Output of currents and voltages • Galvanically insulated via optocoupler • Function display via LED
Current output	Max. ±20 mA on max. 500 Ω load Max. ±10 mA on max. 1 kΩ load
Voltage output	Max. ±10 V on min. 1 kΩ load
Resolution	0.025% at ±20 mA, ±10 mA, ±10 V
Settling time	1 ms
Accuracy	0.3% at 25°C 0.4% at 0…50°C 0.7% at –20…70°C
Output circuits	Operated by means of an internal voltage
Power supply	
Operating voltage	4.7…5.1 VDC, max. 1.9 W (picked off at the TM bus)
Mechanics and Connectors	
Terminals	Removable screw terminals (grid size 5.08)
Dimensions	131x63x73 mm (LxWxH, dimensions w/o DIN rail)
Weight	Approx. 300 g

8.3.16 TE-6430

Binary inputs	
2 count pulse inputs	• Acquisition of count pulses − 2 count pulse inputs or − 1 count pulse input + 1 transfer input • Galvanically insulated from logic circuits and ground • Not galvanically insulated from each other • Secured by means of EMC filter and interference protection facilities • Autonomous module functions are supplied by backup voltage, thus counting function and counts are preserved correctly also over a voltage failure of up to 72 hours
Input signal frequency	Max. 5 kHz (each input)
Bounce suppression	Counter freq. stage / Pulse length / pulse discontinuation 5 kHz / >10 µs / >100 µs 500 Hz / >150 µs / >1 ms 50 Hz / >1.5 ms / >10 ms 20 Hz / >3 ms / >25 ms
Voltage level	Logical 0: < 12 VDC Logical 1: > 18 VDC
Input circuits	18…78 VDC (operated with external voltage source)
Nominal power per input	Max. 120 mW at 24 VDC Max. 420 mW at 60 VDC
Power supply	
Operating voltage	5 VDC ± 5 % (voltage is picked off at the TM bus)
Connecting Power	Startup: 0.60 W Normal operation: 0.15 W
Buffer elements	Double-layer condensers (goldcaps)
Mechanics and Connectors	
Terminals	Removable screw terminals (grid size 5.08)
Dimensions	131x63x73 mm (LxWxH, dimensions w/o DIN rail)
Weight	Approx. 220 g

Buffer Time Chart



Caution:

At t=0 gold caps have to be loaded for at least 24 hours !
Longer load time has no influence for gold cap discharging time. Measured charging time can differ about -20% to +80%, direct proportional to gold cap capacity divergency of nominal value. (according to gold cap specification).
VCC-CAP=2.35V is the minimal voltage, for correctly working. The specified discharging times are valid at 10Hz input signal frequency (both channels).

A. Order Information

Contents

A.1. Power Supply Modules 132
A.2. Master Control Module 132
A.3. I/O Modules 133
A.4. Interface Modules 136
A.5. Accessories 137
A.6. Engineering Tools 143

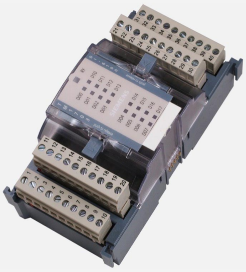
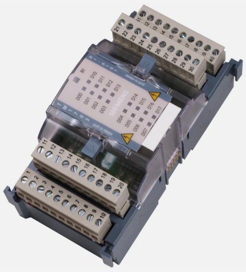
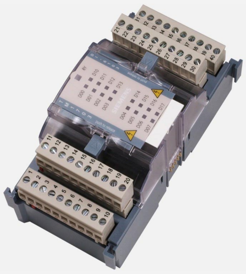
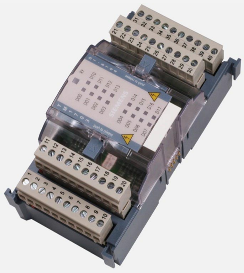
A.1. Power Supply Modules

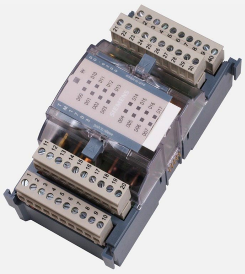
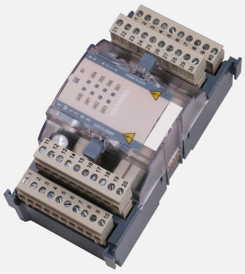
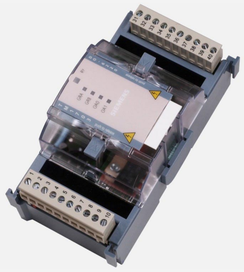
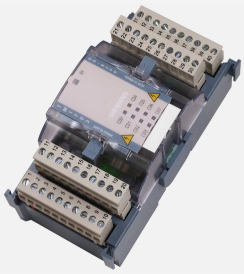
	Designation	Item number/MLFB
	PS-6630 Power supply module 24…60 VDC (EMC+)	GC6-630 6MF11130GG300AA0
	PS-6632 Power supply module 110…220 VDC (EMC+)	GC6-632 6MF11130GG320AA0

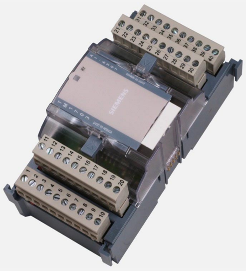
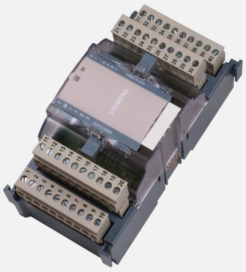
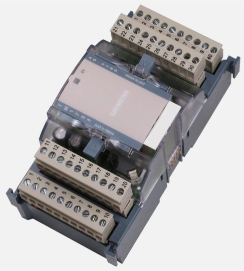
A.2. Master Control Module

	Designation	Item number/MLFB
	CP-6010 emic Master control module	GC6-010 6MF11130GA100AA0

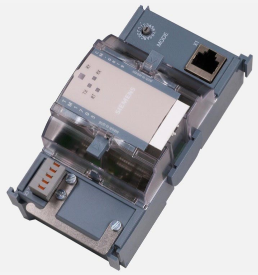
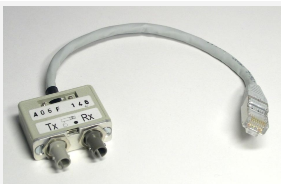
A.3. I/O Modules

	Designation	Item number/MLFB
	DI-6100 Binary input 2x8, 24…60 VDC	GC6-100 6MF11130GB000AA0
	DI-6101 Binary input 2x8, 110/220 VDC	GC6-101 6MF11130GB010AA0
	DI-6102 Binary input 2x8, 24…60 VDC 1 ms	GC6-102 6MF11130GB020AA0
	DI-6103 Binary input 2x8, 110/220 VDC 1 ms	GC6-103 6MF11130GB030AA0
	DI-6104 Binary input 2x8,220 VDC	GC6-104 6MF11130GB040AA0

	Designation	Item number/MLFB
	DO-6200 Binary output transistor 2x8, 24…60 VDC	GC6-200 6MF11130GC000AA0
	DO-6212 Binary output relays 8x 24…220 VDC/230 VAC	GC6-212 6MF11130GC120AA0
	DO-6220 Command out Basic module	GC6-220 6MF11130GC200AA0
	DO-6221 Command out Basic module measurement	GC6-221 6MF11130GC210AA0
	DO-6230 Command output Relay module	GC6-230 6MF11130GC300AA0
	AI-6300 Analog input 2x2 ±20 mA/±10 V	GC6-300 6MF11130GD000AA0

	Designation	Item number/MLFB
	AI-6307 Analog input 2x2 ±2.5 mA/±5 mA/±10 V	GC6-307 6MF11130GD070AA0
	AI-6308 Analog input 2x2 ±1 mA/±2 mA/±10 V	GC6-308 6MF11130GD080AA0
	AI-6310 Analog input 2x2 Pt100/Ni100	GC6-310 6MF11130GD100AA0
	AO-6380 Analog output 4x ±20 mA/±10 mA/±10 V	GC6-380 6MF11130GD800AA0
	TE-6430 Counter input 2x 24…60 VDC	GC6-430 6MF11130GE300AA0

A.4. Interface Modules

	Designation	Item number/MLFB
	CM-0819 RS232/RS485 Converter insulated	GA0-819 6MF11112AJ100AF0
	CM-0821 Field bus interface ring (3x FO, 1x el.)	GA0-821 6MF11110AJ210AA0
	CM-0822 Field bus interface star (4x FO)	GA0-822 6MF11110AJ220AA0
	CM-0823 Field bus interface ring (3x FO,1x EIA-485)	GA0-823 6MF11110AJ230AA0
	CM-0827 Fiber optic interface (el.-FO)	GA0-827 6MF11110AJ270AA0

A.5. Accessories

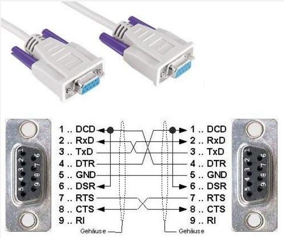
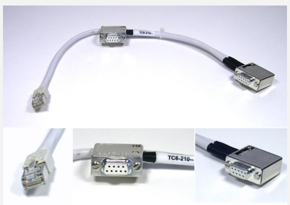
A.5.1. Proprietary Modems

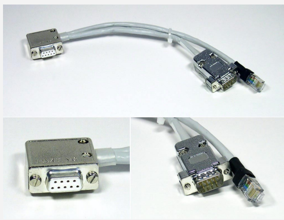
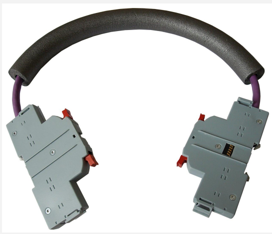
	Designation	Item number/MLFB
	CE-0700 V.23 Leased line modem for DIN rail installation, 400 mW	G21-200 6MF11020BC000AA0
	CE-0701 WT Channel modem for DIN rail installation, 2,0 W	G22-081 6MF11020CA810AA0

A.5.2. Recommended Modems (Third-Party Devices)

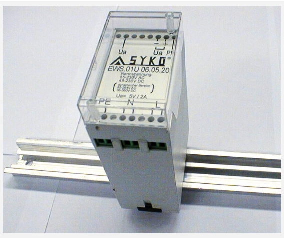
	Designation	Item number/MLFB
	TP Radio WDM 8000 Multi-point traffic	www.tpradio.com
	SATELLINE 2ASxE Multi-point traffic	www.satel.com
	Westermo TD-36AV (22…264 VAC/18…300 VDC) Westermo TD-36LV (10…30 VAC/10…60 VDC) Dial-up traffic analog	www.westermo.com
	Westermo IDW-90 Dial-up traffic ISDN	www.westermo.com
	Cinterion MC52iT Dual band Dial-up traffic GSM inclusive mounting set for DIN rail and connection cable (1.5 m)	G21-030 6MF11020BA300AA0
	Siemens Stationary Antenna GSM Antenna for outdoor mounting	G21-031 6MF11020BA310AA0
	Siemens MD741-1 GPRS router	www.siemens.com
	Dr. Neuhaus Tainy EMOD-V2-IO or Dr. Neuhaus Tainy EMOD-L1-IO	www.neuhaus.de

A.5.3. Cables and Plugs

	Designation	Item number/MLFB
	Direct cable 2xDB9F TM 1703 (e)mic 1.8 m	TF5-204 6MF13140FC040AA0
	Patch cable 1 m Cat.5 (4x2) AWG26/7 Patch cable 2 m Cat.5 (4x2) AWG26/7 Patch cable 3 m Cat.5 (4x2) AWG26/7 Patch cable 5 m Cat.5 (4x2) AWG26/7 Patch cable 10 m Cat.5 (4x2) AWG26/7 (for cabinet internal wirings up to 10 m)	T41-255 6MF13040BC550AA0 T41-251 6MF13040BC510AA0 T41-252 6MF13040BC520AA0 T41-253 6MF13040BC530AA0 T41-254 6MF13040BC540AA0
	Patch cable 1,5 m Cat.5(4x2x0,5) AWG24 Patch cable 3 m Cat.5 (4x2x0,5) AWG24 Patch cable 5 m Cat.5 (4x2x0,5) AWG24 Patch cable 100 m Cat.5 (4x2x0,5) AWG24 (for cabinet external wirings up to 100 m)	TF5-200 6MF13140FC000AA0 TF5-201 6MF13140FC010AA0 TF5-202 6MF13140FC020AA0 TF5-010 6MF13140FA100AA0
Fiber optics length: max. 0.5 km	FO indoor cable 50-DUP-LSOH FO indoor cable 50-2FIB-ARM	TF7-027 6MF13140HA270AA0 TF7-028 6MF13140HA280AA0
Fiber optics length: max. 1.5 km	FO indoor cable 62-DUP-LSOH FO outdoor cable 62-2FIB-ARM	TF7-006 6MF13140HA060AA0 TF7-007 6MF13140HA070AA0
	FO plug ST-50/62	TF7-016 6MF13140HA160AA0
	Modem cable TM 1703 emic for CE-070x 330 mm; 9-pole D-SUB (connection master control module – CE-070x)	TC6-210 6MF13130GC100AA0

	Designation	Item number/MLFB
	Modem cable TM 1703 emic for MC52iT modem 220 mm; 9-pole D-SUB (connection master control module with MC52iT modem)	TC6-211 6MF13130GC110AA0
	D-SUB 9-pole connector locking	TC6-212 6MF13130GC120AA0
	Modular coupler RJ45 9-pole D-SUB female	TF5-101 6MF13140FB010AA0
	CM-6810 TM I/O modules extension cable	GC6-810 6MF11130GJ100AA0

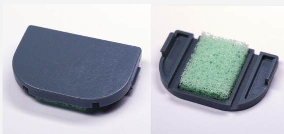
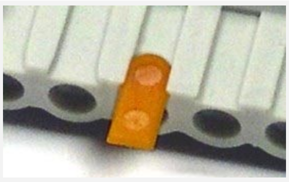
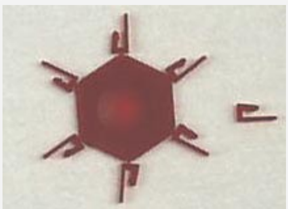
A.5.4. Recommanded Upstream Power Supply Units

	Designation	Item number/MLFB
	Power supply 115/230 VAC, 100…375 VDC, 24 VDC 50 W	www.mtm-power.com
	Power supply 5 V/2 A SYKO EWS 01 U.06.05.20 82…264 VAC or 36…350 VDC	www.syko.de

A.5.5. SD Card

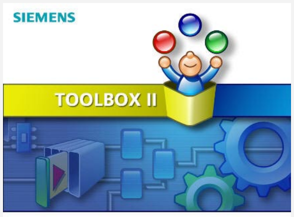
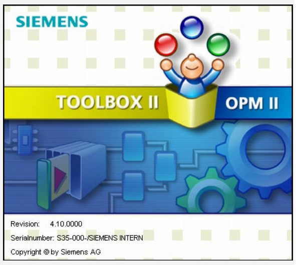
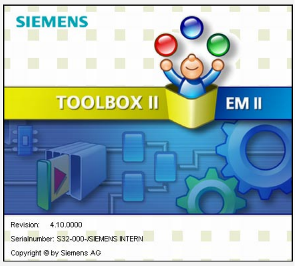
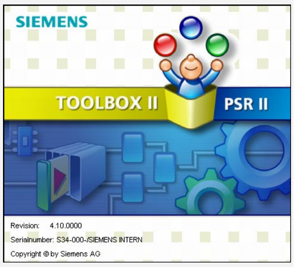
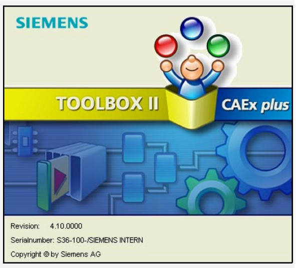
	Designation	Item number/MLFB
	SD card up to 2 GB	CC6-095 6MF12131GA050AG0
	USB 6-in-1 SD card reader	G95-140 6MF11100FB400AB0

A.5.6. Various Incidentials

	Designation	Item number/MLFB
	Bus termination	TC6-050 6MF13130GA500AA0
	Tool for disconnecting the terminal strips	TC6-200 6MF13130GC000AA0
	Coding section f. TM 1703 terminal strip	TC6-055 6MF13130GA550AA0
	PHOENIX CR-MSTB coding element 6 pcs. for pin connector	PHO+1734401 www.phoenixcontact.com
	PHOENIX KLM 3 Terminal strip marker carrier for Clipfix 35-5	PHO+0811969 www.phoenixcontact.com

	Designation	Item number/MLFB
	PHOENIX Clipfix 35-5 Snap-on end bracket for DIN rail	PHO+3022276 www.phoenixcontact.com
	PHOENIX BMKL 20x8 WH Label sheet for Laser printer DIN A4 sheet with 224 white labels	PHO+5032387 www.phoenixcontact.com
	WEIDMUELLER LPA QB22 Cross connection 2 -pole	WEI+147220 www.weidmueller.com
	WEIDMUELLER sheet with 48 adhesive labels	WEI+168551-1044 www.weidmueller.com

A.6. Engineering Tools

	Designation	Item number/MLFB
	TBII_TOOLBOX II Standard_V4 00	V30-524-4 6MF18030AF240AA0
	TBII_TOOLBOX II Standard LIGHT_V4 00	V30-525-4 6MF18030AF250AA0
	TBII_UPDATE_V4	V30-070-4 6MF18030AA700AA0
	TBII_OPM II Object-Oriented Process Data Manager	V30-004 6MF18030AA040AA0
	TBII_EM II Engineering Manager	V30-016 6MF18030AA160AA0
	TBII_PSR II Engineering and Maintenance Computer	V30-017 6MF18030AA170AA0
	TBII_CAEx *plus* Tool for Automation (application program)	V30-090 6MF18031AA000AA0

Further licenses on demand.

Xtender, Unit combining inverter, battery charger and transfer system.

User manual

XTH 3000-12	***XTM 1500-12***	***XTS 900-12***
XTH 5000-24	***XTM 2000-12***	***XTS 1200-24***
XTH 6000-48	***XTM 2400-24***	***XTS 1400-48***
XTH 8000-48	***XTM 3500-24***	
	XTM 2600-48	
	XTM 4000-48	

Common Accessories
Temperature sensor: ***BTS-01***
Accessories *XTM/XTS*:
Remote command module: ***RCM-10***
Accessories *XTS*:
Time and communication interface RTC: ***TCM-01***
External cooling fan: ***ECF-01***
External auxiliary relay module: ***ARM-02***

STUDER Innotec SA 2012 – V4.1.2
51L

SUMMARY

1 INTRODUCTION....5
2 GENERAL INFORMATION....5
2.1 Operating instructions....5
2.2 Conventions....6
2.3 Quality and warranty....6
2.3.1 Exclusion of warranty....6
2.3.2 Exclusion of liability....7
2.4 Warnings and notes....7
2.4.1 General....7
2.4.2 Precautions for using the batteries....8
3 ASSEMBLY AND INSTALLATION....8
3.1 Handling and moving....8
3.2 Storage....8
3.3 Unpacking....8
3.4 Installation site....8
3.5 Fastening....9
3.5.1 Fastening XTH model....9
3.5.2 Fastening XTM model....9
3.5.3 Fastening XTS model....9
3.6 Connections....10
3.6.1 General recommendations....10
3.6.2 Device connection compartment XTH - XTM....11
3.6.3 Device connection compartment XTS....12
3.6.4 Elements of connection cabinet....13
4 CABLING....14
4.1 Choice of system....14
4.1.1 Hybrid type stand-alone systems....14
4.1.2 Grid-connected emergency systems....14
4.1.3 Integrated mobile systems....14
4.1.4 Multi-unit systems....15
4.1.5 Distributed Minigrid....15
4.2 Earthing system....15
4.2.1 Mobile installation or installation connected to the grid via plug connector....15
4.2.2 Stationary installation....16
4.2.3 Installation with automatic PE-neutral switching....16
4.2.4 Lightning protection....16
4.3 Recommendations for dimensioning the system....16
4.3.1 Dimensioning the battery....16
4.3.2 Dimensioning the inverter....17
4.3.3 Dimensioning the generator....17
4.3.4 Dimensioning the renewable energy sources....17
4.4 Wiring diagrams....17
4.5 Connecting the battery....17
4.5.1 Battery cable cross-section and DC protective devices....18
4.5.2 Connecting the battery (Xtender side)....18
4.5.3 Fuse mounting on battery positive pole (XTM only)....19
4.5.4 Battery-side connection....19
4.5.5 Earthing the battery....20
4.5.6 Connecting the consumers at the AC output....20
4.5.7 Connecting the AC supply sources....21
4.5.8 Wiring auxiliary contacts....21
4.5.9 Connecting the communications cables....21
5 XTENDER PARAMETER SETTING....22
5.1 Basic parameter setting in the XTS....22
6 POWERING UP THE INSTALLATION....22
7 DESCRIPTION OF THE MAIN FUNCTIONS....24
7.1 Inverter....24
7.1.1 Automatic load detection (load search)....24

7.2 Transfer relay....24
7.2.1 Type of detection of AC input loss (UPS)....24
7.2.2 Limiting the AC input current "Input limit"....25
7.3 Battery charger....26
7.3.1 Working principle....26
7.3.2 Battery charger current setting....28
7.3.3 Battery protection....28
7.4 Xtender protection....28
7.4.1 Protection in case of overload....28
7.4.2 Protection against overvoltage....28
7.4.3 Protection against overheating....28
7.4.4 Protection against battery reverse polarity....29
7.5 Auxiliary contacts....29
7.6 The real time clock....29
7.7 Entry command (Remote control on/off)....29
8 MULTI-UNIT CONFIGURATION....30
8.1 Three-phase system....31
8.2 Increasing the power by paralleling units....31
8.3 Combined system....31
8.4 Enlargement of an existing installation....31
9 ACCESSORIES....32
9.1 Control centre and display RCC-02/-03 (remote control)....32
9.2 BTS-01 temperature sensor....33
9.2.1 Connecting the temperature sensor (BTS-01)....33
9.3 Remote control Module RCM-10 (XTM/XTS)....33
9.3.1 Connection of the RCM-10 module....33
9.4 Time and communication module TCM-01(XTS)....34
9.5 Auxiliary Relay Module ARM-02 (XTS)....34
9.6 External Cooling Fan unit ECF-01 (XTS)....34
10 OTHER DEVICES COMPATIBLE XTENDER SYSTEMS....34
10.1 BATTERY STATUS PROCESSORS BSP- 500/1200....34
10.2 COMMUNICATION MODULE XCOM-232I....34
11 CONTROL....35
11.1 Main on/off control....35
11.2 Display and control panel....35
12 MAINTENANCE OF THE INSTALLATION....37
13 PRODUCT RECYCLING....37
14 EC DECLARATION OF CONFORMITY....37
15 COMMENTS OF APPENDIX DRAWINGS....38
16 DRAWING'S ELEMENTS (DC SIDE)....39
17 FIGURE ELEMENT'S (AC PART)....40
18 MECHANICAL DIMENSION AND MOUNTING ELEMENT....41
19 NAMEPLATE (FIG. 1B)....42
20 TABLE OF FACTORY'S (DEFAULTS) PARAMETERS SETTINGS....43
21 TECHNICAL DATA....45
22 NOTES....46

1 INTRODUCTION

Congratulations! You are about to install and use a device from the Xtender range. You have chosen a high-tech device that will play a central role in energy saving for your electrical installation. The Xtender has been designed to work as an inverter / charger with advanced functions, which can be used in a completely modular way and guarantee the faultless functioning of your energy system.
When the Xtender is connected to a generator or network, the latter directly supplies the consumers, and the Xtender works like a battery charger and backup device if necessary. The powerful battery charger has an exceptional high efficiency and power factor correction (PFC) close to 1. It guarantees excellent battery charging in all situations. The charge profile is freely configurable according to the type of battery used or the method of usage. The charge voltage is corrected depending on the temperature, thanks to the optional external sensor. The power of the charger is modulated in real time dependent according to the demand of the equipment connected at the Xtender output and the power of the energy source (network or generator). It can even temporarily backup the source if the consumer demand exceeds the source capacity.
The Xtender continuously monitors the source to which it is connected (network or generator) and disconnects itself immediately if the source is missing, disturbed or does not correspond to the quality criteria (voltage, frequency, etc.). It will then function in independent mode, thanks to the integrated inverter. This inverter, which has an extremely robust design, benefits from STUDER Innotec's many years of experience and expertise in this area. It could supply any type of load without faults, enjoying reserves of additional power that is unmatched on the market. All your equipment will be perfectly provided with energy and protected from power outages in systems where energy supply is unpredictable (unreliable network) or voluntarily limited or interrupted, such as hybrid installations on remote sites or mobile installations.
The parallel and/or three-phase network operation of the Xtender offers modularity and flexibility and enables optimum adaptation of your system to your energy requirements.
The RCC-02/-03 control, display and programming centre (optional) enables optimum parametering of the system and guarantees the operator continuous control for all important parameters in the installation.
In order to guarantee perfect commissioning and functioning of your installation, please read this manual carefully. It contains all the necessary information relating to the functioning of the inverters / chargers in the Xtender series. The setting up of such a system requires special expertise and may only be carried out by qualified personnel familiar with the applicable local regulations.

2 GENERAL INFORMATION

2.1 OPERATING INSTRUCTIONS

This manual is an integral part of each inverter/charger from the Xtender series.
It covers the following models and accessories[1]:
Inverter/charger:
XTH 3000-12 – XTH 5000-24 – XTH 6000-48 – XTH 8000-48
XTM 1500-12, XTM 2000-12, XTM 2400-24,
XTM 3500-24, XTM 2600-48, XTM 4000-48
XTS 900-12, XTS 1200-24, XTS 1400-48

External cooling fan: ECF-01
Temperature sensor: BTS-01
Remote command module: RCM-10
Auxiliary relay module: ARM-02

For greater clarity, the device is referred to in this manual as Xtender, unit or device, when the description of its functioning applies indiscriminately to different Xtender models.
These operating instructions serve as a guideline for the safe and efficient usage of the Xtender. Anyone who installs or uses an Xtender can rely completely on these operating instructions, and is bound to observe all the safety instructions and indications contained. The installation and commissioning of the Xtender must be entrusted to a qualified professional. The installation and

[1] Also for 120Vac model (-01)

usage must conform to the local safety instructions and applicable standards in the country concerned.

2.2 CONVENTIONS

	This symbol is used to indicate the presence of a dangerous voltage that is sufficient to constitute a risk of electric shock.
	This symbol is used to indicate a risk of material damage.
	This symbol is used to indicate information that is important or which serves to optimise your system.

All values mentioned hereafter, followed by a parameter number indicate that this value may be modified using the RCC-02/-03 remote control.
In general, the default values are not mentioned and are replaced by a parameter number in the following format: {xxxx}. The default values for this parameter are specified in the defaults parameter table, p.43.

	All parameter values modified by the operator or installer must be transferred into the same table. If a parameter not appearing in the list (advanced parameters) has been modified by an authorised person with technical knowledge, they will indicate the number of the modified parameter(s), the specifications of the parameter(s) and the new value set, at the end of the same table.

All figures and letters indicated in brackets or in square brackets refer to items that can be found in the separate manual "Appendix to the installation and operating instructions" supplied with the device. In this appendix, these figures and letters are encircled.

- The **figures** in brackets refer to elements belonging to the **Xtender**.
- The **uppercase letters** in brackets refer to **AC** cabling elements.
- The **lowercase letters** in brackets refer to **battery** cabling elements.
- The comments on figures and items of figures of the appendix are given p. 39 and following.

2.3 QUALITY AND WARRANTY

During the production and assembly of the Xtender, each unit undergoes several checks and tests. These are carried out with strict adherence to the established procedures. Each Xtender has a serial number allowing complete follow-up on the checks, according to the particular data for each device. For this reason it is very important never to remove the type plate (appendix 1 – fig. 3b) which shows the serial number. The manufacture, assembly and tests for each Xtender are carried out in their entirety by our factory in Sion (CH). The warranty for this equipment depends upon the strict application of the instructions appearing in this manual.

2.3.1 Exclusion of warranty

No warranty claims will be accepted for damage resulting from handling, usage or processing that does not explicitly appear in this manual. Cases of damage arising from the following causes are notably excluded from the warranty:

- Surge voltage on the battery input (for example, 48 V on the battery input of an XTH 3000-12)
- Incorrect polarity of the battery
- The accidental ingress of liquids into the device or oxidation resulting from condensation
- Damage resulting from falls or mechanical shocks
- Modifications carried out without the explicit authorisation of Studer Innotec
- Nuts or screws that have not been tightened sufficiently during the installation or maintenance
- Damage due to atmospheric surge voltage (lightning)
- Damage due to inappropriate transportation or packaging
- Disappearance of original marking elements

2.3.2 Exclusion of liability

The placement, commissioning, use, maintenance and servicing of the Xtender cannot be the subject of monitoring by Studer Innotec. For this reasons we assume no responsibility and liability for damage, costs or losses resulting from an installation that does not conform to the instructions, defective functioning or deficient maintenance. The use of a Studer Innotec inverter is the responsibility of the customer in all cases.
Studer Innotec shall in no event be liable for consequential, incidental, contingent or special damages, even if having been advised of the probability of such damages. This equipment is neither designed nor guaranteed to supply installations used for vital medical care nor any other critical installation carrying significant potential damage risks to people or the environment.
Studer Innotec assumes no responsibility for the infringement of patent rights or other rights of third parties that result from using the inverter.
Studer Innotec reserves the right to make any modifications to the product without prior notification.

2.4 WARNINGS AND NOTES

2.4.1 General

	This manual is an integral part of the device and must be kept available for the operator and installer. It must remain close to the installation so that it may be consulted at any time.

The parameter table available at the end of the manual (p. 43) must be kept up to date in the event of modification of the parameters by the operator or installer. The person in charge of installation and commissioning must be wholly familiar with the precautionary measures and the local applicable regulations.

	When the Xtender is running, it generates voltage that can be potentially lethal. Work on or close to the installation must only be carried out by thoroughly trained and qualified personnel. Do not attempt to carry out ongoing maintenance of this product yourself. The Xtender or the generator connected to it may start up automatically under certain predetermined conditions. When working on the electrical installation, it is important to be certain that the source of DC voltage coming from the battery as well as the source of AC voltage coming from a generator or network have been disconnected from the electrical installation. Even when the Xtender has been disconnected from the supply sources (AC and DC), a dangerous voltage may remain at the outputs. To eliminate this risk you must switch the Xtender OFF using the ON/OFF button (1). After 10 seconds the electronics is discharged and intervention may take place without any danger.

All elements connected to the Xtender must comply with the applicable laws and regulations.
Persons not holding written authorisation from Studer Innotec are not permitted to proceed with any change, modification or repairs that may be required. Only original parts may be used for authorised modifications or replacements.
This manual contains important safety information. Read the safety and working instructions carefully before using the Xtender. Adhere to all the warnings given on the device as well as in the manual, by following all the instructions with regard to operation and use.
The Xtender except XTS, is only designed for indoor use and must under no circumstances be subjected to rain, snow or other humid or dusty conditions. The maximum specifications of the device shown on the type plate, as at fig. 1b, must be adhered to.
In the event of use in motorised vehicles, the Xtender must be protected from dust, splash water and any other humid condition. It must also be protected from vibration by installing absorbent parts.

2.4.2 Precautions for using the batteries

Lead-acid or gel batteries produce a highly explosive gas with normal use. No source of sparks or fire should be present in the immediate vicinity of the batteries. The batteries must be kept in a well-ventilated place and be installed in such a way as to avoid accidental short-circuits when connecting.
Never try to charge frozen batteries.
When working with the batteries, a second person must be present in order to lend assistance in the event of problems.
Sufficient fresh water and soap must be kept to hand to allow adequate and immediate washing of the skin or eyes affected by accidental contact with the acid.
In the event of accidental contact of the eyes with acid, they must be washed carefully with cold water for 15 minutes. Then immediately consult a doctor.
Battery acid can be neutralised with baking soda. A sufficient quantity of baking soda must be available for this purpose.
Particular care is required when working close to the batteries with metal tools. Tools such as screwdrivers, open-ended spanners, etc. may cause short-circuits. Consequently occurring sparks may cause the battery to explode.
When working with the batteries, all metal jewellery such as rings, bracelet watches, earrings, etc., must be taken off. The current output by the batteries during short-circuit is sufficiently powerful to melt the metal and cause severe burns.
In all cases, the instructions of the battery manufacturer must be followed carefully.

3 ASSEMBLY AND INSTALLATION

3.1 HANDLING AND MOVING

The weight of the Xtender is can be up to 50kg depending upon the model. Use an appropriate lifting method as well as help from a third party when installing the equipment.

3.2 STORAGE

The equipment must be stored in a dry environment at an ambient temperature of between -20°C and 60°C. It stays in the location where it is to be used a minimum of 24 hours before being set up.

3.3 UNPACKING

When unpacking, check that the equipment has not been damaged during transportation and that all accessories listed below are present. Any fault must be indicated immediately to the product distributor or the contact given at the back of this manual.
Check the packaging and the Xtender carefully.
Standard accessories:
Installation and operating instructions, c.f. Appendix 1
Mounting plate for XTH and XTS– fig. 2a (25)(26)
One set of cable glands on the unit and/or apart.
Four M6 screws and washer for XTS to assemble the support and the enclosure.

3.4 INSTALLATION SITE

The installation site for the Xtender is of particular importance. XTH and XTM range are designed to indoor use (IP20) and the place of installation must satisfy the following criteria:

- Protected from any unauthorised person.
- Protected from water and dust and in a place with no condensation.
- It must not be situated directly above the battery or in a cabinet with it.
- No easily inflammable material should be placed directly underneath or close to the Xtender.
- Ventilation apertures must always remain clear and be at least 20cm from any obstacle that may affect the ventilation of the equipment.
- In mobile applications it is important to select an installation site that ensures as low a vibration level as possible.

XTS range appliances have a higher grade of protection (IP54).and can be installed outdoor, dust exposed environment or water splash. Care must be taken to not expose the unit under direct sun

irradiation or near to a heat source (i.e. engine compartment). The presence of a heat source may reduce significantly the nominal power of the unit.
Reduce as much as possible exposure to great temperature variation: large heat variation may induce condensation drop inside the appliance.

3.5 FASTENING

⚠	The Xtender is a heavy unit and must be mounted to a non flammable support (wall) designed to bear such a load

The Xtender must be installed vertically onto heavy duty material (concrete or metallic wall) and positioned vertically with cable glands oriented down. A sufficient space around it must be provided to guarantee adequate ventilation of the device (see figs. 2a).

3.5.1 Fastening XTH model

First fix the mounting bracket (26)) supplied with the device using 2 Ø < 6-8 mm >screws**.
Then hang the Xtender on the bracket. Fasten the unit permanently using 2 Ø <6-8 mm> screws** on to the two notches located at the underside of the case.
Dimensions of the appliances are given on Fig 2a of the appendix 1

⚠	A minimum distance of 20 cm in between and/or around the XTH devices is required in order to guarantee sufficient ventilation.

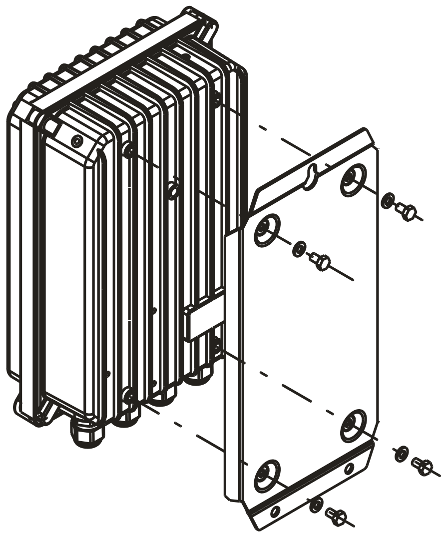
3.5.2 Fastening XTM model

Screw first the top screw (6-8mm **) without washer on a solid wall (concrete or metallic wall) up to a distance of 2mm between head and wall. Hang the apparatus by taking care to release beforehand the trap door of access (27 fig. 2a of the appendix) by inserting it inside the apparatus using a screwdriver, if you estimate that a complete tightening of this point of fixing is necessary. In theory complete tightening is necessary only in the mobile installations.
Dismount the lower plastic cap of the apparatus giving access to the compartment of wiring. Carefully fix the apparatus with two screws (Ø 6-8 mm) in the two clamp holes down inside the compartment of wiring.
If the Xtender is installed in a closed cabinet this must have sufficient ventilation to guarantee an ambient temperature that conforms to the operation of the Xtender.
**: *These items are not delivered with the device.*

⚠	It is imperative to ensure complete and safe fastening of the device. A device that is simply hung may detach and cause severe damage.

3.5.3 Fastening XTS model

The XTS enclosure must be first mounted on the support plate with the 4 screws and washer delivered with the appliance according with figure aside. Then the unit can be fixed on a heavy duty support (concrete or metallic wall) and positioned vertically with cable glands oriented down. An external ventilation unit (ECF-01 p. 34) can be installed on top of the unit before or after wall mounting.



⚠	**The envelope of the XTS can reach temperature higher than 60°C** when used for a long period at the maximum of its performances. These high temperatures may remain present during several tens of minutes after stopping the unit. It's recommended to choose a place of installation in a restricted access area, away from children or any unauthorized person.

3.6 CONNECTIONS

3.6.1 General recommendations

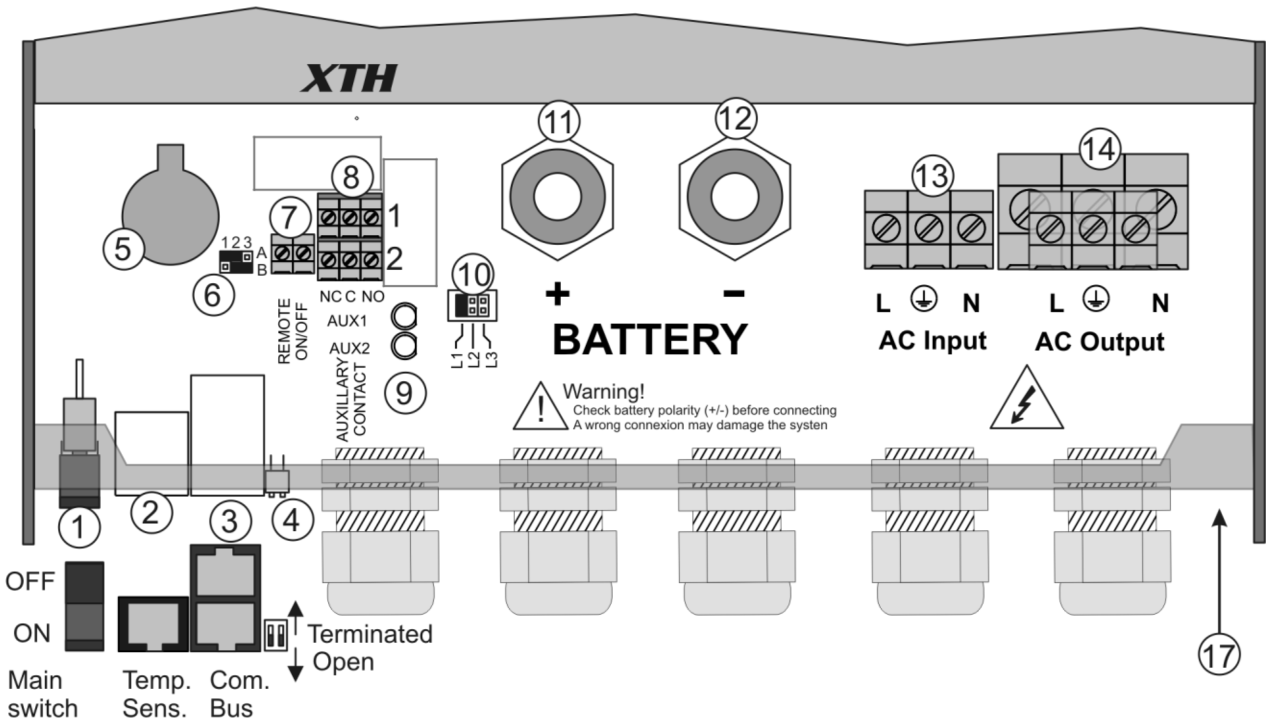
The Xtender falls within protection class I (has a PE connection terminal). It is vital that a protective earth is connected to the AC IN and/or AC OUT PE terminals. An additional protective earth is located at the bottom of the unit (See sect 3.6.4 – p. 11/12, tag (17)).

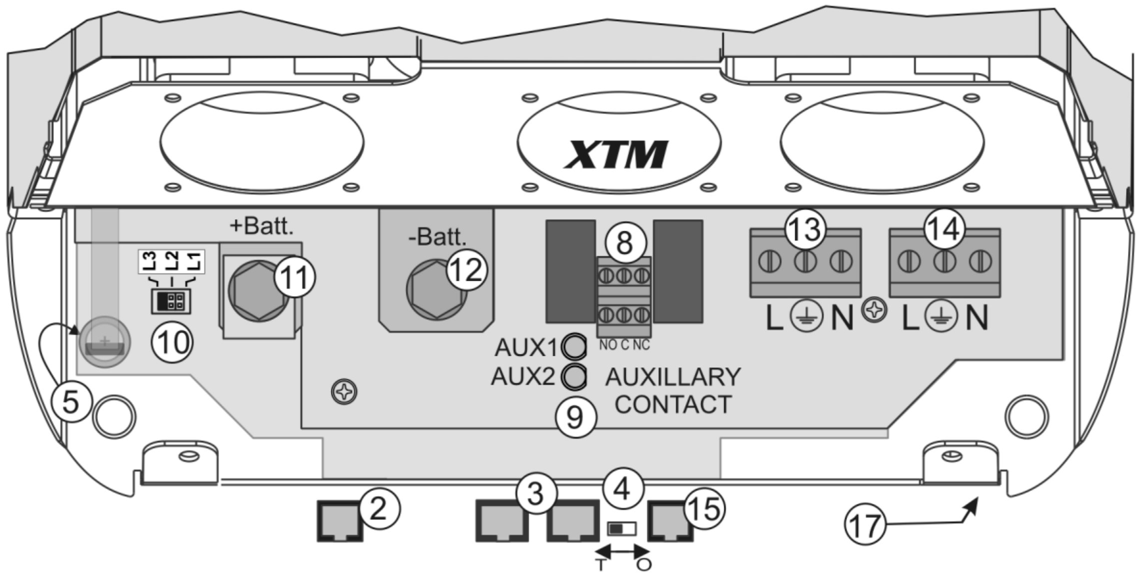
⚠	In all cases, the PE conductor for the equipment must at least be connected to the PE for all equipment in protection class I upstream and downstream of the Xtender (equipotential bonding). It is mandatory that the legislation in force for the application concerned be adhered to.

Tighten of the input (13) and output (14) terminals by means of a no. 3 screwdriver and those for the "Command entry (REMOTE ON/OFF") (7) and "AUX.CONTAC" (8) by means of a no. 1 screwdriver.
The cable cross-sections of these terminals must conform to local regulations.
All connection cables as well as the battery cables must be mounted using cable restraints in order to avoid any traction on the connection.
Battery cables must also be as short as possible and the cross-section must conform with the applicable regulations and standards. Sufficiently tighten the clamps on the "battery" inputs (fig. 4a (11) and (12)).

3.6.2 Device connection compartment XTH - XTM

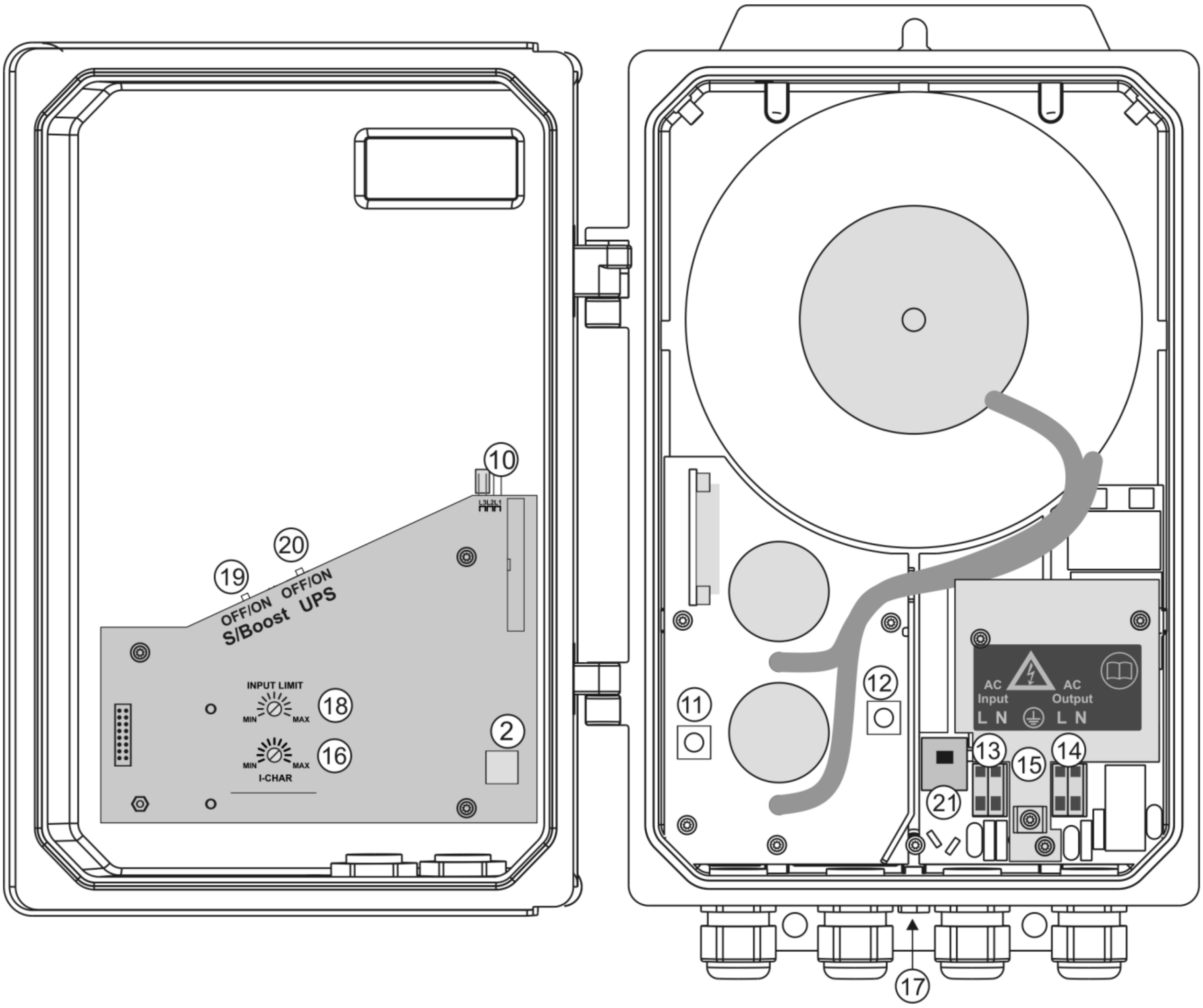
⚠	The unit's connection compartment must remain permanently closed when in operation. It is imperative to close the protection cap on the connection terminals after each intervention in the device. After opening, check that <u>all</u> sources of AC <u>and DC</u> voltage (batteries) have been disconnected or put out of service. Some accessible part inside the compartment can have surface temperature higher than 60°C. Wait for the complete cooling of the unit before opening the compartment.

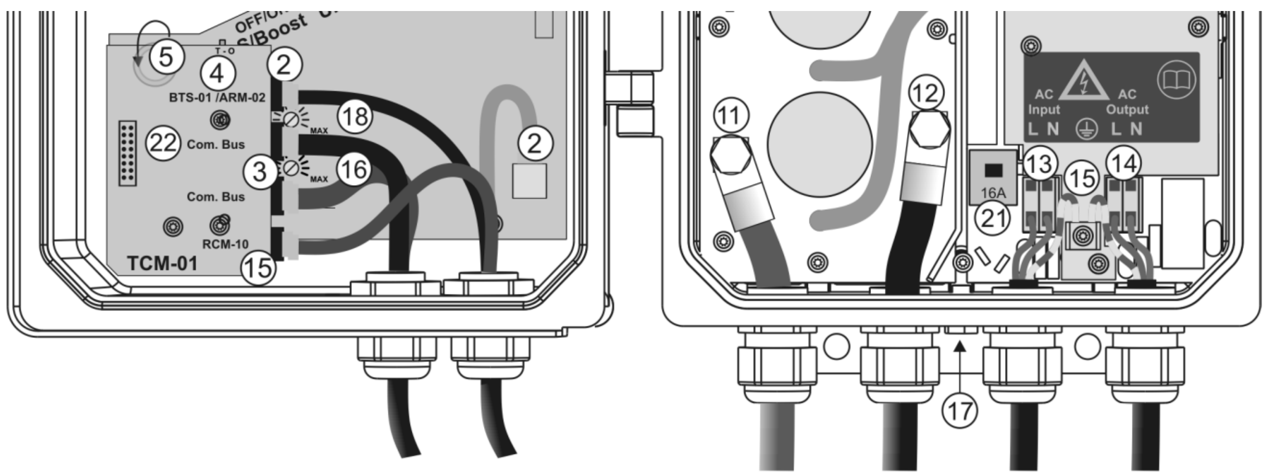




⚠	**Any unused cable entry on the device must be sealed so as to prevent any intrusion. An intrusion of small animals in the unit may cause serious damage not covered by warranty.**

3.6.3 Device connection compartment XTS





⚠	**Any unused cable entry on the device must be sealed so as to prevent any intrusion. An intrusion of small animals in the unit may cause serious damage not covered by warranty.**

3.6.4 Elements of connection cabinet

Pos.	Denomination	Description	Comment
1	ON/OFF Main switch	Main on/off switch	See sect. 11.1 – p. 35. In XTM ahd XTS series, this function is deported on the remote command module RCM-10. See sect. 9.3 – p. 33
2	Temp. Sens	Connector for the battery temperature sensor	See sect. 9.2 – p. 33. Only connect the original Studer BTS-01 sensor
3	Com. Bus	Double connector for connecting peripherals such as the RCC-02/03 or other Xtender units	For the XTS model, these connectors are available only if the module TCM-01 (see sect. 9.4 – p. 34) is implemented.
4	O / T (Open / Terminated)	Switch for terminating the communication bus. Set position (open) if the 2 connectors (3) are occupied. Set position T if only one is occupied.	On model XTH the 2 termination switches (4) must be in the same position: Or the 2 in position O (open) or the 2 in position T (terminated)
5	--	3.3 V (CR-2032) lithium ion type battery socket	Used as a permanent supply for the internal clock. See sect. 7.6 - p. 29
6	--	Jumper for programming the off/on switch by dry contact	See sect. 7.7 – p. 29 and fig. 8b point (6) and (7). They are positioned at A-1/2 and B-2/3 by default
7	Command entry (REMOTE ON/OFF)	Entry command terminals.. In XTM series, this entry is deported on the remote command module RCM-10. See sect. 9.3 – p. 33	Allow to dive a function – to be defined by programming – by the closing of a dry contact or by the presence of a voltage across these terminals. See sect. 7.7 – p. 29).
8	AUXILLARY CONTACT	Auxiliary contact For XTS model, available only with module ARM-02 (see sect. 9.5 - p. 34	(See sect. 7.5 – p. 29) Take care not to exceed the admissible loads
9	--	Activation indicators for auxiliary contacts 1 and 2	See sect. 7.5 – p. 29
10	L1/L2/L3	Phase selection jumpers.	See sect. 8.1. – p. 31. Jumper default at position L1
11	+BAT	Positive pole battery connection terminals	Carefully read sect. 4.5 – p.17 Take care with the polarity of the battery and when tightening the clamp.
12	-BAT	Negative pole battery connection terminals	
13	AC Input	Connection terminals for the alternative power supply (generator or public network)	See sect. 4.5.7 - p. 21. Note: It is imperative that the PE terminal be connected.
14	AC Output	Connection terminals for the device output.	See sect. 4.5.6 - p. 21. Note: Increased voltages may appear on the terminals, even in the absence of voltage at the input of the inverter.
15	RCM-10	Connector for RCM-10 module	Only on XTM. See sect. 9.3 – p. 33
16	I-CHAR	Rotating knob to adjust the battery charge current	Only in XTS model.
17	⏚	Connection for supplementary protective earth.	This connection can also be used as principal protective earth. See sect. 3.6.1– p. 10.
18	INPUT LIMIT	Rotating knob to adjust the input current limit	Only in XTS model. For other models, see sect. 7.2.2 – p. 25

19	OFF/ON S/Boost	Activation of source assistance "Smart boost" function	Only in XTS model. For other models, see sect. 7.2.2.4 – p. 26
20	OFF/ON UPS	Setting of sensitivity of the detection of AC input loss: OFF=tolerant / ON=Fast	Only in XTS model. For other models, see section. 7.2.1 – p. 24
21	16A	AC input protective device: Only on XTS model. This protective device will trip in case of excessive load when the XTS is connected to an unprotected source higher than 16A. It can be reset after removing the default downstream (load too high) and upstream (source greater than 16A. (check the unit is connected thru an upstream protective device (fuse or circuit breaker) max. 16 A	
22	--	Insertion holes for TCM-01 optional communication module (see sect. 9.3.1 - p. 33	

4 CABLING

The connection of the Xtender inverter / charger is an important installation step.
It may only be carried out by qualified personnel and in accordance with the applicable local regulations and standards. The installation must always comply with these standards.
Pay attention that connections are completely tightened and that each wire is connected at the right place.

4.1 CHOICE OF SYSTEM

The Xtender may be used in different system types, each of which must meet the standards and particular requirements associated with the application or site of installation. Only an appropriately qualified installer can advise you effectively on the applicable standards with regard to the various systems and the country concerned.
Examples of cabling are presented in appendix I of this manual, fig. 5 and following. Please carefully read the notes associated with these examples in the tables on p. 33 and following.

4.1.1 Hybrid type stand-alone systems

The Xtender can be used as a primary supply system for off- grid sites where a renewable energy source (solar or hydraulic) is generally available and a generator is used as backup. In this case, batteries are generally recharged by a supply source such as solar modules, wind power or small hydropower systems. These supply sources must have their own voltage and/or current regulation system and are connected directly to the battery. (Example, fig. 11)
When the energy supply is insufficient, a generator is used as a back-up energy source. This allows the batteries to be recharged and direct supply to consumers via the Xtender transfer relay.

4.1.2 Grid-connected emergency systems

The Xtender can be used as an emergency system, also known as an uninterruptible power supply (UPS) – enabling a reliable supply to a site connected to an unreliable network. In the event of an interruption to the energy supply from the public network, the Xtender, connected to a battery, substitutes the faulty source and enables a support supply to the users connected downstream. These will be supplied as long as the energy stored in the battery allows. The battery will quickly be recharged at the next reconnection to the public grid.
Various application examples are described in figs. 8a – 8c in appendix 1.

The use of the Xtender as a UPS must be carried out by qualified personnel who have been checked by the responsible local authorities. The diagrams in the appendix are given for information and as a supplement. The applicable local standards and regulations must be adhered to.

4.1.3 Integrated mobile systems

These systems are meant to be temporarily connected to the grid and ensure the supply of the mobile system when this is disconnected from the grid. The main applications are for boats, service vehicles and leisure vehicles. In these cases, two separate AC inputs are often required, one connected to the grid and the other connected to an on-board generator. Switching between two sources must be carried out using an automatic or manual reversing switch, conforming to the

applicable local regulations. The Xtender has a single AC input.
Various application examples are described in figs. 10a – 10b – 10c.

4.1.4 Multi-unit systems

Whatever system is selected, it is possible to realise systems composed of several units of the same type and the same power output. Up to three Xtenders in parallel or three extenders forming a three-phase grid or three times two or three Xtenders in parallel forming a three-phase / parallel grid, may be thus combined.

4.1.5 Distributed Minigrid

The implementation of the Xtender on top of a distributed minigrid (beyond the main building) requires special care in choosing the distribution system.
Studer Innotec recommends a TT distribution for the DC grid as well as for the AC grid.

The size of the grid increases greatly the exposure of the inverters to atmospheric overvoltages and to non equipotentiality in the grid. This is particularly noticeable in the aerial distribution grids. In this case a very special care must be taken to well implementing all protection measures of the installation.

The IT system is not recommended for the distribution. This kind of distribution is most of the time forbidden by the local laws. The achievement of low voltage electric system is <u>always</u> subject to local laws and must imperatively be implemented and controlled by qualified and professionally authorized staff. Studer Innotec accepts no liability for damages due to non confirming installation and to the lack of compliance with the local rules or with the recommendations of this manual.

4.2 EARTHING SYSTEM

The Xtender is a protection class I unit, which is intended for cabling in a grid type TT, TN-S or TNC-S. The earthing of the neutral conductor (E) is carried out at a sole installation point, upstream of the RCD circuit breaker (D).
The Xtender can be operated with any earthing system. In all cases it is imperative that the protective earth be connected in compliance with the applicable standards and regulations. The information, notes, recommendations and diagram mentioned in this manual are subject to local installation regulations in every case. The installer is responsible for the conformity of the installation with the applicable local standards.

4.2.1 Mobile installation or installation connected to the grid via plug connector

When the input of the device is connected directly to the grid via a plug, the length of the cable must not exceed 2 m and the plug must remain accessible.
In the absence of voltage at the input, the neutral and live are interrupted, thereby guaranteeing complete isolation and protection of the cabling upstream of the Xtender.
The earthing system downstream of the Xtender is determined by the upstream earthing system when the grid is present. In the absence of the grid, the earthing system downstream of the inverter is in isolated mode. The safety of the installation is guaranteed by the equipotential bonding.

The connection (link) between the neutrals (C) upstream and downstream of the Xtender is not permitted in this configuration.

This connection type guarantees the optimal continuity for supplying the Xtender loads. The first isolation fault will not lead to an interruption in the supply.
If the installation requires the use of a permanent isolation controller this would have to be de-activated when the TT network is present at the Xtender input.

⚠	All sockets and protection class I devices connected downstream of the Xtender must be properly connected to the earth (earthed socket). The cabling rules above remain valid, including in installations, in all cases where the Xtender input is connected to the grid via a plug connector.

4.2.2 Stationary installation

The installation may be equivalent to a mobile installation (with interrupted neutral).
In a fixed installation where the neutral is connected to the earth at a single installation point upstream of the Xtender, it is permissible to carry out a connection of the neutrals in order to preserve an unchanged earthing system downstream, independent of the operating mode of the Xtender. This choice has the advantage of keeping the protection devices downstream of the Xtender. This connection can be executed according to the examples in appendix 1, or carried out by modifying the parameter {1486}
In this case the appearance of the first fault will lead to the installation stopping or the disconnection of the protection devices upstream and/or downstream of the Xtender.
Safety is guaranteed by the equipotential bonding and by any RCD circuit-breakers placed downstream.
This connection (C) is not permitted if a socket is installed upstream of the Xtender.

4.2.3 Installation with automatic PE-neutral switching

In certain applications, it is desirable to keep the neutral upstream and downstream of the Xtender separated (C) while re-establishing the earthing system (TN-S, TT or TNC-S) in the absence of voltage at the input. This functionality is forbidden by default by the parameter {1485}. This This parameter can be modified by the parameter {1485} via the RCC-02/-03 remote control. This modification must be carried out possessing technical knowledge, at the responsibility of the installer and in conformity with the applicable regulations and standards.
The authorization of this function adherence to the requirements for an earth-neutral connection at the source.

4.2.4 Lightning protection

As per the installation site, it is highly recommended to set a protection strategy to protect your installation against lightning. The strategies depend on various parameters directly linked to each site and we recommend therefore to deal very professionally with this issue.

⚠	The damages due to lightning are generating most of the time significant costs (full replacing of the printed electronic board) and are not covered by Studer Innotec's warranty.

4.3 RECOMMENDATIONS FOR DIMENSIONING THE SYSTEM

4.3.1 Dimensioning the battery

The battery capacity is dimensioned according to the requirements of the user – that is 5 to 10 times its average daily consumption. The discharge depth of the battery will therefore be limited and the service life of the battery will be extended.
On the other hand, the Xtender must have a battery capacity that is large enough to be able to take full advantage of the performance of the equipment. The minimum capacity of the batteries (expressed in Ah) is generally dimensioned in the following way: five times the rated power output of the Xtender / the battery voltage. For example, the model XTH 8048 must have a battery of a minimum capacity of 7000*5/48=730 Ah (C 10). Because of the inverter's extreme overload capacity, it is often recommended that this value be rounded up. An under-dimensioned battery may lead to an accidental and undesired stopping of the Xtender in the event of high instances of use. This stoppage will be due to a voltage that is insufficient on the battery, subject to a strong discharge current.
The battery will be selected with regard to the greatest value resulting from the calculations set out above.
The battery capacity determines the adjustment of the parameter {1137} "battery charge current". A value between 0.1 and 0.2 x C batt. [Ah] (C10) enables an optimum charge to be guaranteed.

⚠	The method proposed below is strictly indicative and in no way constitutes a guarantee of perfect dimensioning. The installer is solely responsible for good dimensioning and installation

4.3.2 Dimensioning the inverter

The inverter is dimensioned in such a way that the rated power output covers the power of all the consumers which will be used at the same time. A dimensioning margin of 20 to 30% is recommended to guarantee that the Xtender will work well in an ambient temperature of more than 25 °C.

4.3.3 Dimensioning the generator

The power output of the generator must be the same or more than the average daily power. Optimally, it should be two or three times this power. Thanks to the input limit function (see sect. 7.2.2 - p. 25) it is not necessary to over-dimension the generator. Indeed, the loads those are temporarily higher than the power of the generator will be supplied by the inverter.
Ideally the generator should not have a power output by phase that is less than half of the power of the Xtender(s) present at this phase.

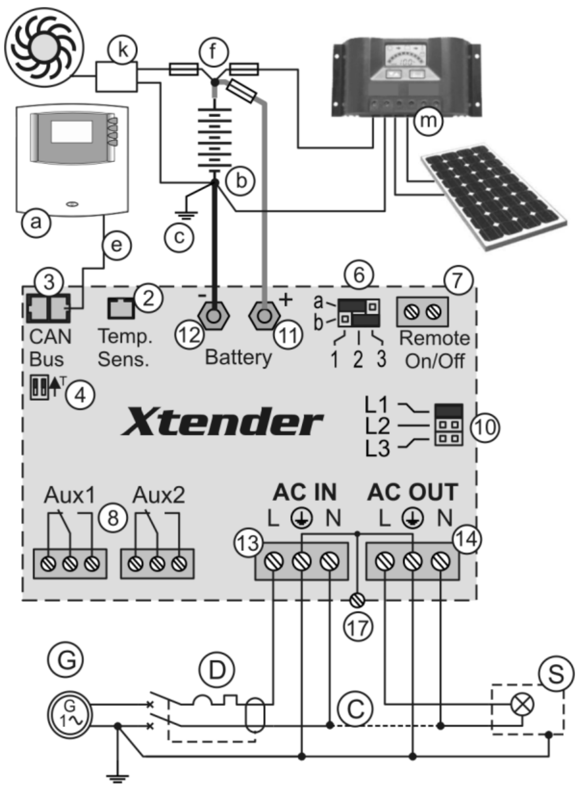
ℹ	The power available downstream of the inverter when the generator is working is the same as the sum of the two powers if the Smart Boost function is activated. The sum of the currents is limited to a maximum of 57A (80A for the models XTH 8000-48, XTH 6000-48-01, and XTH 5000-24-01). This sum is limited to 20A in XTS model

4.3.4 Dimensioning the renewable energy sources

In a hybrid system, the alternative energy sources such as the solar generator, wind power and small hydropower should, in principle, be dimensioned in such a way as to be able to cover the average daily consumption.

4.4 WIRING DIAGRAMS

Several schematics and wiring comments as in the diagram aside are proposed in Annex I of this manual.
The diagram aside gives an example of hybrid system for remote site with some renewable energy sources and single phase generator.
These diagrams are indicative, and in any case the wiring is subsidiary to compliance with local standards and practices, under the responsibility of the installer.
Comments regarding the letters / and / or numbers cited in the diagram aside and of those in the appendix are given in sect. 16 to 19.
The elements of these diagrams are referenced by a capital letter when relates to the alternating current (AC) elements.
The elements referenced by a lowercase letter relates to the direct current elements (DC part of the diagram.)



4.5 CONNECTING THE BATTERY

The terminals of dc input / output of the apparatus (11) - (12) p. 9 are intended to be exclusively connected to a battery, usually of lead acid batteries with gelled or liquid electrolyte

⚠	The use of the Xtender connected to any other type of DC source without battery (buffer) is strictly prohibited and not cause significant damage to the device and / or at source

The use of other battery type like Ni-Cd, Li-Ion or other is possible subject to a proper setting of load profile in accordance with the specifications of the manufacturer of the battery and under the responsibility of the installer

⚠	Each Xtender is connected directly to the battery through its own protective device (fuse or circuit breaker. It should <u>never</u> be connected to the output of a DC voltage regulator like solar regulator, without having the battery as buffer. All other consumers or sources are connected directly to the battery by their own protective devices. (See details (f) on Fig. 11-18)

Lead batteries are usually available in 2 V, 6 V or 12 V block types. In the majority of cases, in order to obtain an operating voltage that is correct for Xtender usage, several batteries must be connected in series or in parallel depending on the circumstances.

ℹ	In multi-unit systems, all Xtenders from the same system must be connected according to the same battery bank.

The various cabling options are presented in figures 5a-5b (12 V), 5c-5e (24 V) and 6a to 6d (48 V) in appendix I of this manual.

4.5.1 Battery cable cross-section and DC protective devices

⚠	The battery cables must be protected by one of the following measures in all cases: - protection device (fuse) at each pole - protection device (fuse) on the pole not connected to the earth

Range	Battery fuse	Cable cross-section (<3m)
XTS-900-12	100A	$25mm^2$
XTS 1200-24	80A	$25mm^2$
XTS-1400-48	50A	$16mm^2$
XTM-4000-48	200A	50mm2
XTM-2600-48	100A	25mm2
XTM-3500-24	300A	70mm2
XTM-2400-24	200A	50mm2
XTM-2000-12	300A	70mm2
XTM-1500-12	250A	70mm2
XTH-8000-48	300A	95mm2
XTH-6000-48	300A	70mm2
XTH-5000-24	300A	95mm2
XTH-3000-12	350A	95mm2

The battery cables must also be as short as possible.
It is always preferable to keep the cable at the negative pole of the battery as short as possible.
In order to avoid any further loss and protection redundancy, the XTH does not have an internal fuse.
A protective device (f) must be installed as close as possible to the battery and sized according to the table on side.
The recommended cable cross-sections are valid for lengths less than 3 m. beyond this length it is strongly recommended oversize the battery cables.

For safety reasons, we recommend an annual check on the tightness of all connections.
For mobile installation the connections should be checked more frequently for tightness.

⚠	The cable lugs must be carefully fixed and tightened sufficiently to guarantee minimum loss. Insufficient tightening may cause dangerous heating at the connection point.

4.5.2 Connecting the battery (Xtender side)

Insert the cable glands supplied on the battery cable before tightening the cable lugs. Crimp the cable lugs and fasten the cable gland on the device. Repeat this for the second battery cable. Fix the battery cables to the appropriate connections „+ Battery “and „- Battery “. The M8 screws must

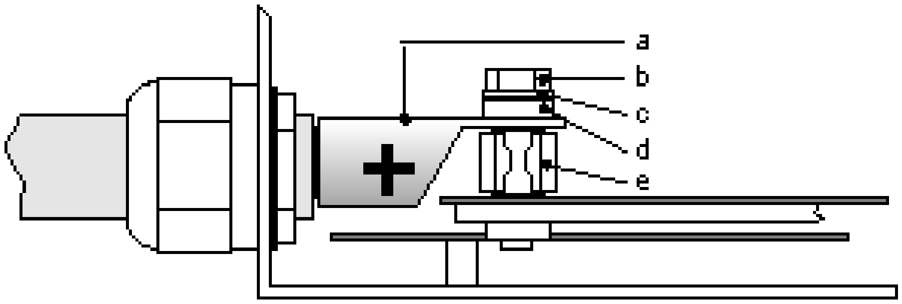
be very well tightened.
On XTM range, you can insert, if required, a fuse directly on the positive connection to the battery following the below procedure.

4.5.3 Fuse mounting on battery positive pole (XTM only)

A fuse delivered with the unit (XTM) can be mounted directly on the positive connecting pole to the battery respecting the below stacking order.

ⓘ	The XTS is equipped with an electronic protection device protecting it from accidental reversal of polarity of the battery. This does not exempt of installing a protective device close to the battery

The presence of this fuse does not exempt an installation of a protective device (fuse or circuit breaker) as close as possible of the battery.



a = **M10 cable lug!!**
b = bolt M8 x 30
c = washer
d = ceramic washer
e = fusible

⚠	Be careful with the orientation of the ceramic washer. There is a small lip on one side which must fit into the M10 cable lug's hole.

4.5.4 Battery-side connection

⚠	Before connecting the battery, carefully check the voltage and polarity of the battery using a voltmeter. Incorrect polarity or over- voltage may seriously damage the device.

Prepare the batteries for connection: appropriate battery clamps, protection device (f), cable in good conditions with correctly fitted clamps.
Fasten the negative cable on to the negative pole (-) of the battery and the positive cable on the open protection device (f).

ⓘ	When connecting the battery, a spark may occur when connecting the second pole. This spark is normal and due to the load of the internal filtering capacity of the Xtender even if the unit is halted by the main on off command (1).

⚠	As of the connection of the battery, it is necessary to check that the parameter values of the Xtender are consistent with the recommendations of the battery manufacturer. Non-conforming values may be dangerous and/or seriously damage the batteries.

The default values of the battery's charge threshold level are shown in fig. 3a and specified in the parameter table p. 43. If they are not acceptable when compared to the batterys manufacturer's specification,, it is necessary to modify them via the RCC 02/03 remote control before connecting the voltage sources on the AC input (charger). Studer Innotec is not responsible for default values not corresponding with the recommendations of the manufacturer.
If the factory settings are modified, the new values must be entered on the parameter table on p. 43 of this manual. The default values proposed by Studer Innotec are the usual values for lead acid

battery or gel batteries (VRLA or AGM).
The cabling and connection of the installation should only be carried out by an appropriately qualified professional. The installation material such as cables, connectors, distribution boxes, fuses, etc. must be adapted and must conform to the applicable laws and regulations the application under consideration.

4.5.5 Earthing the battery

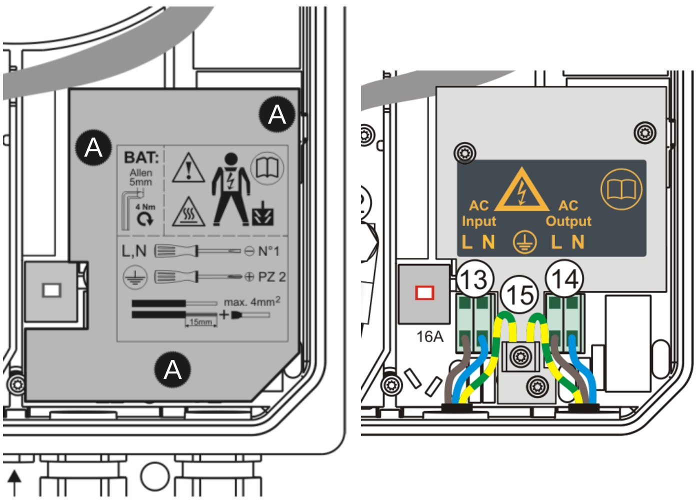
One of the two battery conductors can be earthed. This may be either the positive or negative pole. In all cases the installation must conform to the local regulations and usage or specific standards associated with the application.
In case of earthing, the earthing conductor cross-section must at least be equivalent to the cross-section of the battery conductor. The earthing of the equipment must also adhere to these regulations. In this case the use of the additional earthing screw is recommended ((17) p. 11/12, which is located at the front of the device between the two lower fastening screws.

4.5.6 Connecting the consumers at the AC output

⚠	High voltages may be present on the connection terminals (13) and (14). Make sure that the inverter is deactivated and that there is no AC or DC voltage present on the AC IN terminals and battery terminals, before proceeding with the connection.

The 230 V consumers must be connected on the "AC OUT" (14) connection terminals with the wire cross-section conforming to the standards with regard to the rated current at the Xtender output (see fig. 1a). Distribution must conform to the local standards and regulations, and generally, be realised via a distribution table.
The Xtender terminals are marked in the following way:
N = neutral, L = live
⏚= protective earth (connected to the enclosure of the device).

On the model XTS remove the cover plate by unscrewing the three screws (A figure below) to access the input/output AC terminals (13-14) and protective earth (15).



4.5.6.1 *Sizing of AC output protective devices:*

If protective devices are installed at the output, we recommend B curve devices. They will be sized at maximum to the highest the value listed on the unit's nameplate at point (37) (Fig. 1a of the Appendix) or by the addition of the first value plus the value of the input protective device. (i.e. inverter current + input current).
Cross-sections of downstream wiring must be sized accordingly

ℹ	No downstream protective device is formally required if cross-sections of cable used for distribution satisfy regulatory requirements for the largest rated output current listed on the nameplate at the point (37) of Appendix 1a.

If the source assistance function (Smart Boost)(see sect. 7.2.2– p. 25 is not used, the size of the protection device for the output (F) will be established at a maximum value equal to the rated current of the inverter, or at the maximum value of the protection device at the input (H) if that one exceeds the rated current of the inverter.
If the AC input (13) is not used the protective device will be sized equal or smaller than the smaller value indicated on the nameplate on tag (37)

⚠	Due to the source assistance function (Smart Boost) the current at the output of the device may be higher than the rated current of the inverter. It is the sum of the current supplied by the additional source and the current supplied by the inverter. In this case, the dimensioning of the output cables will be carried out by adding the current indicated on the protection device (H) located on the upstream of the unit, to the nominal current of the inverter. (See fig. 1a and chap. 7.2.2.4 – p. 26)

4.5.7 Connecting the AC supply sources

The Xtender is intended to be supplied by alternative voltage sources such as the public grid or a generator. Check that the rated voltage of the source corresponds to the rated voltage (34) of the Xtender specified on the nameplate (fig. 1b)tag(34).
The source must be connected to the input terminals marked “AC INPUT” (13) with sufficient wire cross-section, depending on the power output of the source, and protected by a protection device of the appropriate calibre. This will be at the **maximum 50A for XTH and XTM** range and **16A for XTS** appliances.
The terminals are marked in the following way:
N = neutral, L = live
⏚= protective earth (connected to the enclosure of the device).

ℹ	An additional earthing terminal (17) is present between the two fastening screws at the bottom of the unit. It can be used instead of a connection on the input terminals of the device, particularly when cable cross-sections used at the output do not allow the use of a three-wire cable (live, earth and neutral) through the conduit glands of the connection cables of the input and output (AC IN and AC OUT), or when the earthing of one of the poles of the battery. PE required using same or greater cross-sections than the battery cable.

4.5.8 Wiring auxiliary contacts

These contacts are reversing contacts that are potential-free available in XTH and XTM units. On XTS models, these auxiliary contacts are available on the external auxiliary relay module (accessory) ARM-02 (see sect. 9.5 – p. 34). The admissible currents and voltages for these contacts are 16 A: 250 VAC/24VDC or 3 A: 50 VDC max. The Contact is shown as activated when the corresponding LED is lit. The representation of the contact near the terminals corresponds to the status of the contact when not activated.
The cabling of these auxiliary contracts depends solely on the chosen application and on the specific programming applied and cannot be described in this manual.
To dedicate/program particular functions to these contacts, please refer to user manual of the remote control unit RCC-02/03
The factory-set functions for these 2 auxiliary contacts are covered in the sect. 7.5 – p. 29.

⚠	**Any unused cable gland on the unit must be properly closed.** If not, there is a high risk of intrusion of small animals inside the unit and a risk of damage not covered by warranty

4.5.9 Connecting the communications cables

The XTH, XTM, and XTS with built-in TCM-01 accessory, is equipped with a pair of RJ45/8 connectors that allow information transfer via a communication bus for different consumer types which have the proprietary protocol of Studer Innotec. In this network all parties in the network are connected in series (chain).
The length of the communication bus cable must not exceed 300 m.
In a system comprising a single Xtender, the connection of the RCC-02 or RCC-03 may be conducted without stopping the Xtender (hot plug).
The communication bus will be used to interconnect other Xtender inverters in the case of a multi-unit application or to connect other types of users who have the proprietary protocol of Studer Innotec. In these cases, the plug-in of interconnected units is done only after the switch-off of the installation, by disconnecting the battery or by using the main “ON/OFF” button (1) if present.

⚠	The 2 switches for the communication bus termination, "Com. Bus" (4) both remain in position T (terminated) except when both connectors are in use. In this case, and only in this case, both must be placed in the O open position. If one of the two connectors is not in use, the two termination switches (14) will be in position T.

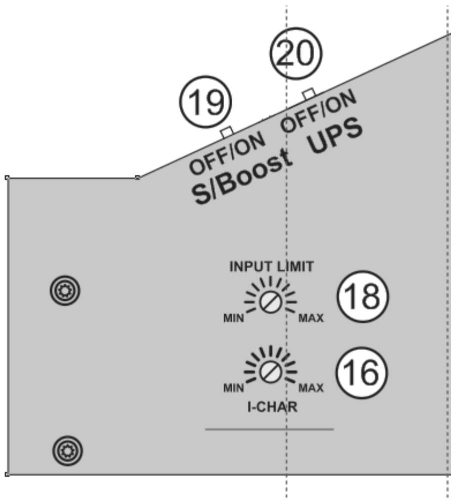
5 XTENDER PARAMETER SETTING

All inverters of the Xtender family have many factory settings and some of them can be modified by the user or installer. Some basic parameters mentioned in Chapter 7 must be set at the commissioning. For models XTM and XTH, this setting must be done by connecting the remote control described in RCC-02/03 chap. 7.3.1 - p. 36. For the model XTS 4 of them can be done directly into the unit before powering up.

Many features and associated parameters not described in this manual are described further in the manual accompanying remote control RCC-02/03 or downloaded from the website *www.studer-innotec.com*.

5.1 BASIC PARAMETER SETTING IN THE XTS

For XTS models, the 4 parameters / basic functions below can be modified directly in the compartment inside the door. All other parameters can be adjusted, if necessary, via the remote RCC-02/03 and communication module TCM-01.



⚠	Before opening the enclosure, it is mandatory to disconnect all AC and DC sources (battery) of the product to avoid any risk of electrical shock.

These 4 parameters can be set as below:

• The battery current charge {1138} as described chap. 7.3.2 - p. 28 by the potentiometer (16)

• The max. AC source (input limit) {1107} as described chap. 7.2.2 - p. 25 by the potentiometer (18)

• The source current assistance (Smart boost) function {1126} as described chap.7.2.2.1 - p. 25 by the slide button (19)

• The type of detection of AC-input loss (UPS) Fast/Tolerant/slow {1552} as described chap. 7.2.1- p. 24 by the slide button (20)

6 POWERING UP THE INSTALLATION

⚠	It is imperative that the closing cap for the connection compartment be installed and screwed tight before the installation is energised. There are dangerous voltages within the interior of the connection compartment.

The Power up of the Xtender must be carried out in the order given below. Any Power off must be carried out in the reverse order.

6.1.1.1 Connecting the battery

⚠	A too high or inappropriate battery voltage may seriously damage the Xtender. For example, installing a 24 V battery in the Xtender 3000-12. If the Xtender XTH or XTM) has been connected the wrong way around by accident (incorrect polarity of the battery) it is highly likely that the protection fuse on the battery cable may melt and will have to be replaced. If such is the case, it will be necessary to disconnect all the connections to the Xtender including the battery. If, after replacing the fuse, the Xtender proves not to work correctly after reconnecting the battery with the correct polarity, it will have to be returned to your distributor for repair. The XTS is electronically protected against reverse polarity. In case of reverse polarity connection, the unit will remain off. No alarm will signal the fault. It will operate normally after recovery of the correct polarity.

6.1.1.2 Putting the Xtender(s) in operation using the main ON/OFF switch (1) if present

The Xtender is supplied and is ready for operation. If you require immediate start-up of the inverter when the battery is powered up, the main switch (1) must be in the "ON" position and the parameter {1111} activated. If special configurations or settings are required by the system, it is recommended to do so immediately according to sect. 5 - p. 22

6.1.1.3 Connecting the consumers at the output

Activate the output protection device (F) if existing, and/or press the ON/OFF button (41). The light indicator "AC out" (46) lights up or flashes (in the event of an absence of consumers).

6.1.1.4 Activating the input circuit breaker(s) (H)

If an AC source (generator or electrical grid) valid in frequency and voltage is present at the AC input, the device automatically goes into transfer and will start to charge the batteries. The consumers at the output are therefore supplied directly by the power source present at the input.

Your installation is now in operation.

7 DESCRIPTION OF THE MAIN FUNCTIONS

7.1 INVERTER

The Xtender is equipped with a high-performance inverter which supplies a perfect and very precise sine wave. Any unit designed for the 230 V/50 Hz electrical grid (or 120V/60Hz for model XTx-xxxx-01) may connect to it without any problem, up to the rated power out of your Xtender. The inverter is protected against overloads and short-circuits.
Thanks to the largely over-dimensioned performance level, loads of up to three times greater than the Xtender's rated output can be faultlessly supplied for short (3 sec) periods of use, thus allowing motors to be started up without any problem.
When the Xtender is operating the LED "ON" (43) is glowing.
When the Xtender is in inverter mode, the LED "AC out" (46) is glowing. If it flashes, the inverter is in "load search" mode (see following sect. "Automatic load detection").

7.1.1 Automatic load detection (load search)

In order to save battery energy, the Xtender inverter stops and automatically goes into load search mode when the detected load is lower than the sensitivity set by the parameter {1187}. It automatically goes back into operation when a power consumer greater than this value demands it. The indicator (46) flashes if the inverter is in "load search" mode, which also indicates that the AC voltage is present at the output in an intermittent form.
The detection threshold for the absence of loads can be adjusted according to the parameter range {1187} by means of the RCC-02/-03 remote control. When the parameter is set to 0 the inverter will still operate even in the absence of any consumer.
In load search mode (standby) the system will thus consume minimal power from the battery (see table of technical data p. 45).

7.2 TRANSFER RELAY

The Xtender can be connected to an alternative power source such as a generator or public network. When the voltage at the entry satisfies the voltage {1199 + 1470} and frequency {1505 - 1506} parameters, the transfer relay will be activated after a delay {1528}. This delay may be adjusted (extended) to allow a fully stable status of the generator before transfer.
When the transfer relay is activated, the voltage present at the input of the Xtender is available at the output for the consumers connected. At the same time the battery charger goes into operation.

> When the transfer relay of the Xtender is active, the voltage at the output of the Xtender is equivalent to that which is present at the input and cannot be influenced or improved by the Xtender. The consumers are supplied by the source present at the "AC IN" input via the transfer relay.

The maximum current of the transfer relay is 50 A for XTH and XTM model. It is of 16A in XTS model.
The sharing of energy between consumers and the battery charger is adjusted automatically (see sect. 7.2.2 – p. 26). The transfer relay will be deactivated when the input voltage no longer satisfies the parameter {1199} or {1432} min. and max. voltage and frequency at the input or when the current limit {1107} is exceeded, if the exceeding of this limit is prohibited {1436}. It then passes immediately into inverter mode. In this case the loads are supplied exclusively by the battery via the inverter (see sect. 7.2.2.4 – p. 26). This switching always takes place automatically.
The presence of increased dynamic loads (such as pneumatic angle grinders, etc.) may lead to an undesirable opening of the transfer relay due to the weakness of the source. To this case, a delay in the opening of the transfer relay can be adjusted with the parameter {1198}.
When the generator stops, the change from transfer mode to inverter mode normally takes place without any interruption of the output voltage. The interruption will be 20 ms in case of input voltage sudden disappearing when the type of detection of input loss (UPS) {1552} is selected to "tolerant".

7.2.1 Type of detection of AC input loss (UPS)

When the Xtender is connected to the public grid or to a generator supplying stable and clean AC voltage, the type of detection of input loss {1552} can be selected to "fast". In this mode, perturbation or lack of voltage of less than 1 millisecond can be detected, switching the unit in

inverter mode immediately.. This mode guarantees a zero or maximum of 15 ms transfer time
This mode should not be used in presence of highly disturbed utility grid or with a low power generator or a generator supplying a poor quality voltage. In that case the parameter {1552} will be set on “tolerant”. In the XTS model, this can be selected by positioning the UPS slide switch (20) in “off” position. The tolerance of this mode is adjustable with the parameter {1510} if required.
The ”tolerant” UPS mode insure a interruption time of max. 20 milliseconds.
In rare cases, due to the low quality of the source, and if the transfer relay switches too frequently, it is possible to further reduce the sensitivity of detection AC input loss of by changing the parameter {1552} to "slow" via remote control RCC-02/03. In this case, the interruption of power will be 40 ms max.

ℹ	If the Xtender is connected to a generator, this must have a power at least equal to half of the power of the Xtender(s) to which it is connected.

7.2.2 Limiting the AC input current ”Input limit”

7.2.2.1 Principle

In order to best use the resources available at the input (depending on the generator size or the grid output) and to protect the source from overload, it’s possible to adjust the limit of the input current with the parameter {1107}.
The Xtender will automatically distribute the available power to the charger and the user and supply the balance of power if the load demand exceeds the fixed limit thanks to the current assistance function so called “smart boost”.

⚠	Due to the current assistance feature, the battery can be fully discharged despite the presence of the grid or the generator! The average power consumed by the user must not exceed the power of the source, at the risk of discharging the battery.

This system proves to be a decisive advantage particularly in all mobile systems (boats, leisure vehicles and service vehicles) that are frequently connected to sources with a limited value such as a portable or camping power supply. Despite a limited source, all the greater power applications downstream of the Xtender remain functional.
Despite a limited source, all loads connected downstream the Xtender remain functional!
The system will reduce automatically the charging current– from its target value {1138} to 0 – according to the current used at the output and the the maximum current available at the input set by the parameter {1107}. The greater the current at the output, the more the part of the current at the input assigned to charging the battery is reduced. If the current exceeds the limit {1107}, the Xtender will supply the balance current from the battery.
The wiring of the system (cable gauge) must take into account this particular function which allow to have the sum of the current supplied by the inverter plus the current supplied by the source,
I.e. If the system have a 5kW source (22A) and a 5 kW Xtender, the available power at the output is 10kW! In this example, the wire gauge must be chosen for 45A.

7.2.2.2 Exceeding input limit current

If, despite the decrease in current from the charger and using the source current assistance the limit is exceeded, the transfer relay will remain activated and the source may then be overloaded, causing the opening of the protective device upstream (H).
Exceeding the limit may be prohibited by the parameter {1436}. In this case, if the current exceeds the limit {1107}, the transfer relay will open and the user then powered exclusively by the inverter, as long as the output current exceeds the current limit input. If the input current limit is exceeded due to a short circuit downstream, the transfer relay will remain activated and the protective device upstream of the Xtender (H) will trip.

7.2.2.3 Second value of input current limit

A second value of the input limit, to be activated by the command entry (see sect. 7.7 - p. 29, is programmable by the parameters {1566} (Use a different value for the maximum current of the AC source) and {1567} (Second maximum current of the AC source).

ℹ	In the case of mobile applications the installation of an RCC-02/-03 remote control is recommended, in order to be able to adapt the value of the input current limit if necessary, for each connection to a limited grid.

7.2.2.4 Deactivation of the source assistance function (Smart Boost)

This feature the source current assistance (smart boost" can be disabled by setting {1126}.
The remote RCC-02/03 is necessary to disable the function on the model XTH and XTM. On the XTS model it is possible to disable it by selecting the slide button (19) in OFF position.

7.2.2.5 Automatic reduction of the current limit input

When the device is connected to a low power generator, most often, the voltage of the generator falls down before its rated power. To compensate partially this side effect, the Xtender has a system of automatic reduction of the input current limit, if the voltage drops beyond a threshold set by the parameter {1309}+ {1433 }, to fall to zero when it reaches the value set by parameter {1309}. This avoids overloading the generator and too frequent transition of the transfer relay.
This feature is also used when a variable power sources is connected to the input of the Xtender. This is particularly the case of 230Vac alternators type "Dynawatt" coupled to drive motors whose speed varies. These devices have their source voltage decrease depending on the available power. A correct setting of thresholds {1309} and {1433} ensures continuous power output with the "Smart Boost"
This feature can be disabled by setting the {1527} especially when the Xtender is connected to a public network.

7.2.2.6 Setting the current "Input limit"

The maximum input current can be adjusted by the knob (18) on the XTS or via remote control RCC-02/03 on other models or on the XTS with the module TCM-01. The parameter {1107} is part of the basic parameters of the device and must be adjusted at commissioning (see sect. 5 - p. 22) depending on the capacity of the source as follows:
• If the device is connected to a network: the value is sized according to the upstream protective device (fuse or circuit breaker) or a lower value if desired.
• If the device connected to a generator, the following empirical formula can be used:
Generator power below 1 kW: 0.7 x Pnom / Uac
Generator power below 3 kW: 0.8 x Pnom / Uac
Generator power above 3 kW: 0.9 x Pnom / Uac
Given the wide divergence of performance and quality of available generators on the market, these formulas are approximate and are not a guarantee of proper adjustment of the installation.

7.3 BATTERY CHARGER

7.3.1 Working principle

The battery charger for the Xtender is completely automatic and is designed in such a way as to guarantee an optimum charge for the majority of the lead-acid or gel batteries. Once the transfer relay is activated, the battery charger goes into operation and the charge indicator (44) lights up.
The charging process is at 3 levels (I/U/Uo) as described in figure below.
this process guarantees optimum charging of the batteries. The charging current is given by the parameter {1138} and can be adjusted continuously from 0 to the nominal value with the help of the RCC-02/-03 or with the rotating knob (16) inside the model XTS (see sect. 5.1 – p. 22). All times and threshold can be adjusted with the remote control unit RCC-02/03.

ℹ	If the battery voltage is lower than the critical disconnection threshold {1488} operation of the charger will be automatically prevented. Only the transfer relay is authorised to operate in this case. The battery must then be recharged by an external source up to a voltage higher than the critical disconnection threshold in order to allow the Xtender charger to operate.

The charge cycle, programmed by default, as shown in the example described in the figure opposite, runs automatically.
The line (28) indicates the development of the battery voltage.
The lower line (29) indicates the battery current (input and output).

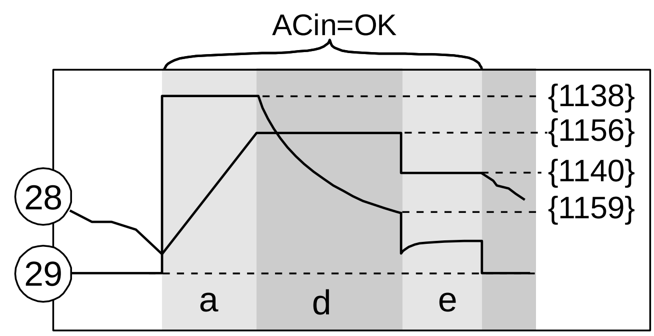
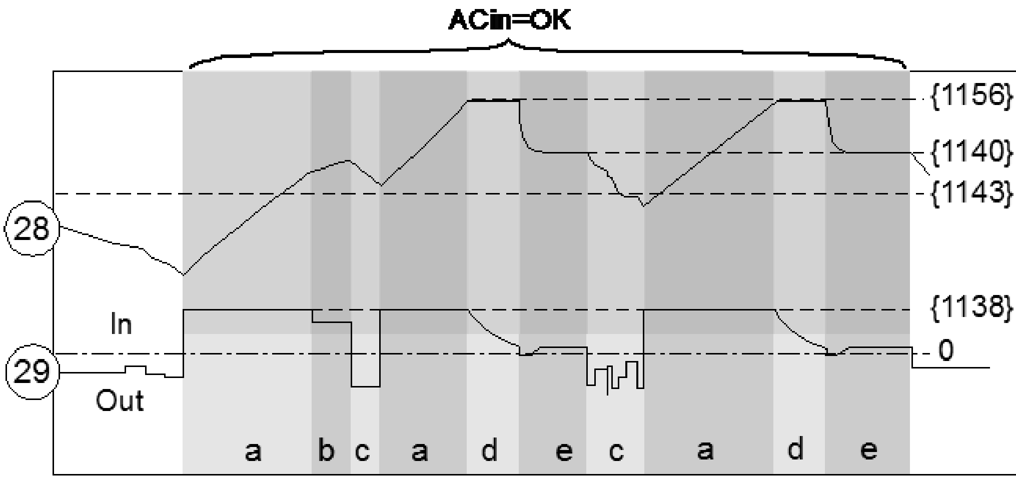


Fig. 3b: Simplified charge cycle, without input current limitation

The cycle starts with a continuous current charge **(a)** adjusted by default according to the parameter {1138}. If the ambient temperature is increased or the ventilation blocked, the current may be reduced and become lower than the selected current. Once the absorption voltage {1156} is reached, the cycle passes to voltage adjustment mode **(d)**, known as the absorption phase, the duration of which is set by the parameter {1157}. The minimum interval between two absorption cycles is limited by the parameter {1161).
At the expiry of the absorption time, or if the absorption current is lower than the parameter {1159}, the voltage is set to a lower value {1140}. This phase **(e)** is known as the maintenance or "floating" phase. Due to the limiting function for the input current (see the above p. 25), it is perfectly normal for the charge current to be lower than the selected current if the limit of the AC input current {1107} is reached (b). In this event the AC IN indicator (45) flashes. The charge current will be limited too if the battery voltage ripple is higher than 0,5V/cell.
If the "Smart Boost" function is activated {1126} and the power required by the consumer exceeds the power of the source, the battery will be discharged (c) despite the presence of the grid or the generator. In this case the LED "charge" (4) goes out. The consumers must ensure that they have average consumption that is less than the power of the source (generator or public grid) in order to avoid a complete discharge of the battery. These situations are set out in the figure below.



Charge cycle example with input current limitation and "Smart Boost"

If the BTS-01 temperature sensor is used, the voltage adjustment thresholds for the battery are corrected in real time by means of the battery temperature. The value of this correction is set by the parameter {1139} in the parameter table p. 43.

ℹ	Much more complex charge profiles or exclusion of the charger can be configured using the RCC-03/03 remote control.

⚠	Parameters of the battery charger are under the responsibility of the operator. Incorrect parameter that does not correspond to the charging methods of the battery recommended by the manufacturer may be dangerous and/or considerably diminish the battery service life. If the factory settings are modified, it is imperative that the new values be entered in the parameter table p. 43.

7.3.2 Battery charger current setting

The maximum charging current can be adjusted by the knob (16) on the XTS or via remote control RCC-02/03 on the other models or on the XTS with the module TCM-01. The parameter {1138} is part of the basic parameters of the device and must be adjusted at commissioning (see chap. 5 - p. 22) depending on battery capacity. It will be chosen in principle a value between 0.1 and 0.2 x the nominal battery capacity C10. (I.e. 10A for a battery of 100 Ah/C10)

7.3.3 Battery protection

The battery is protected against deep discharge by stopping the inverter if the low voltage disconnection level {1108} is reached. The indicator (52) flashes once when the battery has reached the disconnection threshold and the inverter will stop some time after {1190}. This threshold can be dynamically corrected {1191} with an advanced algorithm that computes automatically the battery voltage compensation in function of the instantaneous power. This correction may also be manually fixed {1532} by setting the low voltage disconnection at full load {1109}. These dynamic corrections can be deactivated by setting the parameter {1191}. The inverter will stop immediately if a critically voltage of 1.5V/cell is reached. The inverter will restart automatically when the battery voltage has reached the restarting threshold {1110}.
This restarting threshold {1110} can be automatically readjusted if the parameter {1194} is activated, in order to better protect the battery against repeated cycling in an "almost empty" state of charge. The restarting threshold is then incremented {1298} up to a maximum value {1195}, whenever the LVD (low voltage disconnection) is reached. The restarting threshold will be reset to its initial value when the value of parameter {1307} is reached.
If the inverter is repeatedly {1304} encountering a low voltage disconnection in a short period {1404}, it will stop permanently and will only start again via an operator's manual restart.

7.4 XTENDER PROTECTION

The Xtender is protected electronically against overloads, short-circuit, overheating and reverse current (cabling of a voltage source on AC out).

7.4.1 Protection in case of overload

In the event of overload or short-circuit at the output, the inverter stops for some seconds {1533} {1400}, and restarts. If the inverter is repeatedly encountering this situation {1300} in a short period, it will stop permanently and will only start again via an operator's manual control.

7.4.2 Protection against overvoltage

If the battery voltage exceeds the value set by the parameter {1121} the inverter stops and starts up again when the voltage is less than {1110}. If the Xtender is repeatedly encountering this situation 3 times during one minute, it will stop permanently and will only start up again via an operator's manual control.

⚠	A battery voltage greater than 1.66 x the nominal voltage may lead to significant damage or destroy the device.

7.4.3 Protection against overheating

Insufficient ventilation, increased ambient temperature or obstructed ventilation may lead to overheating of certain internal components of the unit. In this case, the device will automatically limit its power output as long as this abnormal situation persists.

7.4.4 Protection against battery reverse polarity

The Xtender is protected from reverse polarity by means of an external fuse installed on the battery.

> The XTS is equipped with a full electronic protection device protecting it from accidental reversal of polarity of the battery. This does not exempt by installing a fuse close to the battery. In case of reverse polarity, the fuse will not be destroyed and the unit will operate normally after restoring the correct battery polarity

7.5 AUXILIARY CONTACTS

The XTH, XTM and XTS, with TCM-01 and ARM-02 module, have two dry reversing contacts that are potential-free. The status of the contacts in deactivated mode is indicated by the annotations, N.C. = normally closed and N.O. = normally open. When the contact is activated
Maximum contact loads: 230 Vac / 24 Vdc: 16 A or: max. 50Vdc/ 3A
These dry contacts are programmed by default for the following functions:
Contact no. 1 (AUX 1): The contact has a function of automatic start of generator (two wires). The contact will be activated when the battery voltage is below a value, during a given time fixed by parameters {1247/48}/{1250/51}/{1253/54} The contact will be deactivated or when the charge cycle has reached floating {1516}, or when the "Aux. 1 deactivation voltage" {1255} is reached during a predetermined time {1256}

> The voltage of the battery is automatically compensated according to the instantaneous battery current the same way as it is done for compensation of LVD (see sect. 7.3 – p. 26) if parameter {1191} is activated.

Contact no. 2 (AUX2) : alarm contact by default. It is deactivated when the inverter is out of service or is working at reduced performance, either because of manual control or if there is an operational fault such as overload, under-voltage of the battery, over-temperature, etc.
If the operator or installer requires different behaviour for the auxiliary contacts, they are both freely and individually programmable depending on the battery voltage, the output power, the inverter status, the internal clock and the Battery state of charge (if BSP module is present) . These setting can be done with the the RCC-02/-03 (remote control unit)
The intelligent programming of the auxiliary contacts allows many applications to be considered such as:

- Automatic startup of the generator (two or three wires)
- Automatic load shedding of lower priority loads of the inverter (2 sequences)
- Global or individual alarm
- Automatic disconnection (load shedding) of the source

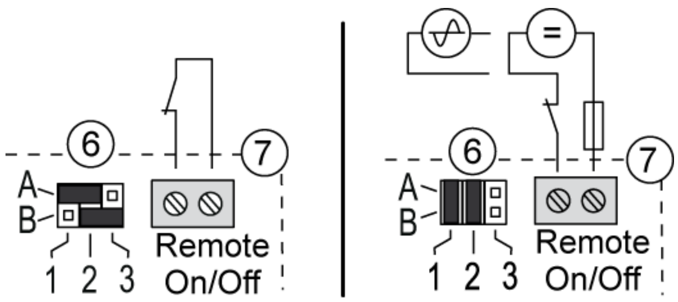
> For more information on the auxiliary contacts nr 1 and 2 programming, do refer to our application notes available on Studer web site: *www.studer-innotec.com*. Like:
> AN003: Anti-blackout system for grid connected application (Solsafe)
> AN005: Automatic management of 2 different energy sources
> AN007 Automatic start of a generator

7.6 THE REAL TIME CLOCK

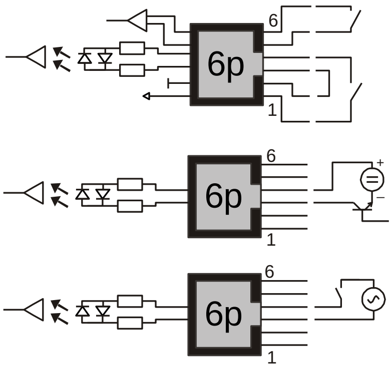
The XTH, XTM and the XTS with optional TCM-01 module (see sect. 9.4 – p. 34) has a real time clock that allows notably to program the functioning of the auxiliary contacts according to time schedule. This clock must be adjusted via the use of the RCC-02/-03 remote control.

7.7 ENTRY COMMAND (REMOTE CONTROL ON/OFF)

This function and associated terminal block (7) is available as a standard on XTH series. It is available on the series XTM and XTS with optional TCM-01 module (see sect. 9.4– p. 34) using the external module RCM-10 in option.



See sect. 9.3 - p. 33.
This entry can be used to drive one or more function that you can choose thru programming with the RCC-02/-03.
There is no dedicated function from factory. In multi-unit configuration (see below) the chosen functionality must be the same in every unit in the system. Only one unit can be wired to apply the function to every Xtender in the system. If the entry command is used as an emergency stop, (all functions halted), it has to be wired on the unit with the highest serial number (master) of phase one.
The function is activated, or by opening /closing a potential free contact, or by applying a voltage on the entry.
On XTH model, the wiring is done across the entry terminal block (7). The jumpers (6) must be correctly positioned according to the chosen variant as described in the figure opposite.
Driving by a dry contact: the jumpers are left in original factory setting A1-2 and B2-3
Driving by a voltage (Max. 60 V eff./30mA): the jumper are positioned A+-B1 and A2-B2
On XTM and XTS + TCM-01, the wiring of this entry is done on the RCM-10 plug according to the wiring example on the figure aside, or wired thru the external module RCM-10 according to sect. 9.3 – p. 33.



Main ON/OFF (only with dry contact)

Command entry with dry contact

Command entry with external DC source. (Max. 60V d.c / 60 mA)

Entry command by external AC source. (Max. 60 V a.c./ 60 mA)

8 MULTI-UNIT CONFIGURATION

Several Xtenders can be used in the same system, either to create a three-phase system or to increase the power output of a single or two phases. The implementation of this configuration requires particular precautions and it must be installed and commissioned by qualified personal only.

⚠	When multi-unit system is commissioned, the software's version of every unit will be automatically checked and units may refuse to start in case of incompatibility. If so, an upgrade of every units is be required with the RCC-02/-03 and the last software version available by the manufacturer. (Read the RCC-02 user's manual to perform this operation).

⚠	In Multi-units system every Xtender in the system shares the same battery bank. Separate battery bank are no allowed

In these multi-unit systems, the units must be interconnected via a communication bus connected to the connectors (3) by a cable (**art. no. CAB-RJ45-8-2**) of a maximum length of 5 metres. The XTS model must be equipped with TCM-01 to be used in multi-units configuration.
Various application examples are described from fig. 12 to fig. 19 of Appendix 1.

⚠	It is important to read and adhere to the descriptions associated with each of the figures mentioned above

⚠	In multi-unit system, it is recommended to use the automatic LVD dynamic compensation. See parameter {1532}

In configuration with several Xtenders, each unit is controlled independently using the ON/OFF push button (41). When the on/off control is given via the RCC-02/-03 remote control, it is applied simultaneously to all units.

8.1 THREE-PHASE SYSTEM

Three Xtenders of the same voltage (power or type can be different) can be used and combined in order to establish a three-phase grid. An example of cabling in three-phase is given at figs. 13.-14 of the appendix.
When 3 Xtenders are wired to form a three-phase grid, the wired phases at the input determine the jumper position for selecting the phase (10). It is vital to determine and select the phase for each Xtender. If the grid is not available at the input of the master unit (phase 1), all the units of the system will switch to inverter mode. If only a single-phase source is available, it must be connected to phase 1. The other two phases will therefore be supplied by the other two working units in inverter mode.

8.2 INCREASING THE POWER BY PARALLELING UNITS

Up to three Xtenders of same type - power and voltage- can be wired in parallel in order to increase the system's rated power output. In this configuration, all the ACin inputs of the Xtender must be wired. The most recent unit (according to the serial number) in the phase will act as the master and will decide on the operation or suspension of the units in parallel according to the consumer's power demand. The yield of the installation is therefore still optimal.
It is possible to deactivate the master/slave mode with the parameter {1547}. In that case, the load search mode is disabled.
An example of parallel connection is given in fig.12 Appendix 1 and the comments on p. 37.

⚠	If the current of the source (per phase) is greater than 50A (XTH and XTM) or 16A (XTS), a protective device max. 50A, respectively 16A must be installed on each of the 2 or 3 devices connected to the same phase. If the power source is limited to 50A, respectively 16A, only one device is common enough.

8.3 COMBINED SYSTEM

It is possible to combine a three-phase system with one or several phases made up of 2 or 3 Xtenders in parallel. An example of cabling is given at fig. 15.
A combination of more than one inverter on only one (or two) phase is also possible. for example, it's possible to build up one powerful phase for the most single phase consumer and the 2 other phases with only one Xtender each for the 3 phase (motor) application as in the example Fig 15 Appendix I
It is therefore possible to combine up to nine Xtenders by running three Xtenders in parallel in a three-phase grid. Examples of cabling are given in figs. 16 to 18 Appendix 1 and the comments on p. 38.

8.4 ENLARGEMENT OF AN EXISTING INSTALLATION

Only subject to compatibility, it is most of the time possible to enlarge an existing installation by adding one or several inverters in parallel or in a three phase configuration. The compatibility of the new units must be checked by giving Studer Innotec the serial numbers of the inverters in the existing installation.

⚠	The inverters belonging to the same system must be equipped with the same software version. Take care to download the latest software version from manufacturer's website and do update all units of the system before the commissioning.

9 ACCESSORIES

9.1 CONTROL CENTRE AND DISPLAY RCC-02/-03 (REMOTE CONTROL)

An RCC-02/-03 remote display and programming unit can be optionally connected to the Xtender via one of the two RJ45-8-type "Com. Bus" (3) connectors.
These connectors may only be used for connecting a CAN-ST compatible accessory, excluding any other connection such as LAN, Ethernet, ISDN, etc.
The RCC-02/-03 control centre is vital for modifying the parameters of the system. Many parameters and features are not described in this manual. The manual for the RCC-01/03 (downloadable on *www.studer-innotec.com*) describes in detail each of these parameters and the context in which they can be used.
It also allows the following functions:

- Display of function synopsis
- Display of the measured operational values (current / voltage / power output, etc.)
- Updating of software or implementation of customised software
- upload/download of inverter parameter
- Updating of inverter parameters
- Events logging of error message
- Data acquisition of Xtender and other participants connected to the communication bus like the BSP (Battery status processor) or / and compatible solar charge controller

RCC-02

RCC-03

The features of the RCC-02 and the RCC-03 are the same. They only differ in their external appearance. The RCC-02 is designed for wall mounting, whereas the RCC-03 is designed as a board device.
The RCC-03 model must be taken off the table to allow access to the SD card slot (during updating, for example).
Model N°: RCC-02: Dimensions: H x W x D / / 170 x 168 x 43.5mm
RCC-03: Dimensions: H x W x D / / 130 x 120 x 42.2mm

ℹ	The two remote control models are delivered with a 2 m cable. Cables of specific lengths (5 m, 20 m and 50 m) can be ordered. The article no. is as follows: CAB-RJ45-xx. The length in metres is specified as xx

Up to 3 RCC-02/-03 remote controls can be connected in series on the communication bus of one Xtender or an Xtender multi-inverter system. In a system comprising a single Xtender, the connection of the RCC-02 or RCC-03 may be done without stopping the Xtender (warm). When connecting an RCC-02/-03 remote control in a multi-unit system, it is recommended that all units in the system be stopped (disconnected from battery or by the main ON/OFF switch (1) if present) and that the communication bus on the device on which the connection is being made be terminated.

⚠	The switch (2 for XTH) for the communication bus termination, "Com. Bus" (4) remains (both for XTH) in position T (terminated) except when <u>both</u> connectors (3) are in use. In this case, and only in this case, the switch (both for XTH) must be placed in the O open position. If one of the two connectors is not in use, the termination switches (4) (two for XTH) will be in position T.

9.2 BTS-01 TEMPERATURE SENSOR

The optimal operating voltages for lead batteries vary depending on the temperature. A temperature sensor is optionally available to correct the battery voltage and guarantee an optimum charge whatever the battery temperature. The correction factor given by the correction of the sensor is set by the parameter {1139}
Article no. for the temperature sensor (including a 3 m cable): BTS-01.
Dimensions: H x W x D / / 58 x 51.5 x 22 mm.

9.2.1 Connecting the temperature sensor (BTS-01)

The temperature sensor, BTS-01 is supplied with a 3 m cable fitted with RJ11/6-type plugs. It may be connected or disconnected at any time (including when the device is in use) using the corresponding socket (2) marked "Temp. Sens." on the Xtender. Plug the connectors into the socket (2) until they click in. The temperature sensor sleeve may simply be stuck onto the battery or directly next to it. The temperature sensor will be recognised automatically and the correction made immediately.

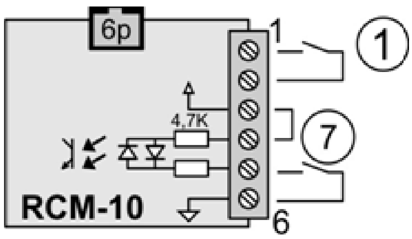
9.3 REMOTE CONTROL MODULE RCM-10 (XTM/XTS)

The optional remote control module for XTM and XTS + TCM-01 gives the possibility to have the 2 following function:

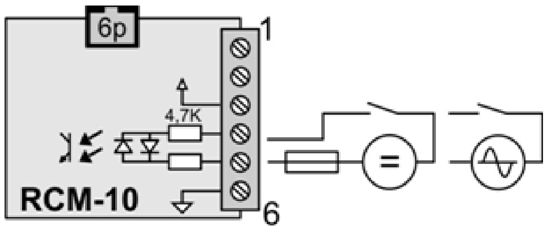
Main ON/OFF (1) see sect.11.1 below.
This operation can only be controlled by a potential free contact.
Command entry (7) see sect. 7.7 – p. 29.
This module can be mounted on DIN rail
Article n°: RCM-10
Supplied with a 5m cable (max. length 10m).
Dimensions: 45 x 78mmH
Height on rail: 40mm

.

9.3.1 Connection of the RCM-10 module



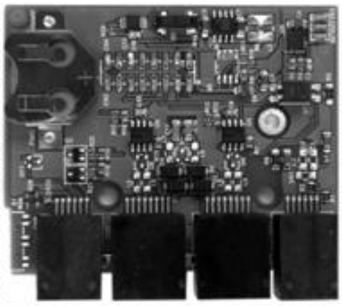
The control module MCM-10 can be "hot plugged" on the connector " RCM-10 "(15) without interrupting the operation of the unit.
The main ON/OFF function as described in Sect. 11.1 - p. 35 may be obtained by connecting a potential free contact (1) between terminals 1 and 2. When this contact is closed, the Xtender is stopped.



Terminals 3 to 6 of RCM-10 are used as input control as described in Sect. 9.3- p.33. The function dedicated by programming can be activated or by a dry contact (7) between 5 and 6 with a connection between 3 and 4, or by an AC or DC voltage of 60 V rms max. between terminal 4 and 5.

ℹ	The function "main ON/OFF" can be driven only by a potential free (dry) contact.

9.4 TIME AND COMMUNICATION MODULE TCM-01(XTS)



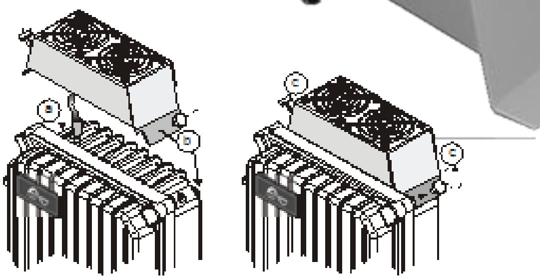
This module lets you connect the XTS to the remote control RCC-02/03, as well as to other XTS or devices available and compa-tible with the Xtender range.
The module also features a real time clock and connectors to connect the ARM-02, RCM-10 and BTS-01 modules.
The module is mounted inside the XTS, according to the manual delivered allong with it.

9.5 AUXILIARY RELAY MODULE ARM-02 (XTS)

This external module, connected by a 5m cable supplied with the accessory, allows XTS to have auxiliary contacts as described sect. 7.5 - p. 29. This module can be mounted on DIN rail.
It requires the installation of the communication module TCM-01 inside the XTS

9.6 EXTERNAL COOLING FAN UNIT ECF-01 (XTS)

The External cooling fan unit ECF-01 is an optional accessory.
It improves the performance of the device (see technical data p. 57).
It is particularly recommended to use this accessory if the ambient temperature is high (> 40 ° C).
This unit has a of protection degree IP 54 and can be exposed to water spray without damage. It will however be not exposed to splash dirty water to prevent mud or similar particles from clogging the mechanism. The assembly instructions are supplied with the accessory



10 OTHER DEVICES COMPATIBLE XTENDER SYSTEMS

The devices listed below are compatible and can be part of a system Xtender and interconnected by the communication bus. Their complete description is available on our website *www.studer-innotec.com*

10.1 BATTERY STATUS PROCESSORS BSP- 500/1200

This module is delivered with a 500 or 1200 A shunt. It allows current measurement, voltage and battery temperature. It computes the information and provides to the Xtender system all the information derived from these measures, like the state of charge, time before discharge, history of the state of charge over 5 days etc.

10.2 COMMUNICATION MODULE XCOM-232I

This RS232 module isolated allows access to most of the values and settings of devices connected to the Xtender communication bus. It also features an SD card for the acquisition of measured data, the setting of units and historic event generated by the devices.

11 CONTROL

11.1 MAIN ON/OFF CONTROL

This switch (1) interrupts the electronic supply and all the Xtender peripherals. The residual consumption on the battery is therefore less than 1 mA.
The ON/OFF switch is used only for the complete stoppage of the whole system. This switch is not available in the XTM. The function can be added with the use of the remote command module RCM-10.

11.2 DISPLAY AND CONTROL PANEL

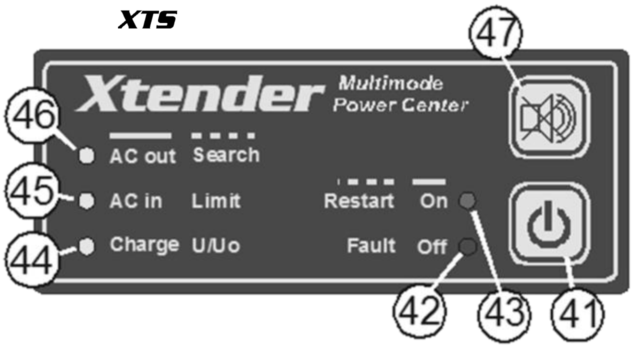
The Xtender has a ON/OFF button and light indicators at the front of the unit, allowing clear identification of the operating mode.

(41) The ON/OFF button allows the start-up or complete stop of the system. In the systems comprising several units, each unit is started or stopped individually. For a simultaneous start-up of all the units use the dry contact control (see sect. 7.7 – p. 29) or the ON/OFF button of the RCC-02/-03 remote control.

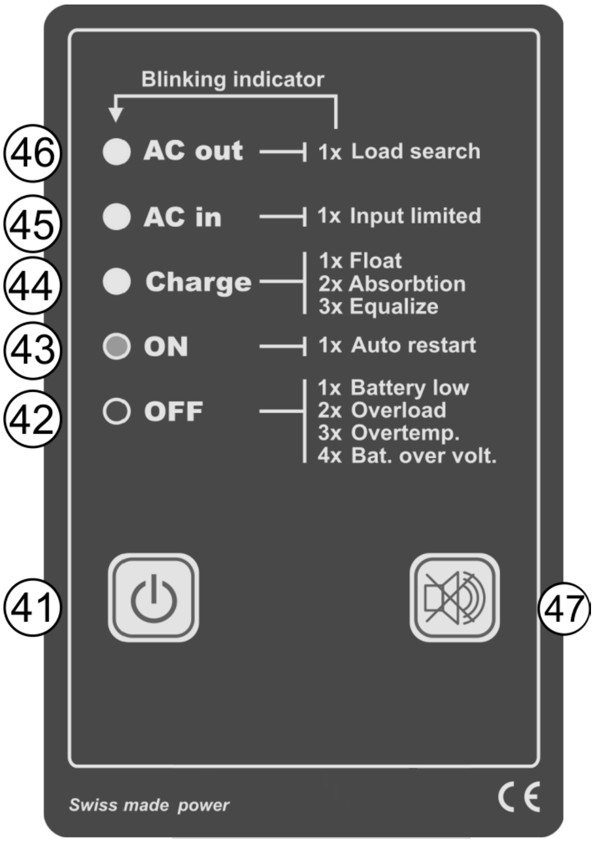
⚠	Even when the equipment has stopped, dangerous voltages may be present at the Xtender input.

(42) This indicator lights up when the equipment has been stopped manually using the ON/OFF button (41). It also allows the cause of an unintentional stoppage of the device to be indicated via the different flashes, the imminence of a stoppage or the temporary limitation of its performance.
The table below describes the type of fault according to the number of flashes on the indicator (42).

XTS



XTH et XTM



	Indicated alarm	Comment
1x	(Imminent) stoppage due to a too low battery voltage.	If the inverter has not yet stopped, it is recommended to disconnect all non-priority consumers and/or start up the generator. If the inverter has stopped it will restart automatically when the battery voltage has reached the correct value again {1110}. It can be restarted manually using the ON/OFF button (41) as long as the battery voltage is higher than 1,5V/cell. The charger remains functional as the battery voltage remain higher than 1,5V/cell. See also sect. 7.4 – p. 28.
2x	Stoppage due to overload in the equipment, due to either a short-circuit or too high load for the inverter.	In this event the equipment will make 3 restart attempts within a few seconds and will stop if the overload remains (see sect. 7.4.1 – p. 28). It is vital to eliminate the cause of the overload without restarting. Restarting is carried out manually by pressing the button (41).
3x	Decrease in the rated output of the device due to a too high internal temperature.	This may be due to too great a load for the device, at too high an ambient temperature or counteracted or obstructed ventilation. The power output of the device will therefore be limited to around 50% of the Pnom. including in charger mode or Smart Boost mode.
4x	Battery voltage higher than the maximum limit set by the parameter {1121}.	Check the cause of this excess voltage. The equipment will restart automatically when the voltage falls below the threshold value {1122}. See sect. 7.4.2 – p. 28.
5x	No transfer. Insufficient power from the source	In this case, the Xtender remains in operation in inverter mode until the output power decrease below the input limit and does not allow the transfer relay to close. You must increase the input current limit {1107}, or authorise the exceeding of this limit {1436} or authorise backup on the source {1126}, or disconnect some consumers (decrease of loads).
6x	Startup prevented due to unwanted voltage at the device output.	Voltage is present at the device output. Check your cabling: correct the fault and start the installation again using a manual control on the button (41).
7x	Indicates missing voltage on one of the units of the system in a multi-unit configuration.	Check the input protection devices (H) for all the system units.
8x	Software incompatibility in a multi-units system	The software version of all units in the system must be harmonised. Proceed according to the RCC-02/-03 user manual to upgrade the software.
9x	Loss of synchronization between the units	Failure of the link between the units. Check the presence and the state of the communication cables between units.

(43) This indicator is glowing continuously when the device is working.
It flashes when the equipment is temporarily stopped due to a fault displayed by the indicator (42) or a ON/OFF control wired at the command entry ("Remote ON/OFF") (7), or when the equipment is put to idle mode by the master unit in a multi-inverter parallel system (see sect. 8.2 - p. 31).

⚠	The equipment will restart automatically when the conditions that led to the temporary stoppage have gone away.

In the systems with multi-units in parallel, the indicator (43) blinks 2 times when the Xtender is temporarily stopped by the master unit of the concerned phase while this mode is authorized. {1547}.

(44) This indicator lit continuously when the charger is working and has not yet reached his absorption phase.

It flashes twice during the absorption phase and once during the floating phase.
If the Smart Boost mode has been activated, this indicator goes out temporarily when source backup is required by users (loads).

(45) This indicator lit continuously when a n alternative voltage with correct values, either in frequency {1112-1505-1506}, or in voltage {1199} is present at the AC IN input of the device and the current limit set by the user has not been reached.
It flashes one time when the current limit at the input {1107} set by the user has been reached. In this case the charger current is reduced in order to guarantee priority supply to the users (see .sect. 7.2.2.2 - p. 25).
If the Smart Boost mode (see sect. 7.2.2.4 – p. 26) is used and the inverter is part of the user supply – therefore the battery is discharged – the "charge" indicator (44) will be glowing.
If the input current is exceeded nevertheless, and this exceed not permitted by parameter{1436}, the Xtender goes back to inverter mode (transfer relay open) and the indicator (42) will keep flashing as long as the user current exceeds the limit value of the input current {1107}.
If grid feeding is allowed {1127} this indicator is blinking 2 times while feeding.

(46) This indicator lit continuously when an alternative voltage of 230V is present at the equipment output. It flashes when the device is in "load search" mode according to sect. 7.1.1 – p. 24.

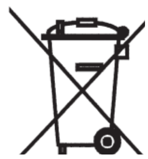
(47) Receipt button to stop the acoustic warning (XTM only). The duration of the acoustic alarm {1565} is factory settled to 0 sec (deactivated).

12 MAINTENANCE OF THE INSTALLATION

With the exception of the periodic checking of connections (tightening and general condition) the Xtender does not require any special maintenance.

13 PRODUCT RECYCLING

The model of the Xtender series conform to the European directive 2002/95/EC on hazardous substances and does not contain the following elements: lead, cadmium, mercury, hexavalent chrome, PBB or PBDE.



To dispose of this product, please use the service for the collection of electrical waste and observe all applicable obligations according to the place of purchase.

14 EC DECLARATION OF CONFORMITY

The inverter and accessories described in this manual comply with the following directive and standards:

Directive 2004/108/EC:
EN 61000-6-1:2005, EN 61000-6-3:2006, EN 55014, EN 55022, EN 61000-3-2:2006, EN 62040-2:2006
Low Voltage Directive 2006/95/EEC:
EN 50178 :1997, EN 62040-1:2008, EN60950-1:2005
Directive RoHS : 2002/95/EC

CH -1950 Sion, 15 June 2011

STUDER Innotec SA - R. Studer

15 COMMENTS OF APPENDIX DRAWINGS

Fig.	Description and comment
1a	**Dimensioning table for the downstream protection device (F).** This table helps to size the Xtender upstream and downstream protection devices. Due to the source assistance function, it should be outlined that the downstream protection can be of higher gauge than the upstream one.
1b	**Type plate and series no.** See sect. 18 - p. 42. The intactness of this label is vital for any possible warranty claims. It must not be altered or removed.
2a	**Dimensions and fastening the device** The support (wall) must be appropriate for supporting the increased weight of the device without any risk.
5a	**12 V battery: connection in series and in parallel / series for 2 V cell**
5b	**12 V battery: connection of 12 V battery in parallel**
5c	**24 V battery: connection in series and in parallel / series for 2 V cell**
5d	**24 V battery: connection in series and in parallel / series for 12 V battery block**
6a	**48 V battery: connection in series and in parallel / series for 12 V battery block**
6b	**48 V battery: connection in series for 12 V battery block**
6c	**48V battery: Series connection of 2V cell**
6d	**48 V battery: connection in parallel / series for 2 V cell**
7a	**Xtender XTS circuit diagram** This diagram shows the major electrical components and control elements and their interaction in XTS model , for proper understanding of the operating principle of the device
7b	**Xtender XTH/XTM circuit diagram** This diagram shows the major electrical components and control elements and their interaction in XTH and XTM model , for proper understanding of the operating principle of the device
8a	**Single-phase installation (AC and DC part)** This example illustrates the most routinely used installation, allowing the attainment of an emergency system or a hybrid system (remote sites) ensuring the supply in single-phase from a generator and/or the battery when the AC source is absent. See also sect. 4.1.1– p. 14.
8b	**Command entry variants (ON/OFF remote control)** This example illustrates the various possibilities for connecting the entry command (remote ON/OFF on former version) terminal block (7), enabling to controls the programmed function (See also sect. 7.7 p.29.) with a dry contact or a voltage source (max 60V eff./30mA). The maximum wire length on this control should not exceed 10 m.
8c	**Installation with three-phrase source and secured single-phase output – AC and DC part** In this example, the three-phase users will only be supplied when the generator or grid are operating.
9a	**Fixed installation with plug connection to the single-phase source – AC part** Special feature: The connection of the neutral upstream and downstream of the Xtender (C) is prohibited in this configuration (presence of a plug upstream). See also sect. 4.2 – p. 15.
9b	**Fixed single-phase installation with connection by plug to a three-phase source – AC part** Highlight(s): The connection of the neutral upstream and downstream of the 'Xtender (C) is prohibited in this configuration (presence of a plug upstream). See also sect. 4.2 – p. 15.
10a	**Example of installation in a vehicle (AC part)** Highlight(s): The connection of the neutral (C) is not permitted (presence of a socket upstream). The earth-neutral connection is absent in inverter mode (neutral stand-alone system). The safety is guaranteed by the equipotential bonding (frame). The automatic re-establishment of the earth-neutral connection downstream of the device in inverter mode can be programmed. Consult the table of figures, item (V). See also sect. 4.2.3 – p. 16.
10b	**Example of installation in a boat without an isolation transformer (AC part)** Highlight(s): Where there are multiple sources, for example connection to the dock and on-board generator, a source reverser (X) guaranteeing switching with phase and neutral interruption must be installed.

Fig.	Description and comment
10c	**Installation example in a boat, with isolation transformer** Characteristic: With several power sources, like shore connection and onboard generator, a switchover (X) must be installed, to safely switch between the different voltage supplies with guaranteed interruption of the phase and neutral conductors. Moreover, an earth must be formed (E) after the isolation transformer.
11	**Example of a hybrid installation:** This is the most common system used to establish an emergency system or a hybrid system (grid-remote sites) ensuring a single-phase supply from a generator and/or the battery. Highlight(s): In a hybrid installation, the sources for recharging a battery (k-m) are connected directly to the batterie via their own regulator and their own protective device. This does not interfere with the Xtender charger.
12	**Example of parallel connection of 2 or 3 Xtenders** 1. Only Xtenders of the same power output may be connected in parallel. 2. Wiring precautions: The cable lengths and cross-sections of AC in input (A) and AC out output (B) must be the same for all inverters in parallel in the same phase. 3. Variant: The sum of the lengths of the cables (A1) + (B1) of Xtender 1 must be the same as the sum of the lengths of the cables (A1) + (B1) of Xtender 2, and ditto for Xtender 3 4. The AC input for each Xtender must be protected individually by a protection device (H) of the appropriate size but max. 50A (16A for XTS). 5. The protection device at the output of the Xtender (F) can be shared and of appropriate calibre at the sum of the currents of the devices in parallel. 6. In a multi-unit system, the functionality dedicated to the command entry (sect. 7.7 - p. 29) must be the same for every unit. One unit only have to be wired and the function is applied to every unit of the system.
13	**Example of three-phase cabling of 3 Xtenders – three-phase input** Highlight(s): When 3 Xtenders are wired to form a three-phase grid, the wired phases at the input determine the jumper position for selecting the phase (10). It is vital to determine and select the phase for each Xtender. See also sect. 8.1 – p. 31. The comments for fig. 12 - 4 to 6 are valid.
14	**Example of three-phase cabling of 3 Xtenders – single-phase input** Highlight(s): In a three-phase configuration, if only one phase is available as a source, only one Xtender will be wired on that source. Phase 2 and 3 will be permanently fed from the two other units connected only to the battery (not connected to ACin). It is vital to determine and select the phase for each Xtender. The comments for fig. 12 are valid.
15	**Example of three-phase, input and output wired, with reinforced phase** Highlight(s): This installation allows a three-phase supply with a reinforced phase The reinforced phase may be incorporated on two or even three inverters in parallel. The protection device at the output on which 2 or 3 Xtenders are wired must be calibrated according to the sum of the maximum currents of the devices in parallel. The comments for fig. 12 to 13 are valid.
16	**Example of cabling of 9 Xtenders in three-phase and parallel – AC part** Special feature: In fixed high power installations, it is advised that a shared neutral be retained, distributed to all parties in the grid (see (C)) The comments for figs. 12 to 15 are valid.
17	**Example of cabling of 9 Xtenders in three-phase and parallel – DC part (distribution bar)**
18	**Example of cabling of 9 Xtenders in three-phase and parallel – DC part in star formation**
19	**Connection of remote controls RCC-02/-03** At an Xtender or at a system with several Xtender maximally 3 remote controls can be attached.

16 DRAWING'S ELEMENTS (DC SIDE)

Elem.	Description	Comment
a	RCC-02/-03 remote control	This device allows complete configuration of the installation as well as displaying the system behaviour. It is recommended but not necessary for the installation to function well. See sect. 9.1 – p. 32.

Elem.	Description	Comment
b	Battery	The battery capacity is constituted according to figures 5a to 6d based on the required voltage. Note: It is vital that the voltage and the polarity of the battery be checked before connecting to the inverter. An overload or incorrect polarity could seriously damage the Xtender. Correct dimensioning of the batteries is essential for trouble free operation of the system. See sect. 4.3.1 – p. 16.
e	Communications cable	Communications cable. Only an original cable supplied by Studer Innotec may be used. The total length of the communications cable must not exceed 100 m for 3 x RCC-02/-03 or 300 m for a single RCC-02/-03.
f	Protection devices	A fuse-type device, thermal circuit breaker or magnetic-thermal circuit breaker (see fig. 8a) must be installed on at least one of the two battery conductors. It will ideally be placed on the positive pole of the battery and as close as possible to this. The calibre of the device is selected according to the cable cross-section used. If the negative pole of the battery is not earthed, it must also be protected by such a device.
h	Distribution bar	Positive pole of the battery
j	Distribution bar	Negative pole of the battery
k	Wind-powered or/and micro-hydro generator	One or more wind-powered generators or/and micro-hydro with their own regulation system may be used to directly charge the battery. Its dimensioning does not depend on the Xtender and does not interfere with it.
m	Solar generator	One or more solar-powered generators with their own regulation system may be used to directly charge the battery. Its dimensioning does not depend on the Xtender and does not interfere with it.
r	Command Entry	A control device may be connected to the terminals (7) of the Xtender. See sect. 7.7 – p. 29. On XTM and XTS this input is available on a separate 8external) device RCM-10 (see sect. 9.3.1- p. 33).
t	BTS-01 temperature sensor	The sensor is placed in immediate proximity to the battery. If the installation comprises several Xtenders, a single sensor is connected to one of the units. See sect. 9.2 - p. 33.

17 FIGURE ELEMENT'S (AC PART)

Elem.	Description	Comment
A	Input supply cable	The cross-section is defined by means of the maximum current at source and the protection device (H). In multi-unit systems, cables (A) of the same phase must have the same length and cross-section (see comment fig. 12-2/3).
B	Output supply cable	In multi-unit systems, cables (B) of the same phase must have the same length and cross-section (see comment fig. 12-2/3). The cross-section must be selected by means of the Xtender's output current given on the type plate and the protection device selected for the input (see fig. 1a).
C	Connection of the neutrals	See sect. 4.2 - p. 15. In a fixed installation where the neutral is connected to the earth at a single installation point upstream of the Xtender, it is permissible to carry out a connection of the neutrals in order to preserve an unchanged earthing system downstream, independent of the operating mode of the Xtender. The downstream protecting ground fault device. This connection (C) is not permitted if a socket is installed upstream of the Xtender.
D	Differential circuit breaker	A protection device can be installed downstream of the source (G or U) according to the local requirements and in compliance with the applicable regulations and standards.

Elem.	Description	Comment
E	Earth-neutral connection bridge	The neutral is earthed at a single point of the installation, downstream of the source and upstream of the protection device(s) at the default current (DDR). When several sources are available, each source must have an earthed neutral. If the source has to be retained with an isolated earthling system (IT) the applicable local provisions and regulations must be applied.
F	AC output protection devices for the Xtender	A protection device dimensioned in dependence of the cable cross-section used may be installed downstream of the Xtender (main circuit breaker before distribution). The cable cross-section is to be dimensioned according to the calculation table of maximum output current (fig. 1). The Xtender has an internal current limitation the value of which is stated on the type plate Fig. 1b (35).
G	Generator	The generator is dimensioned according to the requirements of the user. Its rated current will determine the adjustment of the parameter {1107} “maximum current of the AC source”.
H	Protection devices at the Xtender input	The protection device at the input of the Xtender must be dimensioned according to the power output of the source at the cable cross-section used. It will not exceed a calibre equivalent to the input current “I AC in” given on the type plate of the unit Fig. 1b (35).
K	Connection plug / socket	If the Xtender is connected to an AC source by means of a plug, the connection cable must not exceed a length of 2 m, and the socket must remain permanently accessible. The socket will be protected by a protection device of appropriate calibre. The connection of the neutrals (C) is prohibited in this case.
S	Secured grid	Distribution to the users supplied by the grid or the generator when this is present or by the Xtender within the limit of its power output from energy stored in the battery. This distribution is carried out in conformity with the local standards and regulations.
T	Non-secured grid	Distribution to users supplied exclusively via the present grid or the generator. This distribution is carried out in conformity with the local standards and regulations.
U	Public grid	The connection to the public grid imposes adherence to the local standards and regulations at the responsibility of the installer. The installation should, in principle, be checked and approved by an official body.
V	Automatic earth-neutral connection	This connection is deactivated by default. In may be used in certain specific cases for automatically re-establishing the neutral system type TT (TNC, TNS, TNC-S) when the Xtender is in inverter mode. The activation is carried out via RCC-02/-03 remote control by configuration of the parameter {1485}. This operation may only be carried out by qualified personnel, under the responsibility of these personnel, and in conformity with the local standards and regulations. See 4.2.3 – p. 16.
W	Galvanic isolator	This device (optional) is generally used to reduce the risk of electrolytic corrosion due to the direct current when a boat is connected at the dock.
X	Source reversing switch	When the installation has more than one supply source, it is necessary to install a switching device between the sources, simultaneously switching the neutral and the phase(s) of these sources. In all cases this device (manual or automatic) must guarantee interruption of the connected source before its connection to another source.
Y	Isolation transformer	This device (optional) prevents the risk of galvanic corrosion due to direct currents when a boat is connected at the dock.

18 MECHANICAL DIMENSION AND MOUNTING ELEMENT

Pos.	Description	Comments
25	Mounting hook-up for XTS	Delivered with the unit (without screws for wall affixing)
26	Mounting hook-up for XTH	
27	Access shutter to the top fastening screw	This flap should be resealed after tightening the screws to prevent intrusion of small animals that could damage the device

19 NAMEPLATE (FIG. 1B)

Pos.	Denomination	Description	Comments
30	Model	Model	
31	Pnom*/P30*	Rated power output / power for 30 minutes with external cooling fan ECF-01	Model XTS only
32	Pnom/P30	Rated power output / power for 30 minutes	
33	Udc Battery	Rated battery voltage (accepted input range)	
34	Idc Charge/inv/inv*	Maximum current in charger/nominal current in inverter/in inverter with external cooling fan for XTS model	
35	Uac In	Maximum current at input / output	See sect. 7.2 – p. 24.
36	Iac In	Rated AC input voltage (input range)	See sect. 7.2.2 – p. 25.
37	Uac Out	Rated output voltage in inverter mode (possible adjustment range in inverter mode)	When the transfer relay is activated, the ac output voltage is equivalent to ac input voltage
38	I AC Out Inv/Inv*/max	Maximum charger current	See sect. 7.2.2 – p. 25.
39	SN:xxxxxxxxxx	Serial no.	
40	IPxx	Protection degree according to IEC 60529	

20 TABLE OF FACTORY'S (DEFAULTS) PARAMETERS SETTINGS

Param. N°	Denomination / description	Units	Fact. value[2]	Mod. value
1107	Maximum current of the AC source	A	STD[3]	
1108	Under voltage of the empty battery	V/cell	1.93	
1109	Sub-voltage of the charged battery	V/cell	1.75	
1110	Restart voltage of the inverter after under voltage of the battery	V/cell	2	
1111	Automatic start up at power up	y/n	no	
1112	Inverter frequency	Hz	50/60	
1121	Maximum DC voltage for stopping the Xtender	V/cell	2.84	
1126	Source assistance (Smart Boost) permitted	y/n	no	
1127	Grid feeding allowed	y/n	no	
1138	Battery charge current	A	STD[3]	
1139	Battery voltage correction according to the temperature	mV/°C/ cell	-5	
1140	Battery maintenance voltage	V/cell	2.27	
1143	Voltage 1 to allow a new battery cycle	V/cell	2.1	
1144	Duration of under voltage 1 to allow a new cycle	min.	30	
1145	Voltage 2 to allow a new battery cycle	V/cell	1.93	
1146	Duration of under voltage 2 to allow a new cycle	sec.	180	
1156	Battery absorption voltage	V/cell	2.4	
1157	Duration of absorption	h	2	
1159	Current at end of absorption	Adc	10	
1161	Minimum interval between absorptions	h	3	
1187	Sensitivity of the charge detection (100% approx.25W)	%	10	
1188	Number of pulse load research	--	1	
1189	Time interval between load search pulses	sec.	0.8	
1190	Duration of under voltage of battery before disconnection	min.	3	
1191	Dynamic compensation for under voltage	y/n	yes	
1194	Battery adaptive low voltage allowed	o/n	no	
1195	Max voltage for adaptive low voltage	V/cell	2.08	
1198	Time elapsing before transfer relay opens	sec.	8	
1199	ACin voltage causing the opening of the transfer relay	Vac	180/90	
1200	Immediate open critical threshold for the transfer	Vac	100/50	
1246	Auxiliary contact 1 activated by voltage 1 {1247} after delays {1248}	y/n	yes	
1247	Voltage 1under which auxiliary contact 1 is activated	V/cell	1.95	
1248	Delays on voltage 1 to activate auxiliary contact 1	min.	1	
1249	Auxiliary contact 1 activated by voltage 2 {1250} after delays {1251}	y/n	yes	
1250	Voltage 2 under which auxiliary contact 1 is activated	V/cell	2	
1251	Delays on voltage 2 to activate auxiliary contact 1	min.	10	
1252	Auxiliary contact 1 activated by voltage 3 {1253} after delays {1254}	y/n	yes	
1253	Voltage 3 under which auxiliary contact 1 is activated	V/cell	2.05	
1254	Delays on voltage 3 to activate auxiliary contact 1	min.	60	
1255	Voltage for deactivation of Aux 1	V/cell	2.25	
1256	Delays on voltage {1255} to deactivate auxiliary contact 1	min.	60	
1258	Auxiliary contact 1 activated by power 1	y/n	yes	
1286	Output voltage	Vac	230/120	
1288	Dynamic compensation of the thresholds (AUX.1)	y/n	no	
1298	Increment step of the adaptive low voltage method	mV/cell	20	
1304	Number of battery under-voltages permitted before final stop	--	3	
1307	Reset voltage for adaptive correction	V/cell	2.2	
1309	Minimum ACin voltage to authorize battery charging	Vac	185/142	

[2] The second value concerns the 120Vac ranges
[3] STD = See technical data p.45

Param. N°	Denomination / description	Units	Fact. value[2]	Mod. value
1404	Period for counting battery under-voltages	sec.	0	
1432	Maximum ACin voltage to switch to inverter mode	Vac	270/135	
1433	Adaptation range of the charge current according to the input voltage	Vac	20/10	
1435	Immediate detection of input voltage loss (UPS)	y/n	no	
1436	Allow to exceed AC input current without opening the transfer relay	y/n	yes	
1470	ACin voltage hysteresis for closing the transfer relay	Vac	10 / 5	NC[4]
1485	Automatic connection Earth-Neutral is forbidden	y/n	yes	
1486	Neutral always connected	yes/no	no	
1488	Critical under voltage of the battery	V/cell	1.5	
1505	Delta of higher frequency accepted	Hz	35	
1506	Delta of lower frequency accepted	Hz	15	
1510	Tolerance on detection of AC-input loss (tolerant UPS mode)	--	100	
1516	Auxiliary contact 1 deactivated by floating mode	y/n	yes	
1517	Auxiliary contact 2 deactivated by floating mode	y/n	no	
1527	Decrease max input limit current with AC-In voltage	y/n	no	
1528	Delay before closing transfer relay	Min.	0	
1532	Kind of dynamic compensation	Auto/ Man	Auto	
1547	Allow slave stand-by in multi units system	y/n	yes	
1565	Acoustic alarm duration	Sec.	0	
1552	Type of detection of AC-input loss (UPS)	Fast/ Tolerant /Slow	Tolerant	
1566	Use a different value for the AC source maximum current	yes/no	no	
1567	Second maximum current of the AC source	A	16	

[2] The second value concerns the 120Vac ranges
[4] NC=Factory setting not changeable

ℹ	To modify the parameters, please refer to the operating instructions for the RCC-02/-03 remote control

21 TECHNICAL DATA

Inverter model	**XTS 900-12**	**XTS 1200-24**	**XTS 1400-48**	**XTM 1500-12**	**XTM 2000-12**	**XTM 2400-24**	**XTM 2600-48**	**XTM 3500-24**	**XTM 4000-48**	**XTH 3000-12**	**XTH 5000-24**	**XTH 6000-48**	**XTH 8000-48**
Nominal battery voltage	12V	24V	48V	12V		24V	48V	24V	48V	12V	24V	48V	
Input voltage range	9.5-17V	19-34V	38-68V	9.5-17V		19-34V	38 - 68V	19-34V	38-68V	9.5-17V	19-34V	38-68V	
Continous power @ 25°C	650**/500VA	800**/650VA	900**/750VA	1500VA	2000VA			3000VA	3500VA	2500VA	4500VA	5000VA	7000VA
Power 30 min. @ 25°C	900**/700VA	1200**/1000 VA	1400**/120 0VA	1500VA	2000VA	2400VA	2600VA	3500VA	4000VA	3000VA	5000VA	6000VA	8000VA
Power 3 sec. @25°C	2.3kVA	2.5kVA	2.8kVA	3.4kVA	4.8kVA	6kVA	6.5kVA	9kVA	10.5kVA	7.5kVA	12kVA	15kVA	21kVA
Maximum load	Up to short-circuit												
Maximum asymmetric load	Up to Pcont.												
* Load detection (Stand-by)	2 to 25W												
Cos φ	0.1-1												
Maximum efficiency.	93%	93%	93%	93%		94%	96%	94%	96%	93%	94%	96%	
Consumption OFF/Stand-by/ON	1.1W/1.4W/7W	1.2W/1.5W/8W	1.3W/1.6W/8W	1.2W/1.4W/8 W	1.2W/1.4W/10 W	1.4W/1.6W/9W	1.8W/2W/10W	1.4W/1.6W/12 W	1.8W/2.1W/14 W	1.2W/1.4W/14 W	1.4W/1.8W/18 W	1.8W/2.2W/22W	1.8W/2.4W/30W
* Output voltage	Pure sine wave 230Vac (+/- 2%) / 120Vac (1)												
* Output frequency	50Hz / 60Hz(1) +/- 0.05% (crystal controlled)												
Harmonic distortion	<2%												
Overload and short-circuit protection	Automatic disconnection with 3 restart attempts												
Overheat protection	Warning before shut-down – with automatic restart												
Battery charger													
* Charge characteristics	6 steps : bulk - absorption - floating - equalization - reduced floating – periodic absorption												
* Maximum charging current	35A	25A	12A	70A	100A	55A	30A	90A	50A	160A	140A	100A	120A
* Temperature compensation	WithBTS-01 or BSP 500/1200												
Power factor correction (PFC)	EN 61000-3-2												
General data	**XTS 900-12**	**XTS 1200-24**	**XTS 1400-48**	**XTM 1500-12**	**XTM 2000-12**	**XTM 2400-24**	**XTM 2600-48**	**XTM 3500-24**	**XTM 4000-48**	**XTH 3000-12**	**XTH 5000-24**	**XTH 600048**	**XTH 800048**
* Input voltage range	150 to 265Vac / 50 to 140Vac(1)												
Input frequency	45 to 65Hz												
Input current max. (transfer relay) / Output current max.	16A/20A			50A/56A									50A/80A
Transfer time (UPS)	<15ms												
Multifunction contacts	Module ARM-02 with 2 contacts as option			Two independent switchover contacts (potential free,16A-250 Vac / 3A-50Vdc)									
Weight	8.2 kg	9kg	9.3 kg	15 kg	18.5 kg	16.2 kg		21.2 kg	22.9 kg	34 kg	40 kg	42 kg	46 kg
Dimension h x w x l [mm]	110x210x310	110x210x310	110x210x310	133x322x466				133x322x466		230x300x500	230x300x500	230x300x500	
Protection index	IP54			IP20									
Conformity	Directive EMC 2004/108/CE : EN 61000-6-1, EN 61000-6-3, EN 55014, EN 55022, EN 61000-3-2, 62040-2 Low voltage directive : 2006/95/CE : EN 62040-1-1, EN 50091-2, EN 60950-1												
Operating temperature range	-20 to 55°C												
Relative humidity in operation	100%			95% without condensation									
Ventilation	Optional cooling module ECF-01			Forced from 55°C									
Acoustic level	<40dB / <45dB (without / with ventilation)												

* Adjustable value
** value with optional cooling fan module ECF-01
(1) With -01 at the end of the reference (I.e. XTM3500-24-01), means 120V/60Hz. Available for all Xtender except XTH 8000-48

22 NOTES

STUDER Innotec SA
Rue des Casernes 57
1950 Sion – Switzerland
Tél : +41(0) 27 205 60 80
Fax : +41(0) 27 205 60 88
info@studer-innotec.com
www.studer-innotec.com

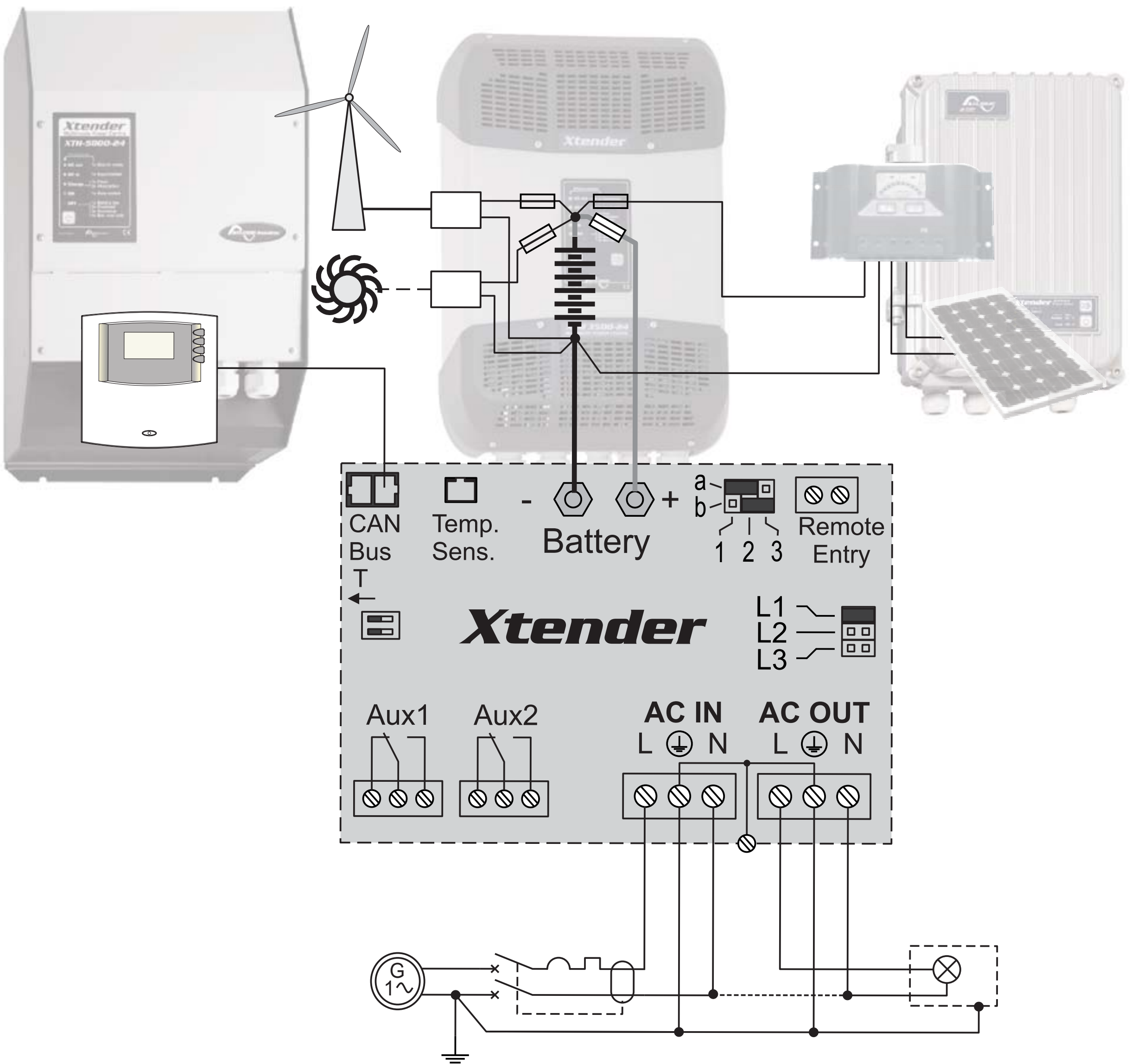
User manual- Manuel utilisateur-Betriebsanleitung-Manual utilizador

Appendix 1 | Annexe 1 | Anhang 1 | Anexo 1

XTH 3000-12
XTH 5000-24
XTH 6000-48
XTH 8000-48

XTM 1500-12
XTM 2000-12
XTM 2400-24
XTM 3500-24
XTM 2500-48
XTM 4000-48

XTS 900-12
XTS 1200-12
XTS 1400-48



This appendix is part of the installation and user manual
Cette annexe fait partie intégrante du manuel d'utilisation
Dieser Anhang ist ein wesentlicher Bestandteil des Betriebsanleitung
Este anexo es parte integrante del manual de utilización

NOTE IMPORTANTE

Cette annexe au manuel est commune à toutes les langues et doit être conservée avec le manuel de la langue de votre choix.
Pour la bonne compréhension de ce document, vous devez vous référer aux commentaires des éléments référencés par des lettres ou des chiffres dans les chapitres suivants du manuel :

Référence :	chap.	commentaires
Figures	15	Intitulés et commentaires des schémas (Figures)
Lettre minuscule	16	Eléments des figures partie DC
Lettre majuscule	17	Eléments des figures câblage AC
Chiffre 1 à 22	3.6.4	Elément du compartiment de raccordement
Chiffre 25 à 29	18	Dimension mécanique et éléments de montage
Chiffre 30 à 40	19	Eléments de l'étiquette d'identification

IMPORTANT NOTE :

This appendix to the manual is common to all languages and must be kept with the manual of your choice.
For the good understanding of this document, you should refer to the comments about elements referenced by letters or numbers in the chapters of the manual mentioned in the below table:

Référence :	Sect.	comments
Figures	15	Comments on drawings (Figures)
Lower-case character	16	Parts (components) of figures DC
Upper-case character	17	Parts (components) of figures AC cabling side
nimber 1 to 22	3.6.4	Elément du compartiment de raccordement
Chiffre 25 to 29	18	Mechanical dimension and mounting elements
Chiffre 30 to 40	19	Wording of identification plate

WICHTIGE ANMERKUNG :

Dieser Anhang zum Bedienerhandbuch ist fèr alle Sprachen identisch und muss mit dem entsprechenden Bedienerhandbuch aufbewahrt werden.
Für ein gutes Verstàndnis diese Dokuments halten Sie sich an die folgenden Kapitel des Bedienerhandbuchs :

Referenz :	kap.	Kommentare
Figuren	15	Kommentare der Schemas (Figuren)
alphabetische kleinbuchstaben	16	Elemente der Figuren des DC Teil
alphabetische Grossbuchstaben	17	Elemente der Figuren des AC
Nummer 1 bis 22	3.6.4	Anschlusselemente
Nummer 25 bis 29	18	Dimension mécanique et éléments de montage
Nummer 30 bis 40	19	Elemente der Identifikationsetikette

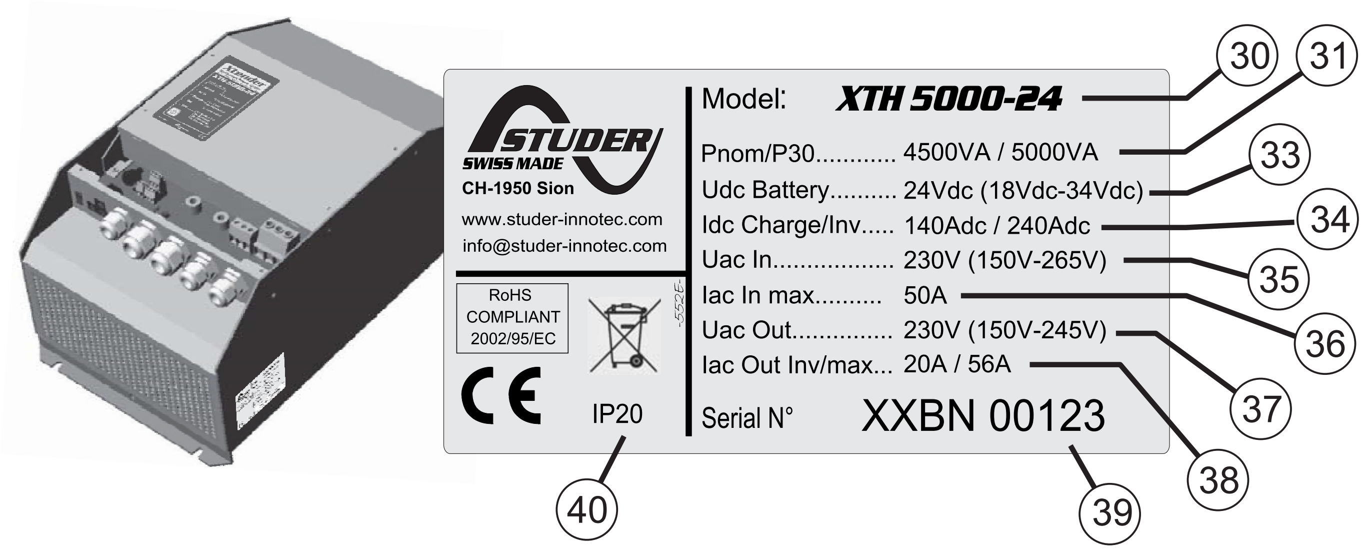
NOTA IMPORTANTE:

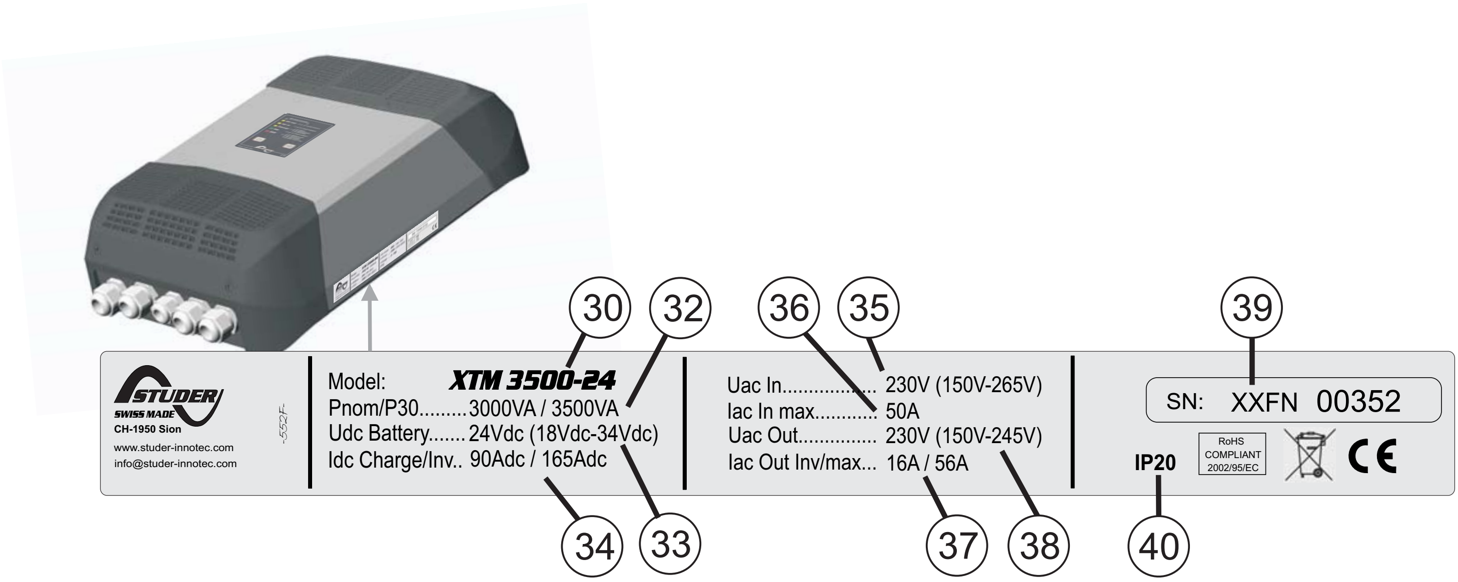
Este anexo al manual es común a todos los idiomas y debe conservarse con el manual del idioma que ha elegido.
Para la buena comprensión de este documento, debe referirse a los capítulos siguientes del manual:

Référencia :	cap.	comentarios
Esquemas (fig.)	15	Los comentarios de los esquemas (Figuras)
caracteres en minúscula	16	Elementos de figuras parte DC
caracteres en mayúscula	17	Elementos de figuras cableado AC
cifras 1 a 22	3.6.4	Elementos de conexiones
cifras 25 a 29	18	Dimensiones mecánicas y accesorios de montaje
cifras 30 a 40	19	Elementos de la etiqueta de identificación

Fig. 1a

Model and specification tag





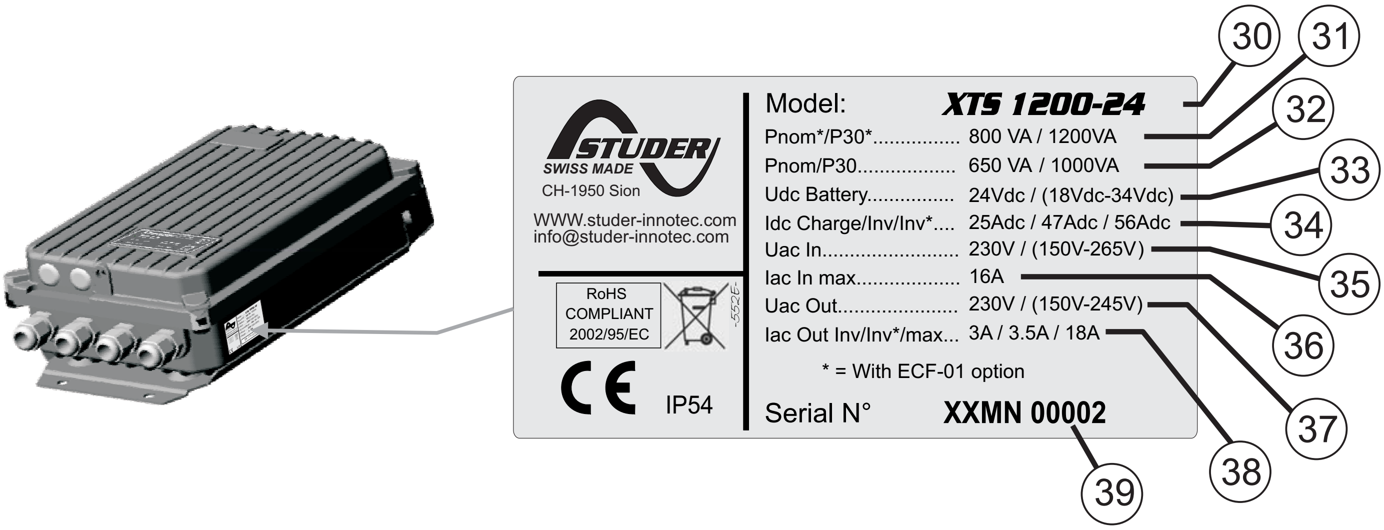
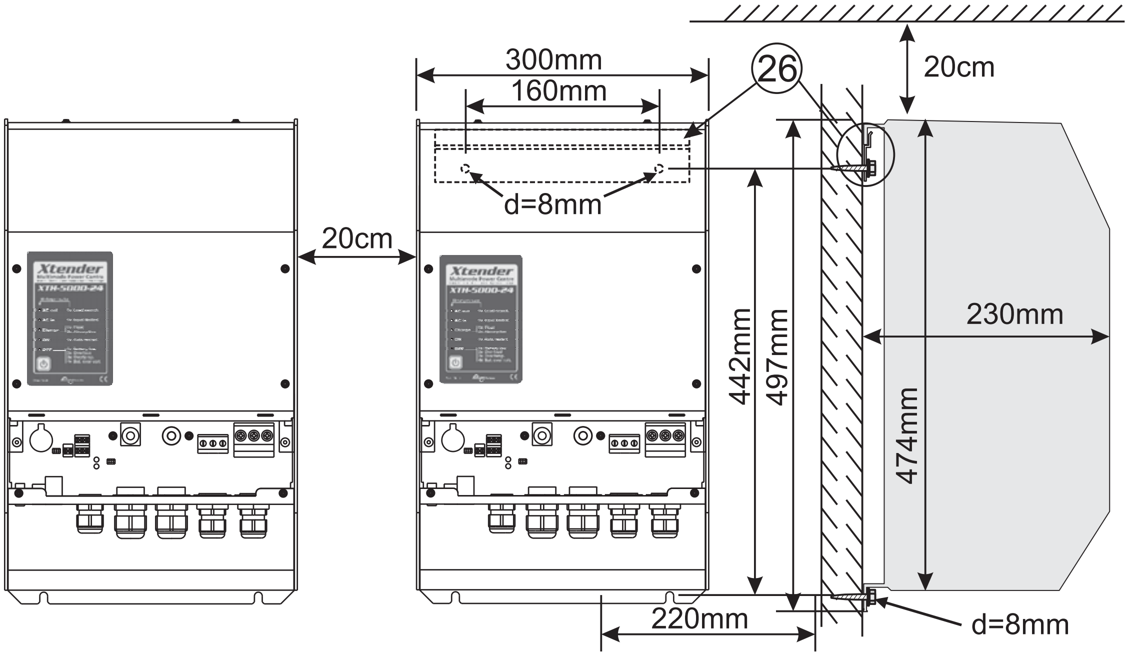


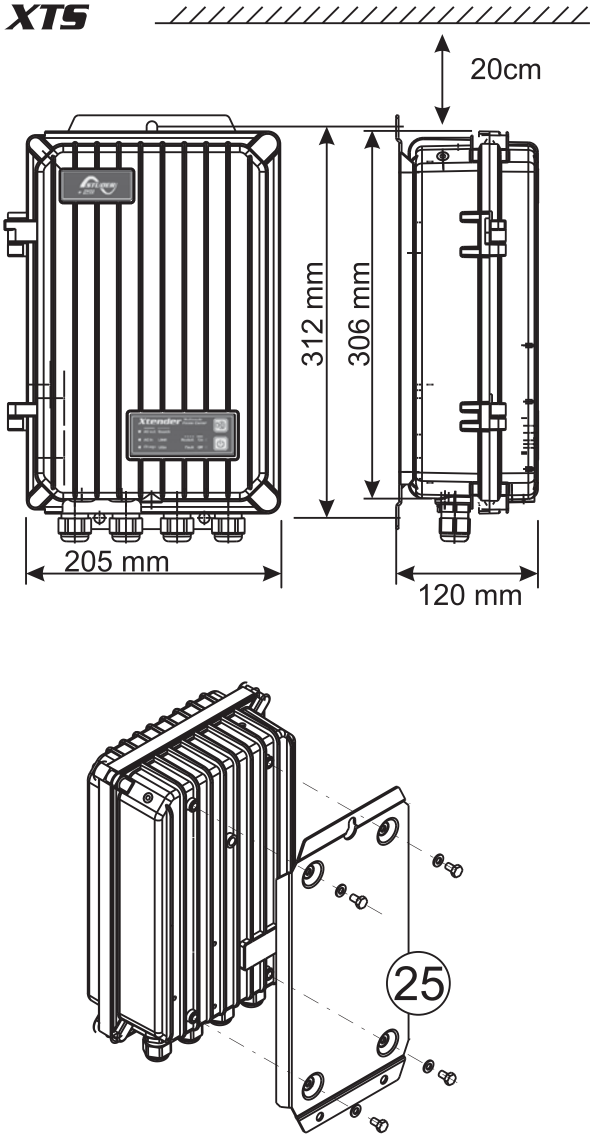
Fig. 2a

Dimension, clearance and affixing

XTH



XTS



XTM

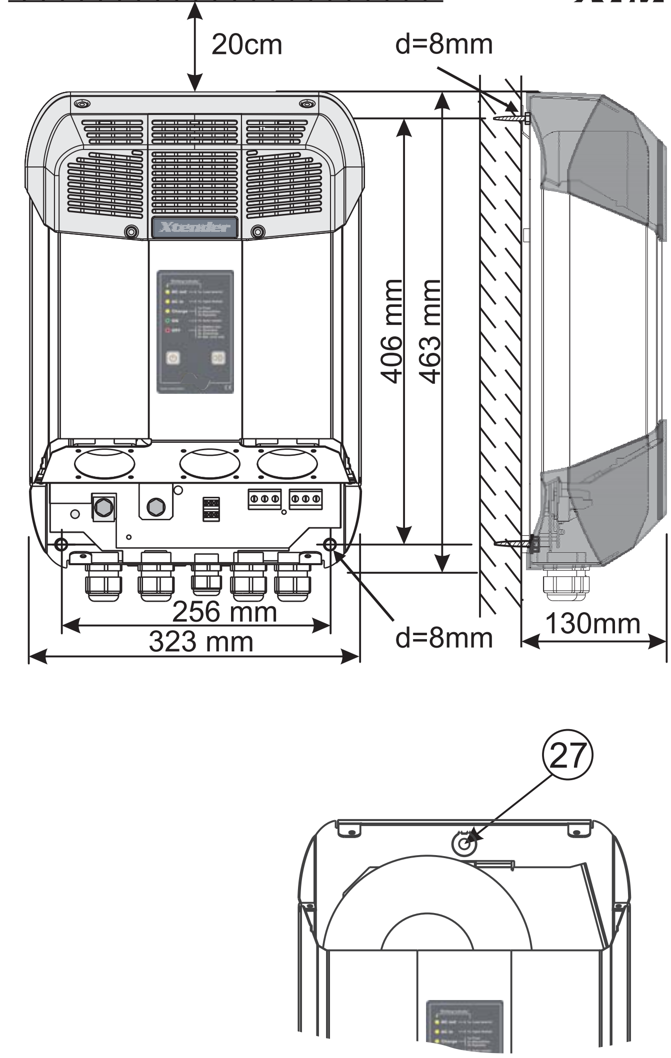


Fig. 5a

12V battery bank wiring with 2Vcell in series and parallel+series

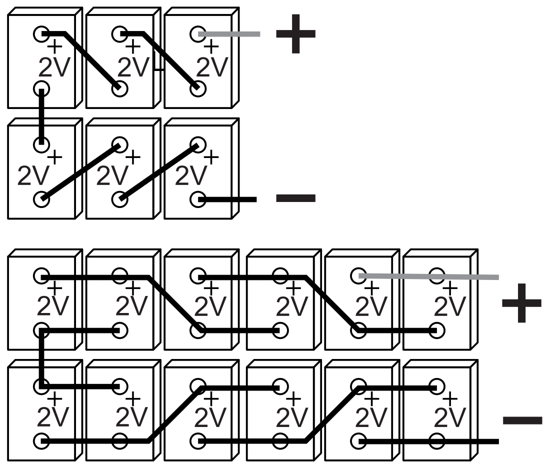


Fig. 5b

12V battery bank wiring with single and parallel 12Vcell

12V

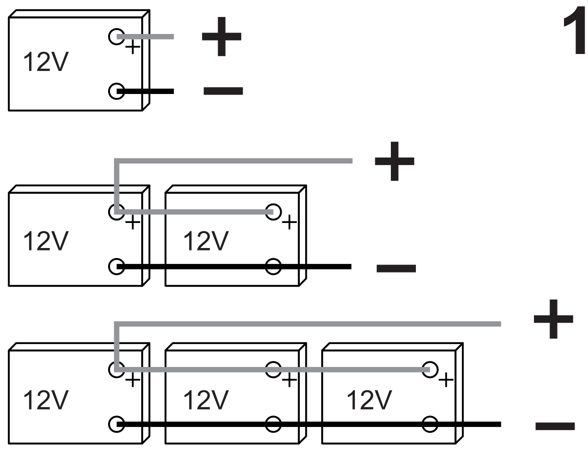


Fig. 5c

24V battery bank wiring with 2Vcell in serie and parallel+series

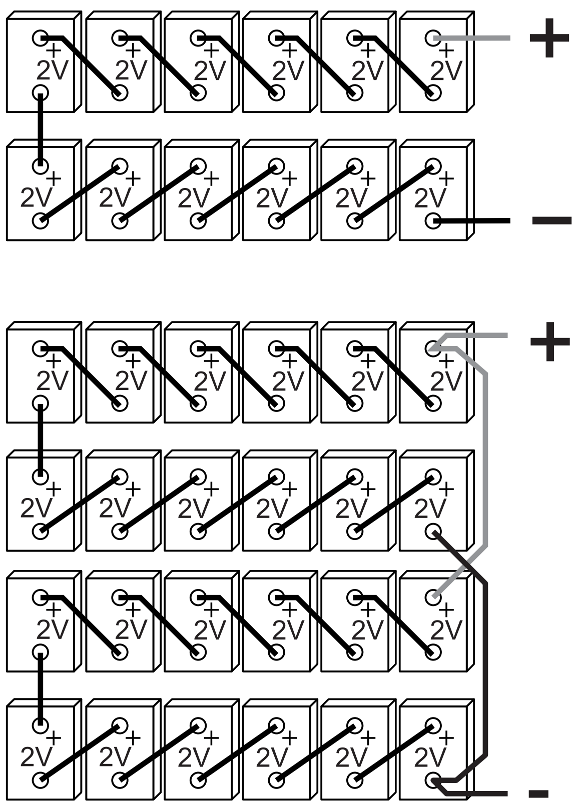


Fig. 5e

24V battery bank wiring with series and series/parallel 12Vcell

24V

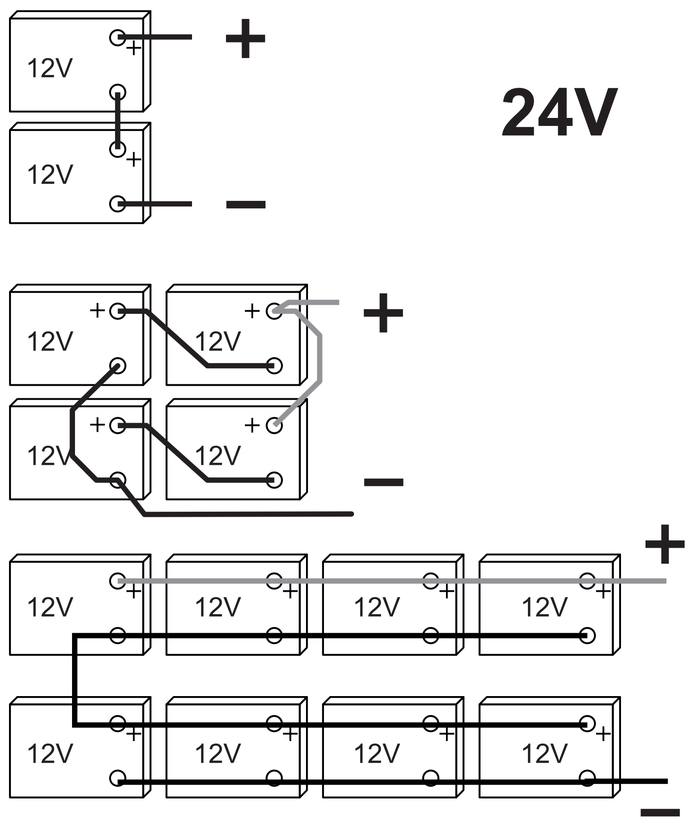


Fig. 6a 48V battery bank wiring with series/parallel 12Vcells

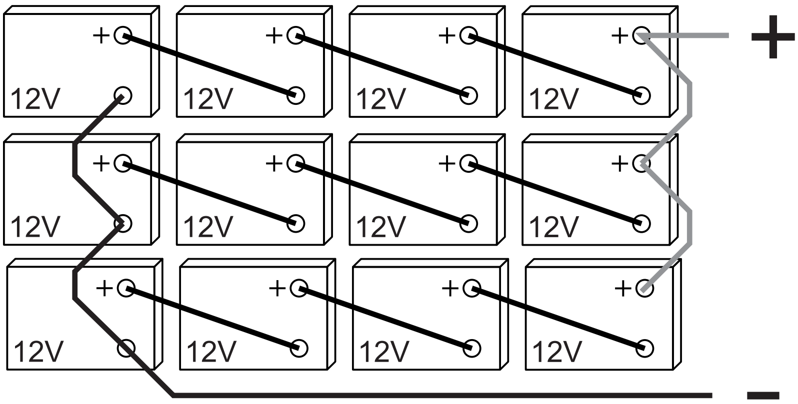
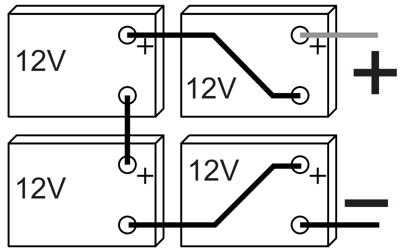


Fig. 6b

48V battery bank wiring with series 12Vcells



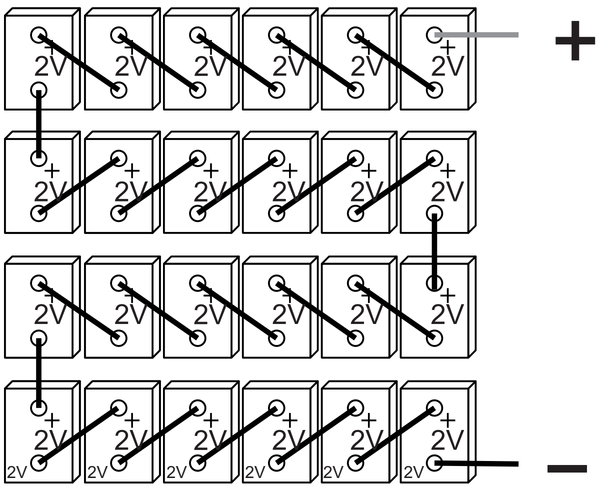
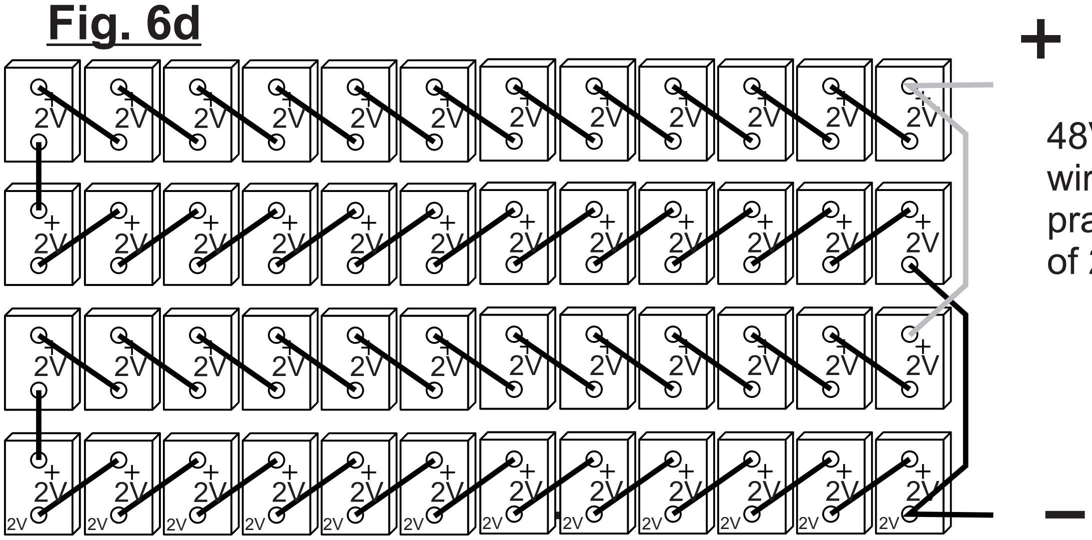


Fig. 6c

48V battery bank wiring with 24 x 2Vcells in series

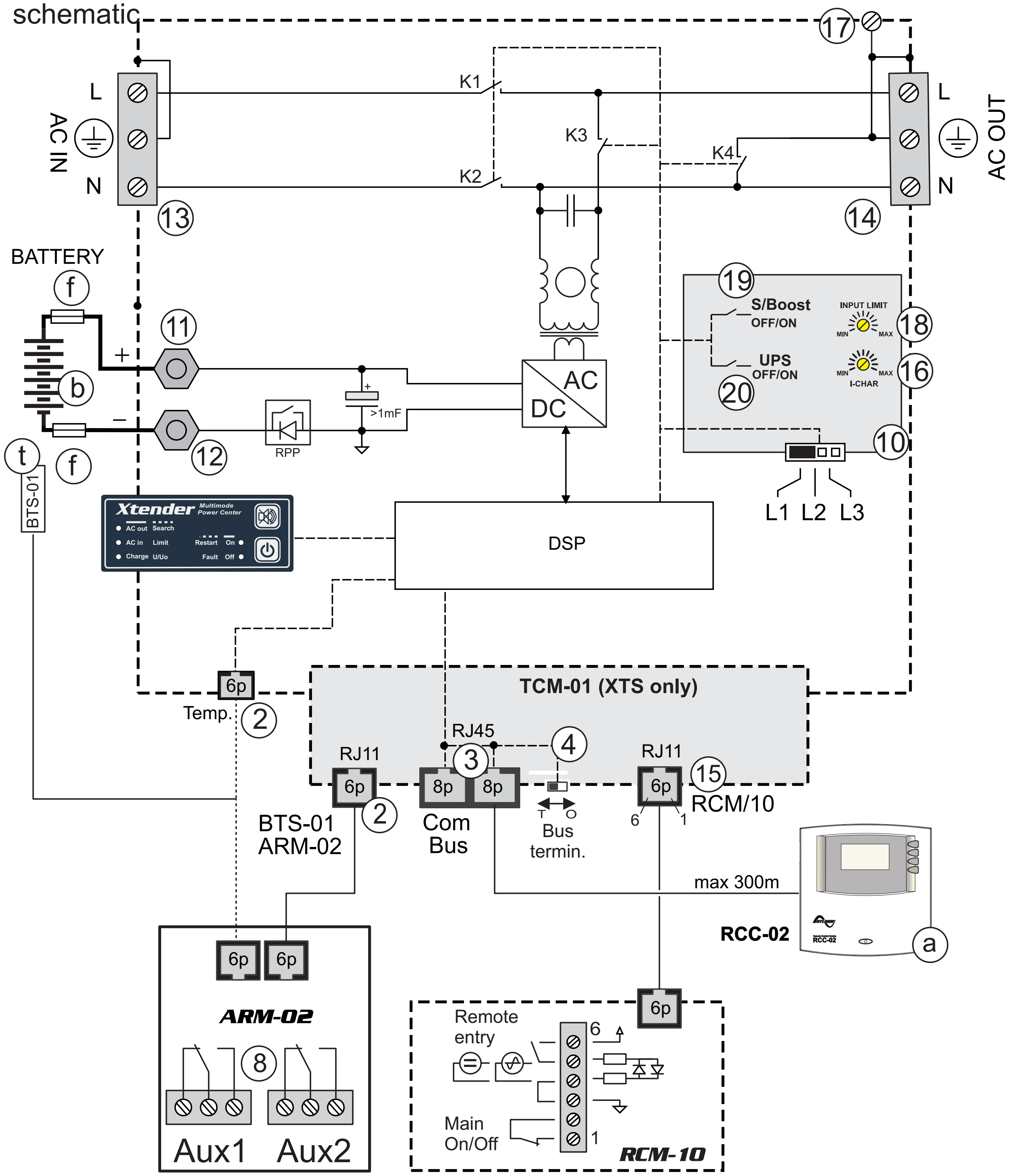
Fig. 6d



48V battery bank wiring with 2 prallelled strings of 24 x 2V cells

Fig. 7

Xtender XTS principle and equivalent schematic



AUXILLARY CONTACT

Remote Command Module

Fig. 7 Xtender principle and equivalent schematic *XTH / XTM*

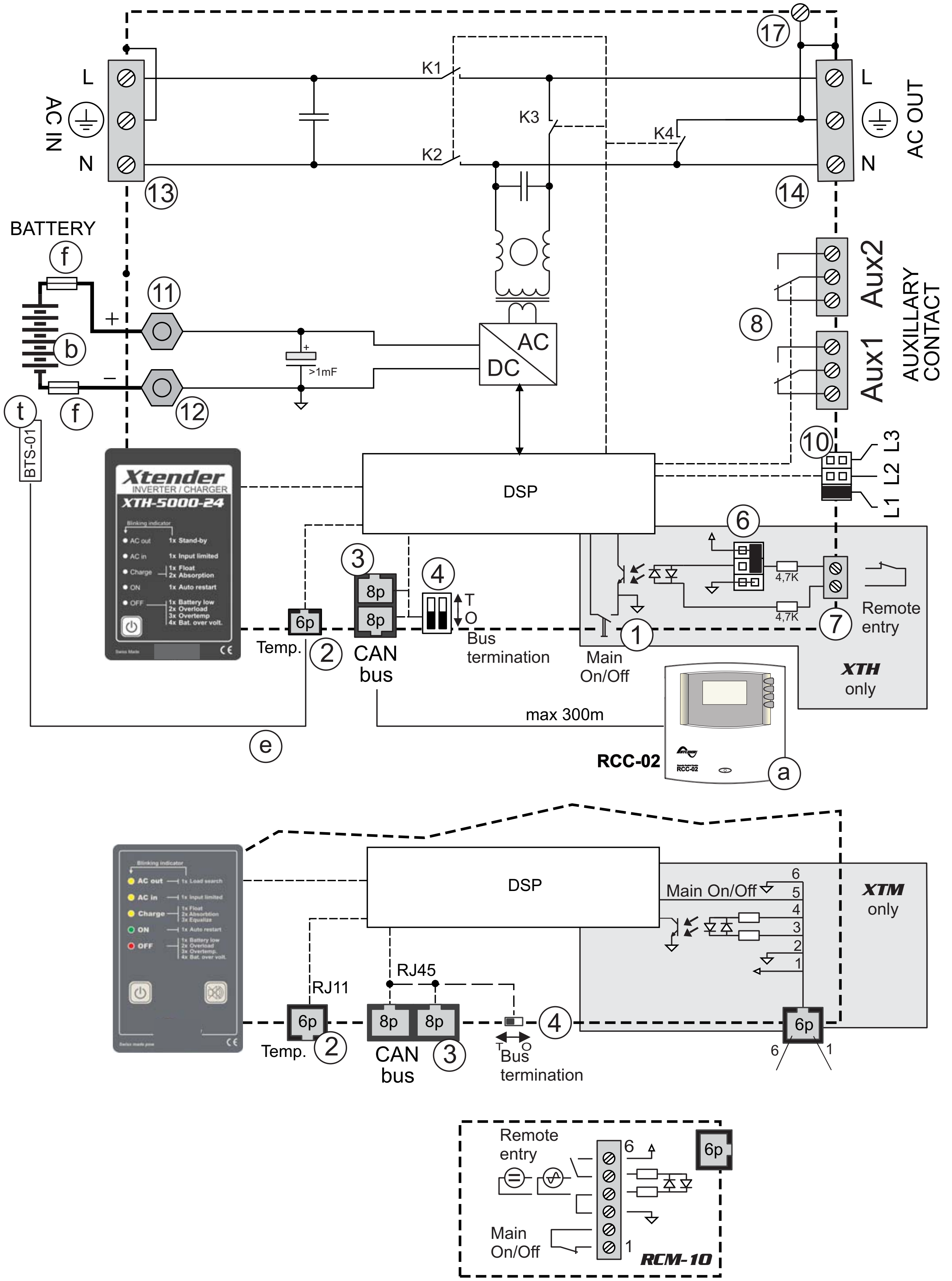


Fig. 8a

Wiring exemple of a single phase system (AC and DC side).

Fig. 8b

Wiring variants for remote control ON/OFF

Max.lengh:5m.
Max.U: 60 Veff
Max. I < 30mA

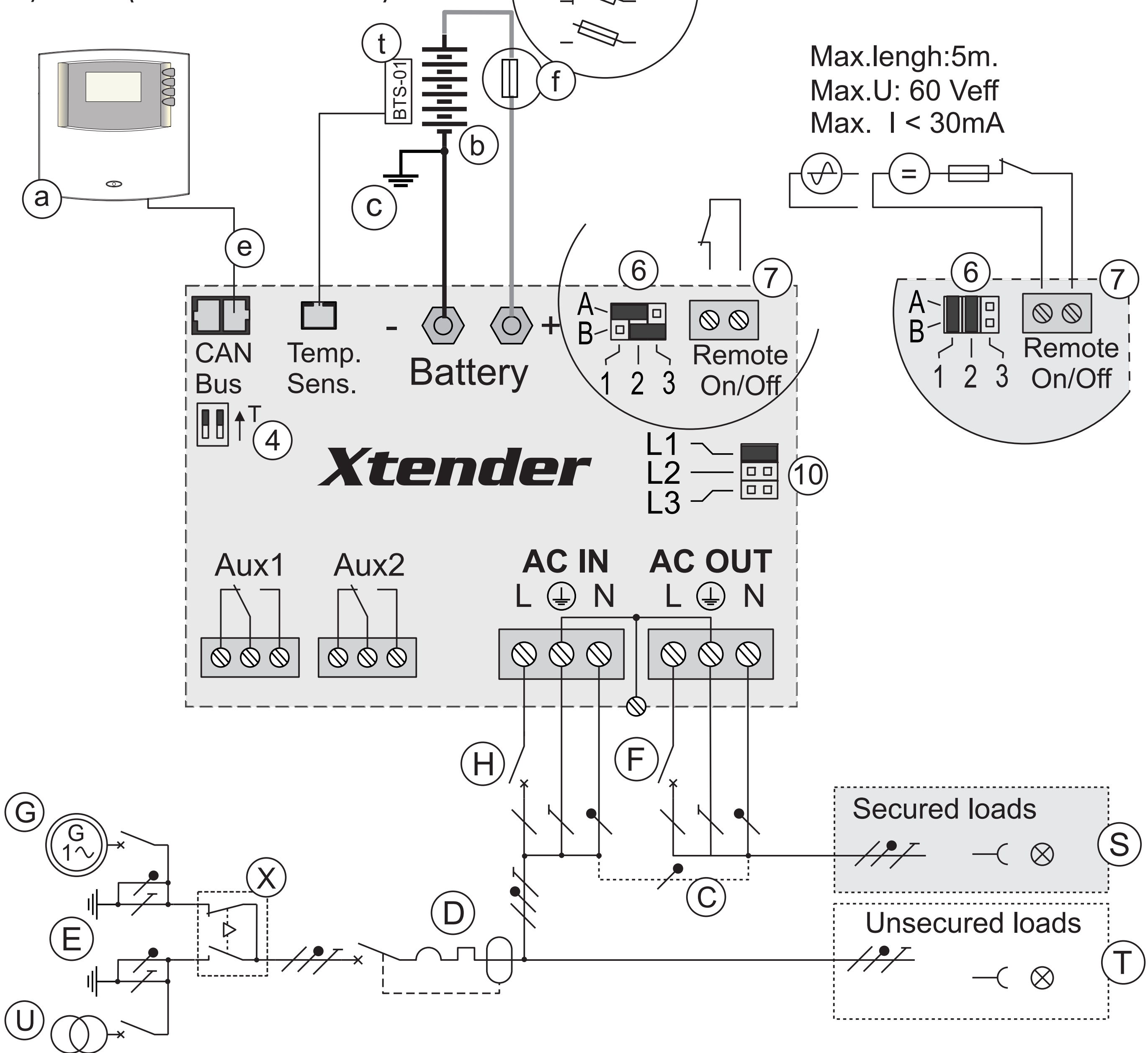


Fig.8c

Wiring exemple of a three-phase in/single phase out system (AC

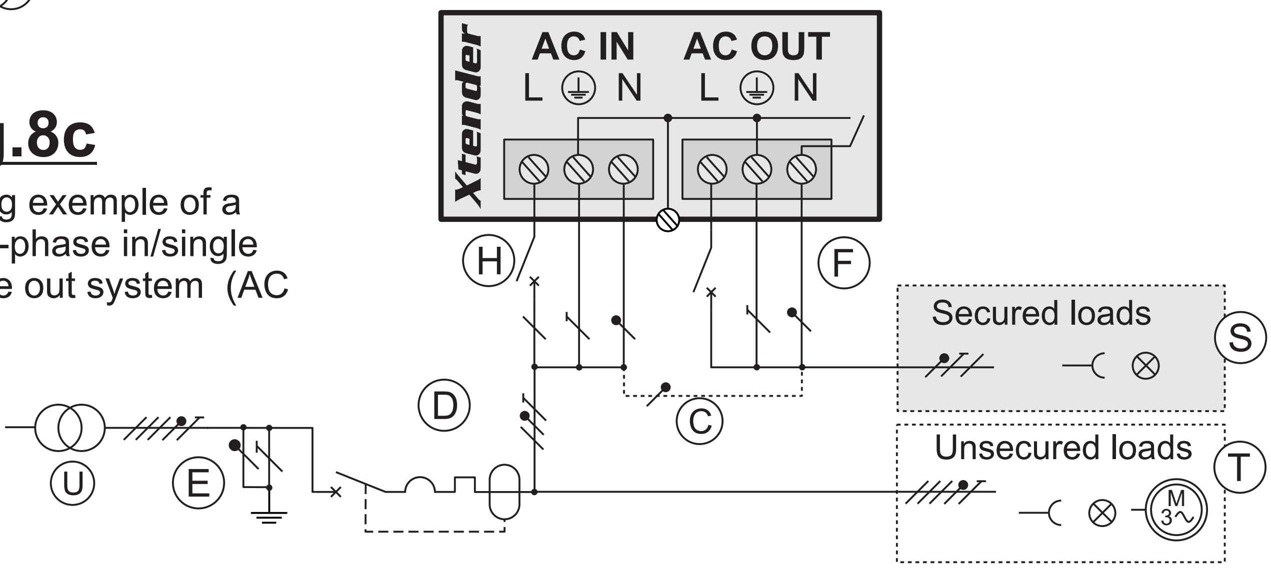


Fig. 9a

Wiring example of single phase with plugged generator

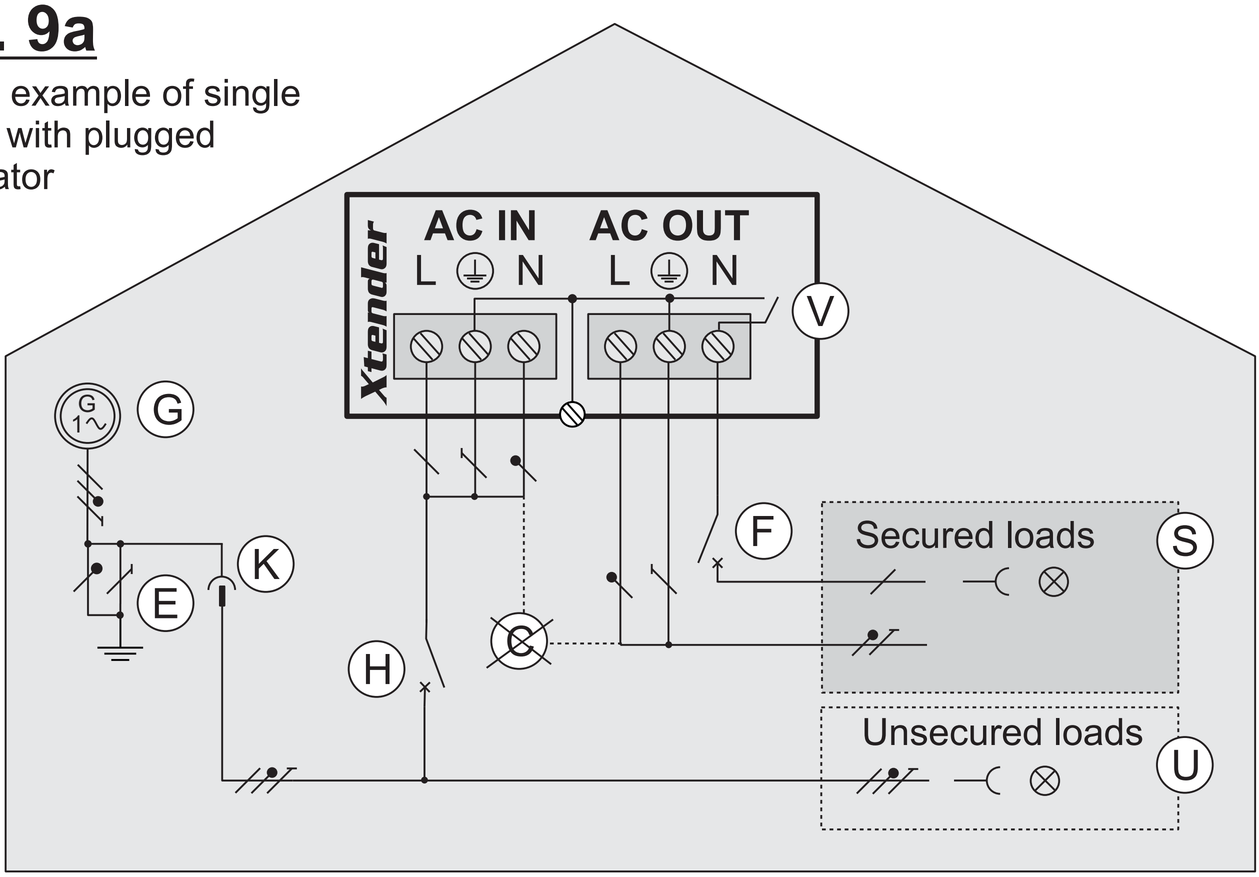


Fig. 9b

Wiring example of triphase in with plugged Xtender

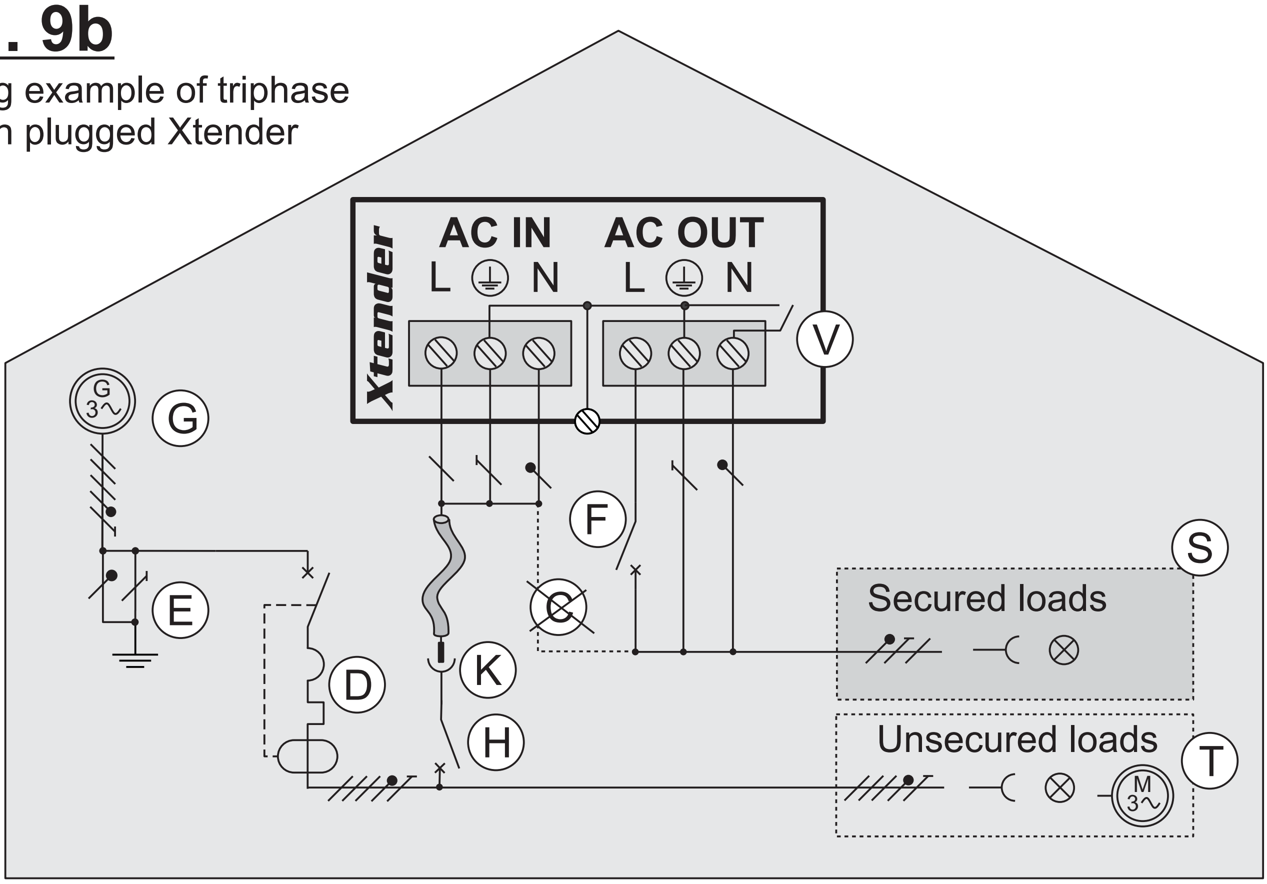


Fig. 10a

Wiring example of a vehicle plugable on AC grid

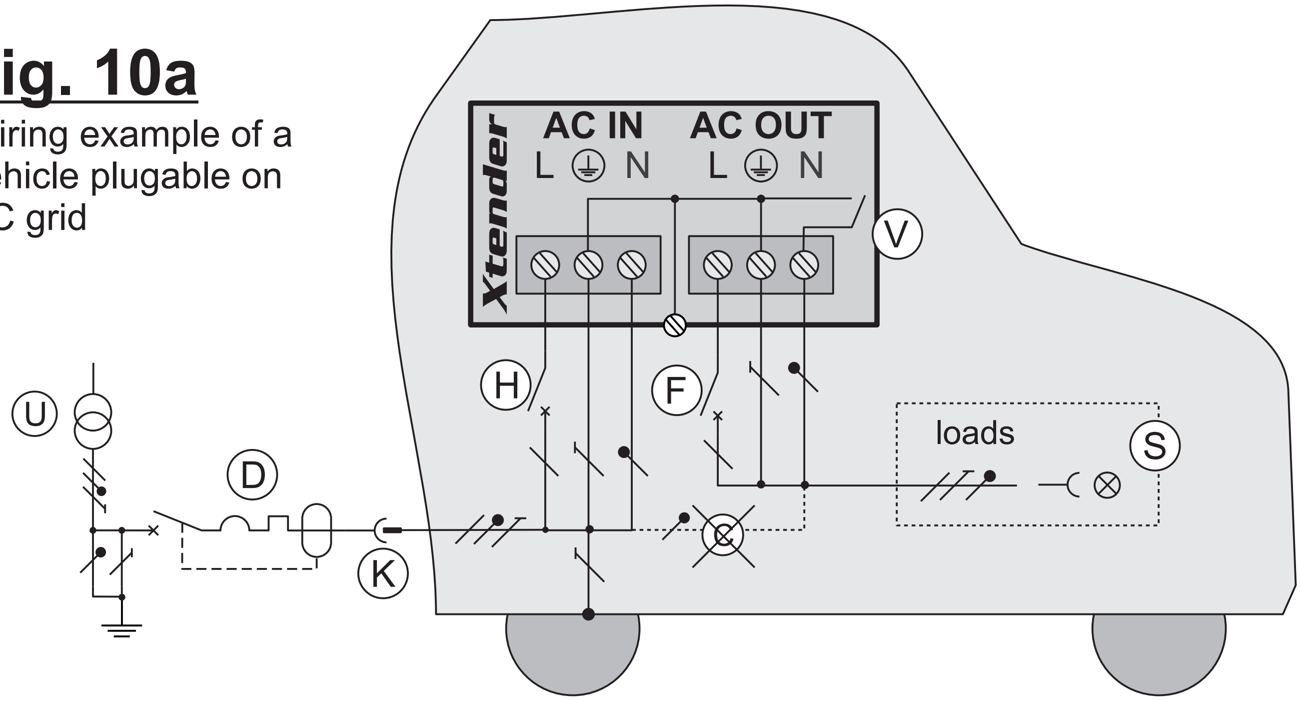


Fig. 10b

Wiring example of a boat plugable on shore AC source without isolation transformer

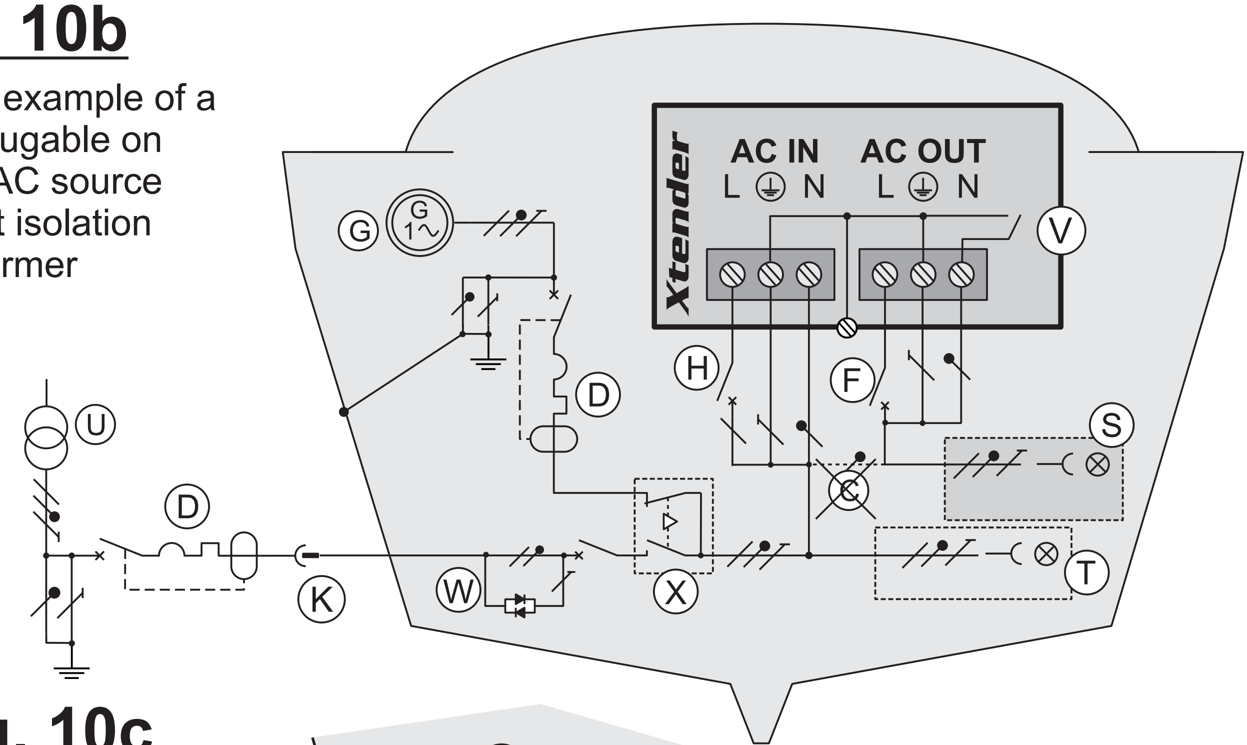


Fig. 10c

Wiring example of a boat plugable on shore AC source with isolation transformer

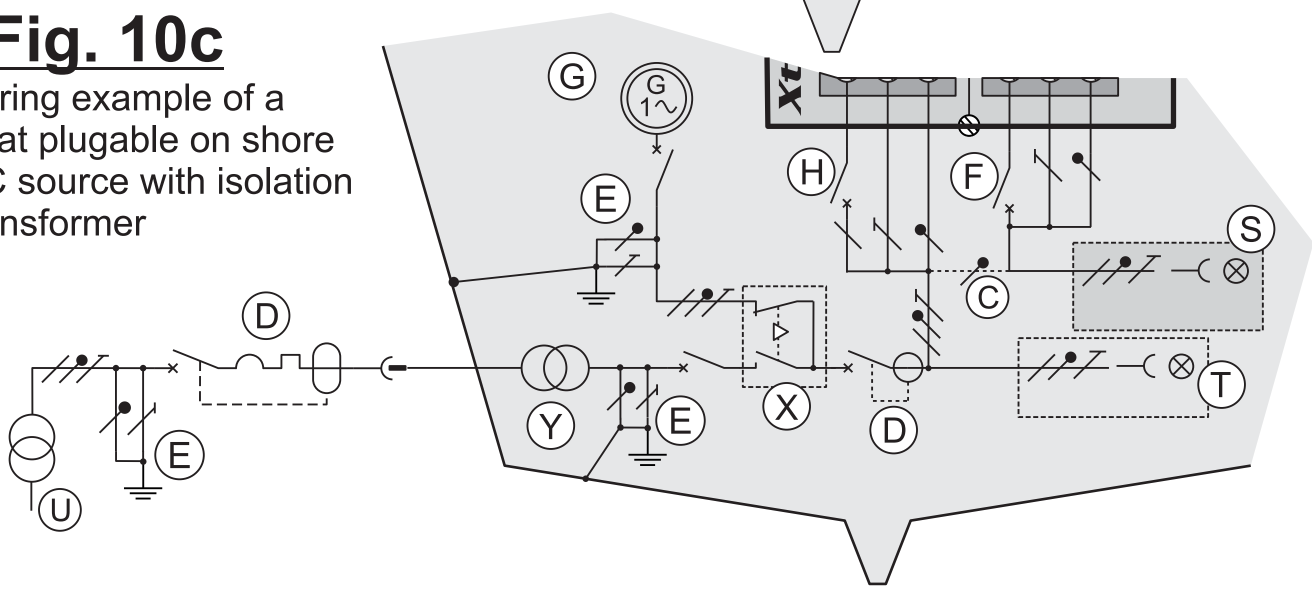


Fig. 11

Wiring example of an hybrid system with solar, PV or hydro DC source

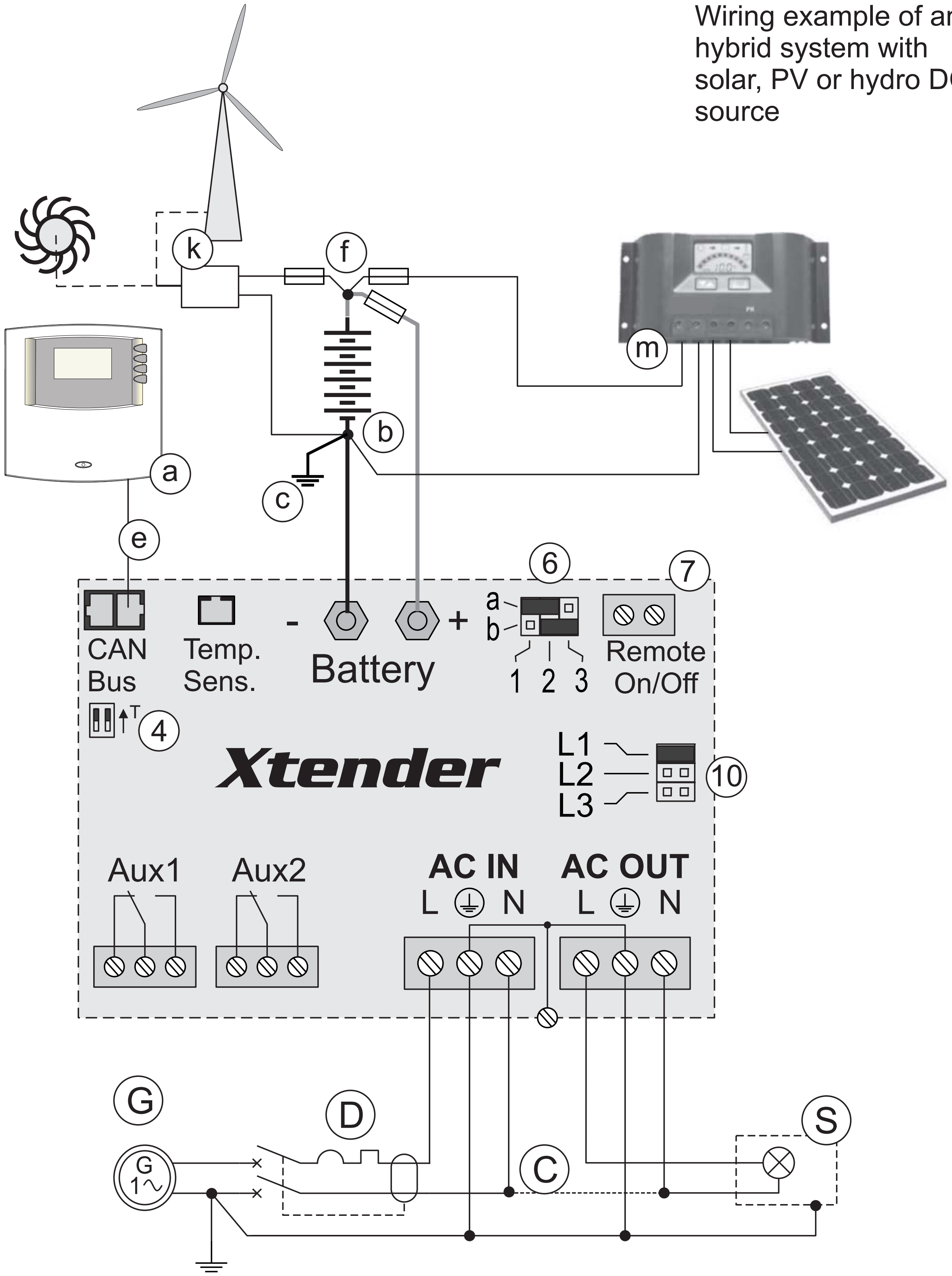


Fig. 12

Wiring example of 3 units paralleled in single phase

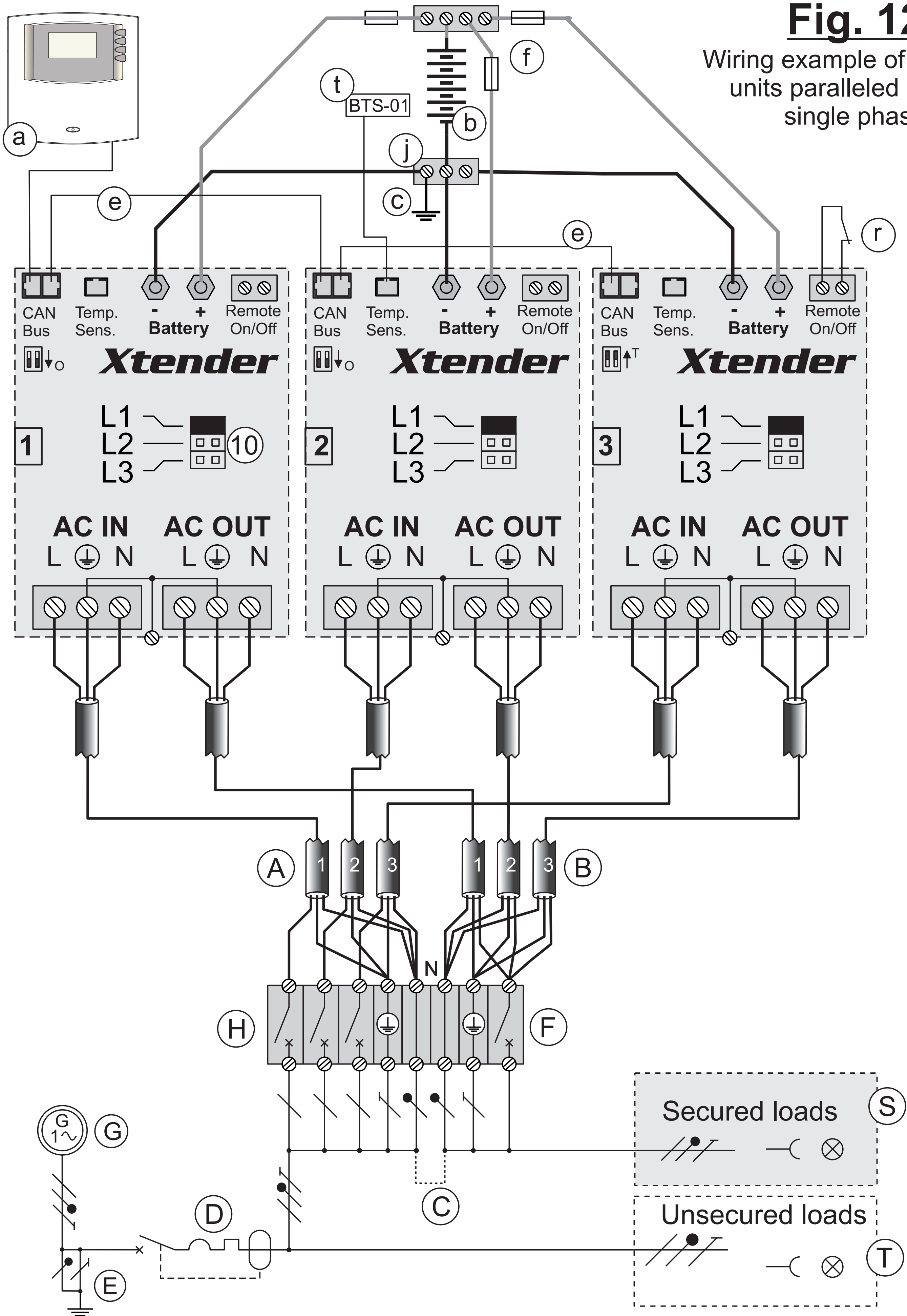


Fig. 13

Wiring example of 3 units in three-phase

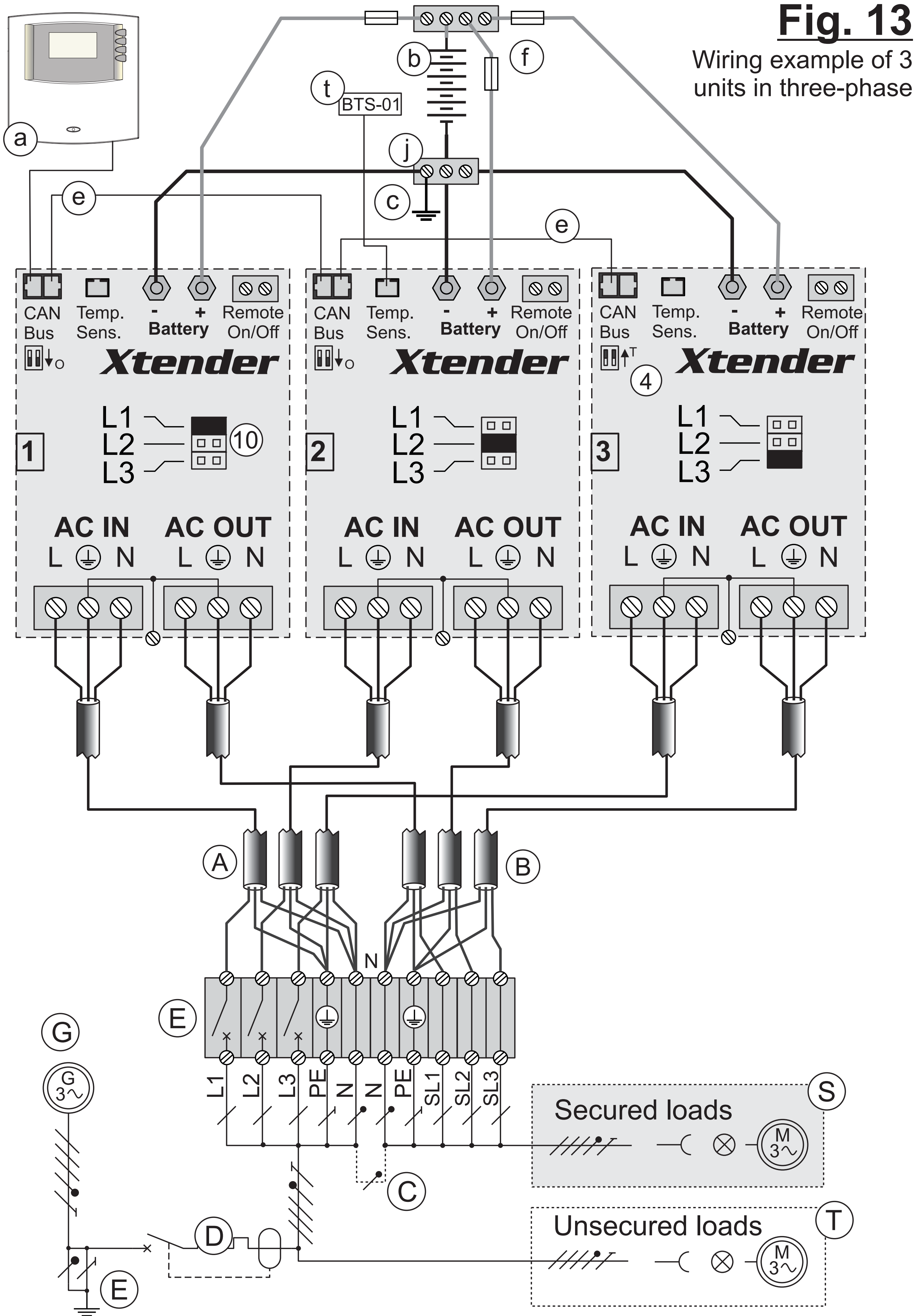


Fig. 14

Wiring exemple of 3 units in three-phase with single phase ACsource

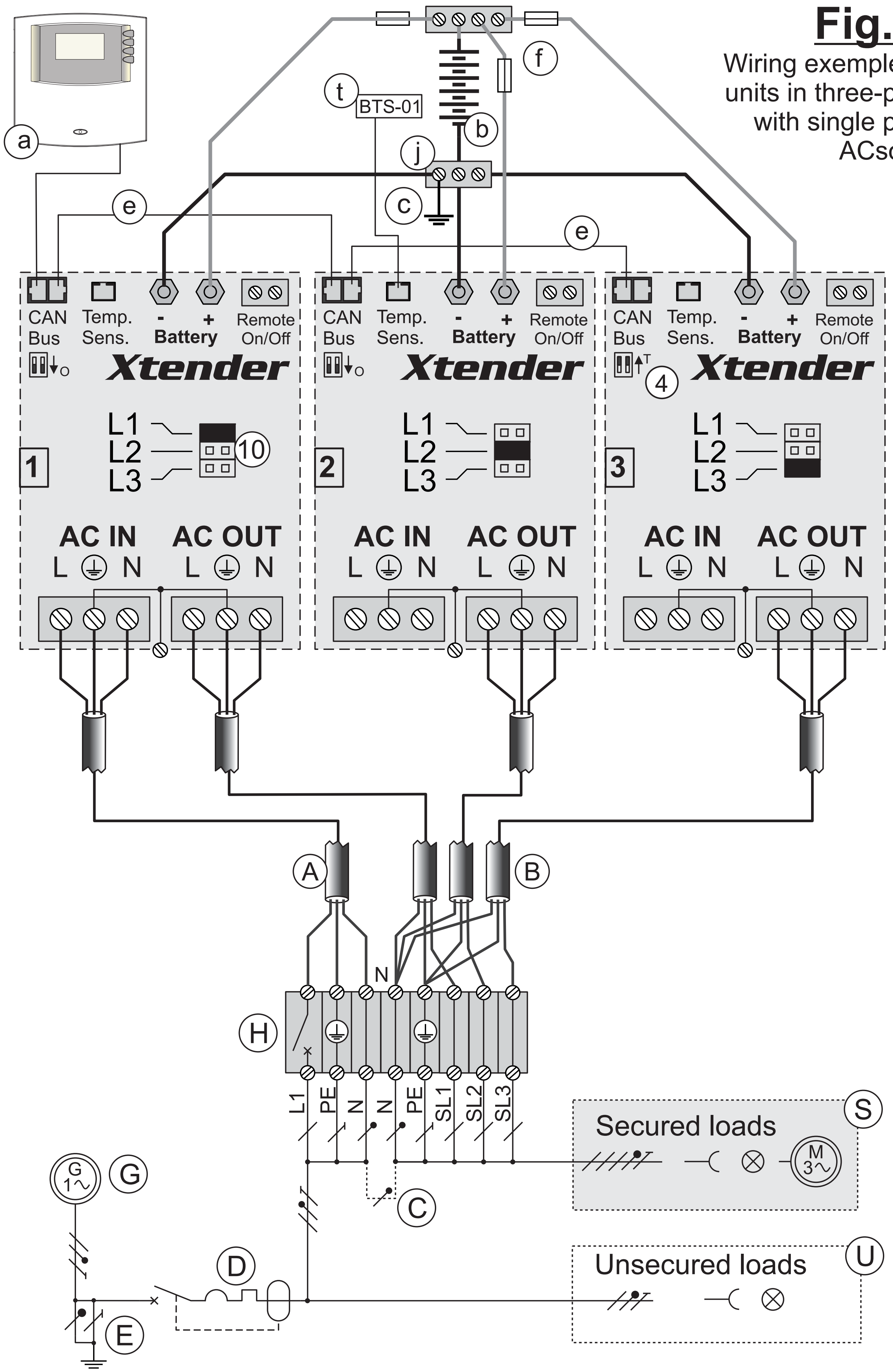


Fig. 15

Wiring example of 3 units in three-phase + one phase (L3) paralled

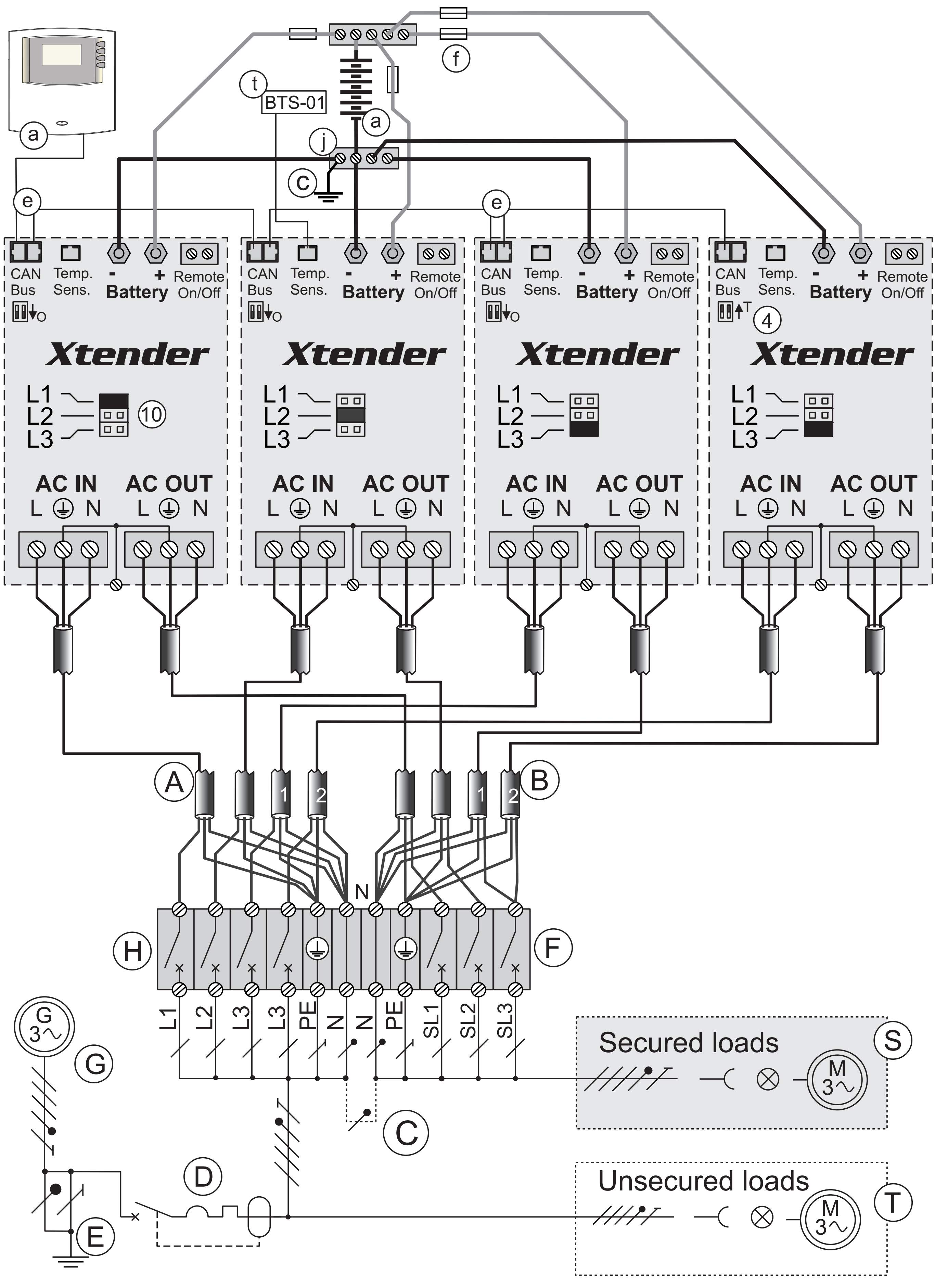


Fig. 16

Wiring example of 3 units paralleled and in three-phase

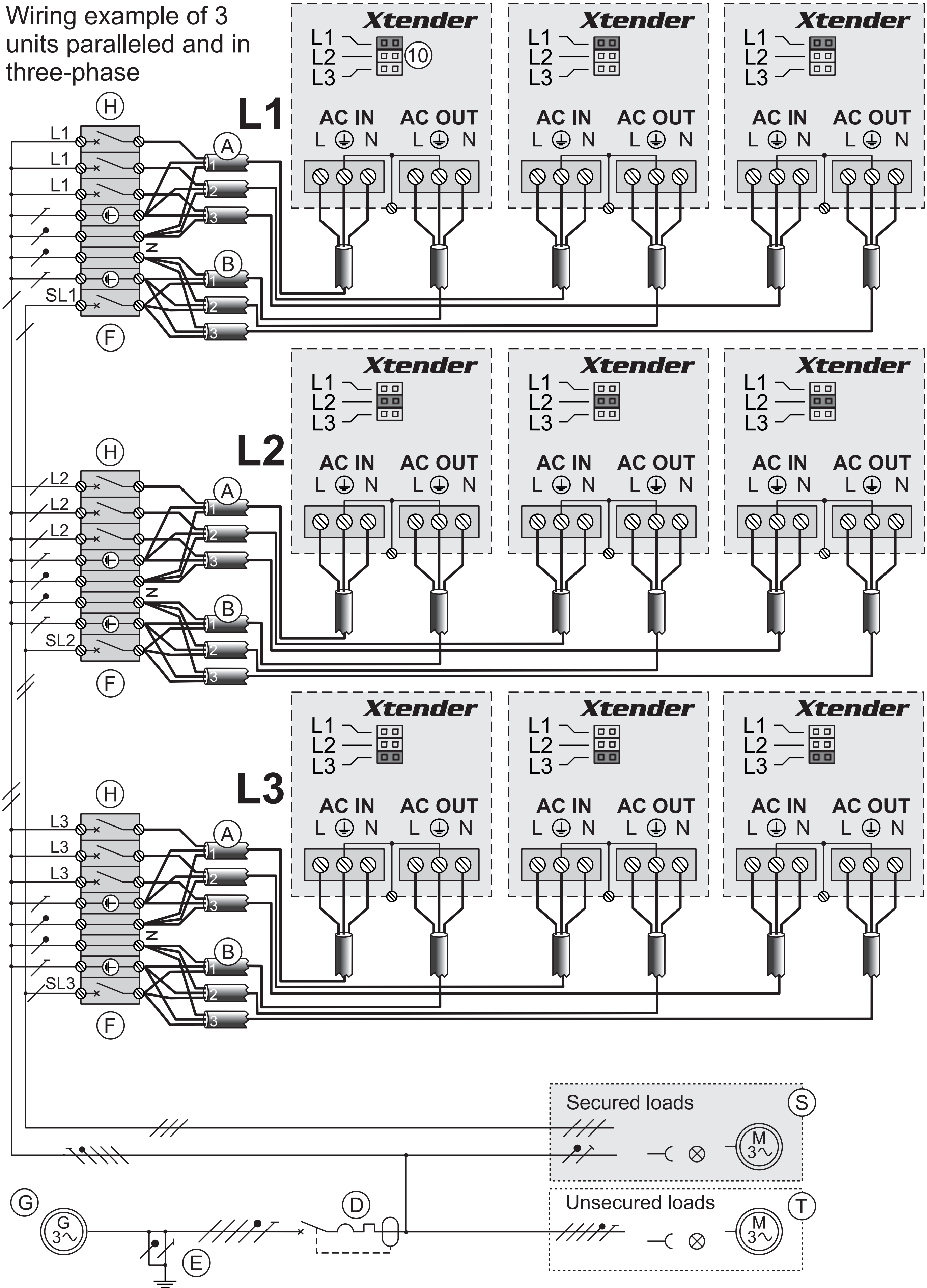


Fig. 17

DC bus wiring example of 3 units paralleled and in three-phase

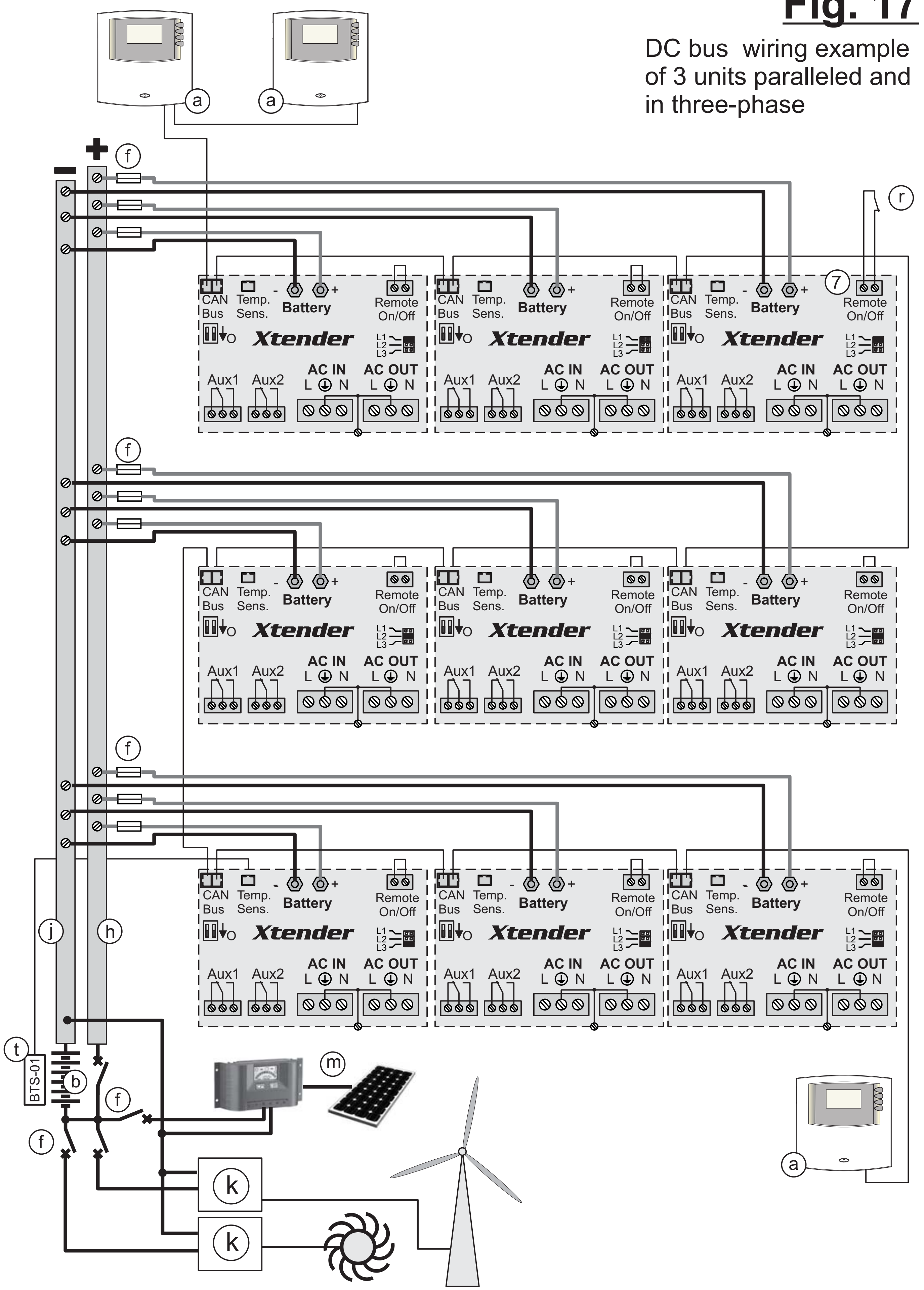


Fig. 18

DC side star wiring example of 3 units paralleled and in three-phase

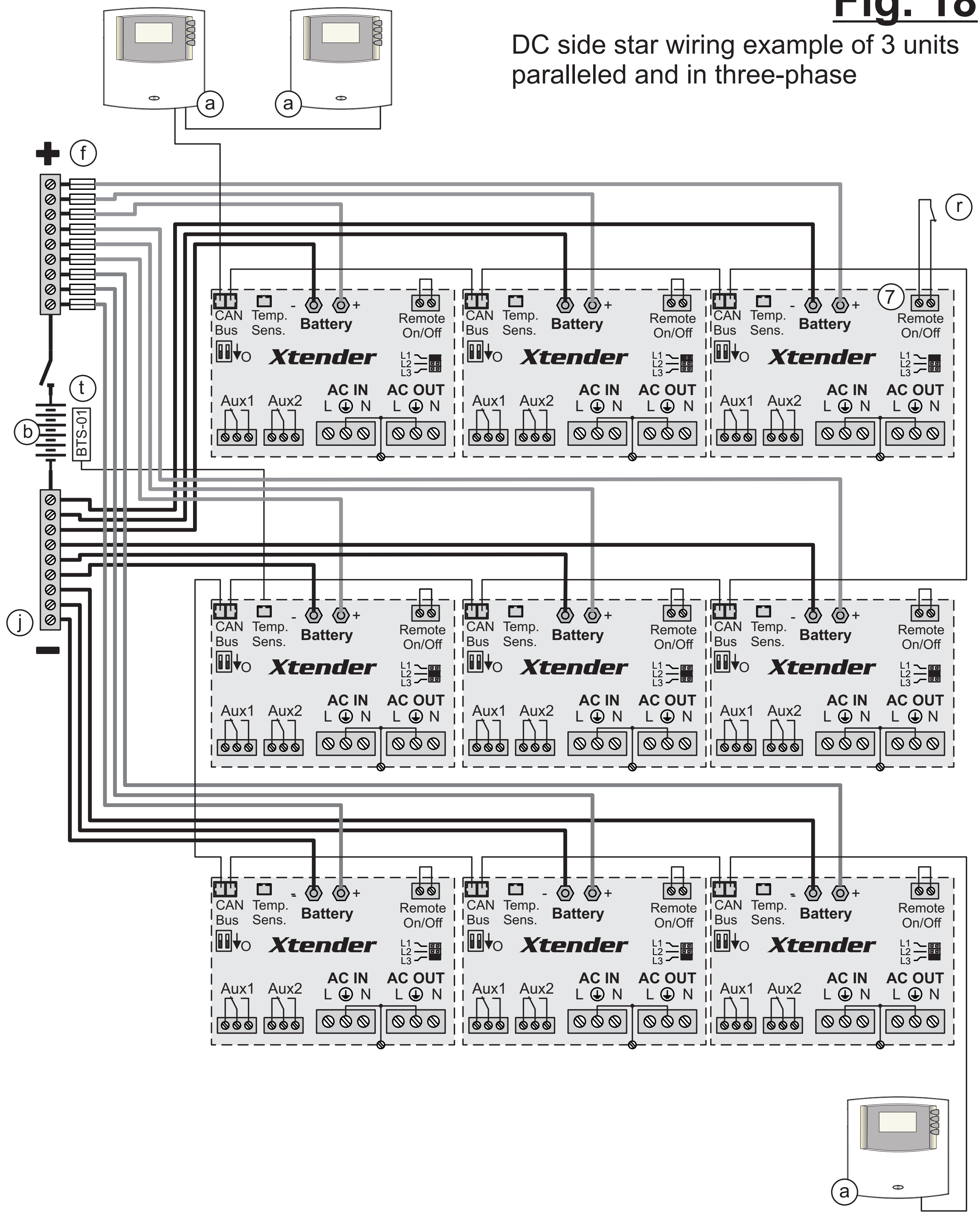
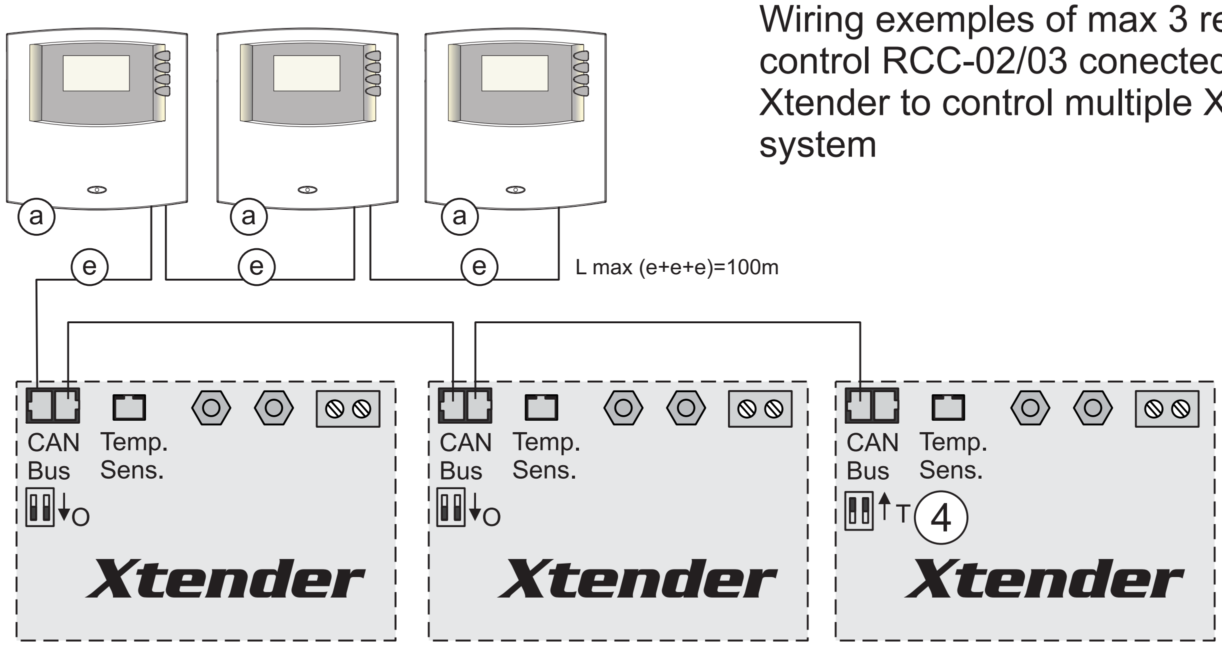
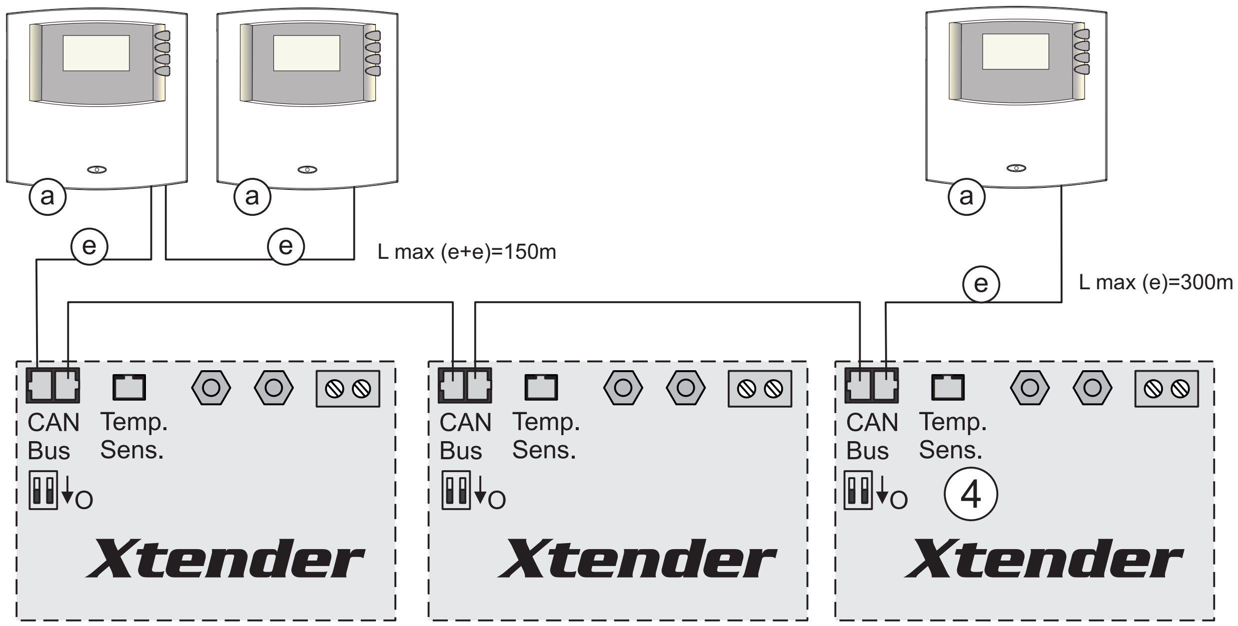


Fig. 19

Wiring exemples of max 3 remote control RCC-02/03 conected on Xtender to control multiple Xtender system





STUDER Innotec SA
Rue des Casernes 57
1950 Sion – Switzerland
Tél : +41 (0) 27 205 60 80
Fax : +41 (0) 27 205 60 88
info@studer-innotec.com
www.studer-innotec.com

Technical specification

Xtender serial protocol

Author : Marc Emery

Date : 08.09.11

Version : V1.3.1

Contents

1. INTRODUCTION ... 2
1.1 Conventions used in this document ... 2
1.2 List of acronyms ... 2
2. PHYSICAL LAYER ... 3
2.1 Connector Pinning ... 3
2.2 Cable to use ... 3
3. DATA LINK LAYER ... 4
3.1 USART configuration ... 4
3.2 Byte Endianness ... 4
3.3 Frame ... 4
3.4 Addressing the devices ... 5
3.5 Response delay ... 5
4. APPLICATION LAYER ... 6
4.1 Services ... 6
4.2 Object model ... 6
4.2.1 READ_PROPERTY service ... 7
4.2.2 WRITE_PROPERTY service ... 8
4.2.3 Format ... 8
4.3 Error codes ... 9
4.4 System state objects ... 10
4.4.1 Properties ... 10
4.4.2 Available system states on the Xtender Inverter ... 10
4.4.3 Available system states on the BSP ... 12
4.5 Parameter objects ... 13
4.5.1 Properties ... 13
4.5.2 Values of level properties ... 13
4.5.3 Available parameters on the Xtender Inverter ... 13
4.5.4 Cyclic write of parameters on the Xtender Inverter ... 14
4.5.5 Hours encoding ... 14
4.5.6 Days of the week encoding ... 14
4.5.7 Month of the year encoding ... 14
4.5.8 Date encoding ... 15
4.5.9 Signal encoding ... 15
5. EXAMPLES OF FRAMES ... 16
5.1 Command line tool ... 16
5.2 Read the value of a system state ... 16
5.3 Write the qsp_value of a parameter ... 17
6. ANNEXES ... 18
6.1 Xtender parameters ... 18
6.2 BSP parameters ... 24
6.3 RCC parameters ... 25

1. Introduction

This technical specification describes the protocol used to communicate with the Studer Innotec Xcom-232i communication module. It is also valid for the discontinuted RCC-02/-03 special execution ES N° 32 (RCC-02/-03-32).

1.1 Conventions used in this document

- Numbers that start with "0x" are in hexadecimal, like in the C integer litterals.
- constant values are usually represented in UPPER CASE
- field names are in lower_case_with_underscore

1.2 List of acronyms

RCC	The Studer Innotec remote control used to configure the Xtender system
Xcom-232i	The Studer Innotec RS-232 communication module that has the function of a DCE, Data Communications Equipment
DTE	Data Terminal Equipment, the PC or controller system that wants to communicate with the Xcom-232i
SCOM	Naming prefix used for the Studer Innotec serial protocol

2. Physical layer

The physical layer is RS-232. The Xcom-232i is equiped with a DE-9 (also known as DB-9) Female connector which provides this interface.

The serial port is galvanically separated with an isolation of 500 V DC relative to the negative battery potential.

2.1 Connector Pinning

On the female connector of the RCC, only the wires "receive data", "transmitted data" and ground are connected. The other wires are not connected, and the DTE must ignore signals such as CTS, DTR or DCD.

pin number	usage
1	not connected
2	RxD
3	TxD
4	not connected
5	GND
6	not connected
7	not connected
8	not connected
9	not connected

2.2 Cable to use

The cable to be used with a PC is a Female-Male, straight.

3. Data link layer

The data link layer, as defined in the OSI model, is used to send and receive frame on the RS-232.

3.1 USART configuration

The RS-232 is defined with :

- A fixed baudrate of 38400 bps
- 1 start bit
- 8 bit of data, LSB first
- 1 parity bit
- even parity
- 1 stop bit

3.2 Byte Endianness

All values are in little endian, i.e. LSB bytes are send on the Physical layer first.

3.3 Frame

The Xcom-232i and the DTE exchange frames consist of a header of 14 bytes followed by a variable number of data bytes and 2 bytes of checksum.

start_-byte	frame_-flags	src_-addr	dst_-addr	data_-length	header_-checksum	frame_-data	data_-checksum
1 byte	1 byte	4 bytes	4 bytes	2 bytes = N	2 bytes	N bytes	2 bytes

- The start byte is always 0xAA
- a frame_flags field, reserved, must be 0x00 in this version of the protocol
- src_addr is the source address, 32 bit little endian
- dest_addr is the destination address, 32 bit little endian
- the length of the frame's data, in byte
- the checksum of the header, from frame_flags to data_length (included)
- the data bytes
- the checksum of all the data bytes of frame_data
- The maximum number of frame_data is 242 (so that 14+242+2 = 256)

The checksum is computed with the following algorithm:

```
A = 0xFF
B = 0
For I FROM 0 TO number_of_bytes -1 DO
    A := (A + DATA[I]) mod 0x100;
    B := (B + A) mod 0x100;
END
checksum[0] := A
checksum[1] := B
```

A and B are byte values and the addition is made modulo 256.

After an invalid parity bit, header or data checksum, the data link layer is reseted and waits for an other frame.

3.4 Addressing the devices

address	devices	remarks
101 to 109	XTH and XTM inverters	ordered by the index displayed on the RCC
301 to 331	MPPT	ordered by the index displayed on the RCC
401	Xcom MS	
501 to 503	Xcom-232i	
601	BSP	
1	alias for the gateway that the DTE uses to communicate (the Xcom-232i to which you speak with RS-232)	

3.5 Response delay

The response delay of the Xcom-232i can be up to 2 seconds. This is a good value for a timeout in the DTE implementation.

4. Application layer

The OSI layers 3 to 6 are not used. The application layer defines a number of « services ». A DTE sends a request frame and waits for a response frame from the Xcom-232i. If an error in the header checksum or data checksum is detected, there is no response from the application layer and the Xcom-232i waits for another request as if nothing has been received.

The Xcom-232i copies the src_addr of the request in the response dst_addr.

4.1 Services

The first two bytes of frame_data define the type of service and different flags for this service.

service_flags	service_id	service_data
1 byte	1 byte	N bytes

service_flags:

BIT7-BIT2 : reserved, must be all zero in this version of the protocol

BIT1 : is_response flag, 0 if it is a request from the DTE to the Xcom-232i, 1 if it is response from the Xcom-232i

BIT0 : error flag, 0 in case of success, 1 if an error occurred. In case of a request, error is always 0.

service_id:

One of the following services, described later in this document:

READ_PROPERTY = 0x01

service_data:

The data specific to the service. In case of a problem the errors are reported in a service-specific way, but the response has to include the error code described in the next section.

4.2 Object model

The different data accessible on each device are organized in object classes. Every object class has a number of properties. The service READ_PROPERTY is used to read the object's properties.

4.2.1 READ_PROPERTY service

This service is used to read an object's property.

The DTE sends a request frame with the following frame_data:

flags	service_id	object_type	object_id	property_id
0x00	0x01	2 bytes	4 bytes	2 bytes

flags : is_response =0, error=0

service_id : 0x01 for READ_PROPERTY

object_type : the object type identifier, defined later in this document

object_id : the object identifier, specific to each object type, i.e. two objects with different type can have the same id

property_id : identify the property in the object

The RCC responds with a frame with the following frame_data:

service_flags	service_id	object_type	object_id	property_id	property_data
0x02 or 0x03	0x01	2 bytes	4 bytes	2 bytes	N bytes

flags : flags_response = 1, error= 0 or 1

service_id : 0x01 for READ_PROPERTY

object_type : same as the request

object_id : same as the request

property_id : same as the request

property_data : If error=0 the value of the property, in the type of the property. If error=1, two bytes identifying the error code.

4.2.2 WRITE_PROPERTY service

This service is used to write an object's property.

The DTE sends a request frame with the following frame_data:

flags	service_id	object_type	object_id	property_id	property_data
0x00	0x02	2 bytes	4 bytes	2 bytes	n byte

flags : is_response = 0, error = 0

service_id : 0x02 for WRITE_PROPERTY

object_type : the object type identifier, defined later in this document

object_id : the object identifier, specific to each object type, i.e. two objects with different types can have the same id

property_id : identify the property in the object

property_data : the data in the right data type.

The RCC responds with a frame with the following frame_data:

service_flags	service_id	object_type	object_id	property_id	error_id
0x02 or 0x03	0x02	2 bytes	4 bytes	2 bytes	0 or 2 bytes

flags : flags_response = 1, error= 0 or 1

service_id : 0x01 for READ_PROPERTY

object_type : same as the request

object_id : same as the request

property_id : same as the request

property_data : If the flag error = 0, 0 byte of data if not, to byte of type bytes identifying the error code.

4.2.3 Format

The property data are encoded in different formats described below. Some properties have a format that can be different from one object to an other in the same object_type. For example an the value_qsp of parameter can be an ENUM or a FLOAT depending on the parameter id (identified by the object_id). In this case it is described here as type DYNAMIC. The DTE must then know the exact type of the property for each object to decode it.

INVALID_FORMAT = 0

BOOL = 1 : binary data, 1 byte, 0 = false, 1 = true, other values are invalid

FORMAT = 2 : a property what define the format of an other property, 16 bit integer

ENUM = 3 : a value that is part of a enumeration of possible values, represented with a 16 bit integer

ERROR = 4 : 16 bit error code

INT32 = 5 : 32 bit signed value

FLOAT = 6 : float in 32 bit IEEE 754 format, little endian

STRING = 7 : ISO_8859-15 string of 8 bit characters

DYNAMIC = 8 : a property with a different format for each object id

BYTE_STREAM = 9 : a stream a byte of abitrary length

example of dynamic value:

an object class has the property "type" of format FORMAT and the property "value" of format DYNAMIC.

for the object x, if "type" = 6 (FLOAT), "value" is a 4 byte IEEE 754 little endian float.

4.3 Error codes

The following error codes can be returned:

name	error_id	meaning
INVALID_FRAME	0x0001	malformed frame
DEVICE_NOT_FOUND	0x0002	wrong dst_addr field
RESPONSE_TIMEOUT	0x0003	no response of the server
SERVICE_NOT_SUPPORTED	0x0011	wrong service_id field
INVALID_SERVICE_ARGUMENT	0x0012	wrong service_data
SCOM_ERROR_GATEWAY_BUSY	0x0013	gateway (for example XCOM-232i) busy
TYPE_NOT_SUPPORTED	0x0021	the object_type requested doesn't exist
OBJECT_ID_NOT_FOUND	0x0022	no object with this object_id was found
PROPERTY_NOT_SUPPORTED	0x0023	the property identified by property_id doesn't exist
INVALID_DATA_LENGTH	0x0024	the field property_data has an invalid number of bytes
PROPERTY_IS_READ_ONLY	0x0025	a writing to this property is not allowed
INVALID_DATA	0x0026	this value is impossible for this property
DATA_TOO_SMALL	0x0027	the value is below the minimum limit
DATA_TOO_BIG	0x0028	the value is above the maximum limit

WRITE_PROPERTY_FAILED	0x0029	writing is possible, but failed
READ_PROPERTY_FAILED	0x002A	readind is possible, but failed
ACCESS_DENIED	0x002B	insufficient user access
INVALID_SHELL_ARG	0x0081	the command line tool used received the wrong arguments

4.4 System state objects

These objects are the information about the current state of the system. They cannot be modified and their values change during the operation of the system.

object_type = 0x01

object_id : see the table in next section

4.4.1 Properties

Name	property_id	format	remark
Value	0x01	DYNAMIC	variable length, see the format in following table

4.4.2 Available system states on the Xtender Inverter

The values defined in the following table are accessible on the Xtender XTH and XTM inverters. The states available are the same as the values that can be chosen to be displayed on the RCC.

The system states are related with inverter parameters that you can be configured with the RCC. The description of the functionalities for each parameter can be found in the RCC manual with the index by id number at the end.

id	Description	short name	unit on the RCC	unit	FORMAT	related parameter or description
3000	Battery voltage	Ubat	Vdc	V	FLOAT	
3001	Battery temperature	Tbat	°C	°C no sensor : return ~32767 °C	FLOAT	value given by the external battery temperature sensor BTS-01
3005	Battery charge current	Ibat (m)	Adc	A	FLOAT	
3006	Battery voltage ripple	Ubat ond	Vrip	V	FLOAT	
3010	Battery cycle phase	Phase		0: invalid value 1:Bulk 2: Absorpt. 3: Equalise 4: Floating 5: R.float. 6: Per.abs. 7: Mixing 8: Forming	ENUM	see parameter {1137}
3011	Input voltage AC-In	U in	Vac	V	FLOAT	
3012	AC input current AC-In	I in	Aac	A	FLOAT	
3013	Input power AC-In	P in	kVA	kVA	FLOAT	
3014	Input frequency	F in	Hz	Hz	FLOAT	
3018	Power sharing active	P sharing			BOOL	see parameter {1107}
3019	Boost active	Boost			BOOL	see parameter {1126}
3020	State of transfer relay	Transfert		0: Opened 1: Closed	ENUM	
3021	Output voltage AC-Out	U out	Vac	V	FLOAT	
3022	Output current AC-Out	I out	Aac	A	FLOAT	
3023	Output power AC-Out	P out	kVA	kVA	FLOAT	
3024	Output frequency	F out	Hz	Hz	FLOAT	
3028	Operating state	Mode		0: invalid value 1: Inverter 2: Charger 3: Boost 4: Injection	ENUM	give the current working mode of the inverter. See {1107} for Boost, {1522} for Injection (grid-feeding), charger and inverter mode are oblivious.
3030	State of output relay	Rel out		0: Opened 1: Closed	ENUM	
3031	State of auxiliary relay I	Aux 1		0: Opened 1: Closed	ENUM	see parameter {1201}
3032	State of auxiliary relay II	Aux 2		0: Opened 1: Closed	ENUM	see parameter {1201}
3049	State of the system	Sys state		0: Off 1: On	ENUM	
3051	Search mode state	SB state		0: Off 1: On	ENUM	see parameter {1187}
3076	Discharge of battery of the previous day	E out YD	E2O	kWh	FLOAT	
3078	Discharge of battery of the current day	E out Day	E1O	kWh	FLOAT	
3080	Energy from AC-In of the previous day	Eac in YD	E2	kWh	FLOAT	
3081	Energy from AC-In of the current day	Eac in Day	E1	kWh	FLOAT	
3082	Consumers energy of the previous day	Eac out YD	E2	kWh	FLOAT	
3083	Consumers energy of the current day	Eac out Dy	E1	kWh	FLOAT	

4.4.3 Available system states on the BSP

As on the inverter, all values that can be displayed on the RCC can be read.

id	Description	short name	unit on the RCC	unit	FORMAT	related parameter or description
7000	Battery voltage	Ubat	V	V	FLOAT	
7001	Battery current	Ibat	A	A	FLOAT	
7002	State of Charge	SOC	%	%	FLOAT	
7003	Power	C_cons	W	%	FLOAT	
7004	Remaining autonomy	Trem	minutes	minutes	FLOAT	
7006	Relative capacity	Crel	%	%	FLOAT	
7007	Ah charged today	0d<	Ah	Ah	FLOAT	
7008	Ah discharged today	0d>	Ah	Ah	FLOAT	
7009	Ah charged yesterday	-1d<	Ah	Ah	FLOAT	
7010	Ah discharged yesterday	-1d>	Ah	Ah	FLOAT	
7011	Total kAh charged	tot<	kAh	kAh	FLOAT	
7012	Total kAh discharged	tot>	kAh	kAh	FLOAT	
7013	Total time	Ttot	days	days	FLOAT	
7017	Custom charge Ah counter	cus>	Ah	Ah	FLOAT	
7018	Custom discharge Ah counter	cus<	Ah	Ah	FLOAT	
7019	Custom counter duration	Tcus	h	h	FLOAT	
7029	Battery temperature	Tbat	°C	°C	FLOAT	

4.5 Parameter objects

All parameters accessible from the remote control can also be modified with the protocol. The behaviour is the same as if a physical person changes the value with the remote control buttons. Currently, only changes at the level qsp are possible.

Values of type FLOAT can take any value between min and max but are rounded to the edition step on the remote control.

object_type = 0x02

4.5.1 Properties

Name	property_id	format	Remark
value_qsp	0x05	DYNAMIC	the value that can be entered on the remote control in level qsp or installer.
min_qsp	0x06	DYNAMIC	Minimum that can be entered on the remote control in level qsp or installer.
max_qsp	0x07	DYNAMIC	Maximum that can be entered on the remote control in level qsp or installer.
level_qsp	0x08	ENUM	accessibility level of this parameter modifiable in level qsp or installer.

4.5.2 Values of level properties

The property `level_qsp` of type ENUM can take the following values:

Name	value
VIEW_ONLY	0x00
BASIC	0x10
EXPERT	0x20
INSTALLER	0x30
QSP	0x40

4.5.3 Available parameters on the Xtender Inverter

The change of parameters when the inverters are in operation should be done carefully. The modification of parameters can restart the corresponding algorithm inside the inverter, and thus the change of a value in a cyclic way could sometimes lead to unexpected behaviour.

object_id : a number starting at 1000. See the complete parameter references at the end of the RCC User manual.

4.5.4 Cyclic write of parameters on the Xtender Inverter

The Xtender inverter store the parameter values in a non volatile flash memory. Because of the endurance of this memory, the number of write on a single parameter property is only garanted for 1000 write operations.

To allow the cyclic write of parameters without count limit, the parameter {1550} "Parameters saved in flash memory" as been introduced in the Xtender software.

This parameter has the value "yes" by default. A write of "no" to this parameter value stop the write in the non-volatile flash memory. This operation is written in the flash memory only the first time, so consecutive writes of the value "no" to {1550} can be repeated without limit.

After parameter {1550} has been set to "no", all other parameters can be written without count limit. Because the values of all other parameters are not stored in flash, the read operation will give the values before {1550} as be changed to "no". Also, after a reset the old values will be taken.

To use the inverter with cyclic write operations you must:

- ensure that all inverters have a firmware version >= 1.4.6
- set the parameter {1550} to "no" on all targeted inverter
- avoid to write cyclically on other devices like BSP, RCC, ...
- ensure that no "reset default/factory settings", "apply configuration file (masterfile)" or modification with the remote control change {1550} to "yes"

It is a good pratice to cyclically write "no" to {1550}.

A write of "yes" to the parameter {1550} reactivate the write in flash. It will be written in the flash every time and should not be used more that 1000 time.

4.5.5 Hours encoding

the hours encoding is in minute since 00:00 in INT32. For example 13:41 is 13*60+41 = 821.

4.5.6 Days of the week encoding

The days of the week selection (parameters {1205}, for example) is coded as a bit field in a INT32. A day selected as it bit set to 1.

bit	BIT31-7	BIT6	BIT5	BIT4	BIT3	BIT2	BIT1	BIT0
day of the week	undefined	SU	SA	FR	TH	WE	TU	MO

4.5.7 Month of the year encoding

The month of the year selection (parameters {1479}, for example) is coded as a bit field in a INT32. A month selected as it bit set to 1. January is BIT0 and December BIT11. The BIT31 to 12 are undefined.

4.5.8 Date encoding

The Date (parameters {5002}, for example) is coded as a INT32. The value is the number of second since 1.1.1970 00:00:00.

4.5.9 Signal encoding

The Signal (parameters {1468}, for example) is coded as a INT32. To send a signal, you must write the value 1 to the parameter value.

5. Examples of frames

The byte stream is represented in hexadecimal. As specified above, the encoding is little endian.

5.1 Command line tool

To help the implementation of the protocol we supply the command line tool `scom.exe`. Please contact Studer Innotec for the last version of the executable.

5.2 Read the value of a system state

generated by the command:

```
>scom.exe --port=COM3 --verbose=3 read_property src_addr=1 dst_addr=101
object_type=1 object_id=3000 property_id=1 format=FLOAT
```

Request

start_-byte	**frame_-flags**	**src_addr = 1**	**dst_addr = 101 (first inverter)**	**data_length = 10**	**header_-checksum**	**frame_-data**	**data_-checksum**
AA	00	01000000	65000000	0A00	6F71	10 bytes	C590

flags : is_response = false error = false	**service_id = READ_-PROPERTY**	**object_type = SYSTEM_STATE**	**object_id = 3000**	**property_id = value**
00	01	0100	B80B0000	0100

Total number of bytes: 14+10+2 = 26 bytes

Response

start_-byte	**frame_-flags**	**src_addr =101**	**dst_addr = 1**	**data_length = 14**	**header_-checksum**	**frame_-data**	**data_-checksum**
AA	00	65000000	01000000	0E00	7309	14 bytes	6357

flags : is_response = true error = false	**service_id = READ_PROPERTY**	**object_type = SYSTEM_STATE**	**object_id = 3000**	**property_id = value**	**value= 23.453125**
02	01	0100	B80B0000	0100	00A0BB41

Total number of bytes: 14+14+2 = 30 bytes

5.3 Write the qsp_value of a parameter

Set the battery charge current at 12.0 A.

generated by the command:

```
>scom.exe --port=COM3 --verbose=3 write_property src_addr=1 dst_addr=101
object_type=2 object_id=1138 property_id=5 format=FLOAT value=12.0
```

Request

start_-byte	**frame_-flags**	**src_-addr=1**	**dst_addr-=101**	**data_-length = 14**	**header_-checksum**	**frame_data**	**data_-checksum**
0xAA	00	01000000	65000000	0E00	7379	14 bytes	FF9B

flags : is_response =false error =false	**service_id = WRITE_-PROPERTY**	**object_type = PARAMETER**	**object_id = 1138**	**property_id = value_qsp**	**property_data = 12.0**
00	02	0200	72040000	0500	00004041

Total number of bytes: 14+14+2 = 30 bytes

Response

start_-byte	**frame_-flags**	**src_-addr=1**	**dst_addr-=101**	**data_-length = 10**	**header_-checksum**	**frame_data**	**data_-checksum**
0xAA	00	65000000	01000000	0A00	6F01	10 bytes	0x80F6

flags : is_response =true error =false	**service_id = WRITE_-PROPERTY**	**object_type = PARAMETER**	**object_id = 1138**	**property_id = value_qsp**
02	02	0200	72040000	0500

Total number of bytes: 14+10+2 = 26 bytes

6. Annexes

6.1 Xtender parameters

Level	User ref.	Parameter	Scom format
Basic	1100	BASIC SETTINGS	ONLY LEVEL
Basic	1551	Basic parameters set with buttons (inside XTS)	BOOL
Basic	1107	Maximum current of AC source (Input limit)	FLOAT
Basic	1138	Battery charge current	FLOAT
Basic	1126	Smart-Boost allowed	BOOL
Basic	1124	Inverter allowed	BOOL
Basic	1552	Type of detection of AC-input loss (UPS)	ENUM
Basic	1187	Standby level	FLOAT
Basic	1395	Restore default settings	INT32
Inst.	1287	Restore factory settings	INT32
Expert	1137	BATTERY MANAGEMENT AND CYCLE	ONLY LEVEL
Expert	1125	Charger allowed	BOOL
Basic	1138	Battery charge current	FLOAT
Expert	1139	Battery temperature compensation	FLOAT
Expert	1568	Undervoltage	ONLY LEVEL
Expert	1108	Battery undervoltage level without load	FLOAT
Expert	1531	Battery undervoltage dynamic compensation	ONLY LEVEL
Expert	1191	Battery undervoltage dynamic compensation	BOOL
Expert	1532	Kind of dynamic compensation	BOOL
Expert	1109	Battery undervoltage level at full load	FLOAT
Expert	1190	Battery undervoltage duration before turn off	FLOAT
Expert	1110	Restart voltage after batteries undervoltage	FLOAT
Expert	1194	Battery adaptive low voltage (B.L.O)	BOOL
Expert	1195	Max voltage for adaptive low voltage	FLOAT
Expert	1307	Reset voltage for adaptive correction	FLOAT
Expert	1298	Increment step of the adaptive low voltage	FLOAT
Expert	1121	Battery overvoltage level	FLOAT
Expert	1122	Restart voltage level after an battery overvoltage	FLOAT
Expert	1140	Battery floating level	FLOAT
Expert	1467	Force phase of floating	INT32
Expert	1141	New cycle menu	ONLY LEVEL
Expert	1142	Force a new cycle	INT32
Expert	1143	Battery voltage level 1 to start a new cycle	FLOAT
Expert	1144	Time period under battery voltage level 1 to start a new cycle	FLOAT
Expert	1145	Battery voltage level 2 to start a new cycle	FLOAT
Expert	1146	Time period under battery voltage level 2 to start a new cycle	FLOAT
Expert	1149	New cycle priority on absorption and equalization phases	BOOL
Expert	1147	Battery cycling restricted	BOOL
Expert	1148	Minimal delay between cycles	FLOAT
Expert	1451	Phase of absorption	ONLY LEVEL
Expert	1155	Absorption phase allowed	BOOL
Expert	1156	Battery absorption voltage	FLOAT
Expert	1157	Absorption duration	FLOAT
Expert	1158	End of absorption triggered with current	BOOL
Expert	1159	Current limit to quit the absorption phase	FLOAT
Expert	1160	Maximal frequency of absorption control	BOOL
Expert	1161	Minimal delay since last absorption	FLOAT
Expert	1452	Phase of equalization	ONLY LEVEL
Expert	1163	Equalization allowed	BOOL
Expert	1162	Force equalization	INT32
Expert	1291	Equalization before absorption phase	BOOL
Expert	1290	Equalization current	FLOAT
Expert	1164	Equalization voltage	FLOAT
Expert	1165	Equalization duration	FLOAT

Expert	1166	Number of cycles before an equalization	FLOAT
Expert	1284	Equalization at fixed interval	BOOL
Expert	1285	Weeks between equalizations	FLOAT
Expert	1168	End of equalization triggered with current	BOOL
Expert	1169	Current limit to quit the equalization phase	FLOAT
Expert	1453	Phase of reduced floating	ONLY LEVEL
Expert	1170	Reduced floating allowed	BOOL
Expert	1171	Floating duration before reduced floating	FLOAT
Expert	1172	Reduced floating voltage	FLOAT
Expert	1454	Phase of periodic absorption	ONLY LEVEL
Expert	1173	Periodic absorption allowed	BOOL
Expert	1174	Periodic absorption voltage	FLOAT
Expert	1175	Reduced floating duration before periodic absorption	FLOAT
Expert	1176	Periodic absorption duration	FLOAT
Expert	1186	INVERTER	ONLY LEVEL
Basic	1124	Inverter allowed	BOOL
Expert	1286	AC Output voltage	FLOAT
Expert	1548	AC voltage increase according to battery voltage	BOOL
Expert	1560	Max AC voltage increase with battery voltage	FLOAT
Expert	1112	Inverter frequency	FLOAT
Expert	1536	Inverter frequency increase when battery full	BOOL
Expert	1549	Inverter frequency increase according to battery voltage	BOOL
Expert	1546	Max frequency increase	FLOAT
Expert	1534	Speed of voltage or frequency change in function of battery	FLOAT
Expert	1420	Standby and turn on	ONLY LEVEL
Basic	1187	Standby level	FLOAT
Expert	1189	Time delay between standby pulses	FLOAT
Expert	1188	Standby number of pulses	FLOAT
Expert	1599	Softstart duration	FLOAT
Expert	1438	Solsafe presence Energy source at AC-Out side	BOOL
QSP	1572	Modulator ru_soll	BOOL
Expert	1197	AC-IN AND TRANSFER	ONLY LEVEL
Expert	1128	Transfer relay allowed	BOOL
Expert	1580	Delay before closing transfer relay	FLOAT
Basic	1126	Smart-Boost allowed	BOOL
Basic	1107	Maximum current of AC source (Input limit)	FLOAT
Expert	1471	Max input current modification	ONLY LEVEL
Expert	1566	Use an alternate max input current	BOOL
Expert	1567	Second maximum current of AC source (Input limit)	FLOAT
Expert	1527	Decrease max input limit current with AC-In voltage	BOOL
Expert	1554	Decrease max input limit activated by remote entry	BOOL
Expert	1309	AC input low limit voltage to allow charger function	FLOAT
Expert	1433	Adaptation range of the input current according to the input voltage	FLOAT
Expert	1553	Speed of input limit increase	FLOAT
Expert	1295	Charge current decrease coef. at voltage limit to turn back in inverter mode	FLOAT
Expert	1436	Overrun AC source current limit without opening the transfer relay (Input limit)	BOOL
Basic	1552	Type of detection of AC-input loss (UPS)	ENUM
Expert	1510	Tolerance on detection of AC-input loss (tolerant UPS mode)	FLOAT
Expert	1199	Input voltage giving an opening of the transfer relay with delay	FLOAT
Expert	1198	Time delay before opening of transfer relay	FLOAT
Expert	1200	Input voltage giving an immediate opening of the transfer relay (UPS)	FLOAT
Inst.	1432	Absolute max limit for input voltage	FLOAT
QSP	1500	Standby of the charger allowed	BOOL
Expert	1505	Delta frequency allowed above the standard input frequency	FLOAT
Expert	1506	Delta frequency allowed under the standard input frequency	FLOAT
Expert	1507	Duration with frequency error before opening the transfer	FLOAT
Expert	1575	AC-IN current active filtering	BOOL
Expert	1201	AUXILIARY CONTACT 1	ONLY LEVEL
Expert	1202	Operating mode (AUX 1)	ENUM
Expert	1497	Combination of the events for the auxiliary contact (AUX 1)	BOOL
Expert	1203	Temporal restrictions (AUX 1)	ONLY LEVEL

Expert	1204	Program 1 (AUX 1)	ONLY LEVEL
Expert	1205	Day of the week (AUX 1)	ENUM
Expert	1206	Start hour (AUX 1)	INT32
Expert	1207	End hour (AUX 1)	INT32
Expert	1208	Program 2 (AUX 1)	ONLY LEVEL
Expert	1209	Day of the week (AUX 1)	ENUM
Expert	1210	Start hour (AUX 1)	INT32
Expert	1211	End hour (AUX 1)	INT32
Expert	1212	Program 3 (AUX 1)	ONLY LEVEL
Expert	1213	Day of the week (AUX 1)	ENUM
Expert	1214	Start hour (AUX 1)	INT32
Expert	1215	End hour (AUX 1)	INT32
Inst.	1216	Program 4 (AUX 1)	ONLY LEVEL
Inst.	1217	Day of the week (AUX 1)	ENUM
Inst.	1218	Start hour (AUX 1)	INT32
Inst.	1219	End hour (AUX 1)	INT32
Inst.	1220	Program 5 (AUX 1)	ONLY LEVEL
Inst.	1221	Day of the week (AUX 1)	ENUM
Inst.	1222	Start hour (AUX 1)	INT32
Inst.	1223	End hour (AUX 1)	INT32
Expert	1269	Contact active with a fixed time schedule (AUX 1)	ONLY LEVEL
Expert	1270	Program 1 (AUX 1)	ONLY LEVEL
Expert	1271	Day of the week (AUX 1)	ENUM
Expert	1272	Start hour (AUX 1)	INT32
Expert	1273	End hour (AUX 1)	INT32
Expert	1274	Program 2 (AUX 1)	ONLY LEVEL
Expert	1275	Day of the week (AUX 1)	ENUM
Expert	1276	Start hour (AUX 1)	INT32
Expert	1277	End hour (AUX 1)	INT32
Expert	1278	Program 3 (AUX 1)	ONLY LEVEL
Expert	1279	Day of the week (AUX 1)	ENUM
Expert	1280	Start hour (AUX 1)	INT32
Expert	1281	End hour (AUX 1)	INT32
Expert	1455	Contact active on event (AUX 1)	ONLY LEVEL
Expert	1225	Xtender is OFF (AUX 1)	BOOL
Expert	1518	Xtender ON (AUX 1)	BOOL
Expert	1543	Remote entry (AUX 1)	BOOL
Expert	1226	Battery undervoltage (AUX 1)	BOOL
Expert	1227	Battery overvoltage (AUX 1)	BOOL
Expert	1228	Inverter or Smart- Boost overload (AUX 1)	BOOL
Expert	1229	Overtemperature (AUX 1)	BOOL
Expert	1520	No overtemperature (AUX 1)	BOOL
Expert	1231	Active charger (AUX 1)	BOOL
Expert	1232	Active inverter (AUX 1)	BOOL
Expert	1233	Active Smart-Boost (AUX 1)	BOOL
Expert	1234	AC input presence but with fault (AUX 1)	BOOL
Expert	1235	AC input presence (AUX 1)	BOOL
Expert	1236	Transfer relay ON (AUX 1)	BOOL
Expert	1237	AC out presence (AUX 1)	BOOL
Expert	1238	Bulk charge phase (AUX 1)	BOOL
Expert	1239	Absorption phase (AUX 1)	BOOL
Expert	1240	Equalization phase (AUX 1)	BOOL
Expert	1242	Floating (AUX 1)	BOOL
Expert	1243	Reduced floating (AUX 1)	BOOL
Expert	1244	Periodic absorption (AUX 1)	BOOL
Expert	1529	Autonomy test running (AUX 1)	BOOL
Expert	1245	Contact active according to battery voltage (AUX 1)	ONLY LEVEL
Expert	1288	Use dynamic compensation of battery level (AUX 1)	BOOL
Expert	1246	Battery voltage 1 activate (AUX 1)	BOOL
Expert	1247	Battery voltage 1 (AUX 1)	FLOAT
Expert	1248	Delay 1 (AUX 1)	FLOAT

Expert	1249	Battery voltage 2 activate (AUX 1)	BOOL
Expert	1250	Battery voltage 2 (AUX 1)	FLOAT
Expert	1251	Delay 2 (AUX 1)	FLOAT
Expert	1252	Battery voltage 3 activate (AUX 1)	BOOL
Expert	1253	Battery voltage 3 (AUX 1)	FLOAT
Expert	1254	Delay 3 (AUX 1)	FLOAT
Expert	1255	Battery voltage to deactivate (AUX 1)	FLOAT
Expert	1256	Delay to deactivate (AUX 1)	FLOAT
Expert	1516	Deactivate if battery in floating phase (AUX 1)	BOOL
Expert	1257	Contact active with inverter power or Smart-Boost (AUX 1)	ONLY LEVEL
Expert	1258	Inverter power level 1 activate (AUX 1)	BOOL
Expert	1259	Power level 1 (AUX 1)	FLOAT
Expert	1260	Time delay 1 (AUX 1)	FLOAT
Expert	1261	Inverter power level 2 activate (AUX 1)	BOOL
Expert	1262	Power level 2 (AUX 1)	FLOAT
Expert	1263	Time delay 2 (AUX 1)	FLOAT
Expert	1264	Inverter power level 3 activate (AUX 1)	BOOL
Expert	1265	Power level 3 (AUX 1)	FLOAT
Expert	1266	Time delay 3 (AUX 1)	FLOAT
Expert	1267	Inverter power level to deactivate (AUX 1)	FLOAT
Expert	1268	Time delay to deactivate (AUX 1)	FLOAT
Inst.	1503	Contact active according to battery temperature (AUX 1) With BSP or BTS	ONLY LEVEL
Inst.	1446	Contact activated with the temperature of battery (AUX 1)	BOOL
Inst.	1447	Contact activated over (AUX 1)	FLOAT
Inst.	1448	Contact deactivated below (AUX 1)	FLOAT
Expert	1501	Contact active according to SOC (AUX 1) Only with BSP	ONLY LEVEL
Expert	1439	Contact activated with the SOC 1 of battery (AUX 1)	BOOL
Expert	1440	Contact activated below SOC 1 (AUX 1)	FLOAT
Expert	1581	Delay 1 (AUX 1)	FLOAT
Expert	1582	Contact activated with the SOC 2 of battery (AUX 1)	BOOL
Expert	1583	Contact activated below SOC 2 (AUX 1)	FLOAT
Expert	1584	Delay 2 (AUX 1)	FLOAT
Expert	1585	Contact activated with the SOC 3 of battery (AUX 1)	BOOL
Expert	1586	Contact activated below SOC 3 (AUX 1)	FLOAT
Expert	1587	Delay 3 (AUX 1)	FLOAT
Expert	1441	Contact deactivated over SOC (AUX 1)	FLOAT
Expert	1588	Delay to deactivate (AUX 1)	FLOAT
Expert	1589	Deactivate if battery in floating phase (AUX 1)	BOOL
Expert	1512	Security, maximum time of contact (AUX 1)	BOOL
Expert	1514	Maximum time of operation of contact (AUX 1)	FLOAT
Expert	1569	Reset all settings (AUX 1)	INT32
Expert	1310	AUXILIARY CONTACT 2	ONLY LEVEL
Expert	1311	Operating mode (AUX 2)	ENUM
Expert	1498	Combination of the events for the auxiliary contact (AUX 2)	BOOL
Expert	1312	Temporal restrictions (AUX 2)	ONLY LEVEL
Expert	1313	Program 1 (AUX 2)	ONLY LEVEL
Expert	1314	Day of the week (AUX 2)	ENUM
Expert	1315	Start hour (AUX 2)	INT32
Expert	1316	End hour (AUX 2)	INT32
Expert	1317	Program 2 (AUX 2)	ONLY LEVEL
Expert	1318	Day of the week (AUX 2)	ENUM
Expert	1319	Start hour (AUX 2)	INT32
Expert	1320	End hour (AUX 2)	INT32
Expert	1321	Program 3 (AUX 2)	ONLY LEVEL
Expert	1322	Day of the week (AUX 2)	ENUM
Expert	1323	Start hour (AUX 2)	INT32
Expert	1324	End hour (AUX 2)	INT32
Inst.	1325	Program 4 (AUX 2)	ONLY LEVEL
Inst.	1326	Day of the week (AUX 2)	ENUM
Inst.	1327	Start hour (AUX 2)	INT32
Inst.	1328	End hour (AUX 2)	INT32

Inst.	1329	Program 5 (AUX 2)	ONLY LEVEL
Inst.	1330	Day of the week (AUX 2)	ENUM
Inst.	1331	Start hour (AUX 2)	INT32
Inst.	1332	End hour (AUX 2)	INT32
Expert	1378	Contact active with a fixed time schedule (AUX 2)	ONLY LEVEL
Expert	1379	Program 1 (AUX 2)	ONLY LEVEL
Expert	1380	Day of the week (AUX 2)	ENUM
Expert	1381	Start hour (AUX 2)	INT32
Expert	1382	End hour (AUX 2)	INT32
Expert	1383	Program 2 (AUX 2)	ONLY LEVEL
Expert	1384	Day of the week (AUX 2)	ENUM
Expert	1385	Start hour (AUX 2)	INT32
Expert	1386	End hour (AUX 2)	INT32
Expert	1387	Program 3 (AUX 2)	ONLY LEVEL
Expert	1388	Day of the week (AUX 2)	ENUM
Expert	1389	Start hour (AUX 2)	INT32
Expert	1390	End hour (AUX 2)	INT32
Expert	1456	Contact active on event (AUX 2)	ONLY LEVEL
Expert	1333	Xtender is OFF (AUX 2)	BOOL
Expert	1519	Xtender ON (AUX 2)	BOOL
Expert	1544	Remote entry (AUX 2)	BOOL
Expert	1334	Battery undervoltage (AUX 2)	BOOL
Expert	1335	Battery overvoltage (AUX 2)	BOOL
Expert	1336	Inverter or Smart-Boost overload (AUX 2)	BOOL
Expert	1337	Overtemperature (AUX 2)	BOOL
Expert	1521	No overtemperature (AUX 2)	BOOL
Expert	1339	Active charger (AUX 2)	BOOL
Expert	1340	Active inverter (AUX 2)	BOOL
Expert	1341	Active Smart-Boost (AUX 2)	BOOL
Expert	1342	AC input presence but with fault (AUX 2)	BOOL
Expert	1343	AC input presence (AUX 2)	BOOL
Expert	1344	Transfer contact ON (AUX 2)	BOOL
Expert	1345	AC out presence (AUX 2)	BOOL
Expert	1346	Bulk charge phase (AUX 2)	BOOL
Expert	1347	Absorption phase (AUX 2)	BOOL
Expert	1348	Equalization phase (AUX 2)	BOOL
Expert	1350	Floating (AUX 2)	BOOL
Expert	1351	Reduced floating (AUX 2)	BOOL
Expert	1352	Periodic absorption (AUX 2)	BOOL
Expert	1530	Autonomy test running (AUX 2)	BOOL
Expert	1353	Contact active according to battery voltage (AUX 2)	ONLY LEVEL
Expert	1354	Use dynamic compensation of battery level (AUX 2)	BOOL
Expert	1355	Battery voltage 1 activate (AUX 2)	BOOL
Expert	1356	Battery voltage 1 (AUX 2)	FLOAT
Expert	1357	Delay 1 (AUX 2)	FLOAT
Expert	1358	Battery voltage 2 activate (AUX 2)	BOOL
Expert	1359	Battery voltage 2 (AUX 2)	FLOAT
Expert	1360	Delay 2 (AUX 2)	FLOAT
Expert	1361	Battery voltage 3 activate (AUX 2)	BOOL
Expert	1362	Battery voltage 3 (AUX 2)	FLOAT
Expert	1363	Delay 3 (AUX 2)	FLOAT
Expert	1364	Battery voltage to deactivate (AUX 2)	FLOAT
Expert	1365	Delay to deactivate (AUX 2)	FLOAT
Expert	1517	Deactivate if battery in floating phase (AUX 2)	BOOL
Expert	1366	Contact active with inverter power or Smart-Boost (AUX 2)	ONLY LEVEL
Expert	1367	Inverter power level 1 activate (AUX 2)	BOOL
Expert	1368	Power level 1 (AUX 2)	FLOAT
Expert	1369	Time delay 1 (AUX 2)	FLOAT
Expert	1370	Inverter power level 2 activate (AUX 2)	BOOL
Expert	1371	Power level 2 (AUX 2)	FLOAT
Expert	1372	Time delay 2 (AUX 2)	FLOAT

Expert	1373	Inverter power level 3 activate (AUX 2)	BOOL
Expert	1374	Power level 3 (AUX 2)	FLOAT
Expert	1375	Time delay 3 (AUX 2)	FLOAT
Expert	1376	Inverter power level to deactivate (AUX 2)	FLOAT
Expert	1377	Time delay to deactivate (AUX 2)	FLOAT
Inst.	1504	Contact active according to battery temperature (AUX 2) With BSP or BTS	ONLY LEVEL
Inst.	1457	Contact activated with the temperature of battery (AUX 2)	BOOL
Inst.	1458	Contact activated over (AUX 2)	FLOAT
Inst.	1459	Contact deactivated below (AUX 2)	FLOAT
Inst.	1460	Contact activated only if the battery is charged (AUX 2)	BOOL
Expert	1502	Contact active according to SOC (AUX 2) Only with BSP	ONLY LEVEL
Expert	1442	Contact activated with the SOC 1 of battery (AUX 2)	BOOL
Expert	1443	Contact activated below SOC 1 (AUX 2)	FLOAT
Expert	1590	Delay 1 (AUX 2)	FLOAT
Expert	1591	Contact activated with the SOC 2 of battery (AUX 2)	BOOL
Expert	1592	Contact activated below SOC 2 (AUX 2)	FLOAT
Expert	1593	Delay 2 (AUX 2)	FLOAT
Expert	1594	Contact activated with the SOC 3 of battery (AUX 2)	BOOL
Expert	1595	Contact activated below SOC 3 (AUX 2)	FLOAT
Expert	1596	Delay 3 (AUX 2)	FLOAT
Expert	1444	Contact deactivated over SOC (AUX 2)	FLOAT
Expert	1597	Delay to deactivate (AUX 2)	FLOAT
Expert	1598	Deactivate if battery in floating phase (AUX 2)	BOOL
Expert	1513	Security, maximum time of contact (AUX 2)	BOOL
Expert	1515	Maximum time of operation of contact (AUX 2)	FLOAT
Expert	1570	Reset all settings (AUX 2)	INT32
Expert	1489	AUXILIARY CONTACTS 1 AND 2 EXTENDED FUNCTIONS	ONLY LEVEL
Expert	1491	Generator control active	BOOL
Expert	1493	Number of starting attempts	FLOAT
Expert	1492	Starter pulse duration (with AUX2)	FLOAT
Expert	1494	Time before a starter pulse	FLOAT
Expert	1574	Main contact hold/interrupt time	FLOAT
Expert	1101	SYSTEM	ONLY LEVEL
Expert	1537	Remote entry (Remote ON/OFF)	ONLY LEVEL
Expert	1545	Remote entry active	BOOL
Expert	1538	Prohibits transfert relay	BOOL
Expert	1539	Prohibits inverter	BOOL
Expert	1540	Prohibits charger	BOOL
Expert	1541	Prohibits Smart-Boost	BOOL
Expert	1542	Prohibits grid feeding	BOOL
Expert	1566	Use an alternate max input current	BOOL
Expert	1567	Second maximum current of AC source (Input limit)	FLOAT
Expert	1554	Decrease max input limit activated by remote entry	BOOL
Expert	1576	ON/OFF command	BOOL
Inst.	1578	Activated by AUX1 state	BOOL
Inst.	1579	Prohibits battery priority	BOOL
Expert	1296	Batteries priority as energy source	BOOL
Expert	1297	Battery priority voltage	FLOAT
Expert	1565	Buzzer alarm duration	FLOAT
Expert	1129	Auto restarts	ONLY LEVEL
Expert	1130	After battery undervoltage	BOOL
Expert	1304	Number of batteries undervoltage allowed before definitive stop	FLOAT
Expert	1404	Time period for batteries undervoltages counting	FLOAT
Expert	1305	Number of batteries critical undervoltage allowed before definitive stop	FLOAT
Expert	1405	Time period for critical batteries undervoltages counting	FLOAT
Expert	1131	After battery overvoltage	BOOL
Expert	1132	After inverter or Smart-Boost overload	BOOL
Expert	1533	Delay to restart after an overload	FLOAT
Expert	1134	After overtemperature	BOOL
Expert	1111	Autostart to the battery connection	BOOL
Expert	1484	System earthing (Earth - Neutral)	ONLY LEVEL

Expert	1485	Prohibited ground relay	BOOL
Expert	1486	Continuous neutral	BOOL
Expert	1473	Autotest of the battery autonomy	ONLY LEVEL
Expert	1474	Functionality test (weekly)	BOOL
Expert	1495	Start manually a functionality test (weekly)	INT32
Expert	1475	Day in the week of the test	ENUM
Expert	1476	Hour of the beginning of the test	INT32
Expert	1477	Duration of the test	FLOAT
Expert	1478	Autonomy test (monthly)	BOOL
Expert	1496	Start manually an autonomy test (monthly)	INT32
Expert	1479	Months of the test	ENUM
Expert	1480	Day in the month of the test	FLOAT
Expert	1481	Day in the week of the test	ENUM
Expert	1482	Hour of the beginning of the test	INT32
Expert	1483	Duration of the test	FLOAT
Inst.	1550	Parameters saved in flash memory	BOOL
Inst.	1415	Global ON of the system	INT32
Inst.	1399	Global OFF of the system	INT32
Expert	1468	Reset of all the inverters	INT32
Expert	1282	MULTI XTENDER SYSTEM	ONLY LEVEL
Expert	1283	Integral mode	BOOL
Expert	1461	Multi inverters allowed	BOOL
Expert	1462	Multi inverters independents	BOOL
Expert	1555	Battery cycle synchronized by master	BOOL
Expert	1547	Allow slaves standby in multi-Xtender system	BOOL
Expert	1571	Splitphase: L2 with 180 degrees phaseshift	BOOL
Inst.	1437	Minigrid compatible	BOOL
Inst.	1577	Minigrid with shared battery energy	BOOL
Expert	1522	GRID-FEEDING	ONLY LEVEL
Expert	1127	Grid feeding allowed	BOOL
Expert	1523	Max grid feeding current	FLOAT
Expert	1524	Battery voltage target for forced grid feeding	FLOAT
Expert	1525	Forced grid feeding start time	INT32
Expert	1526	Forced grid feeding stop time	INT32

6.2 BSP parameters

Level	User ref.	Parameter	Scom format
Basic	6000	BASIC SETTINGS	ONLY LEVEL
Basic	6001	Nominal capacity	FLOAT
Basic	6002	Nominal discharge duration (C-rating)	FLOAT
Basic	6017	Nominal shunt current	FLOAT
Basic	6018	Nominal shunt voltage	FLOAT
Expert	6003	Reset of battery history	INT32
Basic	6004	Restore default settings	INT32
Inst.	6005	Restore factory settings	INT32
Expert	6016	ADVANCED SETTINGS	ONLY LEVEL
Expert	6031	Reset of user counters	INT32
Expert	6019	Self-discharge rate	FLOAT
Expert	6020	Nominal temperature	FLOAT
Expert	6021	Temperature coefficient	FLOAT
Expert	6022	Charge efficiency factor	FLOAT
Expert	6023	Peukert's exponent	FLOAT
Expert	6042	Activate the end of charge synchronization	BOOL
Expert	6024	End of charge voltage level	FLOAT
Expert	6025	End of charge current level	FLOAT
Expert	6026	Minimum duration before end of charge	FLOAT

6.3 RCC parameters

Level	User ref.	Parameter	Scom format
Basic	5000	Language	ENUM
Expert	5036	Other languages	ONLY LEVEL
Basic	5038	Choice of the second language	ENUM
Basic	5039	Choice of the third language	ENUM
Basic	5040	Choice of the fourth language	ENUM
Basic	5001	Time	INT32
Basic	5002	Date	INT32
Basic	5003	Day	FLOAT
Basic	5004	Month	ENUM
Basic	5005	Year	FLOAT
V.O.	5012	User level	Not supported
Expert	5019	Force remote control to user BASIC level	INT32
Expert	5057	Datalogger	ONLY LEVEL
Expert	5058	Datalogger enabled	BOOL
Expert	5059	Save today's datas	INT32
Basic	5013	Save and restore files	ONLY LEVEL
Basic	5041	Save all files (system backup)	INT32
Basic	5068	Restore all files (system recovery)	INT32
Basic	5070	Apply configuration files (masterfile)	INT32
Expert	5032	Separator of the .csv files	ENUM
Expert	5069	Advanced backup functions	ONLY LEVEL
Expert	5030	Save messages	INT32
Expert	5049	Save and restore RCC files	ONLY LEVEL
Expert	5015	Save RCC parameters	INT32
Expert	5016	Load RCC parameters	INT32
Expert	5050	Save and restore Xtender files	ONLY LEVEL
Expert	5017	Save Xtender parameters	INT32
Expert	5018	Load Xtender parameters	INT32
Inst.	5033	Create Xtender configuration file (masterfile)	INT32
Expert	5034	Load Xtender configuration file (masterfile)	INT32
Expert	5045	Load Xtender parameters preset	Not supported
Expert	5051	Save and restore BSP files	ONLY LEVEL
Expert	5052	Save BSP parameters	INT32
Expert	5053	Load BSP parameters	INT32
Inst.	5054	Create BSP configuration file (masterfile)	INT32
Expert	5055	Load BSP configuration file (masterfile)	INT32
Inst.	5047	Format the SD card	INT32
Expert	5061	Start update	INT32
Inst.	5042	Modification of access levels of many parameters	ONLY LEVEL
Inst.	5043	Change all parameters access level to:	ENUM
Inst.	5044	Restore default access level of all parameters	INT32
Expert	5007	Backlight	ONLY LEVEL
Expert	5008	Backlight always off	BOOL
Expert	5009	Backlight switch off after	FLOAT
Expert	5026	Red backlight flashing on Xtender off and faulty	BOOL
Basic	5021	Extended and special functions	ONLY LEVEL
Basic	5006	Display contrast	FLOAT
Inst.	5073	Choice of standard display	ENUM
Expert	5010	Come back to standard display after	FLOAT
Expert	5011	Visibility of the transitory messages	FLOAT
Basic	5027	Acoustic alarm active	BOOL
Expert	5031	Remote control acoustic alarm duration	FLOAT
Expert	5056	Switching ON and OFF of system on level "VIEW ONLY"	BOOL
Inst.	5071	Reset of all the remotes control	INT32
Inst.	5072	Activation of old CAN protocol (v 1.1.x)	BOOL

Xcom-232i

User Manual

Xcom-232i: User Manual

V1.0.0

About the software

This document applies to the version of software V1.4.2 or higher of the Xcom-232i. It is possible to update the latest version available on "www.studer-innotec.com/support".

Legal Notice

The use of Studer Innotec SA devices is the responsibility of the customer in all cases. Studer Innotec SA reserves the right to make any modification to the product without prior notice.

Product recycling

The Xcom-232i conforms to the European directive 2002/95/EC on hazardous substances and does not contain the following elements: lead, cadmium, mercury, hexavalent chrome, PBB or PBDE.

To dispose of this product, please use the service for the collection of electrical waste and observe all applicable obligations according to the place of purchase.

Table of Contents

1. Introduction 7
1.1. The communication module Xcom-232i 7
1.2. Conventions 7
1.2.1. Symbols 7
1.3. Warranty and liability 7
1.3.1. Warranty and liability 7
1.3.2. Exclusion of warranty 7
1.3.3. Exclusion of liability 8
1.3.4. Compatibility 8
1.4. Safety precautions 8
1.4.1. Generalities 8
1.4.2. Warnings 8
2. Declaration of CE conformity 9
3. Dimensions 10
3.1. Views of different sides with dimensions 10
3.2. Exploded view 11
4. Installation 12
4.1. Mounting 13
4.2. Connecting the communication bus 13
5. Description of the communication module Xcom-232i 14
5.1. Front 14
5.2. Back 16
5.3. MicroSD card 16
6. The communication RS-232 17
7. Data logger 18
7.1. Functioning 18
7.2. Analysis and visualization of the data with the Xtender data analysis tool or with the Xtender Matlab® data analysis 18
8. Software(s) updating 19
8.1. Updating process 19

1. Introduction

1.1. The communication module Xcom-232i

Equiped with a serial port RS-232, the communication module Xcom-232i was designed for the remote communication with any SCADA system[1]. This module allows also the data logging (energy consumption of a systeme, state of the auxiliary relais, input currents and voltages, etc...) on a MicroSD card thanks to the function "Data logger".

1.2. Conventions

1.2.1. Symbols

⚡	This symbol is used to indicate the presence of a dangerous voltage that is sufficient to constitute a risk of electric shock.
⚠	This symbol is used to indicate a risk of material damage.
ℹ	This symbol is used to indicate information that is important or which serves to optimize your system.

1.3. Warranty and liability

1.3.1. Warranty and liability

During production and assembling, each Xcom-232i gets several controls and tests. They are carried out in full respect of fixed procedures. Each Xcom-232i is given a serial number allowing a perfect follow-up of the controls, in conformity with the specific data of every device. For this reason, it is very important to never remove the descriptive sticker bearing the serial number. The production, the assembling and the tests of each Xcom-232i are entirely carried out in our factory in Sion (CH). The warranty of this product depends on strictly following the instructions in this manual. The warranty period for the Xcom-232i is 5 years from the date of manufacture.

1.3.2. Exclusion of warranty

No warranty will be applied for damages caused by handling, operation or actions that are not described in this manual. Damages arisen from the following events are not covered by the warranty:

- Liquid in the device or oxidation due to condensation.
- Failures due to a fall or to a mechanical shock.
- Modifications made without the explicit authorization of Studer Innotec SA.
- Nuts or screws partially or insufficiently tight during installation or maintenance.
- Damages due to atmospheric overvoltage (lightning).
- Damages due to transport or improper packaging.
- Disappearing of original marking items.

[1] Supervisory Control And Data Acquisition

1.3.3. Exclusion of liability

Installation, commissionning, use and maintenance of this device can not be supervised by the company Studer Innotec SA. For this reason, we do not accept any liability for the damages, the costs or the losses generated either by an installation that is not conforming to the prescriptions, by a defectuous operation or by a poor maintenance. The use of this device is under the responsibility of the end-user. This device is neither designed nor guaranteed for the supply of life support applications or any other critical application with potential risks for human beings of for the environment. We shall assume no liability for patent infringement or other third party rights involved in the use of this device.

1.3.4. Compatibility

Studer Innotec SA guarantees the compatibility of the software updates with the hardware for one year, starting from the date of purchase. The updates are no longer guaranteed beyond this date and a hardware upgrade may be required. Please contact your reseller for any additional information on compatibility.

1.4. Safety precautions

1.4.1. Generalities

Do read carefully all safety instructions before proceeding to the installation and commissionning of the device. Not respecting these instructions might constitute a lethal physical danger but can also damage the functionnalities of the device. Therefore do keep this manual close to the device.

> Do, for any installation, follow strictly the local and national norms and regulations in force.

1.4.2. Warnings

- Wherever the installation, the person in charge of installation and commissionning must know perfectly the safety measures and the prescriptions in force in the country. Therefore, the whole maintenance must be carried out by a qualified staff.
- All components connected to this device must be conform to the laws and regulations in force. The persons without a written authorization from Studer Innotec SA are forbidden to do any change, modification or repair whatsoever. Regarding authorized modifications and replacements, only genuine components shall be used.
- This device is meant for a use only indoor and must under no circumstances stand in the rain, the snow or any other humid or dusty environment.
- In case of use in motor vehicles this device must also be protected against vibrations by absorbing components.

2. Declaration of CE conformity

The communication module (Xcom-232i) described in this manual is conform to the following norms:

- EN 55014
- EN 55022
- EN 61000-3-2
- EN 61000-6-3
- EN 61000-6-1

Studer Innotec SA
Rue des Casernes 57
1950 Sion
Switzerland
+41(0) 27 205 60 80
+41(0) 27 205 60 88
info@studer-innotec.com
http://www.studer-innotec.com

Sion, février 2011

Studer Innotec SA (R. Studer)

3. Dimensions

3.1. Views of different sides with dimensions

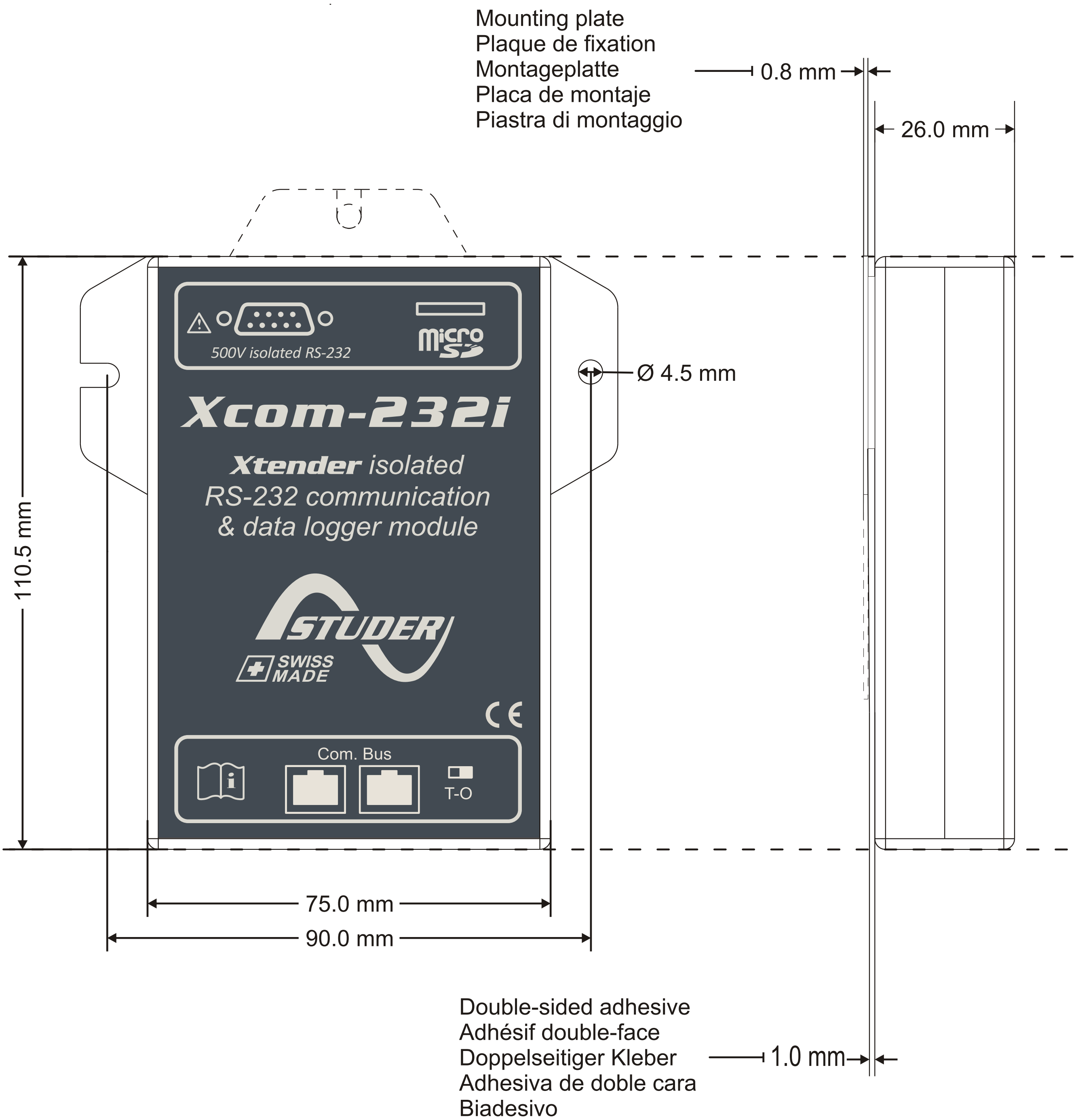


Figure 3.1. Views of different sides with dimensions

3.2. Exploded view

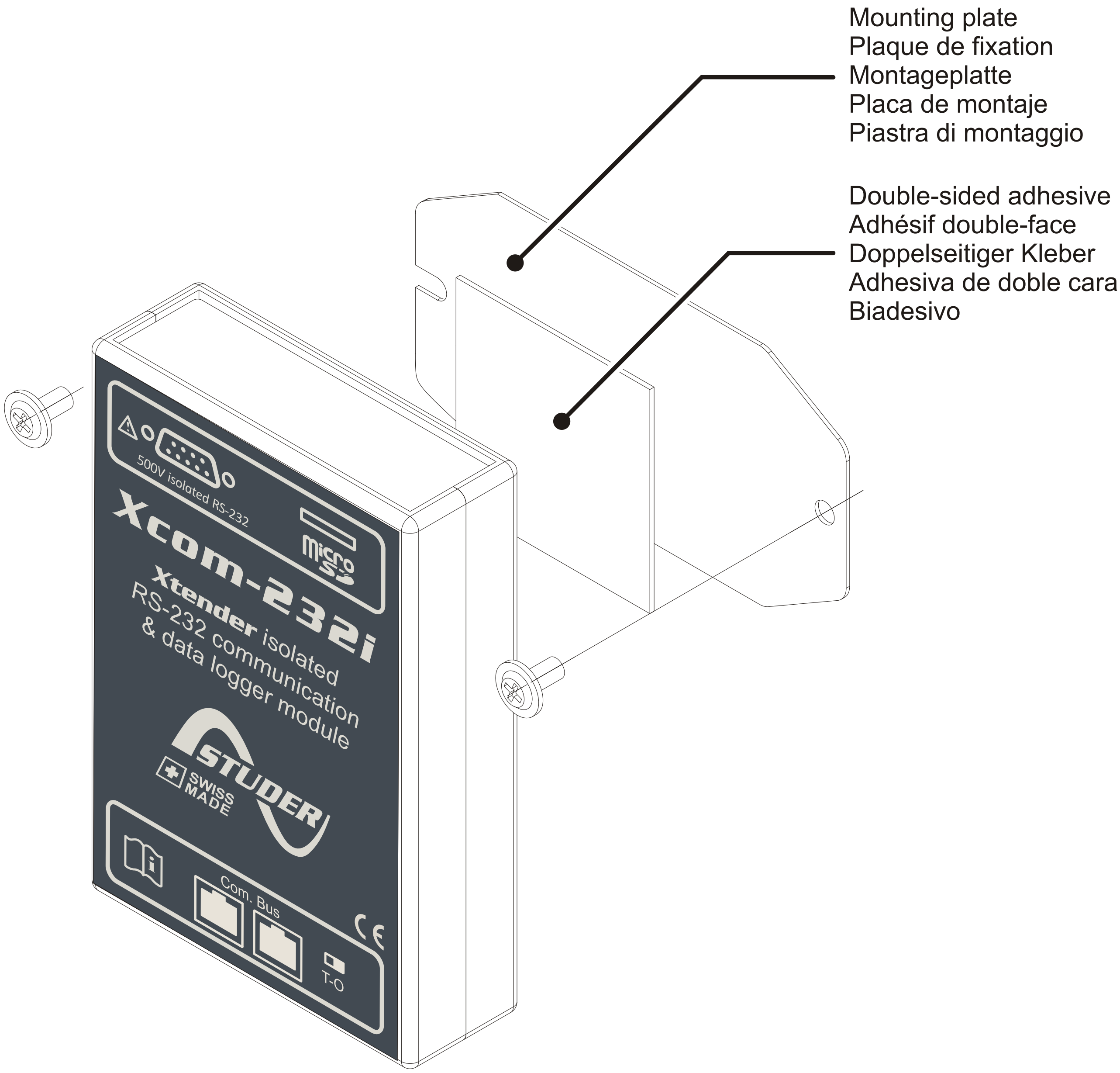


Figure 3.2. Exploded view

4. Installation

Due to the more restrictive limits of the connection RS-232 (compared to the connection on the Xtender communication bus), the Xcom-232i is meant for a mounting as close as possible to the supervision or SCADA control system (PC, programmable logic controller, microcontroller).

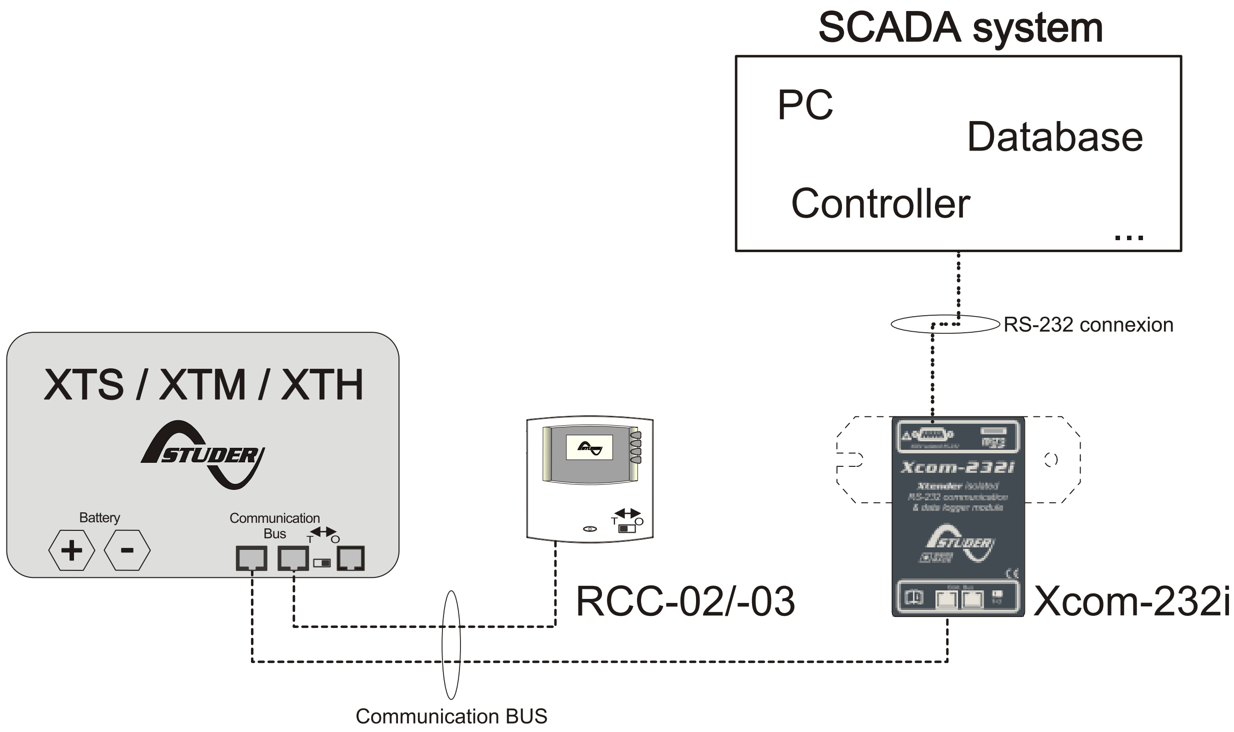


Figure 4.1. Connection schematics of the Xcom-232i (example 1)

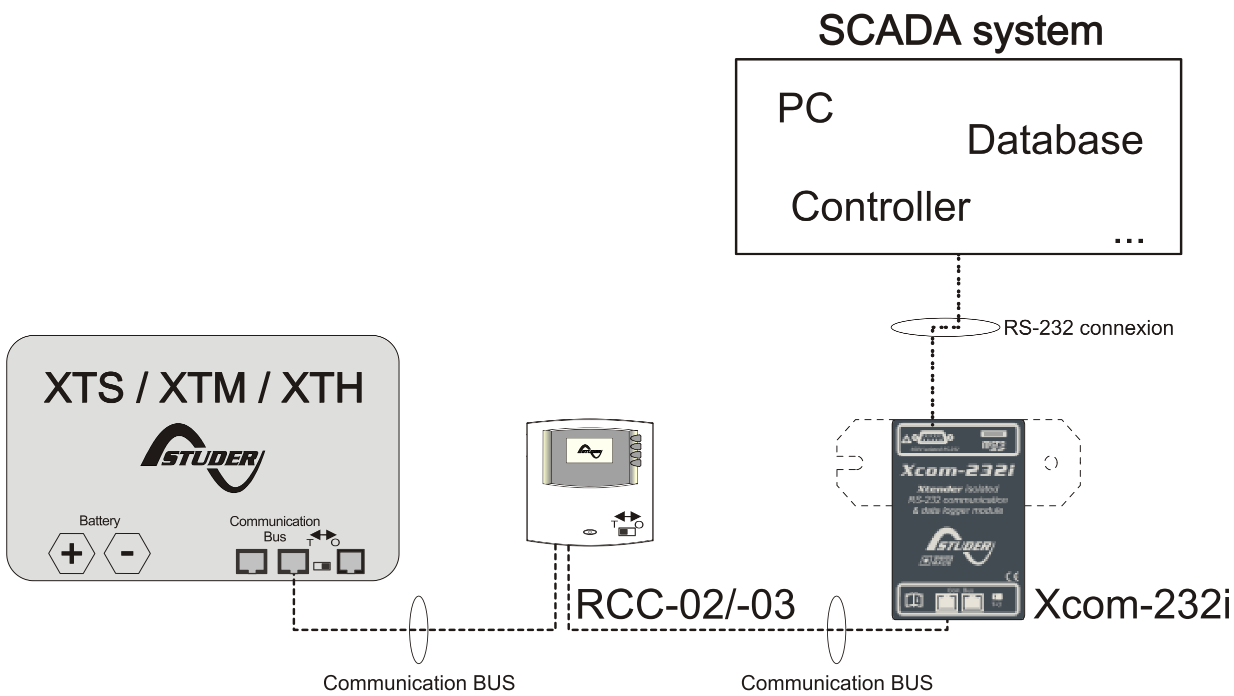


Figure 4.2. Connection schematics of the Xcom-232i (example 2)

4.1. Mounting

The Xcom-232i can be mounted directly on any support by means of the supplied fixing plate or on a bald surface with a double-side adhesive (see Figure 3.2 (p. 11)).

4.2. Connecting the communication bus

The devices of the Xtender range are equipped with a owned communication bus for data exchange, configuration and updating of the system. Connection is being made by linking the devices with the communication cables. One gets then a bus online where a linkend must be activated on the devices on each end, to obtain the configuration of the Figure 4.3 .

Each device is equipped with a switch offering to choose between open "O" or terminated "T". The devices at the end of the line must be set on "T". The others, receiving two communication cables, must be set on "O".

By default, the termination is activated on each product of Studer Innotec SA.

A wrong setting of the linkends can lead to an erratic running of the installation or impede its updating.

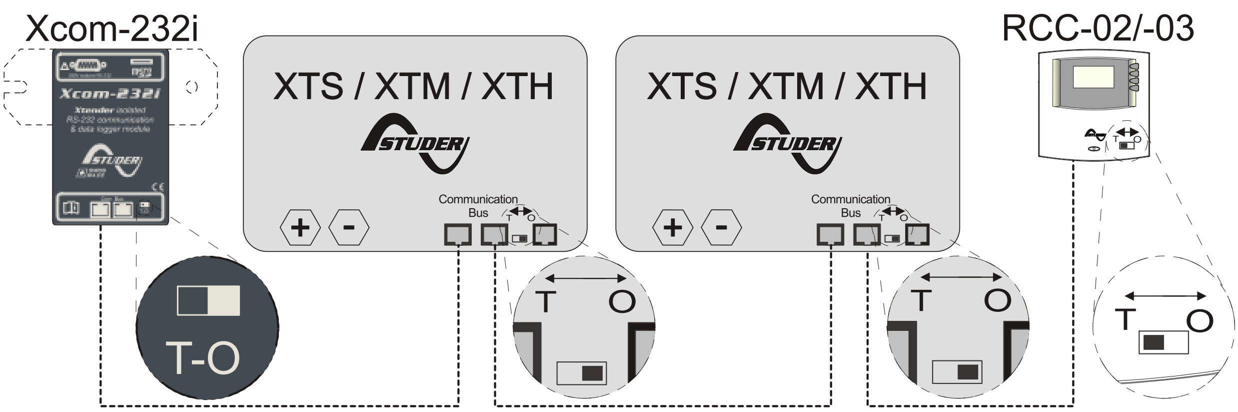


Figure 4.3. The communication bus on line of a system Xtender (example)

5. Description of the communication module Xcom-232i

The communication module Xcom-232i consists on its front and on its back of different parts with various functions. Here below, you will find the description of each part and of its function(s).

5.1. Front

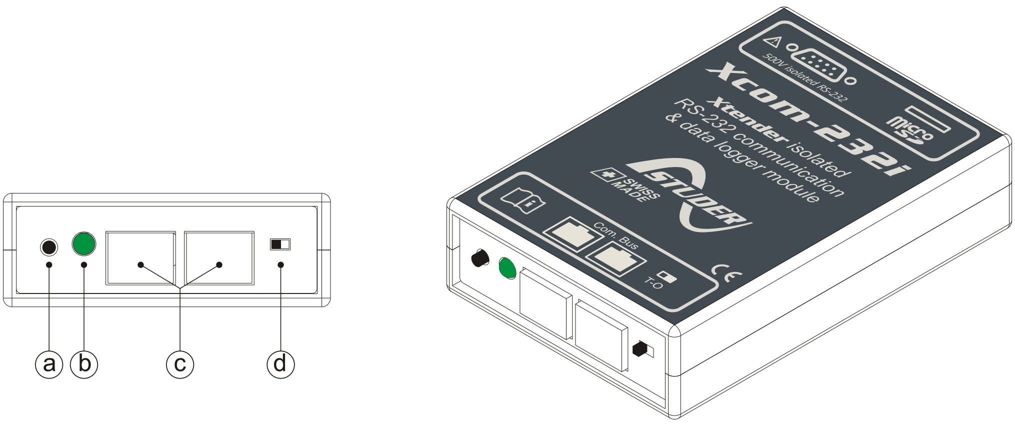


Figure 5.1. Front and isometric view of the Xcom-232i

Key	Description of the part	Description of the function
a	Push button	This button enables the activation/deactivation of the data logging function[i]. The function is activated or deactivated by pushing the button more than 3 seconds. When the data logging function is activated, the signalisation LED (b) is continuously green.
b	Bicoloured signalisation LED	The signalisation LED has different functions each corresponding to a specific colour and blinking frequency. Here below the detail of each function. **Update processing:** • Once the Xcom-232i is updated (after insertion of a MicroSD card containing the updating), the "red colour" signalisation LED blinks with a cyclical ratio of 50 % (Ton = 50 % | Toff = 50 %). The updating process can take between 3 and 15 minutes. During this period, it is possible that the signalisation LED does not meet exactly the cyclical ratio described above (Ton = 50% | Toff = 50 %). The updating will be completed as soon as the the "red colour" signalisation LED stops blinking for at least 5 seconds.

Key	Description of the part	Description of the function
		Error during updating: • If the Xcom-232i detects an error, the "red colour" signalisation LED lights continuously (Ton = 100 % | Toff = 0 %). **MicroSD card full:** • If the Xcom-232i detects that MicroSD card is full, the "red colour" signalisation LED blinks with a cyclical ratio of 10 % (Ton = 10 % | Toff = 90 %). **Data logging:** • When the data logging function is activated, the "green colour" signalisation LED lights (Ton = 100% | Toff = 0 %). **Communication (via RS-232 connection):** • When the communication via the RS-232 connection is active, the "green colour" signalisation LED blinks with a cyclical ratio of 20 % (Ton = 20 % | Toff = 80 %). If many of the 3 states indicated by the "red colour" LED are coming up simultaneously, they will be displayed in the following priority order: 1) "Update processing"; 2) "Error during updating"; 3) "MicroSD card full". If many of the 2 states indicated by the "green colour" LED are coming up simultaneously, the "Communication" signal is reversed (Ton = 80 % | Toff = 20%).
c	Connectors CAN	Connectors for the connection of Xcom-232i to one or several Xtenders.
d	Switch for the CAN termination	This switch allows to activate or not the the communication bus termination[ii]. The termination is activated by default on each product of Studer Innotec Ltd.

[i]See Chapter 7: “*Data logger*” (p. 18)
[ii]See Section 4.2: “Connecting the communication bus” (p. 13)

Table 5.1. Description of the communication module Xcom-232i - Front

5.2. Back

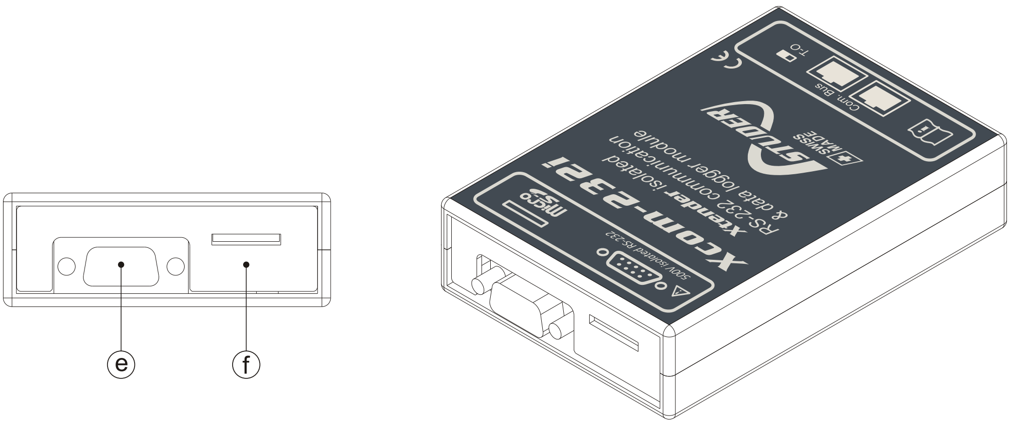


Figure 5.2. Back and isometric view of the Xcom-232i

Key	Description of the part	Description of the function
e	Connector RS-232	A cable RS-232 can be plugged to this connector and be used for the data transmission to systems SCADA[i].
f	MicroSD card reader	Card reader for the insertion of a MicroSD card for the data logging [ii] or the system updates [iii].

[i]See Chapter 6: “*The communication RS-232*” (p. 17)
[ii]See Chapter 7: “*Data logger*” (p. 18)
[iii]See Chapter 8: “*Software(s) updating*” (p. 19)

Table 5.2. Description of the communication module Xcom-232i - Back

5.3. MicroSD card

The Xcom-232i is equipped with a memory stick reader type MicroSD (Micro Secure Digital). This card, supplied with the Xcom-232i, allows among others:

- The updating of the whole system (Xcom-232i; Xtender; BSP) [1]
- The restoring of parameters or settings
- The data logging

> The system of card reading is guaranteed for the following types of cards:
>
> - MicroSD and MicroSD HC
>
> But it is incompatible for these types of cards:
>
> - MicroSD XC as well as cards with a capacity higher than 32 GB

[1] The updating of a remote control RCC-02/-03 or of another Xcom-232i must be done directly on the concerned device.

6. The communication RS-232

The Xcom-232i is a module equiped with a serial port RS-232, enables to be informed of the state of a system consisting of one or several Xtenders. It is then possible to read all data that can be displayed on the remote control basic screen and also to modify the configuration parameters via this serial port. An Xtender system can therefore be connected to various SCADA control and supervision devices (PC, programmable logic controller, microcontroller).

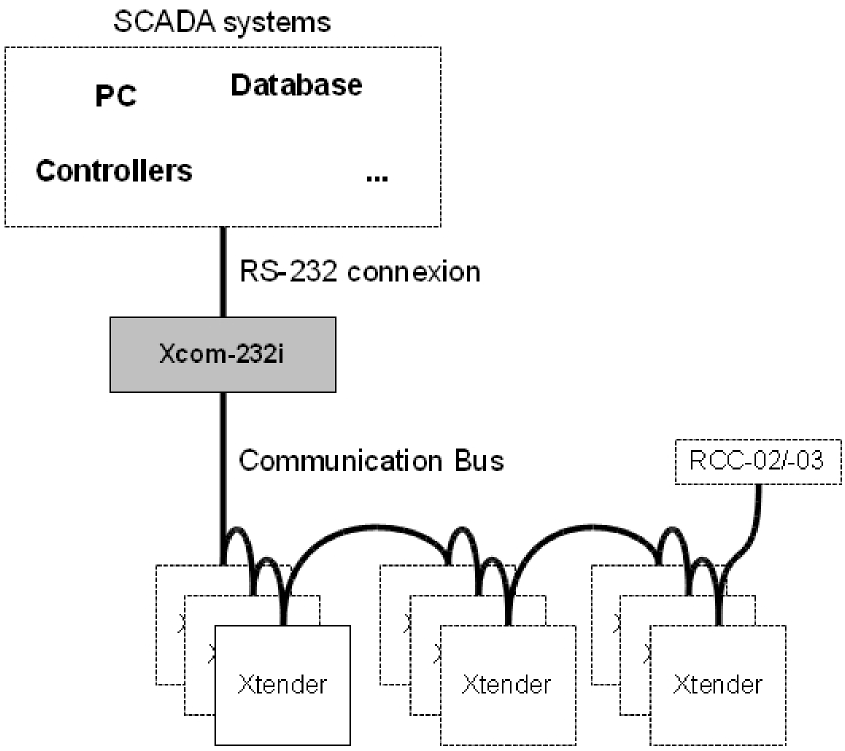


Figure 6.1. Principle schematics of a typical applicationt

From a more technical point of view, the interface RS-232 allows for instance the data transmission with GSM modems, RS-232 bridges to TCP/IP or also with long distance converters RS-422.

The specific protocol, easy, open and fully documented is available on request on www.studer-innotec.com/support (tab Protocol).

7. Data logger

The communication module Xcom-232i offers a function that allows to record many electrical values of your system over a long time. With this function you can for instance follow the energy consumption and the battery voltage, or see the power cuts, the state of the auxiliary relays, the input currents and voltages, the output powers etc… This enables you to work out statistics, to check the system operation or its sizing, to verify the loads behaviour, to anticipate or to detect failures.

> The function data logging of the Xcom-232i is deactivated by default.

7.1. Functioning

If the data logger is activated, a file is created at midnight every day on the SD card inserted in the remote control. This file contains the data of the Xtender system components as well as the recordings of the system electrical values, minute after minute. The file is registered in CSV format that can be read by many softwares. The file name integrates the date of the measure in this form: LGaammjj.csv.

> - In case no MicroSD card was inserted, the daily data will be lost.
> - The software updating of the Xcom-232i will lead to erase the daily data.

7.2. Analysis and visualization of the data with the Xtender data analysis tool or with the Xtender Matlab® data analysis

Attached to this function, Studer Innotec SA offers free of charge an analysis tool in the form of a file type Microsoft® Excel® 2007 which allows to read specifically the CSV files generated by the Xcom-232i. This tool shapes and gathers the data of each Xtender and then displays them graphically. In this way the data become readable and understandable at a glance.

A Matlab® script is also available. It enables to do analysis or to work out a possible simulation.These files can be downloaded for free on www.studer-innotec.com/support.

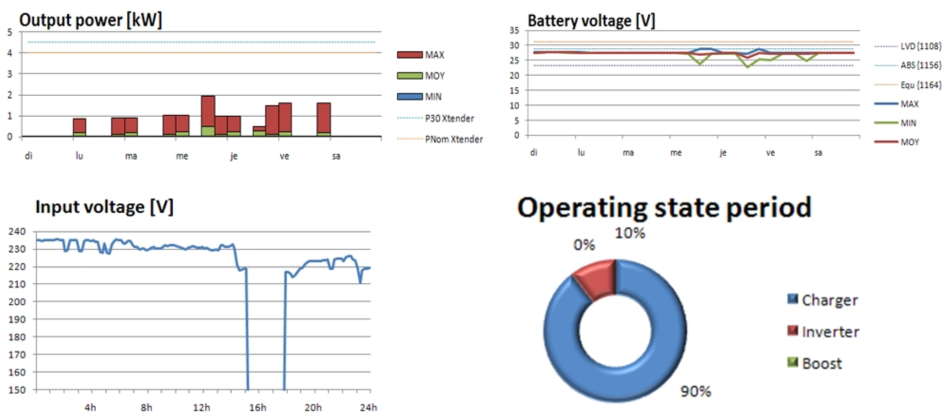


Figure 7.1. Overview of an analysis with the "XTENDER Data Analysis Tool"

8. Software(s) updating

The software of the communication module Xcom-232i as well as the softwares integrated in the inverter-chargers of the series Xtender, the battery monitors (BSP) as well as the communication bridge MPPT (Xcom-MS) can be updated in order to benefit from the new functionalities.

All softwares for updating are available in the technical area of our website www.studer-innotec.com/support.

8.1. Updating process

For more information about the updating process, do refer to the document "Updating procedure" available on: www.studer-innotec.com/support.

Before inserting the MicroSD card [1] to carry out an update, it is better to turn off all Xtenders (putting on "off"). If not manually done, the updating process will automatically stop all Xtenders connected to the communication bus.

To carry out an update, insert the MicroSD card (containing the last update software) in the slot of the communication module Xcom-232i. Prior to do the updating, the system checks automatically the compatibility between the device and the software present on the MicroSD card. The MicroSD card must not be removed until the end of the updating process. In case this process is interrupted, insert again the SD card to let the process carry on.

The updating process can take between 3 and 15 minutes. During this period, it might be possible that the signalisation LED does not respect exactly the cyclical ratio described[2]. The updating will be finished once the "red colour" signalisation LED stops blinking for at least 5 seconds continuously.

The updating of a remote control RCC-02/-03 or of another Xcom-232i must be done directly on the concerned device.

[1] or SD card for the RCC-02/-03
[2] see Chapter 5: "*Description of the communication module Xcom-232i*" (p. 14)

Studer Innotec SA
Rue des Casernes 57
1950 Sion
Switzerland
+41(0) 27 205 60 80
+41(0) 27 205 60 88
info@studer-innotec.com
http://www.studer-innotec.com