SAE IT-systems

FW-50 series5e Manual

Substation automation
Telecontrol system

This document is aimed at system administrators and those involved with the operation, diagnostics and installation of FW-50 series5e bay station controllers:

- net-line FW-50 series5e
- net-line FW-50-4 series5e
- net-line FW-50-14 series5e

Please follow the safety notices.

Our sales team in our Cologne headquarters will be happy to provide you with further information and technical details over the phone: +49 (0)221 59808-0.
In the case of technical problems, please contact our support hotline on +49 (0)221 59808-55.

Firmware using open source GPL/LGPL
The firmware contains open source code according to GPL/LGPL licenses. On demand, we provide you with the source code according to Section 3b of GPL and Section 6b of LGPL. It may be loaded from our service centre https://www.sae-it.com/Servicecenter.html. Alternatively, we mail a CD; in this case please contact us at marketing@sae-it.de.

Telecontrol & Substation automation
FW-50 series5e

Issue date	26.11.2018
File	Manual_FW-50-series5e_intermediate
Link	https://saeit-de.sharefile.eu/d-sfe93790c81244a68

Author:

TÜVRheinland ZERTIFIZIERT
Management System ISO 9001:2015
www.tuv.com ID 0091006152

Products from SAE IT-systems® GmbH & Co. KG have been certified to ISO 9001 since Nov 1996
Cert. reg. no.: 09 100 6152

CE

Table of content

7 Interfaces 95

8 Input/output cards 141

12 Appendix 215

1 Safety instructions

General

IMPORTANT: READ CAREFULLY BEFORE USE.
KEEP FOR FUTURE REFERENCE.
Current specifications can be loaded at any time - see the link on Page 2 or by request to marketing@sae-it.de.

This manual contains important information needed for the deployment and use of the product in the intended manner. It is targeted at qualified technical personnel with appropriate knowledge of automation or data transmission technology.

Qualified technical personnel are:

- Persons who are, in the capacity of project engineers, familiar with the safety concepts used in automation and data transmission technology
- Persons who have been trained in the operation of the unit or the facility as operating personnel, and who are familiar with the corresponding content of this manual
- Persons who have been trained as commissioning engineers / service technicians for such systems in accordance with safety technology standards

Safe operation requires a detailed understanding and technically correct implementation of the installation guidelines, safety information and functions described in this manual.
The components and units described can be employed in a wide variety of areas and facilities. It is therefore absolutely necessary to integrate their functions and the corresponding safety notes into the safety concept of the facility as a whole.

IT security according to BDEW whitepaper

Using a station within the scope of the BDEW whitepaper requires special consideration and application to avert the risks in accordance with the specifications and to satisfy the IT security policy of your company with regard to safe deployment. However, a full description goes beyond the scope of this document. A setup recommendation for safe operation can be found in Section **Fehler! Verweisquelle konnte nicht gefunden werden.** **Fehler! Verweisquelle konnte nicht gefunden werden.**
or via 'Checklist IT-Security' https://saeit-de.sharefile.eu/d-s3e1dbe802914ca4a.

It is imperative to follow the instructions in section Troubleshooting & installation guidelines on Page 39.

For specific questions in individual cases, please contact the support team on +49 221 59808-55.

Hazard warnings

Warnings highlighted specially with  serve to avert danger to the lives and health of personnel as well as material damage.

Warnings highlighted specially with  refer to a possible dangerous high voltage which may be harmful for the lives and health of personnel.

Signal words in accordance with DIN EN 82079-1:

DANGER: Denotes a hazard with a **high level of risk** which can result in severe injury or death when not averted.

WARNING: Denotes a hazard with a **medium level of risk** which can result in severe injury or death when not averted.

CAUTION: Denotes a hazard with a **low level of risk** which can result in minor injury as a minimum when not averted.

DANGER

Opening the housing exposes parts of the unit which may be carrying dangerous voltages.

WARNING

The bay station controller is designed for mounting on DIN top-hat rail NS 35, EN 60715 in the horizontal position, and is grounded by this contact. Ensure that adequate grounding is provided.

CAUTION

Adequate cooling of the bay station controller must be provided. The unit must be installed in the horizontal position for thermal convection. Ventilation grids must not be covered.
Operation outside the admissible ambient temperature range shortens the service life and may result in premature defects.

CAUTION

This is Class B equipment. It can be classified as Class A with expansion modules, and cause radio interference in residential areas. In such cases, the operator may be requested to take appropriate measures.

CAUTION

Supply voltages permanently exceeding 30V DC are not permitted and can trigger the internal safety components.
Exception: Signal and control voltages to 75V DC.

CAUTION

Hot swapping live system cards can result in blocking of the extension bus.

Project planning / installation guidelines

The following guidelines are intended to provide information about how to integrate the product safely in larger systems or installations.

- Individually applicable safety and accident prevention regulations must be followed.
- Units may only be operated continuously when installed and when the housing is closed.
- It must be possible to de-energise the products at all times (for a fixed connection, from an all-pole mains disconnector, and as required a fuse rated at 2.1*I_N for voltages exceeding 75V DC or for radio applications);
- PE connectors must be connected to the protective conductor.
- Please make sure that the supply voltage matches the specifications in the manual, and that tolerances are maintained.
- Malfunctions cannot be ruled out if values fall below or exceed the tolerances specified.
- In the event of power failures or power interruptions, ensure that the installation/system is not transitioned to a dangerous, undefined state.
- Supply cords (especially data transmission cables) must be chosen and installed so as to insure that capacitive and inductive interferences do not impair the facility / system. Adequate measures must be taken to ensure that line interruptions do not result in any undefined states.
- The products must be installed so as to prevent the unintentional triggering of functions.
- Wherever malfunctions can result in material damage or personal injury, additional external safety circuits must be in place (e.g. limit stop switches, mechanical locking devices, etc.)
- The safety of the product relies on appropriate transportation and storage, installation and operation.
- Product repairs may only be carried out by qualified personnel who are familiar with the contents of the manual
  (refer to Section "SERVICING").

Proper use

In accordance with the product information and/or the technical description, the components/the unit may only be used in a manner for which they are designed. The relevant safety standards were observed during the development, production, testing and documentation of the product. The product will normally not give rise to any risk of material or personal damage if the handling regulations and safety notes are observed.

Servicing

Products from SAE IT-systems GmbH & Co. KG (SAE) may only be serviced by SAE customer support or authorised personnel / companies. Only genuine SAE modules and components may be used. Customers are only authorised to replace modules in cases that are explicitly mentioned in the manual. This work must be carried out by qualified personnel. Standard parts such as fuses must correspond to the specified values. Please also take note of the applicable ESD guidelines for work on open devices and manual contact with circuit boards and electronic components.

Disposal

Disposal of the packaging (if any) and the used parts must be in line with the regulations in the country in which the device is installed.

As defined within the scope of EU legislation, equipment introduced to the market after 13/08/2005 must be disposed of in line with the WEEE Directive (new version: 2012/19/EU). This directive classifies equipment from SAE IT-systems into Category 9 (monitoring and control equipment). Our general terms and conditions regulate potential returns.

Material prohibitions in RoHS Directive 2011/65/EC

The revision of RoHS Directive 2002/95/EC and the resultant new version (2011/65/EC) mean the scope of this directive is extended further to include all electric and electronic products.

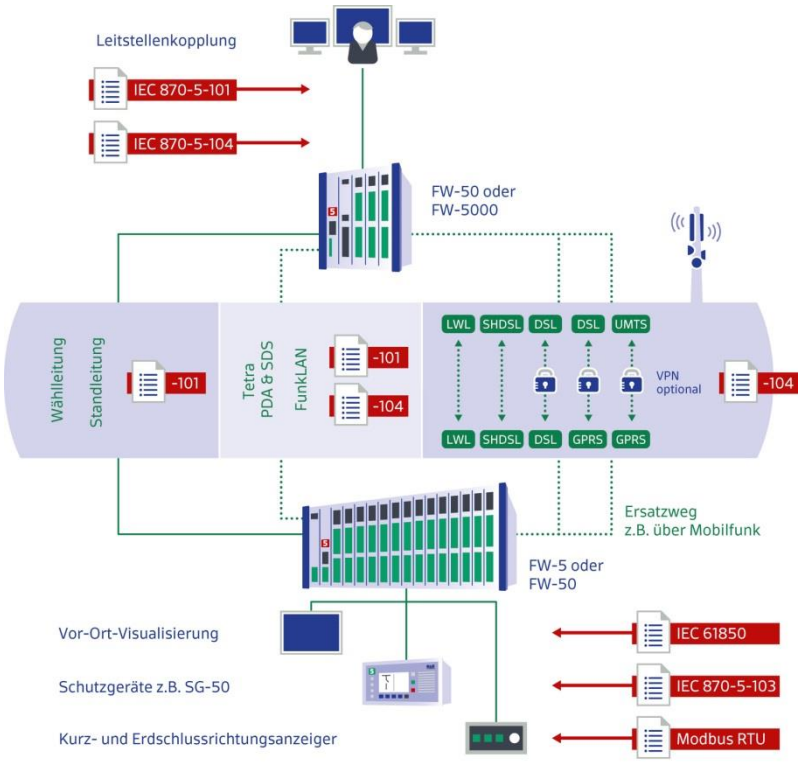
A transition period up to 22/07/2017 applies for SAE IT-systems equipment Category 9 (monitoring and control equipment). Thereafter, the banned substances from RoHS Directive 2011/65/EC enter into force for all newly sold equipment.

According to information from our sub-suppliers at the time, this document was written, no occurrences are known of SVHC substances of very high concern in our products which exceed the limit of notification.

2 System structure

Strengths of FW-50

series5e is a product series comprising advanced components proven in industrial use. These combine high performance and storage capacity with extremely simple handling for rapid integration in substation automation and power system control. Systems with series5e technology equipped with a stronger CPU, memory and functionalities are prepared to cope with todays needs of high IT-security.
The FW-50 series5e supplements the well-established range of FW-50 telecontrol systems with its optimum performance, extended functionality and outstanding ease of operation. Its variant BCU-50 was designed for substation automation equipment with high vibration, shock and isolation resistance according to IEC 61850-3.



Secure and stable

net-line FW-50 series5e is a universally applicable compact telecontrol station and router that offers a high degree of stability. It meets the demands of ambitious applications of communication and automation, ranging from small to large. The concept offers great modularity thanks to plug-in assemblies with a high degree of interference immunity. Its powerful function modules and convenient cross connections, flexible PLC functionality and integration of external components, such as the linking of protective units via IEC61850 or IEC 60870-5-103, enable it to be put to optimum use as e.g.:

- **Station and bay controller**
  in medium and high-voltage switchgears in bay and power system control
- **Monitoring and control unit**
  Utilities industry, waste management and industry in general
- **Data acquisition and communication system**
  in traffic and infrastructure applications

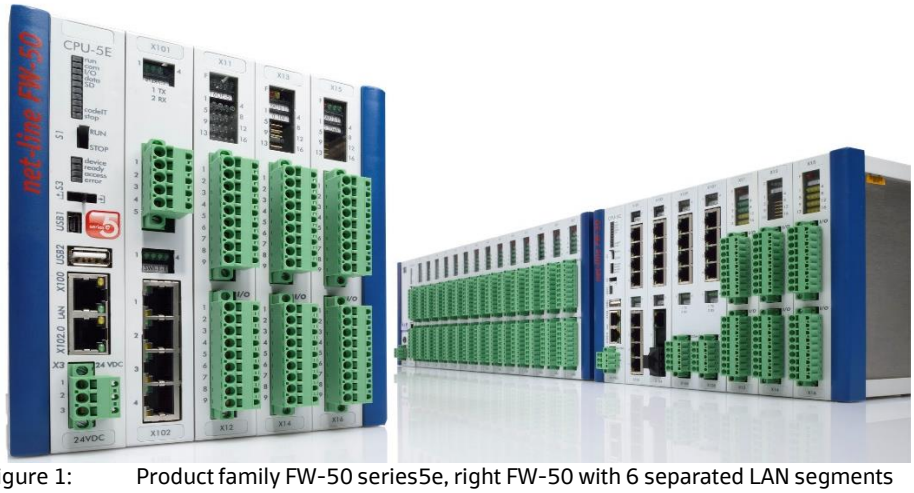


Figure 1: Product family FW-50 series5e, right FW-50 with 6 separated LAN segments

Advantages of the new series

As a genuine expansion of the product range, net-line FW-50 series5e is downward compatible with the successful FW-40 system. All known components of this successful telecontrol system can be used as an input/output card or communication components.
The number of communication channels and capacity of the system have been increased considerably. The highly integrated CPU-5E with ARM-technology, the optimised bus system and the multi-channel use of both autarkic TCP/IP network segments over integrated switches facilitate enhanced communication skills. This allows powerful integrations into structured networks with IEC61850 as well as into existing telecontrol systems (IEC 60870-5-10x) or optionally constructed fieldbus systems.

The latest series5e technology

What does the "e" offer?

The communication requirements of a telecontrol / station control system in an intelligent network are becoming increasingly demanding. At the same time, greater demands are being made of network security - greater dangers from unauthorised access and manipulation are arising due to increased levels of networking. To meet these requirements, we have implemented a yet more powerful processor core in the series5e technology.

The series5e is fully downwards compatible with the series5 and series5+. With a yet more powerful process core, the series5e boasts at least three times the performance of the series5+ with its general computing power alone. For computing intensive applications, more benefits are realised by the integrated FPU floating point unit. For purposes of distinction, the symbol on the left can be found on all new products.
The new technology is deployed in these telecontrol units:

- net-line FW-5 series5e
- net-line FW-5-GATE series5e
- net-line FW-5-GATE-4G
- net-line FW-5-GATE-450
- net-line FW-50 series5e
- net-line BCU-50 series5e
- net-line FW-5000 series5e

Increased performance of the series5e
series5e products offer better performance and greater memory depths:

- Full upward compatibility to series5+
- New, hardened Linux kernel security
- Secure platform for high levels of IT security to BDEW whitepaper
- Front LED for VPN-tunnel, interfaces and system
- 1200 MIPs RISC CPU with up to 3 times the processing speed
- 1 GB memory, 512 MB RAM / 512 MB Flash
- Real-time clock backed up with lithium ion cell for min. 60 days
- 512 KB SRAM backed up, 8 MB NOR Flash for reliable boot processes

Note: **setIT Version 5.004 or higher is required to use the series5e**

In addition to the exclusively technical hardware updates, numerous software functions can be used in the new releases:

setIT V5 features

series5e products offer better performance and greater memory depths:

- Complex integration of standard protocols for:
  - IEC 61850 client and server [e], GOOSE messages [e]
  - IEC 60870-5-104
  - IEC 60870-5-101/- 103
  - DNP3 server
- Protocol converter mode for conversion without process data configuration
- SMART meter link over SML or IEC 62056-21 meter protocol
- DSfG interface
- Various field buses, such as Modbus RTU/TCP, Profibus-DP, 3964R and MPI
- SNMPv3 protocol for status messages from network components
- Extensive upgrades of the redundancy concept
- Selective archive query via IEC-101/-104
- Flexible archive exports
- Some prerequisites for secure operation as per the BDEW whitepaper:
  - IPsec IKEv1/IKEv2 and OpenVPN for secure VPN tunnel
  - RBAC role-based access control user administration for setIT and web server with role assignments as per BDEW whitepaper
  - SYSLOG: central logging of operational messages and processes Syslog filter [e] and Syslog process data indications [e]
  - setIT and embedded system patch management concept
  - ...

[e] series5e only

Products

The system FW-50 series5e is so variable that a division in the router or special equipment with fixed interface allocations cannot be presented transparently in the clear product types. Therefore, only a uniform product description, "FW-50", has been chosen. Nevertheless a differentiation was necessary due to the different housing sizes. As well applications as a router with 6 separated LAN segments and 4 serial interfaces is possible.

Different housing sizes are available, depending on the expansion, size and application. The FW-50 series also remains variable; it enables a free product choice from:

- **net-line FW-50** Standard housing of FW-50 with up to 7 I/O cards
- **net-line FW-50-4** Housing with up to 4 I/O cards
- **net-line FW-50-14** Housing with up to 14 I/O cards

Figure 2: FW-50 series5e in BGT-M with 6 LAN segments, 2 serial interfaces and I/O cards

Product overview

The modular concept of FW-50 series5e enables a custom-fit selection of system cards for the respective application. A large number of input/output modules and interfaces as well as a huge selection of software functions adapts the performance of the system to its requirements. If there is insufficient capacity, bigger racks can be used or very large capacities can be provided in a station by cascading several racks.
A setIT licence is required for configuration see **Fehler! Verweisquelle konnte nicht gefunden werden.** S. **Fehler! Textmarke nicht definiert.**. Additional run-time licenses may be required depending on usage.

net-line FW-50

The units described here are ready-to-use sets comprising:

- FW-50 racks
- CPU modules
- Base software for series5/series5+ run-time system
- Power Supply (using BGT-L /FW-50-14)

with the equipment features stated. These basic sets must be assembled with the desired interfaces and I/O cards and equipped with software functions configured with setIT. The technological development - to provide appropriate IT security in particular - led to an evolution of the CPU modules which are taken into consideration in the following sets. The CPUs are designed upward compatible and can be used in all racks; see note.

Item no.	series5e with CPU-5E	Function
310050080007	net-line FW-50-4 series5e	FW-50 CPU-5E with 4 slots., BGT-S
310050140107	net-line FW-50 series5e	FW-50 CPU-5E with 7 slots., BGT-M
310050140208	net-line FW-50-14 series5e	FW-50 CPU-5E with 14 slots., BGT-L

Item no.	Rack & accessories	Function
310050000005	rack BGT-S USB	housing with 4 slots with USB link without front panel
310050000105	rack BGT-M USB	housing with 7 slots with USB link without front panel
310050000205	rack BGT-L USB	housing 14 slots with USB link without front panel
310004006100	DIN-mount comfort BGT-S	FW-50 Din rail mount
310004006200	DIN-mount comfort BGT-M	FW-50 Din rail mount
310004006300	DIN-mount comfort BGT-L	FW-50 Din rail mount
310004003111	DIN-mount forFW-50 BGT-L	Din rail mount 2 Stck.
310004003000	Wallmount FW-40/FW-50	Wall mount 4 pieces
310004003200	19"-mount for BGT-L	19"-frame forFW-40-13/FW-50-14
310004003300	19"/4HE mount frame BGT-S /M	with reserve for DIN-rail TS35
310050011450	CPU-5E, FW-50 series5e 1 GB	CPU-5E with e335, 512 MB RAM, 512MB Flash
310050011510	series5 memory /archive SD 1 GB	SD Karte with 1 GB forFW-5 & CPU-5B/-5C/-5E

Software & Drivers

Item no.	Item	Function
310050015000	setIT V.5 DemoExtended 30 days	Demo version for setIT V5
310050015010	setIT V.5 single user licence (SUL)	Single user licence
310050015110	setIT V.5 multiple user licence (MUL)	Multiple user licence, per additional user
310050015210	setIT V.5 Company user license (CUL)	Company user license
310050014000	visIT V6 Designer Demo	visIT Designer demo version
310050014010	visIT V6 Designer L-E	Designer SUL 1000 days per station
310050014050	visIT V6 Designer MUL	visIT Designer MUL, network dongle
310000176000	codeIT PLC programming software (SUL)	Single user licence
310000176100	codeIT multiple user licence (MUL)	Multiple user licence
310000176200	codeIT company user licence (CUL)	Company user license
310000176300	codeIT DemoExtended 30 days	codeIT demo version
310050011101	codeIT runtime FW-5 (IEC-61131-3)	Runtime for codeIT (64 kB) Variant 2
310050010010	net-line Grundsoftware series5 BGT-S	Betriebssystem series5
310050010040	net-line Grundsoftware series5 BGT-M	Betriebssystem series5
310050010000	net-line Grundsoftware series5 BGT-L	Betriebssystem series5
310050501000	net-line Grundsoftware BCU-50	Betriebssystem BCU-50
310004010400	net-line driver for IEC-870-5-101/104	Included in the basic software
310004010800	net-line driver for 3964R/RK512	Included in the basic software
310004010900	net-line driver for Modbus	Included in the basic software
310004010910	net-line driver for DSfG	Interconnection of external device
310050010020	net-line driver for IEC-870-5-103	Protective coupler, 1x IEC 60870-5-103
310050010101	net-line driver for IEC-61850 FW-5	For FW-5-xxx
310050010200	net-line driver for SML	From series5+
310050010300	net-line driver for IEC 62056-21	From series5+
310050010400	net-line driver for DNP3 server	From series5+
310050010600	visIT runtime FW-5	Visualisation system runtime

net-line FW-50

The FW-5 is available as different variants. The new series5e technology offers additional performance increases. Further versions are possible following customers' requests.

Design	Modular station control system, telecontrol system and automation plastic/V2A/Alu rack with 4/7/14 slots for integrated I/O and communication components
Configuration	**FW-50** examples: **Max. inputs/outputs** 14 I/O slots (up to 224 dedicated I/O) 2 Ethernet 10/100BaseTx auto-MDIX **Max. communication** 6 switch integrated with 4 RJ-45 100 Mbit/s or 2 RJ-45+ 2 FO FC connectors each 4 serial interfaces 1 communication components e.g. fieldbuses
Input/Output	Selection of more than **50 plug-in cards** for: Single-point, double-point, transformer step indications, measured values and integrated totals, single/double commands (1.5/2-pole), command termination, 1 of n monitoring, set-point values, integrated total outputs
IT-Security	● **BDEW Whitepaper** ● **Firewall** with hardened Kernel ● **End-End Tunnel via VPN** IPsev IKEv1/IKEv2, OpenVPN* ● **SYSLOG Server** ● **Systemcommands** fort empor. release of diagnostic ports ● **signed Firmware and Database**
Communication	**2** **Ethernet LAN** TCP/IP, 10/100BaseTx, auto-MDIX, auto negotiation **4** **additional LAN segments** via switches with internal USB# **4** **serial interfaces**, modularly configured, galv. isolated: RS-485, RS-422, RS-232, WT-12/96, MOD12, BBM, TTY additional serial interfaces via LWL-2* extendable up to 28 FO-links/ starcoupler -103 **2** **USB service and diagnostic interfaces** USB unit with DHCP-Server USB 2.0 host 12 Mbit/s (configuration/archive via memory stick)
Protocols	● **IEC 61850** Stationsbus, client/server ● **IEC 60870-5-101** Fernwirk-, Feldleittechnik ● **IEC 60870-5-103** Schutzgerätekopplung ● **IEC 60870-5-104** Leitstellenkopplung TCP/IP ● **DNP3** server Telecontrol, seriell/UDP ● **IEC 62056-21** Zählerschnittstelle (ehem. IEC 1107) ● **SYM²**/SML Zählerschnittstelle über Netzwerk ● **DSfG** Schnittstelle für Gas ● **SNMP/SNMPv3** Router-Statusmeldungen auslesen ● **https/FTPs** Sichere Kommunikation ● **IPsec IKEv1, IKEv2** Verschlüsselungen /VPN-Tunnel ● **SYSLOG** zentraler Meldeserver ● **Modbus** RTU/TCP Master/Slave ● **MPI / 3964R**/RK512 S7-Kopplung ● **HHH** Horstmann GSM-Reporter ● **NTP- /DCF-Uhr** Synchronisierung
PLC programming	**IEC 61131-3** compatible programming via codeIT, memory 128 kB

may use same ressources, * ab setIT V6

net-line FW-50 overview
Compact, scalable bay station controller in FW-50 housing for modular configuration with communication components and input/output cards at 4, 7 or 14 I/O slots for the direct link-up of single-point/double-point/step position information, integrated totals, measured values, and single/double/regulating step commands, command termination with 1 of n switching commands (1.5 + 2-pole), set point values and flexible data cross-connection/inter-communication in the network.

High-performance Ethernet integration in up to 6 isolated network segments (when using CPU-5C and SWI-2-x) via integrated switches each with 4* 10/100BaseTx or FO +10/100BaseTx; up to 4 serial interfaces for linking via IEC 60870-5-10x protocol to integrate protective units via IEC 61850, IEC 60870-5-103 protocol, smart meter 62056-21, SML, SNMP or external bay station controllers with fieldbuses Profibus-DP, Modbus, DSfG and MPI.
Assembly DIN top-hat rail, wall and rear wall.
Supply voltage 24 V DC, 60 V DC, others via SV-6 or upon request.

net-line FW-50-4 overview
like FW-50 with 4 slots

net-line FW-50-14 overview
like FW-50 with 14 slots

Communication

A wide range of external communication modules using communication channels and protocols established on the market are available.

Protocols

- TCP-IP coupling for integration in networks at 10/100 BaseTx
  - IEC 61850 client and server
  - IEC 60870-5-104
  - IEC 62056-21 over IP
  - DNP3
  - SML
  - Modbus TCP
  - http/https, FTP/FTPs
  - SNMP/SNMPv3
  - VPN tunnel IPsec, OpenVPN[#6]
  - other services such as NTP, ...
- serial on RS-485, CL or V.24 /EIA/RS-232 depending on availability
  - IEC 60870-5-103 Interconnection of protective equipment
  - IEC 60870-5-101 Bay station controller interconnection
  - IEC 62056-21 Meter connectivity
  - DSfG
  - Modbus RTU/ASCII
  - MPI /3964R-RK512
  - PPP protocol

External communication units

- TCP-IP coupling for integration in network
  - GPRS/EDGE *
  - SHDSL*
- RS-485
  - Application of star couplers for linkage of protective equipment
- V.24 /EIA/RS-232
  - Dial-up modem analogue*
  - GSM*
  - ISDN adapter*
  - VFT modem*
  - Serial GPRS link*
  - TETRA packet data*
  - Profibus-DP master/slave*
  - ...

* External module required, [#6] from setIT V6

3 Comissioning

Configuration & diagnostics

All net-line systems are configured and diagnosed with the integrated setIT configuration tool. Combined with the new capabilities of series5/series5+/series5e, the functions provided here feature market-leading technology which enables intuitive setup and reliable startup, together with powerful diagnostics.

series5 offers multiple options for configuration and diagnostics:

- An SD card assumes configuration
- USB host for speedy performing and backup of configuration and archives from USB memory stick
- TCP/IP network connection, internet connection
- USB device as configuration/diagnostics interface USB 2.0 cable

The setIT tool is available in user-oriented license models:

Product	License model
310004013700	setIT Demo Extended 30 days • Test licence, limited to 30 days
310050015010	setIT V.5 single user licence (SUL) • Single user licence + advanced diagnostics
310050015110	setIT V.5 multi user licence (MUL) • Multi user licence for simultaneous use n times, full version with advanced diagnostics
310050015210	setIT V.5 company user license (CUL) • Company user licence, full version unrestricted use

The relevant usage and license conditions apply EULA.

Milestones in commissioning and maintenance

The real-time operating system renders possible the quantum leap to an open system featuring new milestones in terms of speed, memory depth and ease of use. A USB memory stick can be used to update the configuration and system within seconds, or to read and save existing systems and archives as backups.

There are also new means of performing system download and diagnosis. The high-speed upload for instance uses the http internet protocol to load stations quickly and without barriers – both locally and globally*. Diagnosis via web server offers immediate control of the system status and process values all the way to interface analysis; this does not require a setIT licence and can be accessed from any laptop.* For reachable network access from system

- High speed load via network connection or internet
- USB memory stick for speedy startup and updates
- Backup of configuration, system and archives to USB memory stick

Archive memory expansion via SD card (to 8 GB)

Automation with PLC programming

The optional soft PLC offers additional flexibility and allows many kinds of PLC programs to be implemented. Programming is with codeIT, a program from the family of CODESYS automation tools. The PLC data model is embedded in the capacity of the remote terminal unit. The PLC capacity can be integrated statically or selectively.

Product	License model
310050011101	codeIT runtime IEC-61131-3 FW-5 • runtime für codeIT (64 kB) Variante 2
310000176000	codeIT PLC-Programming Single (SUL) • Single User License
310000176100	codeIT Multi-User License (MUL) • License for n- users at a time,
310000176200	codeIT Company License (CUL) • Full License without restriction
310000176300	codeIT DemoExtended 30 Tage • Test licence, limited to 30 days

4 Installation instructions

Troubleshooting & installation guidelines

Telecontrol systems from SAE IT-systems GmbH & Co. KG (SAE) are state-of-the-art electronic devices. Both the mechanical structure and the setup of electronic components are designed for industrial applications.
It is nevertheless imperative to take certain essential measures when installing these units in order to ensure their smooth operation.

Please take note!

Earthing

Interference voltages injected into the unit via the supply and signal line and electrostatic voltages transferred by touching are diverted to the earthing point (PE terminal of the power supply connection).

This earthing point of the DIN top-hat rail must be connected to station earth with a low-resistance copper conductor which is as short as possible (min. 4 mm^2) or must be included in equipotential bonding.
If this is neglected, all measures taken within the unit for reaching a high resistance to damage and interference may be rendered partly ineffective.

When selecting the installation site, make sure the greatest possible distance to electromagnetic interference fields is observed. This is particularly important if frequency converters are in place. In certain circumstances, it may be advisable to seal off any interference-creating devices with pass partition plates.

Inductive loads in the vicinity (e.g. contactor, relay and solenoid valve coils) must be fitted with snubbers (e.g. RC snubber circuits) if they share the same power supply.

The power supply and data line(s) should be realised so as to keep interference away. This can be done, e.g., by not laying the cables parallel to the high-voltage power lines that are likely to cause interference.

Surge protection

To increase isolation and protection against surges, supply lines (of interfaces in particular) can be configured with appropriate upstream surge protection. For FSK modems MOD12, WT12, WT96 and the baseband modem, a combination of transformer (AF line transformer/AF transformer) and surge protection is recommended.

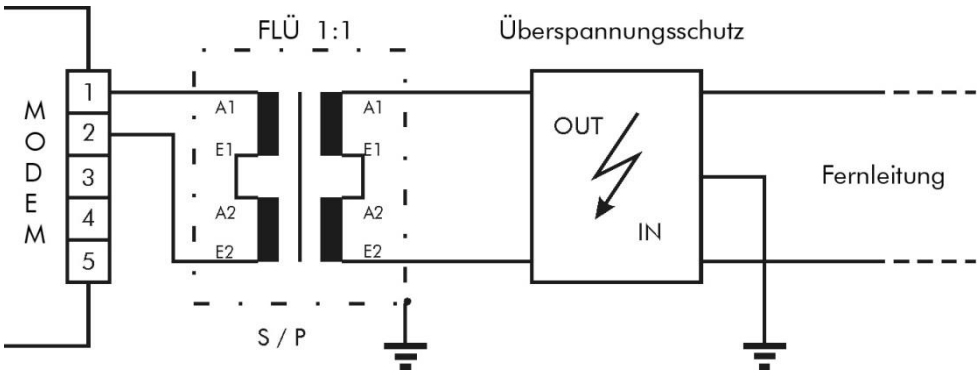


Figure 3: Example surge protection and baseband transformer in front of telecom modem

Shielding lines

Shielding is an important measure for weakening (attenuating) magnetic, electric and electromagnetic interference fields.

Shielding methods

When using shielded lines, only use lines with **braid** if possible (>80% coincidence recommended).
Avoid cables with **foil shielding** as the foil does not shield all frequencies uniformly. In addition, tension and pressure loads can damage foil shields during installation or operation and thus become ineffective.

One-sided or double-sided shielding connection

Using **double-sided shielding** is generally the only way of guaranteeing ideal reduction of all interference frequencies.

One-sided shielding can be more favourable when:
- a potential difference occurs and equipotential bonding is not possible
- there is foil shielding

Shielding connection

A low-impedance link to the protective conductor or protective conductor rail is essential to prevent the interference currents fed into the cable shielding from becoming sources of interference themselves.

We recommend stripping the shielded cable as a continuous strip and applying it to ground.
The shielding end at the interface is not re-applied in this case.
With this type of shield you should use cable clamps made of metal which comprehensive enclose the shielding braids and establish a good contact.

Serial interfaces

All serial ports with fixed reference potential (such as RS-232/V.24, TTY) should be connected with shielded cables.

Analogue inputs

Analogue inputs should always be connected with shielded lines.

Selection of cabinets

Please consider the following criteria for the selection and dimensioning of cabinets:

- Environmental operating conditions at the installation location of the cabinet
- Required distances for substation automation and telecontrol systems
- Total power dissipation of components contained in the cabinet

Ambient conditions on site (e.g. temperature, humidity, chemical evaporation, explosion hazard) predict the required protection category (IPxx) of the cabinet.

Appropriate ambient temperature and cooling

Cabinet dimensions must ensure that the telecontrol systems are not exposed to ambient temperatures exceeding 70°C.
The temperature range can also be limited to below 50°C depending on configuration, activation and variant. The temperature sensor in the FW-50 series5e enables you to check the temperature in the inlet air in the housing. Self-heating means a temperature typically exaggerated by +10°K is measured - this can be calibrated with a calculated value.

Possible measures:

- Installation preferable in the lower area of the cabinet
- Sufficient air for convection (on the left of the base system in particular)
- Closed cabinet with natural convection and forced recirculation via fan
- Cabinet with open-circuit ventilation via natural convection
- Closed cabinet with heat exchanger

CAUTION Devices may be damaged!

Adequate cooling of the bay station controller must be provided. The unit must be installed in the horizontal position for thermal convection.
Ventilation grids must not be covered.

Operation outside the ambient temperature permitted shortens the service life and may result in premature outage.

Example of ambient temperature:
At a cabinet ambient temperature of 30°C and a typical difference of 20°K between outside and inside temperature of the cabinet (for maximum permitted power loss of all internal components), a temperature of 50°C is reached inside the cabinet. For other temperature differences, refer to the temperature characteristics provided by cabinet manufacturers.

5 Mounting a telecontrol station

Installation guidelines

The housing of the FW-50 system is designed for wall-mounting, mounting to DIN top-hat rail or for installation in base frames or cabinets. The mounting dimensions can be derived from the following sections.

According to UL/CSA and EC Directive 73/23/EEC (Low Voltage Directive), installation in a cabinet, housing or enclosed operating room is required in order to satisfy the guidelines for electrical safety.

Under extreme environmental operating conditions, particularly, when using telecontrol systems in cabinets, it might be necessary to install a fan module to optimise the air flow.

Modules with high self-heating

Modules were developed for the telecontrol system FW-50 which demonstrated higher self-heating due to the stipulated requirements and performances.
If these cards are operated with their max. power consumption, additional air flow needs to be provided. This air flow should take place from the bottom of the telecontrol unit housing.

Module	Restrictions
4AA12-1	At ambient temperatures of >40°°C and without additional recirculating air no more than 50% of the output channels should be statically controlled with 20 mA.
16RA-1	At ambient temperatures of >40°°C and without additional recirculating air not more than 50% of the card relays should be statically tightened.

Maintaining minimum distances

During installation in cabinets or housings it must be ensured that the internal cabinet temperature does not exceed the maximum operating temperature specified for the unit.

It must take specific minimum distances between the FW-50 system and neighbouring equipment into consideration.

These minimum distances are need during mounting and operation

- to assemble and disassembly system cards, taking down the individual front panels
- to ensure the air flow needed to heat the modules during operation

The following image shows which minimum distance you must provide for a telecontrol station (here FWR-40).

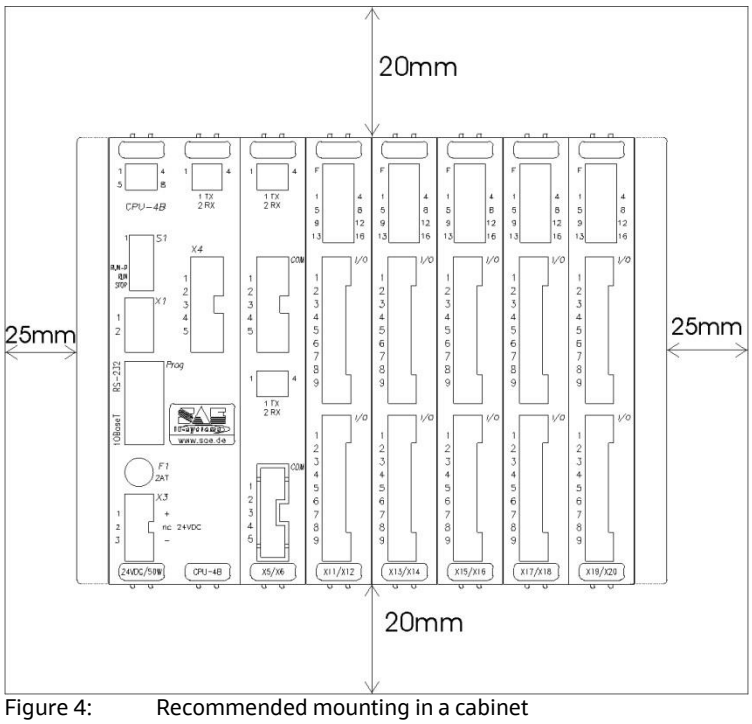


Figure 4: Recommended mounting in a cabinet

For the use of modules with high power consumption (e.g. RA16) we recommend scheduling bigger distances than those displayed above.

Housing mounted one below the other

If several FW-50 systems are mounted in the same cabinet or racks, additional distances need to be maintained and/or air flow/recirculating must be provided between the individual housings.
Depending on the cabinet size and thermal dissipation loss within the cabinet, the minimum distance of 20 mm between two housings mounted above one another can be increased to the necessary minimum distance of 60... 80 mm.

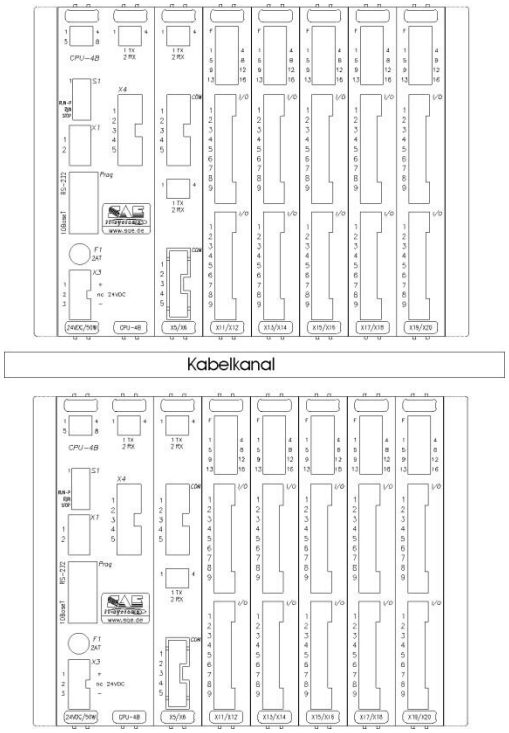


Figure 5: Recommendd mounting in a cabinet

Connecting telecontrol system with local ground

Connect the housing with the local ground. For this purpose, flat plugs 6.3 mm are provided on the left and right wall of the housing. If possible, use the flat plug on the left side. Here, there is a low impedance connection to the noise filter of the telecontrol system.

Minimum cross section of the cable to the local ground: 2.5 mm²

For an improved low impedance connection in a heavily disturbed environment, we recommend a cross section of 6 mm².

Cable cross section	Flat plug 6.3 mm
1.0 .. 2.5 mm²	according to DIN 46245
2.5 .. 6.0 mm²	according to DIN 46245

The racks FW-50

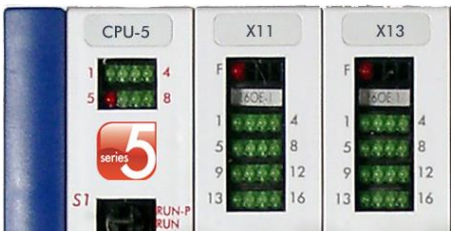
Upgrade from FW-40 to FW-50

Due to the downward compatibility of FW-50, upgrading from net-line FW-40 plants with new racks is possible by simply exchanging the CPU hardware.
At older stations with FW-40-x-G housings, the bus board also had to be changed.
In these cases we recommend replacing the entire rack for economic reasons.
An upgrade of vario units is not provided.

Characteristics to differentiate the new racks

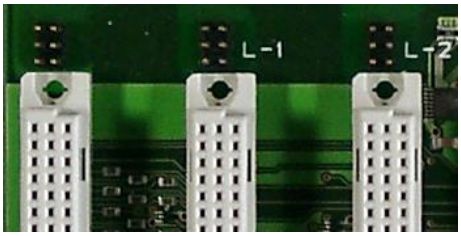
A visual differentiation of series5 housing types to older versions is possible via:

a) the inscription on the upper label border with X terminal designation
b) printing the slot numbers (U-1, U-2 ... and/or L-1, L-2) on the bus board
c) the plug "functional earth" on the bus board (similar to a jumper field)
d) a fully equipped plug connector from position L1 to L7



Inscription of the upper terminals

Screen printing the slot numbers



Functional earth plug

Bus boards and racks

Bus board BGT-S

Figure 6: Bus board of BGT-S for FW-50-4 and FW-40-3

Bus board BGT-M

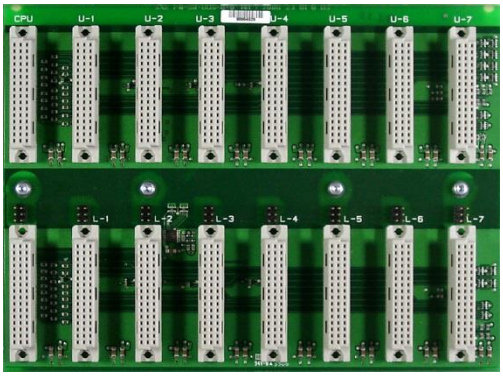


Figure 7: Bus board of BGT-M for FW-50 and FW-40

Bus board BGT-L

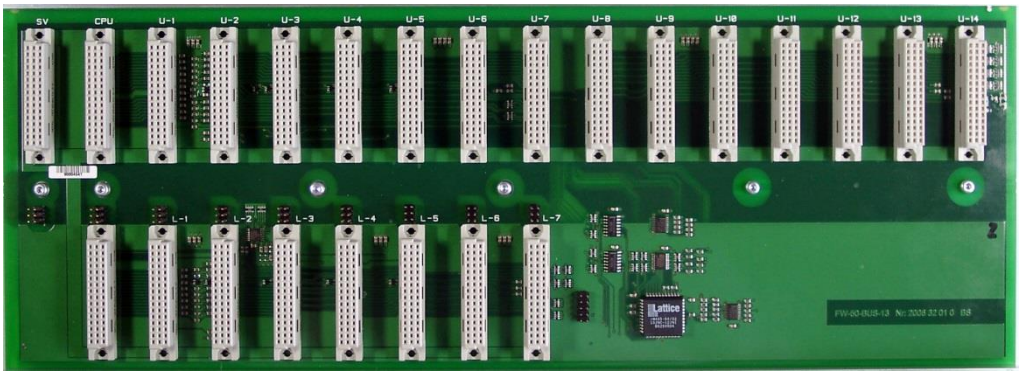


Figure 8: Bus board of BGT-L for FW-50-14 and FW-40-3

Slot designation of the bus boards

A uniform designation of the plug connectors in the system is required in order to ensure a distinctive reference because the configuration of the system is openly designed. This is uniformly printed on all housing types on the bus boards in a legible manner:

- Each row of plug connectors has a designation
  U = upper (top) and L = lower (bottom)
- Each slot (slot) has got a number, apart from CPU and the PS, where applicable

Terminal designation

The designation of the terminals via Xn (according to IEC1346-1 and DIN EN 40179-2:1978) is determined, as has previously been the case, by the type of card and position inside the housing. However, there is a new structured numeration:

- The upper row of connectors are odd numbered, the lower ones have even terminal designations.
- The upper terminals are separately labelled by the upper label

Terminal designation for communication cards for FW-50

- Terminals for interfaces and communication channels start with X100.
- The communication channels are connected before the input/output modules (viewed from the left).
- The communication channel designations have fixed positions from slot numbers U1 (X101) to L7 including (X114).

Slot	PS	CPU	1	2	3	4	5	6	7	8	9	10	11	12	13	14
U	PS	CPU-5	X101	X103	X105	X107	X109	X111	X113	-	-	-	-	-	-	-
L	PS	24 V DC	X102	X104	X106	X108	X110	X112	X114	-	-	-	-	-	-	-

Fixed terminal designations of the communication channels; here with maximum assignment at FW-50-14

FW-50-14 (BGT-L large = PS + CPU+ 14 slots)
FW-50 (BGT-M medium = CPU+ 7 slots)
FW-50-4 (BGT-S small = CPU+4 slots)

see also Bus boards and racks P.1

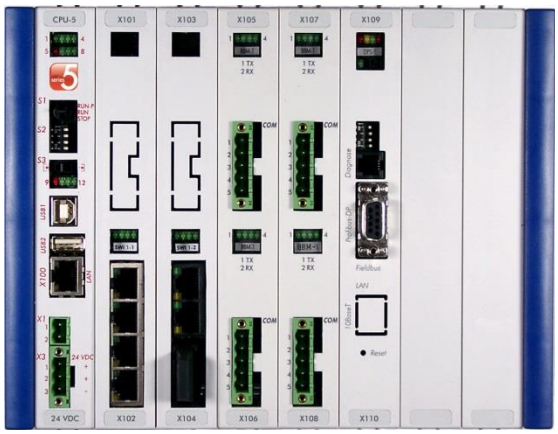


Figure 9: Example - net-line FW-50 with CPU-5 and pure router

Fixed position of switch modules

CPU-5 supports two separated Ethernet interfaces with their own address spaces (network segments). The fixed positions for the connector of the networks are preset.

- The first Ethernet interfaces is located on the front panel of CPU-5 at X100.
- The second Ethernet interface is available via a switch at position X102.
- If the first Ethernet interface should also be operated via a switch, it can be changed from X100 to X104 (L-2).
  The connector at X100 is without function.
- When using a CPR-5C with the new BGT-x-USB racks, 4 additional SWI-2-x switches can be positioned at X101/X103/X105/X107. The switches create a new network segment via USB.

Positions of serial modules

Overall the FW-50 provides four serial interfaces; two in the U segment and two in the L segment of the bus. Furthermore, as is the case with FW-40, the channels are available via jumpers on the interface modules.

- The terminal designation is no longer rigidly fixed; it is dependent on position in the system. This is determined according to the use of switch cards and customer's (extension) requests.
- At the positions U-1 to U-4 and L-1 to L-4 (X101 to X108) a reset signal for selective reinitialisation of the modules is available. Therefore, these positions are especially suitable for serial interfaces.
- In the rear bus segment of FW-50-14, the serial interfaces are not available from U/L-8 onwards.

Terminal designation for I/O cards

- Input/output terminals start at any position after the communication terminals, latest at U-8/L-8.
- Free slots for extensions are possible.
- The designation of input/output terminals X11/X12ff is compatible with the current system. In the new racks, the uneven terminals X11ff are glued in the upper label.

Slot	PS	CPU	1	2	3	4	5	6	7	8	9	10	11	12	13	14
U		CPU-5	X11	X13	X15	X17	X19	X21	X23	X25	X27	X29	X31	X33	X35	X37
L		24 V DC	X12	X14	X16	X18	X20	X22	X24	X26	X28	X30	X32	X34	X36	X38

Input/output cards in series5 racks (here maximum allocation)
In the area of slot 1 to 8, the position X11/12 can be pushed to the ➔ right: input/output modules can start at any position (reserve for expansions).

FW-50-14 (BGT-L large = PS + CPU+ 14 slots)
FW-50 (BGT-M medium = CPU+ 7 slots)
FW-50-4 (BGT-S small = CPU+4 slots

Recommendation for a CPU selection

CPU-5C is the state-of-the-art and most powerful CPU of series5+ generation. It offers the highest immunity, the biggest memory for an intensive IEC 61850 communication and the availability to use up to 6 LAN-segments with SWI-2 devices in BGT-x-USB racks.

CPU-5C is the recommended choice for FW-50 but a sole exception:
Regrettably the serial interfaces in the lower bus at position L1-L4 may not be supported with good performance as needed for protocols IEC 60870-5-101 and -103 in a strict manner. The internal UARTs receive all data, but do not allow an appropriate character to character timeout management. Hence, a snychronisation to a new frame may not be operated according to the standard. A redesign of the device was started, but may not be delivered before 2017.

To avoid problems in the fields, we decided, to give a warning while using these protocols on the lower interfaces starting with setIT V5.000.06. In these cases, we recommend to use CPU-5B+.

CPU-5B+	CPU-5C	**Funktion**
●	●	IEC 61850 simple usage
○	●	IEC 61850 intensive usage
-	●	more than 2 LAN segments
●	○	IEC 61870-101/-103 protocol on lower slots L1-L4
●	●	one serial interface on lower slot with none 870-5 protocol
●	○	two serial interfaces on lower slot with none 870-5 protocol

○ restricted functionality

Overview of CPU cards in racks

All components are developped upward compatible. The later release may be equiped with additional features. Full functionality of a CPU may only be used in new racks. The table below gives an overview of possible application.

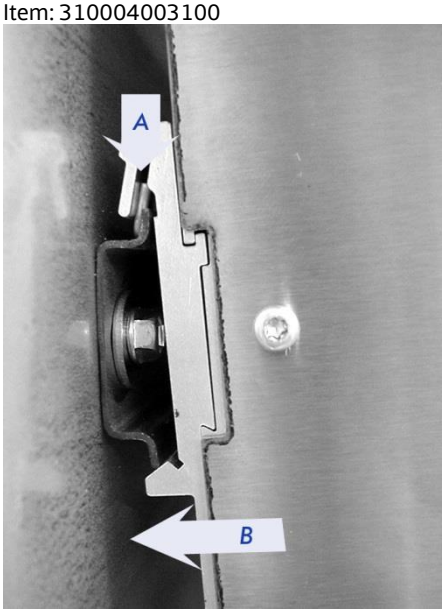
Baugruppenträger	CPU-1	CPU-4B	CPU-5	CPU-5B	**CPU-5B+**	**CPU-5C**
FW-40-3/6/13-G	○ FW-40	● FW-40	-	-	-	-
BGT-S	○	●	●	●	●	-
BGT-M	○	●	●	●	●	-
BGT-L	○	●	●	●	●	-
BGT-S USB	○	●	●	●*	●*	●*#
BGT-M USB	○	●	●	●*	●*	●*#
BGT-L USB	○	●	●	●*	●*	●*#

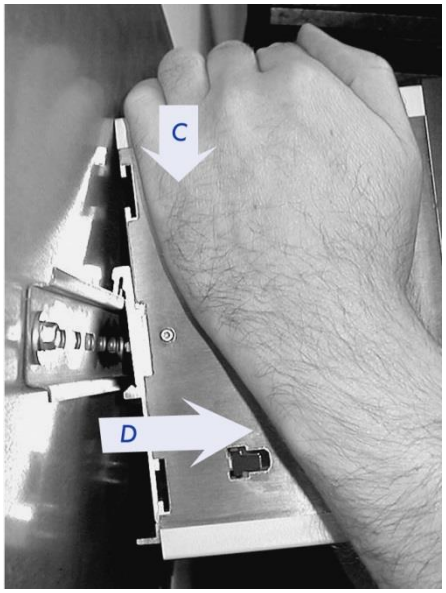
○ easy-line FW-40 ● net-line FW-40
● FW-50 series5 ● FW-50 series5+
* PPP-Mode (GPRS) at X102, X104, X106, X108 with GSM-2
# 4 additional LAN segments via SWI-2 at X101, X103, X105, X107

Fastening the telecontrol system

There are different mounting options available:

- **Wall mounting with screwed latches**
  The 4 screw latches are inserted sideways to the external carrier section of the FW-50 an fastened to the wall with a screw.
  Item: 310004003000
- **Back wall mounting**
  The housing is screwed to a back wall from the back using 4 screws. Item: 310004003300
- **Mounting using DIN top-hat rail**
  The 2 top-hat rail modules are inserted to the middle carrier section and each fastened with a screw* and/or delivered fully assembled.
  Item: 310004003100





The unit is mounted by snapping into the DIN top-hat rail.
Mounting: Hold unit sideways and position from above.
A correct fitting of the spring is essential - spring must be behind the top-hat rail!
Push unit downwards (***A***) and finally allow it to snap in place (***B***)
Dismantling: Hold unit sideways from the top,
using pressure push downwards (***C***) and tilt the front upwards (***D***).
Remove unit from the mounting plate.

- Installation in a 19“ cabinet/frame (only for FW-50-14)
  Both installation angles are inserted sideways into the carrier section of FW-50 and fastened to the housing with one screw* and/or delivered completed assembled. The assembling into 19" frame is executed as customary.
  Item: 310004003200
- Installation in 19"/4HE mounting racks BGT-S/M
  Even the smaller racks BGT-S and -M can be implemented in 19" frames. For this purpose, the BGT is placed in a stainless steel installation tub with 19" mounting tongues. The assembling into 19" frame is executed as customary. Item: 310050003300

* Please use only the screws provided and delivered for the intended purpose. Otherwise there is a risk of carrier section breaking.

New DIN Rail mounting

A new mechanic for a quick mounting and release is avaiable. By four screws the kit will be fixed to the rear wall of the RTU. For mounting, it will be hooked at the rail-hat and locked by the clamp.
The mounting kit is the same for all housings; using BGT-L will need 2 kits Article: 310004003111 DIN-rail mounting for FW-40/FW-50 BGT-L.

Figure 10: DIN rail mounting Article 310004003110 view from rear side

Mounting in 19‘‘-cabinet/rack (FW-50-14 only)

Both mounting brackets are pushed from both sides into the carrier of FW-50 and fixed each with a screw* to the housing unlkess they are delivered ready prepared.
The integration in 19" frame is as usual.

Mounting in 19"/4HU frame BGT-S/M

The smaller housings BGT-S and -M as well may be mounted into a 19"-frame. The housings are fixed in a staneless steel carrier with 19"-mounting holes.
The integration in 19" frame is as usual.

* Please only use the screws, delivered with the mounting unit. Otherwise the carrier may be damaged.

Articleno.	Article	Remark
310004003000	Wall-mounting series FW-50	wall-mounting flange
310004003110	DIN rail mounting for BGT-S/M	DIN mounting for FW-50-4/FW-50
310004003111	DIN rail mounting for BGT -L	set of 2
310004003300	19"/4HU frame for BGT-S /M	with reserve space for DIN-TS35
310004003200	19"/4HU frame for BGT-L	19"-mounting for FW-50-14

Rack dimensions

The dimensions and mounting options of FW-50 racks are equal to those of the FW-40 series.

Rack BGT-M (FW-50)

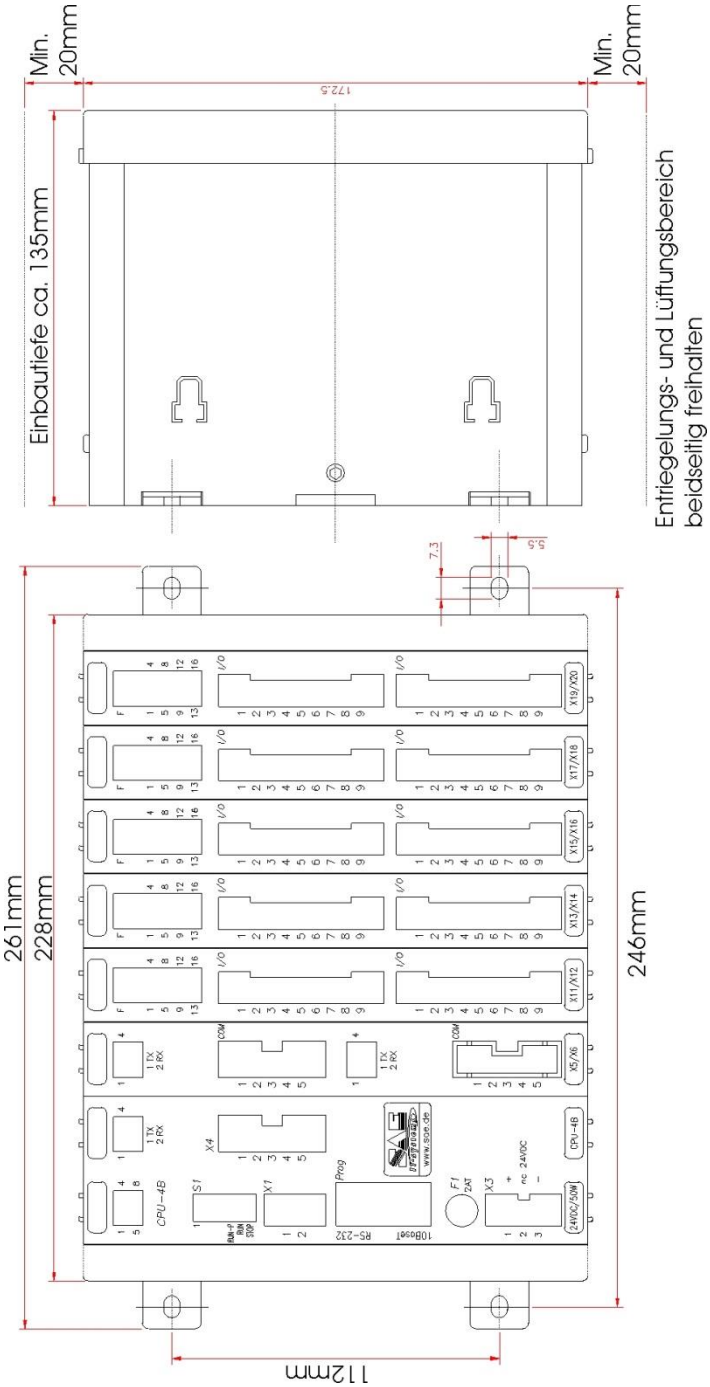


Figure 11: Housing dimensions and wall mounting in BGT-M here FW-40 system

Racks BGT-S (FW-50-4)

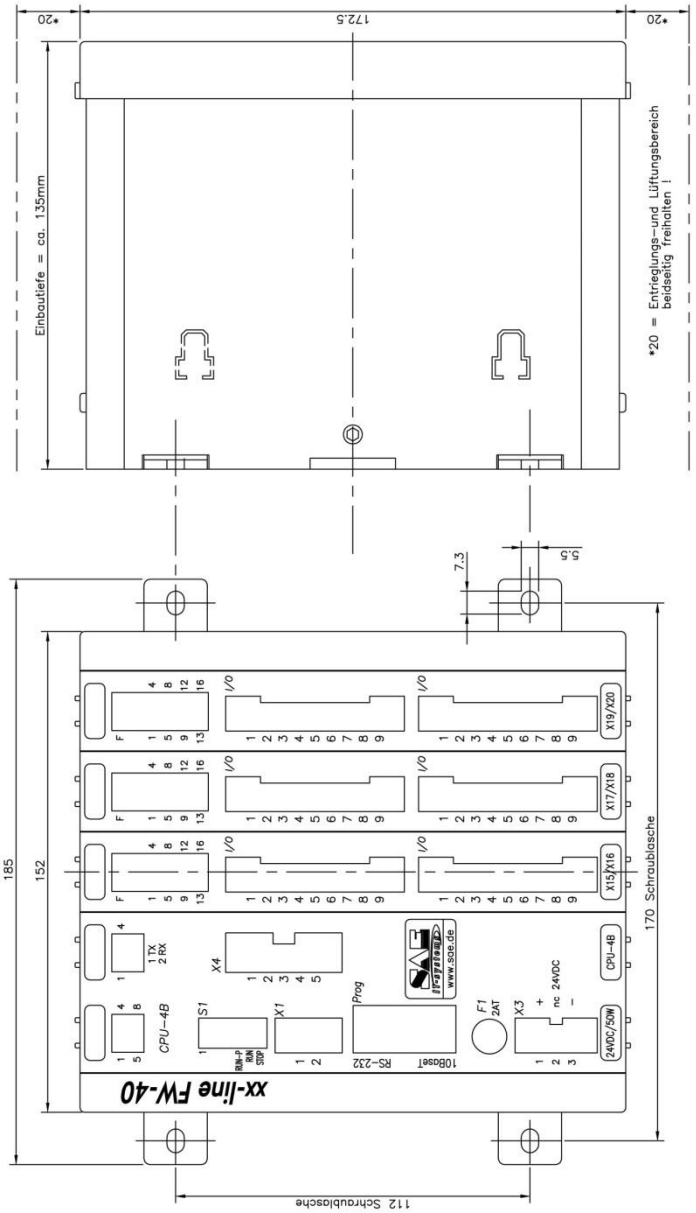


Figure 12: Housing dimensions and wall mounting in BGT-S, here FW-40 system

Racks BGT-L (FW-50-14)

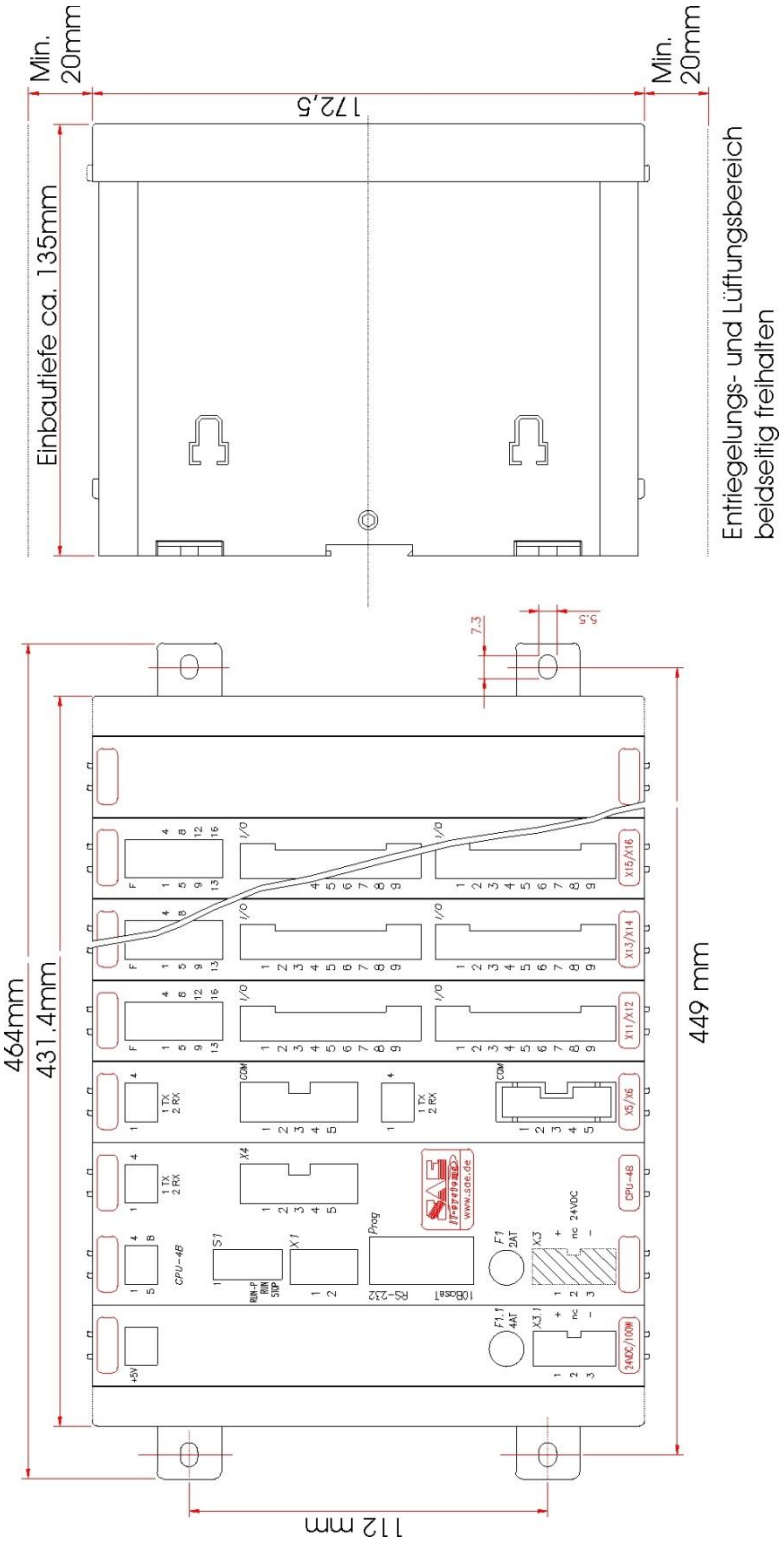


Figure 13: Housing dimensions and wall mounting in BGT-L here FW-40 system

Mounting in 19" rack

Rack BGT-L is used with 19" mounting angles.
(see also Fastening the telecontrol system p. 55)

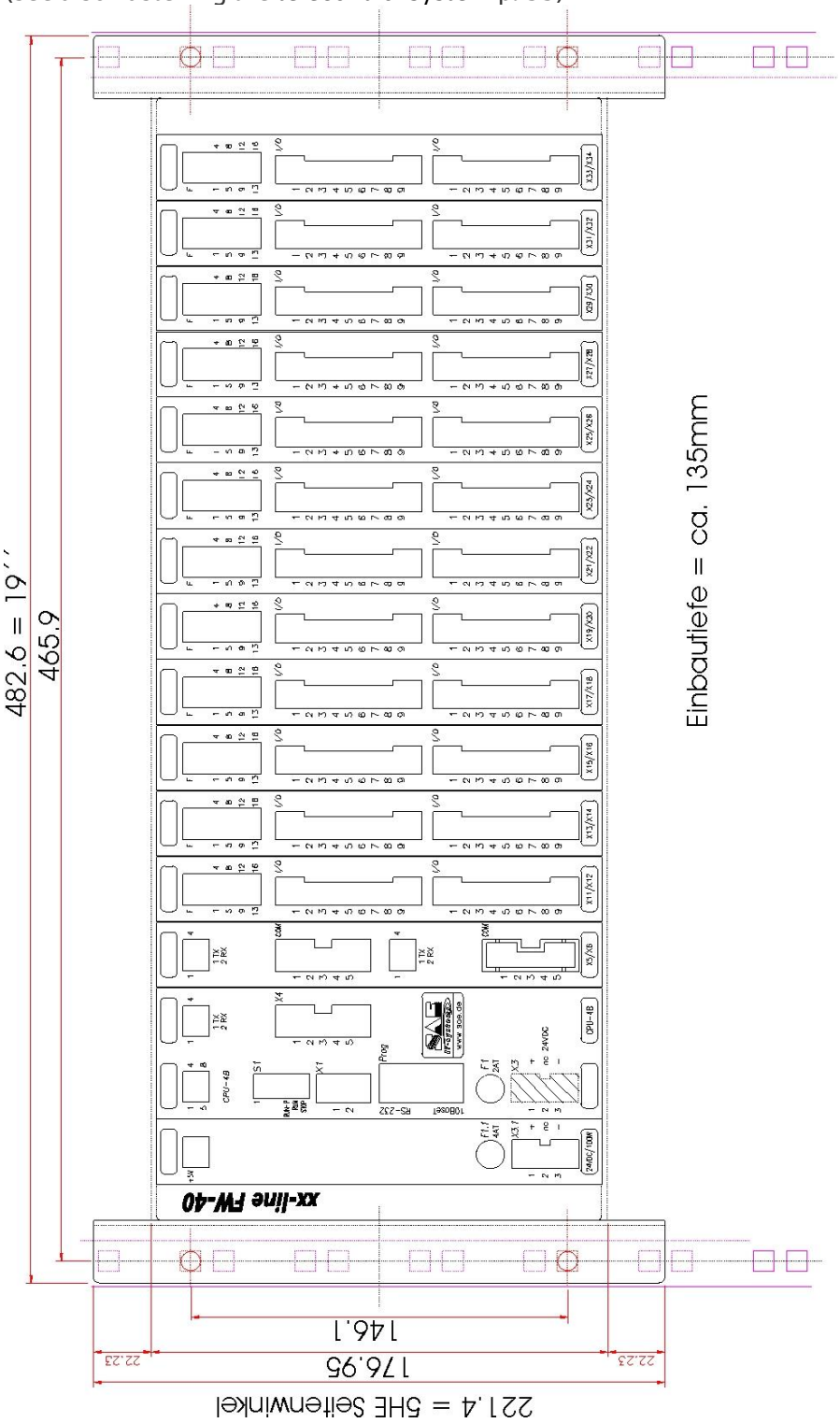


Figure 14: Assembly drawing 19" with BGT-L, here with the FW-40 system

Cable guard rail

Cable guard rails for the racks are available as accessories for fastening and strain relief of the cables and also for shield connection.

Item no.	Item	Function
310004141800	Cable clamp rail BGT-S	Stress relief and shielding ground for BGT-S
310004140000	Cable clamp rail BGT-M	Stress relief and shielding ground for BGT-M
310004140400	Cable clamp rail BGT-L	Stress relief and shielding ground for BGT-L

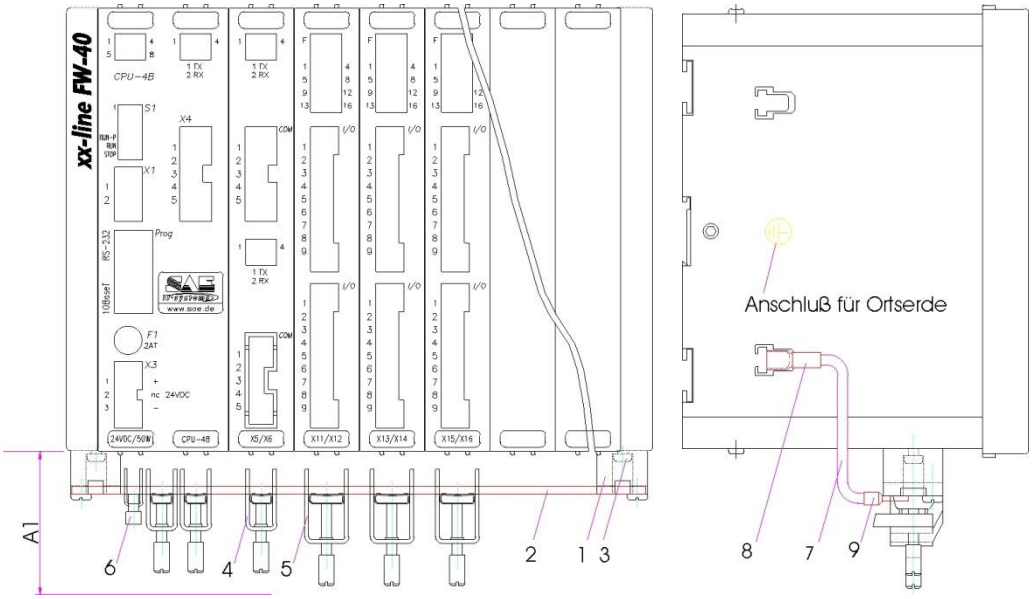


Figure 15: Function and mounting of cable guard rail, here with the FW-40 system

1	Support bracket
2	N - busbar
3	Screw
4	Shielding clamp SK-8 (Phoenix)
5	Shielding clamp SK-14 (Phoenix)
6	Terminal clamp for local ground
7	Cable LIYV 2,5 mm / sw / length 130 mm
8	Blade receptacle isolated 6.3/2.5, blue
9	Wire termination 2,5 mm blue

Guidelines for operation

The FW-50 system is a modular system with detachable front panels. This results in the following guidelines:

WARNING - Danger

Once the front panels have been removed, parts of the unit which may be under dangerous voltage can become accessible. This is particularly applicable to alarm or command system cards (relay) with an operational voltage of more than 48 V AC or 60 V DC.

Approach for replacing system cards

1. Ensure that the supply voltage of the telecontrol system is switched off
2. Ensure that the process/switching voltage at the reporting or command channels is switched off.
3. Remove the respective plug connectors of reporting and command channels
4. Loosen the lock of the front panels and pull out the system card at the upper plug connector on the system card out of the telecontrol system.
5. Insert the system card to telecontrol system by applying pressure on the upper plug connector of the system card.
6. Insert the respective plug connectors for the reporting or command channels
7. Switch the process/switching voltage and supply voltages of the telecontrol system back on
8. Check the functionality of cards based on the LED status

ATTENTION

Removing or inserting system cards under voltage can lead to the destruction of these system cards and thus, to a defect of the telecontrol function.

Process/switching voltage

When selecting a switching voltage (supply), ensure the DC feed is adequately smoothed. The sensitive optocoupler and digital inputs may recognise excessively strong remaining ripples as signals - potentially resulting in incorrect information and incorrect switching.

Connection guidelines for signal and command channels with voltages > 48 V AC or > 60 V DC

If information and command channels are operated with dangerous voltages arrangements for the protection of individuals has got to be made.

DANGER

Before starting work, break all pole, pull plugs and deenergize!

Plugs have to carry a sign "Danger High Voltage" using tensions > 75 V.
Only use power signals with unique source.
Only use the given black terminals to prevent any swap with signals ≤ 75 V DC by different of colour.
Single braids have to be fixed mechanically to prevent a jump over of a energized braid to a neighboured board below 75 V DC.

WARNING

Inobservance may be harmful for the lives and health of personnel!

CAUTION

To fulfill the requirements for an electrical safety, the mounting and operation of the devices only is allowed in a case or a housing with protection class IP 56 or better!

Connection guidelines for modems

All dial up- and dedicated line modems which are available for the system have a separation with doubled or increased isolation. The modules are verified with 3000 V current pulse and 2000 V power frequency withstand voltage.

In order to provide additional protection for dial-up modems and leased circuit modules, they should not be operated without external surge protection modules, and if required with further line disconnectors such as AF for WT-12 or broadband transmission for WT-96.

WARNING

When carrying out servicing work on modem modules or any neighbouring modules, please note that dangerously high voltages might be present on these modules.

Prior to any servicing work, remove the plug connectors from the modem modules.

Configuration of station with USB stick

The FW-5 is delivered in the cleared status (cold status). Only the operating system is active, there are no system drivers of configuration in the memory!

Initial startup is only possible with a USB memory stick with an 'initial load'
Exceptions: Preconfigured systems with station names

Preparation of USB memory stick

1. Start setIT and load designated project.
2. Plug USB stick to PC/laptop interface and wait until the setIT window for memory transfer pops up.
3. Select the desired station and transfer the initial configuration.
4. Now plug the memory stick into Port USB2 of the FW-5.
   By the loading, the memory with the selected configuration is overwritten in the station.

Instructions for memory stick

USB LED		Colour			Function
1. Plug the USB stick					
device	●	green	●	static on	USB stick detected
ready	●	green	○	off	No data for loading on/detected on USB stick
device	●	green	●	static on	Detected setIT data on USB stick
ready	●	green	✳	flashing	
2. Move the USB switch to the right for 3 seconds to update the station **or** to the left to load archives from the station to the stick. With automatic performing on initial start.					
device	●	green	✳	flashing	USB/SD data transfer active: **Please do not remove the USB stick in this operating status.**
ready	●	green	●	static on	
access	●	yellow	●	static on	
3. Possible results:					
device	●	green	●	static on	Data transmission completed USB stick can be removed now. New data is activated after removal of USB stick
ready	●	green	●	static on	
access	●	yellow	✳	flashing	
error	●	red	✳	flashing	USB stick faulty and/or no new data for station on USB stick
access	●	yellow	✳	flashing	The USB stick which has been detected after cold starting contains no initial station files and can be removed.
error	●	red	●	static on	

4. Remove USB stick

LED lights: Diagnostics series5e operating state

run com sys VPN (1 … 4)	Colour	LED state	Function
✶ ✶ ✶ ✶ ○ ○ ○ ○	green	LEDs 1 - 4 flashing simultaneously	Operating system OK, **No system or configuration.**
✶ ○ ○ ○ ○ ✶ ○ ○ ○ ○ ✶ ○ ○ ○ ○ ✶	green	LEDs 1 - 4 forming a running light LED 1 to LED 4	Operating system and system OK, **no configuration** or system in initial state, loading of station from USB stick required
○ ○ ○ ✶ ○ ○ ✶ ○ ○ ✶ ○ ○ ✶ ○ ○ ○	green	LED 4...1 running light LED 4 to LED 1	**System in initial state,** loading of station from USB stick required
✶ ✶ ✶ ✶ ✶ ✶ ○ ○	green	LED 1...4 flashing alternately with LED1/2	The telecontrol manager of the system waits for all drivers to start and report they are ready.
✶ ✶ ✶ ✶ ○ ✶ ○ ○	green	LEDs 1 - 4 flashing alternately with LED2	The sqlite Writer initialises its data area, or the telecontrol manager ascertains an error when the drivers start up.
✶ ○ ○ ○	green	LED1 flashes at 1Hz / 4 Hz LED1 flashes at 2 Hz	Boot process active **Telecontrol station in operation**
○ ● ○ ○	green	LED2 ON LED2 OFF	Communication to master system OK.. **Communication disrupted**.
○ ○ ● ○	green	LED 3 ON LED 3 OFF	Card configuration OK. **Card configuration erroneous**.
○ ○ ● ○	red	LED 3 ON LED 3 OFF	**System fault via group indication** Group indication not active
✶ ● ● ✶ ○ ● ● ○	green	LED 1/4 flashing LED 2/3 statically ON	On startup, momentary possible to delete/reset to initial state with USB switch Operation USB switch on right: Reset & Trigger cold start USB switch on left: Trigger cold start
● ○ ○ ●	green	LED1/4 ON LED2/3 OFF	Station cold start just performed
✶ ○ ○ ✶	green	LED1/4 flashing LED 2/3 OFF	Selection of Reset enabled by user
			Normal operation, operating fault

See also Display and diagnostics on Page 84

Memory extension with SD card

On the top of the device is a card holder readied for the use of SD cards [+] (Secure Digital Memory Card). A memory extension of up to 8 GB can be installed in this slot. This is restricted to 1 GB at the moment however for runtime reasons.
During the start the operating system automatically links the SD card. The information on a SD card is stored so as to be protected from power outages:

- Archive of system as backup (if enabled in the configuration)
  - Interval archive
  - Operational message log
  - Alarm log
- Configuration
  - Configuration data of station

[+] For FW-5-GATE, FW-5-GATE-4G microSD at front

Activating an SD card

To allow an SD card to be checked, it must be created. This setting enables system messages 'SD card error' and 'SD card not plugged in'. The firmware on the card can also be synchronised as a backup

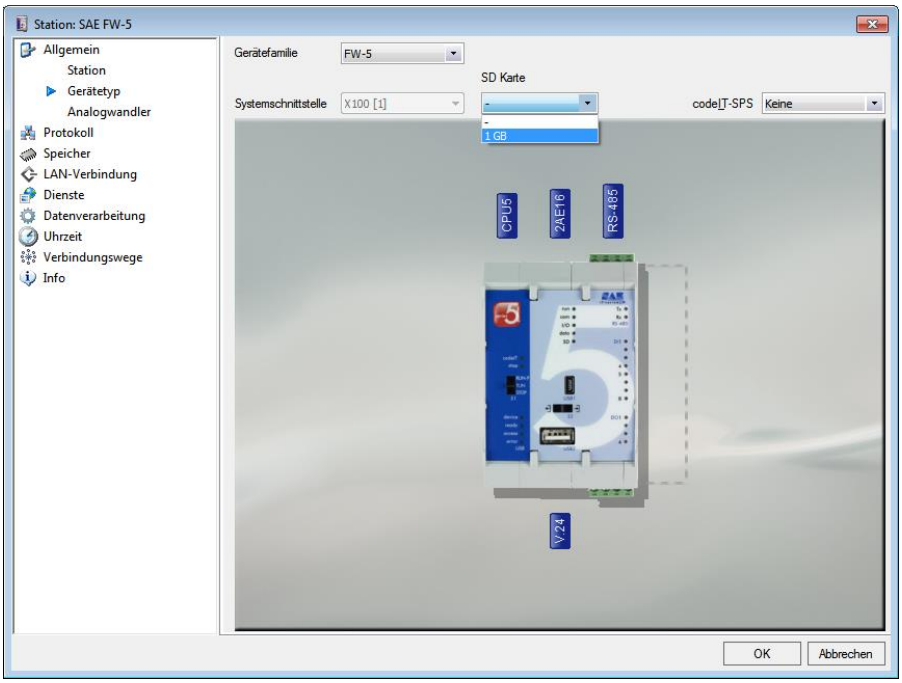


Figure 16: Creating and selecting an SD card

Procedure when using SD cards

- Switch the target system off before plugging in and unplugging a card.
- Now remove the SD card from the packaging.
  !! Take special care to ensure **the contacts of the card are not touched**.
  Long-term contact faults can occur despite the gold-plated contact surfaces.
- Now insert the SD card into the card holder; the contacts should be facing the printed circuit board. Applying slight pressure audibly clicks the card into place.
- Switch the system back on;
  the **SD card is only integrated on a restart**.
- During operation, the 'SD' LED of the CPU shows with static lighting that an SD card has been identified as valid and has been started up.

Note **The SD card may not be plugged in or removed during operation.**

Reading archive data from the SD card by a reader

Insertion of the SD card also means that the archives are stored protected against power outages. If reading of the data directly from the SD card is required, remove the SD card from the card holder of the CPU.
A commercially available SD card reader or SD-USB adapter can now be used to read the data. Windows Explorer® and other suitable software now provide access to the archive data.

Ensure NOT to touch the contacts of the SD card with fingers.

Recording and archive depth

Archive recording in the series5 system is in two areas:

- Internal archive memory / RAM
- Archive backup on SD card

Events with archive entry are stored in the internal memory in real-time. When the SD card is activated, a sequential copy of the recordings is also written to the SD card as an archive backup. This also enables greater signal quantities of up to 9000 events to be recorded in the fast internal memory, sent and be backed up on the SD card.

Archive entries in the SD backup are stored so as to be protected from power outages. The internal memory is volatile and is initialised on a restart.

Internal archive memory

The recording depth of the memory depends on the configuration and corresponds to the archive specifications in setIT memory management. The automatic memory allocation calculates an optimum distribution for typical usage in consideration of the archive entries created. A different allocation of memory depth is possible on a case-by-case basis.

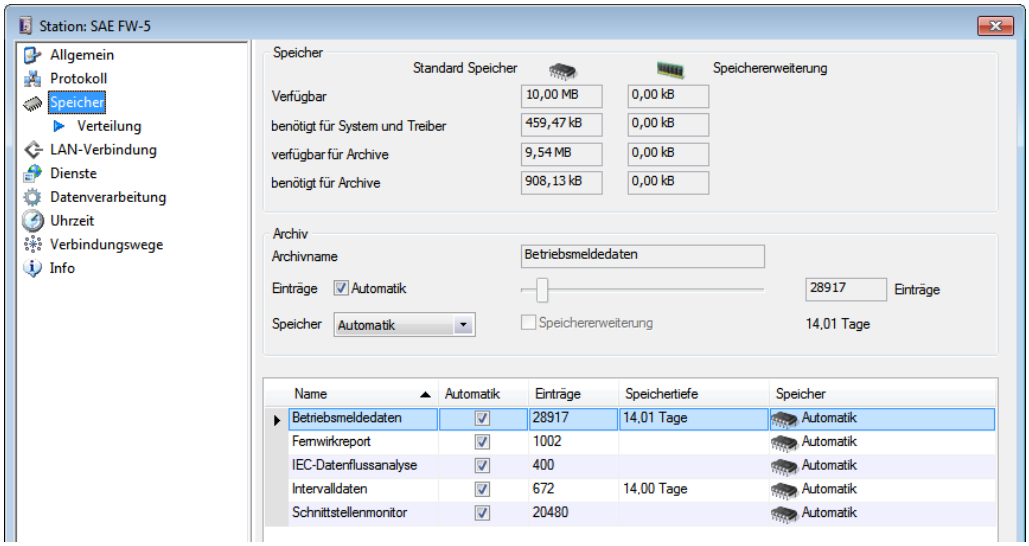


Figure 17: Memory depth of cache

Transfer to the control system/OPC server as per the respective transmission settings is performed from the internal memory. In the event of a communication outage to the control system/OPC server, all recordings are kept in the memory with their event time, and resubmitted when communication is restored.
Overrun messages of the internal archive can be created as process information in the system messages for the plant.

Archive backup on SD card

The recording capacity of the archive backup of the SD card is determined by the memory size of the SD card and the event density. The maximum write speed of the SD card means about 10 events per second can be written to the file system of the SD card. With the series5+ technology, 1000 events per minute can be recorded without loss. A continually large recording density can mean overrun of the internal archive memory.

Memory depth of the SD card on series5

The maximum memory depth can be estimated approximately: The archive entries in csv format on the SD card require 80 bytes on average. A 1 GB card provides about 976 MB of user data. Minus the configuration storage of typically 3.5 MB, about 12 million entries can be stored in the SD archive. The maximum event density of 10 events/s means an overrun after about 14 days. For an assumed recording density of 100 events every 15 minutes, 3.6 years of recording time is mathematically available without memory overrun.

Storage of configuration as backup on SD card

As of version setIT 4.005.05 build 10, all of the firmware (system, operating system and configuration) can also be stored on the SD card. The firmware is automatically synchronised during a download if an SD card is entered in the station definition and 'Synchronise system with SD card' is enabled in the card parameters of the CPU. The latter can be opened by right-clicking the CPU in the station image.

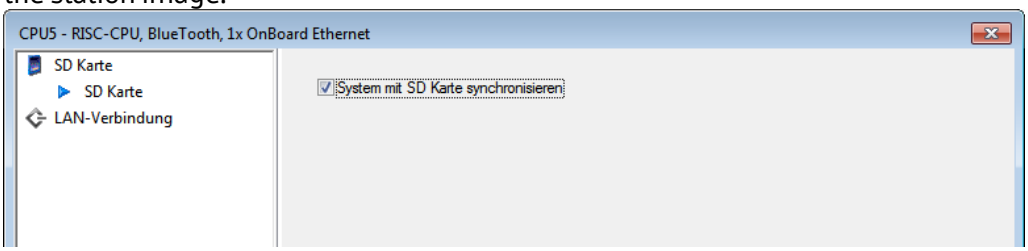


Figure 18: Backup of firmware on SD card

Using configuration from SD card

The configuration from the SD card is used automatically when the system finds no internal data on a restart but a valid configuration can be read from the SD card. This way an intact configuration on an SD card can be loaded from a defective device to new hardware without requiring anything else.

The LED unit flashes when booting from the SD card. Ensure to 'clean' a new CPU with a cold start before the backup from the SD card is used.

The backup on the SD card can also be used to load the configuration via USB (such as with a memory stick adapter).

Information on selecting SD cards

The overall performance of a system depends on the quality of the components used. Given that our bay station controllers and automation devices offer outstanding stability and prolonged service life, all accessories and upgrades should satisfy the same requirements.

Validated SD cards for an industrial environment

Continuous operation in rugged environments means only industry standard SD cards with SLC technology (single level cell) and enhanced temperature range should be used. These cards can certainly not be compared with the commercially available SD cards because the selected components only use high quality technology.
Commercially available (consumer) goods do not meet these requirements because of the rapidly growing mass market and the use of cheapest possible components; usually no more than 10,000 writing cycles are achieved.
The cards we recommend are subject to comprehensive functional and suitability tests prior to validation. We are unable to accept any guarantee for reliable storage when other cards are deployed.

Characteristics of SD cards for industrial/extended environment

Essential characteristics for SD cards capable of validation are:

Cell type.	SLC, single level cell technology
Temperature range	-20° to +85°C
Writing cycles	≥ 1.000.000 cycles writing/deleting
Data logging	≥ 10 years (without further write cycle)
MTBF @25 °C	≥ 2,000,000 hours
Environment	To 95% relative humidity, no condensation

The SD cards selected and validated by ourselves guarantee the parameters above as a minimum with the following values:

Writing cycles	≥ 2,000,000 write/delete cycles
MTBF @25 °C	≥ 4,000,000 hours

Recommended SD cards

Artikel	Bezeichnung
310050011510	SD card with 1 GB for FW-5 /CPU-5B/-5C/5E
310050011530	series5e memory-/archive extension SDHC 4 GB
310050011540	s series5e memory-/archive extension SDHC 8 GB

Remark: only 1 Gb available in setIT V5

Supply voltage connection

The telecontrol system is supplied with voltage via the 3 pole terminal X3 in the front panel of the CPU. In the FW-50 housing variant, the supply voltage is connected via the integrated power supply unit on the CPU unit. The integrated power supply unit filters the input voltage and provides the internal voltages (+5 V DC and 24 V DC) for the system cards.

Power supply terminal

- FW-50 X3 of CPU-5E
- FW-50-4 X3 of CPU-5E
- FW-50-14 X3 of SV-6 or SV-5

The supply may be realised redundantly by assembling an SV-6 at the last slot and thus may be operated by a different tension as well. The earthing of plus pole is available except using LC-variants.

Item no	Item	Function
310050040400	SV-6-24-LC	Power supply 24 V DC for FW-50 low cost #
310050040410	SV-6-48	Power supply 24/48 V DC for FW-50
310050040420	SV-6-60	Power supply 24/60 V DC for FW-50
310050040421	SV-6-60-LC	Power supply 60 V DC for FW-50 low-cost #

not intended for IEC 61850-3

Attention: **A supply of FW-50 with a tension > 75 V is not permitted unless additional mechanical fixations of the front panels!**

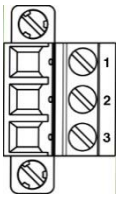
The front panels may be dismounted without a tool; no protection against electrical shock.

Supply of FW-50

The housing FW-50 may be supplied with 24 V DC directly via integrated power supply of CPU-unit.

CPU-5E input voltage	24 V DC, -15% ... +20%
Power consumption of FW-50	Max. 50 W
Power failure protection	Min. 20 ms

Power terminal X3 at CPU-5E



+	**24 V DC**
	n.c.
-	**GND**

A different tension or a redundant supply may be arranged via additional SV-6 at the last slot.

Versorgung über SV-6

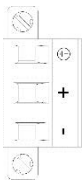
Service X1

	COM A RS-485
	COM B RS-485
	Umod + 24 V DC 0,4 A max.
	Umod -

Melderelais X2

	Powerfailsignal Relais 1 Öffner
	Powerfailsignal Relais 2
	Alarm Relais Kontakt 1 Schließer
	Alarm Relais Kontakt 2

Spannungsanschluss X3:



	Schutzerde / Funktionserde
+	24 | 24/48 | 24/60 | 110 | 220 V DC
-	**GND**

SV-6-24-LC/SV-6-60-LC

Die -LC Varianten sind preisreduzierte Stromversorgungen der SV-6-Serie. Um eine kostengünstige Spannungsversorgung bereitstellen zu können, wurde gegenüber der übrigen SV-6-x Varianten auf einige Funktionen verzichtet:

- keine Galvanische Trennung der Primär- und Sekundärspannung
- keine Strom- und Temperaturmessung
- keine Alarmausgänge
- keine Hilfsspannung U_{mod}

Sie entsprechen damit nicht der Norm IEC 61850-3.

SV-6-24-LC	**Stromversorgung FW-50/ BCU-50** einfache Ausführung ohne galvanische Trennung
Eingangsspannung	24 V DC -15% ...+20%
Stromaufnahme	max. 2,1 A @ 24 V DC, 50 W
Ausfallüberbrückung	min. 20 ms
Sekundärleistung	max. 48 W 1 A @ 5 V, 1,8 A @ 24 V

SV-6-60 -LC	**Stromversorgung FW-50/ BCU-50** einfache Ausführung ohne galvanische Trennung
Eingangsspannung	60 V DC -30% ...+20%
Stromaufnahme	max. 0,9 A @ 60 V DC, 54 W
Ausfallüberbrückung	min. 20 ms @ 50% Last
Sekundärleistung	max. 48 W 1 A @ 5 V, 1,8 A @ 24 V

SV-6-48 /SV-6-60

Die beiden Stromversorgungen sind für die Weitbereichsversorgung zwischen 24 und 60 V DC ausgelegt. Sie versorgen die Einheit mit 24 V DC oder 48 bzw. 60 V DC. Durch die Primärspannungsüberwachung musste eine getrennte 48 V Variante angelegt werden. Durch die Vollaustattung besitzen sie die volle Leistung und Intelligenz der SV-6 Reihe und genügen somit der IEC 61850-3 (h).

SV-6-48	**Interne Stromversorgung 24 / 48 V DC 50 W** Eingangsspannung 24 / 48 V DC ±20%
SV-6-60	**Interne Stromversorgung 24 / 60 V DC 50 W** Eingangsspannung 24 / 60 V DC ±20%
Ausgangsspannung intern	Systemspeisespannungen 24 V DC, 5 V DC geregelt
Ausgangsstrom	2,5 A, geregelt
Netzausfall Unterdrückung	50 ms
Isolation	2,5 kV PS-Erde, 2,5 kV primär/sekundär EMV Level 4
Umwelt	-25° ... + 50°C (> 40° C derating)

Redundante Stromversorgung##

Die Stromversorgung SV-6 ist auch für den redundanten Betrieb ausgelegt. Dabei wird eine SV-6 Baugruppe im letzten Steckplatz des Baugruppenträgers montiert.
Das System erkennt automatisch die Redundanzfunktion. Eine weitere Parametrierung ist nicht zwingend erforderlich, kann aber ab setIT V5.003 durch Einsetzen im Stationsbild vorgenommen werden.
Die 2. Stromversorgung kann aus einer anderen Versorgungsquelle gespeist werden, um die Verfügbarkeit der Gesamtanlage zu erhöhen.

Abbildung 19: BCU-50 mit SV-6 Hauptversorgung und redundanter SV-6

Auch im Fernwirksystem FW-50 ist ein redundanter Betrieb möglich. Auch hier wird die zweite SV-6 am letzten Steckplatz eingesetzt.

6 CPU Modules

The CPU-5-x modules are the heart of the series5 product family for the modular bay station controller net-line FW-50 series5e. A set of CPU modules of the generations have developed in the course of the evolution of technicians and due to actual component changes up to the current series5e. In a FW-50 housing, these CPU borads may be assembled:

- CPU-5C CPU-5C with core series5+
- CPU-5E CPU-5E with core series5e

Both CPU boards use the same PCB as a base but are assembled with a different core-module; CPU-5C leads to a series5+ technology, whereas CPU-5E supports the powerful and modernized series5e core. CPU-5E offers extended performance supporting a rising level of IT-security. It again uses an enforced type of processor with two separated LAN-segments in the front, offers a doubled RAM memory compared to CPU-5C, a USB-HUB for enlargement of additional LAN-segments and a slot for an additional fifth serial interface. CPU-5E has no known restrictions compared to CPU-5C at the lower serial interfaces.

CPU-devices series5e

Itemno.	Item	Function
310050011450	**CPU-5E**, FW-50 series5e 1 GB	CPU-5E with e335, 512 MB RAM, 512MB Flash

The scope of this document is series5e with CPU-5E boards. Information dealing with net-line FW-50 series5+ and CPU-5C may be found in a separate manual https://saeit-de.sharefile.eu/d-s5b89b7be1ff4225a.

CPU-5E series5e

The series5e processor core (800 MHz internal clock frequency) enables a processing speed of 1200 MIPS to be attained. This performance, integrated within a real-time operating system, makes this an open platform for future-proof applications with high data throughputs.
The base version of the FW-50 series5e has an internal data memory of 1 GB (512 MB SDRAM and 512 MB Flash). In addition, the CPU card provides a memory enhancement for configuration and archives on a micro SD card (up to 8 GB). Limited to 1 GB in setIT V5.
The FW-50 series5e provides a highly integrated and secure connection to infrastructures of supply networks (such as Smart Grids); all security features in the series5e technology are used.

- series5e processor with 1200 MIPS at 800 MHz
- 1 GB memory:
  512 MB SLC NAND Flash, 512 MB SDRAM, 8 MB NOR Flash, 512 KB SRAM
- RTC Realtimeclock ±10 ppm
  RTC and SRAM buffered via rechargeable Li-Ion battery
- opt. memory expansion with SD card (to 8 GB)

- 2 separate TCP/IP Ethernet interfaces (10/100 BaseTx)
- 4 additional network segments
  in combination with BGT-x-USB and SWI-2-x
- 4 serial nterfaces
  directly assembled via interface boards up to 115 kbit/s
- 8 additional serial interface lonis via USB485 up to 38,4 kbit/s
- up to 28 FO-media converters via LWL-2 up to 115 kbit/s
- PLC switch on front panel
- USB function button for copying and backing up configuration, and archive backup
- Display and diagnostics using 11 coloured system LEDs on front
- Temperature sensor for ambient temperature
- galvanical isolation of USB device
- the lower serial interfaces X102/X104.. are available for 870-5-10x communication without restrictions

Note: **setIT Version 5.004 or higher is required to use the FW-50 series5e**

Assembly CPU-5E

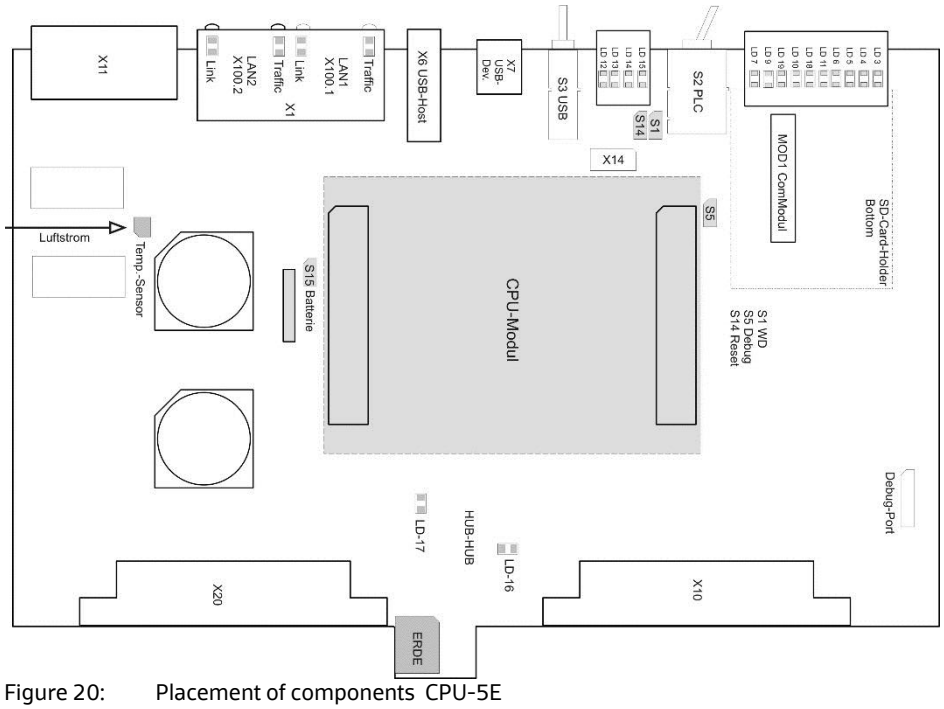


Figure 20: Placement of components CPU-5E

System LED CPU-5E

The LED on the front panel are equivalent to other CPU-boards. **s.** Fehler! Verweisquelle konnte nicht gefunden werden. **S.** Fehler! Textmarke nicht definiert.. An additional LED shows a USB-link for communication via SWI-2-x at the PCB.

LED	Colour			Funktion
LED16 ●	green		off	no link
		●	static on	USB High-Speed active (480 Mbit/s)
LED17 ●	green		off	no link
		●	static on	USB-link moounted in system

Display and diagnostics

The display and diagnostics functions are identical for all FW-50 series5e models. Located on the front panel are LEDs to indicate the operating states of the CPU unit and the statuses of mobile unit, PLC and USB.

System LED

LED	Colour			Function
power ●	green	●	static On	OK: Supply voltage being applied
		○	Off	Error/System OFF
run ●	green	✳	flashing 2 Hz	OK: System running
		✳	***flashing 4 Hz***	***System starting***
		●	static On	Fault
		○	Off	Error/System OFF
com ●	green	●	static On	OK: Communication to master system
		✳	flashing	System starting 1 Hz, communication with one of several NLS's
		○	Off	Communication down
sys ●	green	●	static On	OK: I/O valid
		✳	flashing	System starting
		○	Off	Fault in module or expansion unit
sys ●	red	●	static On	ERROR from group indication detected
		○	Off	OK: No error message active
VPN ●	green	●	static On	all VPN tunnels established
		○	Off	No VPN tunnel established
		✳	***flashing***	at least one VPN tunnel not established ***or system starting***
SD ●	green	●	static On	Card detected; writing archives
		○	Off	No SD card detected or available
		✳	***flashing***	SD card write protected: no more archives may be written /System indication SD-card error is set

Note: ***Functions shown in italics must only be active for a few seconds***.

During the start process, the LEDs show a changing picture:
Light sequence = start process, system initialised.

Synchronous flashing light run + data = cold start option by pushing switch S3 to the right for 3 s.

PLC LED codeIT

PLC LED	Colour			Function
codeIT ●	green	○	Off	PLC STOP or inactive
		●	On	PLC RUN
		✳	flashing	PLC PROG, loading program
stop ●	red	○	Off	OK, normal operation or inactive
		●	On	Fault
		✳	flashing	Prog. operating method Loading program

USB LED

Via the USB LED the states of a pushed in USB-memory stick or a USB-link via cable to setIT will be shown. If the device LED is illuminated, a link was recognised and a data transmission may be established. If the download will be performed via setIT or the webserver, the ready LED is shining for a short period. Refer to the figure in **Fehler! Verweisquelle konnte nicht gefunden werden.** on Page **Fehler! Textmarke nicht definiert.**.

USB-LED	Colours		Function
device	● green	● static ON	USB link recognised
ready	● green	○ OFF	passive state, no data, no USB link
		✳ flashing	Data transmission
		● static ON	**Don't pull the stick in this case**, except access is flashing
access	● yellow	● static ON	**Data transfer active, do not cut the transmission**
		✳ flashing	Data transmission completed, ready
error	● red	○ OFF	no error
		✳ flashing	wrong transmission or information
		● static ON	Error: wrong type of device, wrong kernel

Operating functions

The operating functions are identical for all FW-5 models.

S1: PLC switch for Soft PLC

The PLC switch is on the front panel of the system.

Position	Name	Function
Up	RUN	PLC program running
Down	STOP	PLC program stopped

(refer to PLC programming information on Page 201)

S3: USB switch

The USB function button is on the front panel of the system.

Position	Name	Function
Left		Archiving of archives to stick
Middle	-	Idle position
Right		Data transfer from USB stick to system

Cold start

During a restart, the system shows changing system LEDs (run & data flash simultaneously). Pressing S3 to the right  for three seconds in this phase triggers a cold start, and therefore a reset of the system memory. An initial load is then required.

Fault indicator output

A fault indicator contact can be switched potential-free to free command output DO on an expansion module with a cross-connection of group information of selected system information. The red sys LED on the front panel signals the status.

Technical data FW-50 series5e

FW-50 series5e	**series5e RISC-core**, ARM Cortex A8, 1200 MIPS @800 MHz, FPU, Watchdog, RTC
Data memory	**1 GB memory**: 512 MB SDRAM**,** 512 MB SLC NAND Flash, 512 kB SRAM buffered, 8 MB NOR Flash
Memory expansion, opt.	SDHC card up to **8 GB** currently available 1 GB
Real-time clock	Errors max. ±10 ppm in operation, summer/winter time changeover, leap year correction max. ±20 ppm buffered mode maintenance-free,
Puffer battery	Lithium rechargeable battery 7mAh, Puffer type. 30 days @25°C
LED status indicators	CPU: 11 LEDs with inscription on front panel, green, red **Web-Server** integrated LAN: Traffic green, speed yellow, hdx/vdx on-board
Controls	**PLC switch** in front panel RUN/STOP **USB pushbutton** for config./backup/recovery function
Temperature sensor	Measuring range -25 °C - +100 °C , accuracy ±3°C max.
Capacity	modular extendable via up to 14 I/O-modules or kaskade **Extension via communication** up to 16.000 process data points **IEC 61850** up to 40 IED
Communication	**2 Ethernet LAN** 10/100BaseTx, auto-MDIX, galv. isolated, on the front or via SWI-1-x on X102 and/or X104 **4 serial interfaces** 128, Byte FIFO, 300 to 115 kbit/s opt. 5. Interface for subboard module com5C-RS-485 opt. 28 FO media converter/star coupler via LWL-2
Programming interface	Ethernet LAN 10/100BaseTx, auto-MDIX, USB 2.0 device 480 Mbit/s, mini type B, galv. isolation 1.5 kV USB 2.0 host 480 Mbit/s, bushing type A
Alarm output	on every relay output by set-up
Supply voltage	**CPU-5E:** +24 V DC, +20 % / -15 %, max. 50 W Nominal power approx. 100 mA (without I/O modules) Power-fail management, power failure protect min. 50 ms at 50% Bus-load, SMD-fuse 4 A T **with SV-6: 24 / 48 / 60 V DC ±20%** see SV-6 variants
Insulation resistance	Supply against earth according to EN 60870-2-1 class VW3 5 kV 1.2/50 µs surge voltage 2.5 kVrms power-frequency withstand voltage
Electromagnetic compatibility	EN61000-6-2 (03/2006) EN61000-6-4 (03/2007)
Ambient temperature	-20° ... +70° C, others on request
Relative humidity	< 80%, without condensation
Housing	FW-50 racks, plastic/Metall, IP 20
Mounting	DIN-rail DIN EN 60715 TH35, Wall mount, 19" frame 4HU with
Dimensions	**FW-50-4** 152 x 173 x 135 mm (W x H x D) without mount set **FW-50** 228 x 173 x 135 mm (W x H x D) without mount set **FW-50-L** 432 x 173 x 135 mm (W x H x D)
Terminals	Screw terminals MSTB, 0,2 up to 2,5 mm² or Spring terminals Combicon, 0,2 up to 2,5 mm²
Ambient temperature	**-20° ... +70°C** Ø24h max.+55°C**,** from 48 V DC +60° C
Mounting level	max. 2000 m above sea level pressure> 70 kPa
Relative humidity	<95% at 25°C without condension (class F)

ATTENTION

The new CPU cards are buffered with rechargeable lithium batteries. These cards must be stored in an isolated place; short-circuit can cause a fire. Therefore, always put away separately.

Onboard Schnittstelle com5C_RS-485##

Die CPU-5E kann mit einer weiteren TIA/EIA/RS-485 Schnittstelle ausgestattet werden, die als eine fünfte Feldschnittstelle oder als interne Schnittstelle zum Bus für die Kommunikation intelligenter Karten eingesetzt werden kann. Ab setIT V5 kann diese in den Karteneigenschaften der CPU-5C/CPU-5E aktiviert werden. Die Nutzung dieser Schnittstelle als Feldschnittstelle ist derzeit nur in besonderen Projekten wie dem FWG-50 möglich, da die Signale in Standard Baugruppenträgern derzeit nicht über Klemmen aus dem Rahmen geführt werden können.

Artikelnr	Artikel	Eigenschaften
310000025910	com5C_RS-485 Modul für CPU-5C/5E	weitere Feldschnittstelle
310000025911	com5C_RS-485i Modul für CPU-5C/5E	Schnittstelle für interne Kommunikation

Bestückungsplan com5C_RS-485-1

Die Schnittstelle wird als Aufsteckmodul an Position 'MOD1 ComModul' auf die CPU-5C/CPU-5E gesteckt. Der Stecker S1 führt die Signale nach außen. Neben der Kommunikation steht eine Ansteuerung von Tx/Rx-LED zur Verfügung.

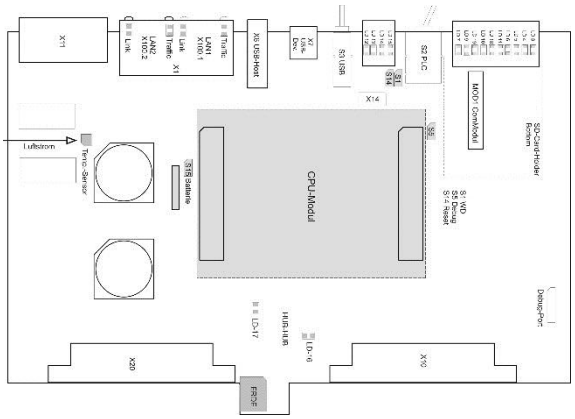


Abbildung 21: CPU-5C/CPU-5E

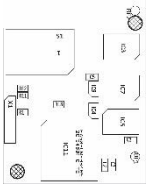


Abbildung 22: com5C_RS-485

Klemmenbelegung

S1	Signal	Funktion
1	**A** (RS-485)	**Schnittstellensignal** RS-485
2	**B** (RS-485)	**Schnittstellensignal** RS-485
3	GND	Masse (für LED)
4	Tx-LED	Sendesignal (5 V) für externe LED mit Vorwiderstand
5	Rx-LED	Empfangssignal (5 V) für externe LED mit Vorwiderstand

Steckertyp S1: JST S5B-PH-SM4-TB (5-Pin 2 mm Raster)

Technische Daten com5C_RS-485

com5C_RS-485	Schnittstelle RS-485 (ANSI/TIA/EIA-485-A-98 R2003)
Betriebsarten	Halbduplex, Busbetrieb
Leitung	2 Leiter, paarig verdrillt und abgeschirmt z.B. LiYCY 2x2x0,25 mm²
Übertragungsart	symmetrisch
Baudrate	300 Bit/s bis 38,4 kBit/s
Tastung	automatisch, Vor-Nachlaufzeit einstellbar in setIT
Reichweite	1200 m
Funktionsanzeige	Tx, Rx LED über S1 Klemmen extern ansteuerbar
Signalempfindlichkeit	+/- 200 mV
Terminierung	270 Ω, mit je 2,2 kΩ Pull-up/-down zur Störzeichenunterdrückung
Potentialtrennung	zwischen Logik und Übertragungsleitung
Prüfspannung	AC Signal/Logik 1000 V AC / Luft- & Kriechstrecken > 1 mm
Leistungsaufnahme	225 mW aus interner 5 V Versorgung
Betriebstemperatur	-20 bis 60°C (Kurzzeitig 70°C)
Relative Luftfeuchte	95% bei 40°C ohne Betauung (Klasse F)

7 Interfaces

Interface types

Ethernet network

SWI-1-1	Ethernet	quadruple switch 10/100BaseTx, RJ45
SWI-1-2	Ethernet	Multimode FO, SC + twice 10/100BaseTx
SWI-1-3	Ethernet	quadruple switch 10/100BaseTx, RJ45 with port mirror
SWI-1-4	Ethernet	Multimode FO, SC + twice 10/100BaseTx, port mirror
SWI-1-5	Ethernet	quadruple switch 10/100BaseTx, RJ45, port mirror
SWI-1-6	Ethernet	Multimode FO, SC/ST + 10/100BaseTx, port mirror
SWI-1-7	Ethernet	Single-mode FO, SC/ST + 10/100BaseTx, port mirror
SWI-2-1	Ethernet	additional LAN segment via internal USB connection quadruple switch 10/100BaseTx, RJ45
SWI-2-2	Ethernet	additional LAN segment via internal USB connection multimode FO, SC +10/100BaseTx,
SWI-2-3	Ethernet	USB-LAN single-mode FO, SC/ST + 10/100BaseTx
ENET-1	Ethernet	TCP/IP LAN connection, RJ-45, 10/100 Mbit/s

Dedicated line

RS-485-2	RS-485	Symmetric, max. 38.4 kbit/s, 1.2 km, up to 31 participants
RS-422-2	RS-422	Symmetric, max. 38.4 kbit/s, 1.2 km, up to 31 participants
BBM-1	baseband modem	Max. 19,2 kbit/s, 10 km, up to 8 participants
MOD12-2	FSK modem	BZT approved, 1200 bit/s max. 25 km, up to 15 participants
WT12-2/4	FSK modem	BZT approved, 1200 bit/s max. 30 km, up to 17 participants
WT96-2/4	FSK modem	9600 bit/s max. 20 km, up to 17 participants
TTY-1	TTY	20 mA current loop, 2-/4-wire, max. 9.6 kbps, 1 km
V24-2	V.24 /RS-232	Asymmetric, max. 115 kbit/s, point-to-point
V24-3	V.24 /RS-232	V.24 redundancy link, max. 115 kbit/s, party line
V24-4	V.24 /RS-232	V.24 for RJ-45 links according to ETSI EN 392-300-5

Fieldbuses

DPM-1	Profibus master/slave	Profibus-DP, 1.2 km, up to 31 participants occupies 2 interfaces and/or an I/O slot
DPS-1	Profibus master/slave	Profibus-DP, 1.2 km, up to 31 participants occupies 2 interfaces and/or an I/O slot

Additional fieldbuses (e.g. Modbus) are operated over dedicated line interfaces

Analogue switched line (PSTN)

WM336-3	Dial-up modem	Dial-up modem up to 33.6 kbit/s 1500 V DC
WM336-4	Dial-up modem	Dial-up modem up to 33.6 kbit/s 3000 V DC

Switched lines (ISDN)

ISDN-1	ISDN-TA	ISDN terminal adapter, 64 kbit/s

Switched lines (GSM)

GSM-1	Dual band GSM	GSM dual band with up to 9600 bit/s
GSM-2	Dual band GSM/GPRS	GSM/GPRS dual band with up to 9600 bit/s

Communication over Ethernet

CPU-5 provides two separated Ethernet interfaces with their own address spaces (network segments) and autarkic IP stacks. The connection can be established in several ways.

- The first Ethernet interface is positioned at the front CPU-5/CPU-5B/CPU-5B+ on X100 (LAN). It can be rearranged on an integrated switch at the position X104.
- The second Ethernet interface is available via a pluggable, integrated switch on position X102.

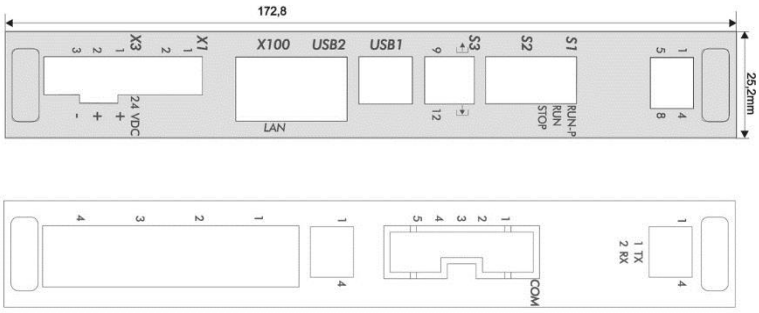


Figure 23: Front panel of CPU-5 and SWI-1

Switch SWI-1-x

Fixed positions have been specified for the switch cards due to the high physical demand for fast Ethernet connection. All types of switches (SWI-1-1 /SWI-1-2 /SWI-1-3 /SWI-1-4) can be used.

- As an integrated interface card, the switch cards occupy the lower part of slot 1 or 2, i.e., at position L-1 or L-2.
  The upper part can be used freely (e.g. with serial interfaces).
- At position X102 (L-1) the second Ethernet interface of CPU-5 is offered as an optional.
- At position X104 (L-2), the 1st Ethernet interface of CPU-5 is offered as an alternative to X100. The channel is automatically switched from X100 to X104 when configuring X104 with a switch card.
  The connector at X100 is without function.

Ethernet card ENET-1

- The ENET-1 card can be used arbitrarily as a serial communication card. It offers an additional IP address range with an IP link.
- Positioning in the system is arbitrary. It occupies half a slot.

Switch modules SWI-1-x

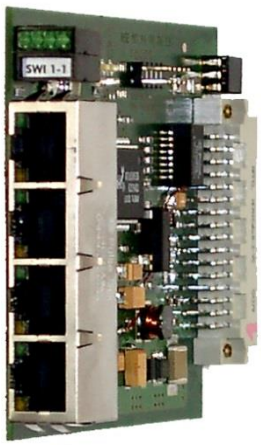
The interface card SWI-1 offers different Ethernet connections as an integrated module in two versions:

- SWI-1-1 quadruple switch 10/100BaseTx, 4* RJ45
- SWI-1-2 FO 100BaseFx Multimode SC + 2* RJ45/ 10/100BaseTx
- SWI-1-3 like SWI1-1 with port mirroring, 4* RJ45
- SWI-1-2 FO like SWI1-3 Multimode SC + 1* RJ45/ 10/100BaseTx
- SWI-1-5 like SWI1-3 with additional traffic shaping (against DOS attacks)
- SWI-1-6 FO like SWI-1-5 with 100BaseFx Multimode SC/ST
- SWI-1-6 FO like SWI-1-5 with 100BaseFx single-mode SC/ST

Additional cabling, mounting and power supply to external components are omitted by integrating the switch in the rack.
As an unmanaged switch, the module forwards the incoming Ethernet frames to the target port in a targeted manner and avoids collisions while operating in the full-duplex mode.
The 10/100BaseTx connectors provide support via half- and full-duplex operation. The connections automatically adjust to the network speed via automatic speed recognition (auto negotiation). The automatic adjustment to the cable priority (auto-MDIX/cross-over detection) enables the use of crossed or 1:1 network cables.

The SWI-1 switch is a OSI-layer 2 unit and can be connected with various networks with the same protocol (layers 3 to 7). Therefore switch-1 provides protocol transparency.

The state and speed of the ports are indicated with multiple LEDs.
The display of the respective port status of the connections A to D take place on the front via the LEDs integrated in RJ45. This issues information on "Traffic" and "Speed".
The information "Full-/Half-Duplex" of the respective ports is displayed using the SMD-LEDs LD2-5 on the printed circuit board.

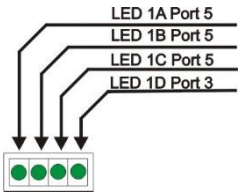


quadruple switch SWI-1-1

Switch SWI-1-2

Status LEDs

The internal port status for the CPU system is displayed on LEDs 1A to 1C of the upper row of LEDs in the front panel. LEDs 1A-1C lights up in a faultless condition. LED 1D displays the status of the fibre optic ports at the fibre glass version SWI-1-2.



LED1A= Duplex: lights up in full-duplex mode
LED1B= Speed: lights up at 100 Mbit/s
LED1C= Link/Activity: Off when pressed/flashing at Traffic

LED1D= Activity Port Fx: Link/Activity of the fibre glass/FO port

Status of connections LED port 1- 4

LED port A to D	Function
Yellow	ON 100·Mbit/s
Speed	OFF 10 Mbit/s
Green	OFF No connection/link
Connection / activity	ON Connection established
	Flashing Activity transmitting/receiving

Internal status LD2 to LD5

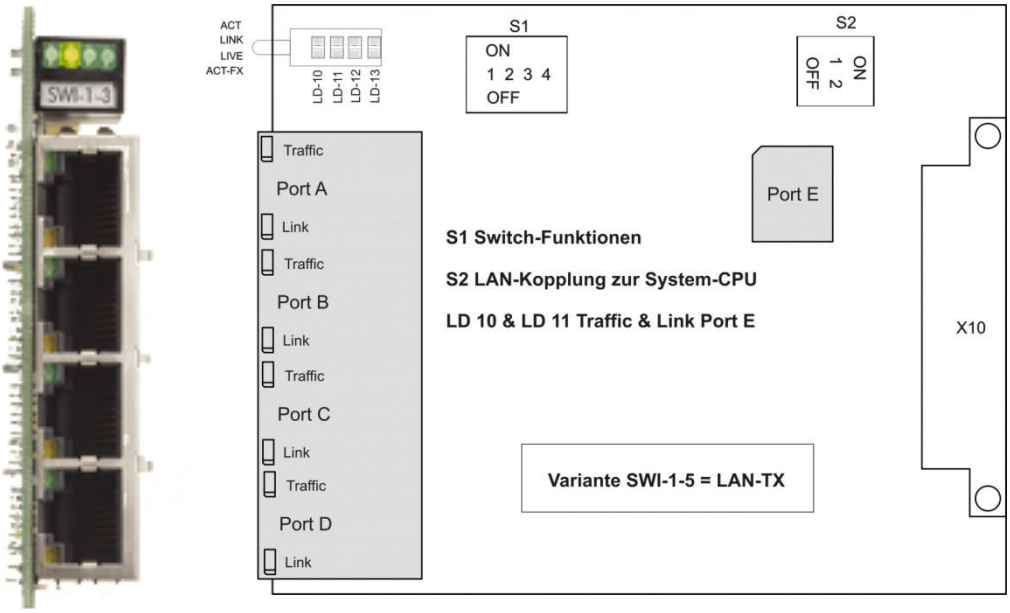
The connection status of the respective ports 1 to 4 with half/full duplex and collision are displayed via yellow internal SMD LEDS on the printed circuit board.

Duplex diagnose LED	State	Function
LD2 = Port 1	ON	Full-duplex connection
	Flashing:	Collision
LD3 = Port 2	ON	Full-duplex connection
	Flashing:	Collision
LD4 = Port 3	ON	Full-duplex connection
	Flashing:	Collision
LD5 = Port 4	ON	Full-duplex connection
	Flashing:	Collision

SWI-1-5 • fourfold Ethernet 10/100BaseTx with port mirror

The SWI-1-5 switch, in term of technology, is based on the SWI-2-x module but it is designed to be upward compatible with the SWI-1-3 module. A port mirrored can be activated via a switch field. For port mirroring, all incoming and outgoing frames for purposes of diagnostics are mirrored in port 1 (above). Furthermore, a bandwidth restriction (traffic shedding) is possible to avoid DOS/brute force attacks. **Pay attention to the slot coding**!

Front layout/location plan

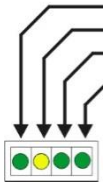


Managed functions SWI-1-5/SWI-1-6 /SWI-1-7

S1	Function	ON	OFF
1	Port mirror mode	**Port mirroring active#** Port 1/A is diagnosis port	Standard function all ports are equal
2	Traffic shaping	no limitation	**Traffic shaping** activated (Data rates limitation)
3/4		-	-

The settings are only read and become active after a restart of the module

LED SWI-1-5 /SWI-1-6 /SWI-1-7



LED1B	Colour			Function
LED10 ●	Green	-	OFF	No communication
LED10 ●	Green	✳	Flashing	Transmission signal, traffic
LED11 ●	Yellow	●	Statically ON	Connection to CPU (duplex)
LED11 ●	Yellow	-	OFF	No connection to CPU system
LED12 ●	Green	✳	4 Hz	Port mirroring active
LED12 ●	Green	-	OFF /Flash ON	Standard - no mirroring

Technical data, cable and line length SWI-1-5

Port 1-4	4 port Ethernet switch 10/100BaseT(X) unmanaged
RJ45 Ports	10/100BaseT(X) speed, auto negotiation, Full/Half duplex mode, auto MDI/MDI-X connection
Diagnostics	Port A – D each with status LED link & traffic Port E internal to the system System LED Live & Functional
Standards	IEEE 802.3 10BaseT, IEEE 802.3u 100BaseT(X), IEEE 802.3x Flow Control
Port mirroring	Can be activated on port A from all data ports
Security	Traffic shaping at port E incl. broadcast storm control
Internet protocol	IPv4, IPv6
Insulation	Class VW2 according IEC 60870-2-1
Cables	4x2 twisted-pair copper cable min. Cat 5e
Line length	Max. 100 m to unit or next hub/switch
Environment	-20°C .. +70°C

Manual selection of the slot SWI-1-5/SWI-1-6/SWI-1-7

The physical interface (PHY) between the components must be right in order to implement an internal Ethernet connection in a cost-effective and space-saving manner. In the meantime, the connection technology has changed so that an automatic adjustment of the PHY between the installed technologies is no longer possible.

ATTENTION **Depending on the unit and slot, a manual selection of the PHY settings must be carried out.**

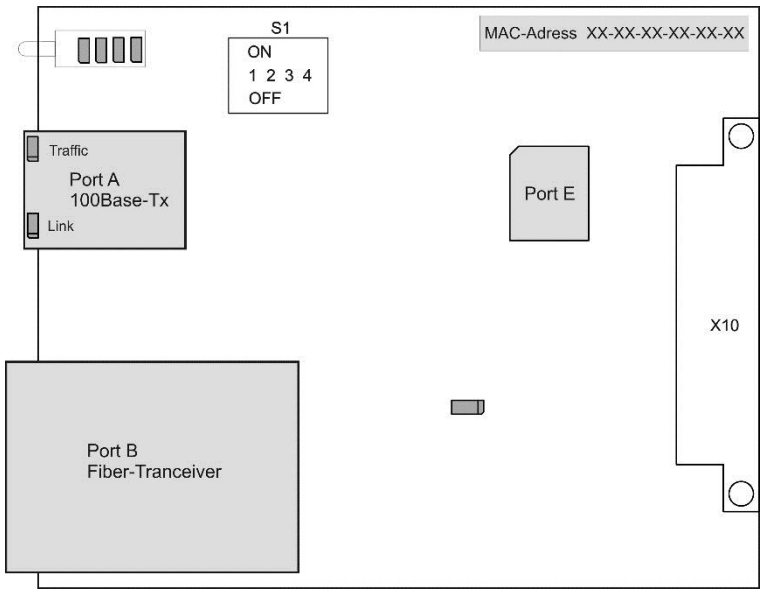
Product	Slot	S2: DIL-1	S2: DIL-2
CPU-5B /5B+	X102	**OFF**	**ON**
	X104	**ON**	**ON**
CPU-5C	X102	**ON**	**ON**
	X104	**ON**	**ON**

Product	Slot	S2: DIL-1	S2: DIL-2
CPU-D5 rev1	LAN1	**ON**	**ON**
	LAN2	**OFF**	**ON**
CPU-D5B/D5C	X100	**ON**	**ON**
	X101	**ON**	**ON**
	X200 (5000-server)	**OFF**	**OFF**
CPU-D5C	X300-X309	**?**	**?**
	X400-X409	**?**	**?**

SWI-1-6 • fibre glass multimode & 1*RJ45 with port mirror

The SWI-1-6 version is identical in construction to SWI-1-5, but via a FO/fibre optic connector with 100 Mbit/s it has a connection via multimode fibre optic cable at port ¾ with duplex SC connection or ST connection.

Front layout/location plan



SWI-1-6: Technical data, cable and line length

FO port 3/4	Fibre glass **multimode SC/ST-Connector**, FO/LWL 100BaseFx	
Connector	**SWI-1-6**: Duplex SC **SWI-1-6-ST**: Duplex ST	
Cables	50/125µm multimode-FO (MM) 62.5/125µm multimode-FO (MM)	0-8 dB 0-11 dB
Wavelength	1310 nm (Tx: 1260 ..1360 nm, Rx: 1260..1610 nm [LM32-A3S-PI-N])	
Insulation	Class VW3 according to IEC 60870-2-1	
Line length	Approx. 2 km fibre data 1.0 dB/km (example)	
Port 1	10/100BaseTx , 1 * RJ45 with Status LED unmanaged Ethernet Switch half/full duplex auto negotiation 10/100 Mbit/s, auto-MDIX	
Topology	Radiating wiring	
Insulation	at connector to port 1 class VW2 according to IEC 60870-2-1	
Cables	4 x 2 Twisted pair copper cable min. cat 5	
Line length	Max. 100 m to unit or next hub/switch	

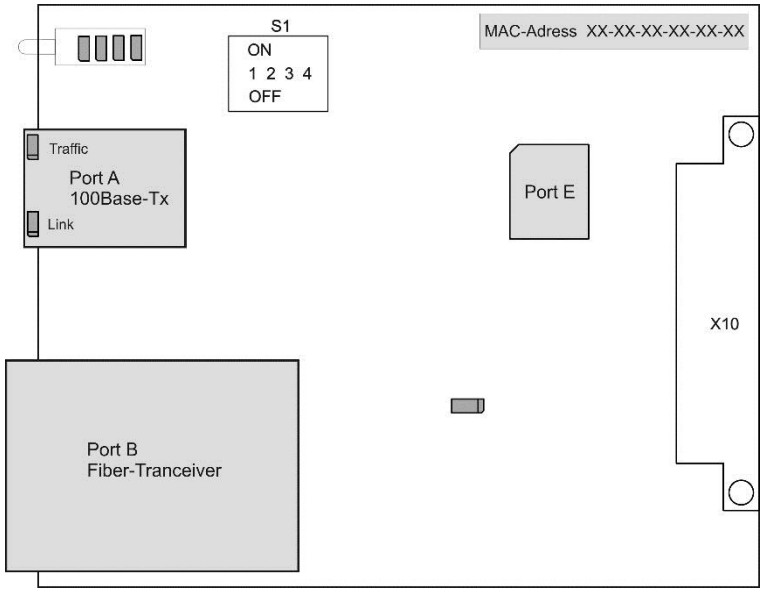
Managed functions & LED function and

ATTENTION **Depending on the unit and slot, a manual selection of the PHY settings must be carried out, see SWI-1-5.**

SWI-1-7 • fibre glass single-mode & 1*RJ45 with port mirror

The SWI-1-7 version is identical in construction to SWI-1-6, but via a single-mode FO/fibre optic connector with 100 Mbit/s, it has a connection at port ¾ with duplex SC connection or ST connection.

Front layout/location plan



SWI-1-7: Technical data, cable and line length

FO port 3/4	Fibre glass **Single-mode SC/ST-Connector**, FO/LWL 100BaseFx,
Connector	**SWI-1-7**: Duplex SC **SWI-1-7-ST**: Duplex ST
Cables	9/125 µm single-mode-FO (MM)
Wavelength	1310 nm (Tx: 1260 ..1360 nm, Rx: 1260..1610 nm [LS32-A3S-PI-N])
Insulation	Class VW3 according to IEC 60870-2-1
Eye safety	IEC 80825-1, FDA CDRH 21-CFR 1040 **Class 1**
Line length	approx. 32 km fibre data 1.0 dB/km (example)
Port 1	10/100BaseTx , 1 * RJ45 with Status LED unmanaged Ethernet Switch half/full duplex auto negotiation 10/100 Mbit/s, auto-MDIX
Topology	Star-shaped wiring
Insulation	at connector to port 1 class VW2 according to IEC 60870-2-1
Cables	4 x 2 Twisted pair copper cable min. cat 5
Line length	Max. 100 m to unit or next hub/switch

Managed functions, LED function and slot coding such as SWI-1-5

ATTENTION **Depending on the unit and slot, a manual selection of the PHY settings must be carried out, see SWI-1-5.**

Switch module SWI-2

The switch modules SWI-2 enable the number of network segments of an FW-50 station to be expanded from two to maximum 6 network segments in a rack via an internal USB connection. Prerequisites for this are:

- Rack BGT-x-USB
- CPU module CPU-5C
- setIT from V5.0
- SWI-2-x module, inserted into X101 /X103 /X105 /X107

The SWI-2-x modules can be configured to positions X101, X103, X105 and/or X107 and can be coupled with an internal USB connection (USB 2.0 480 Mbit/s) to the series5+ core. For each SWI-2 module, an additional IP socket is opened which works as an autarkic network segment in an independent IP address space. In addition to both of the fixed network connectors of the CPU-5C, there are a total of 6 network segments available in FW-50 BGT.

The interface card SWI-2 is available in 3 versions; all have an addition LAN segment available via an internal USB connection.

- SWI-2-1 quadruple switch 10/100BaseTx, 4*RJ45, internal USB-link
- SWI-2-2 multimode FO, SC/ST + RJ45,
  Fibre glass 100BaseFx + 10/100BaseTx
- SWI-2-3 Single-mode FO, SC/ST + RJ45,
  Fibre glass 100BaseFx + 10/100BaseTx

In addition to the expansion of the network segments via SWI-2, the integrated chip-set also enables data transfer management with port mirroring of all transferred frames to connector A (upper RJ-45) and traffic shedding that can be switch offer, a bandwidth limitation to avoid DOS attacks (brute force attacks).

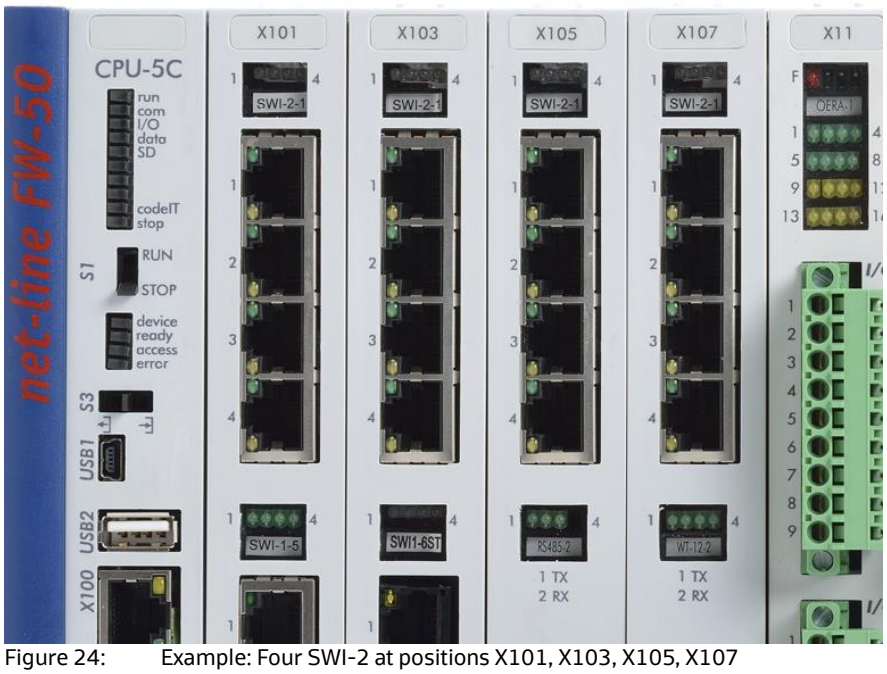
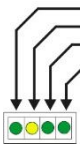


Figure 24: Example: Four SWI-2 at positions X101, X103, X105, X107

Managed functions SWI-2-1/SWI-2-2

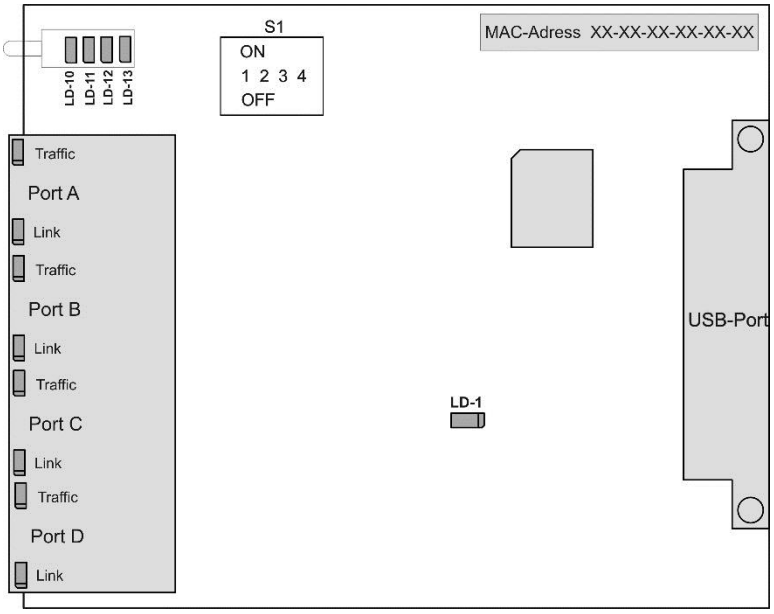
S1	Function	ON	OFF
1	Port mirror mode	**Port mirroring active#** Port 1/A is diagnosis port	Standard function all ports are equal
2	Traffic shaping	No limitation	**Traffic shaping** activated (Data rates limitation)
3-4		-	-

LED SWI-2-1 /SWI-2-2



LED1B	Colour			Function
LED10 ●	Green	-	OFF	no communication
LED10 ●	Green	✳	Flashing	Transmission signal, traffic
LED11 ●	Yellow	●	Statically ON	Connection to CPU (duplex)
LED11 ●	Yellow	-	OFF	no connection to CPU system
LED12 ●	Green	✳	4 Hz	Port mirroring active
LED12 ●	Green	-	OFF/Flash ON	Standard - no mirroring
LED13 ●	Green	-	OFF	no communication FX
LED13 ●	Green	✳	Rapid flashing	Transmission signal, FX-port for SWI-2-2

Layout plan SWI-2-1



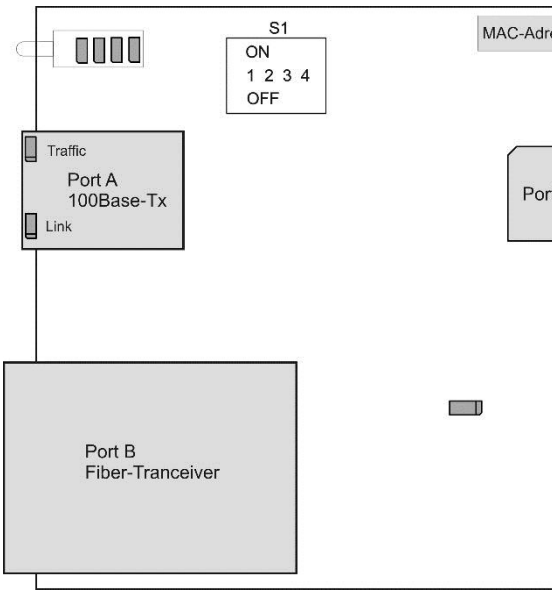
Technical data SWI-2-1

USB	Internal connection to system via USB 2.0 480 Mbit/s
Port 1-4	4 port Ethernet switch 10/100BaseT(X)
RJ45 Ports	10/100BaseT(X) speed, auto negotiation, Full/Half duplex mode, auto MDI/MDI-X connection
Diagnostics	Port A – D each with status LED link & traffic Port E internal to the system System LED Live & Functional
Standards	IEEE 802.3 10BaseT, IEEE 802.3u 100BaseT(X), IEEE 802.3x Flow Control
Port mirroring	can be activated on port A from all data ports
Security	Traffic shaping at port E incl. broadcast storm control
Internet protocol	IPv4, IPv6
Insulation	Class VW2 according IEC 60870-2-1
Cables	4x2 twisted-pair copper cable min. Cat 5e
Line length	max. 100 m to unit or next hub/switch
Environment	-20°C .. +70°C

SWI-2-2 • multimode fibre glass & 1*RJ45 with port mirror

The SWI-2-2 version provides an additional network segment with fibre glass multimode via an internal USB interface. It is identical in construction to SWI-2-1, but via a FO/fibre optic connector with 100 Mbit/s it has a connection via multimode fibre optic cable at port ¾ with duplex SC connection or ST connection.

Front layout/location plan



SWI-2-2: Technical data, cable and line length

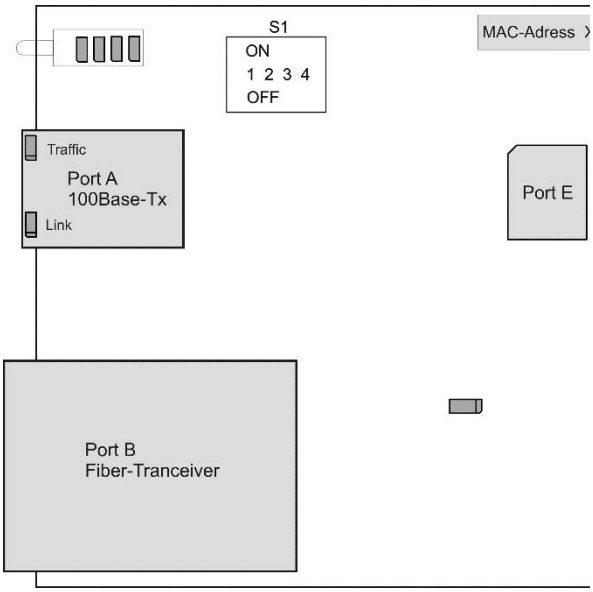
USB	Internal connection to system via USB 2.0 480 Mbit/s
FO port 3/4	Fibre glass **multimode SC/ST-Connector**, FO/LWL 100BaseFx
Connector	**SWI-2-2**: Duplex SC **SWI-2-2-ST**: Duplex ST
Cables	50/125µm multimode-FO (MM) 0-8 dB 62.5/125µm multimode-FO (MM) 0-11 dB
Wavelength	1310 nm (Tx: 1260 ..1360 nm, Rx: 1260..1610 nm [LM32-A3S-PI-N])
Insulation	Class VW3 according to IEC 60870-2-1
Line length	Approx. 2 km fibre data 1.0 dB/km (example)
Port 1	10/100BaseTx , 1 * RJ45 with Status LED unmanaged Ethernet Switch half/full duplex auto negotiation 10/100 Mbit/s, auto-MDIX
Topology	Star-shaped wiring
Insulation	at connector to port 1 class VW2 according to IEC 60870-2-1
Cables	4 x 2 Twisted pair copper cable min. cat 5
Line length	Max. 100 m to unit or next hub/switch

Managed functions and LED such as SWI-2-1

SWI-2-3 • single-mode fibre glass & 1*RJ45 with port mirror

The SWI-2-3 version provides an additional network segment with single-mode fibre glass via an internal USB interface. It is identical in construction to SWI-2-2, but via a single-mode FO/fibre optic connector with 100 Mbit/s it has a connection at port ¾ with duplex SC connection or ST connection.

Front layout/location plan



SWI-2-3: Technical data, cable and line length

USB	Internal connection to system via USB 2.0 480 Mbit/s
FO port 3/4	Fibre glass **single-mode SC/ST-Connector**, FO/LWL 100BaseFx,
Connector	**SWI-2-3**: Duplex SC **SWI-2-3-ST**: Duplex ST
Cables	9/125 µm single-mode-FO (MM)
Wavelength	1310 nm (Tx: 1260 ..1360 nm, Rx: 1260..1610 nm [LS32-A3S-PI-N])
Insulation	Class VW3 according to IEC 60870-2-1
Eye safety	IEC 80825-1, FDA CDRH 21-CFR 1040 **Class 1**
Line length	typ. 15 km fibre data 1.0 dB/km (example)
Port 1	10/100BaseTx , 1 * RJ45 with Status LED unmanaged Ethernet Switch half/full duplex auto negotiation 10/100 Mbit/s, auto-MDIX
Topology	Radiating wiring
Insulation	at connector to port 1 class VW2 according to IEC 60870-2-1
Cables	4 x 2 Twisted pair copper cable min. cat 5
Line length	Max. 100 m to unit or next hub/switch

Managed functions and LED such as SWI-2-1

Serial telecontrol interfaces

The serial interfaces in FW-50 can be used in a completely upward compatible manner with the FW-40 system. The position is no longer rigidly defined. The form factor ½ Euro-format enables two different interface cards in one slot (slot position top and bottom).

- The FW-50 bus offers a total of 4 serial interfaces, two in the upper (U) and two in the lower (L) section of the FW-50 bus. Interface signals are available up to slot U-7 and/or L-7. (This is the area covered by the standard housing BGT-M) The selection of the card continues to take place on the card via J11-14 (COM1 /COM2).
- Terminal designations depend on the position in the system. This is determined by using switch cards and the (expansion) requirements of the customer.
- At the positions U-1 to U-4 and L-1 to L-4 (X101 to X108) a reset signal for selective reinitialisation of the modules is available. Therefore, these positions are particularly suitable for serial interfaces.
- In the rear bus segment of FW--14, the serial interfaces are not available from U/L-8 onwards.
- A FW-50 system can also be used sensibly without a serial interface (as is the case with CPU-4B-ENET) via the Ethernet interface at the front of the CPU-5. This expands the usable space for I/O cards at one slot.

Selection of interfaces

Jumpers S11 to S14 hold the same function in all interface cards. Determining which serial channel (X4-X7) should operate the module is set with these jumpers.

S11 - S14	COM of the serial card	Slots for FW-50	Comment
1-2	COM1	**X101** and **X102**	**Default setting**
2-3	COM2	X103 and X104	

Interfaces for dedicated lines

Interface card RS485-2 / RS422-2

With the RS485-2 interface card, the following functions

- Interfaces according to RS485, 2-wire half-duplex or
- Interface according to RS422, 4-wire full duplex

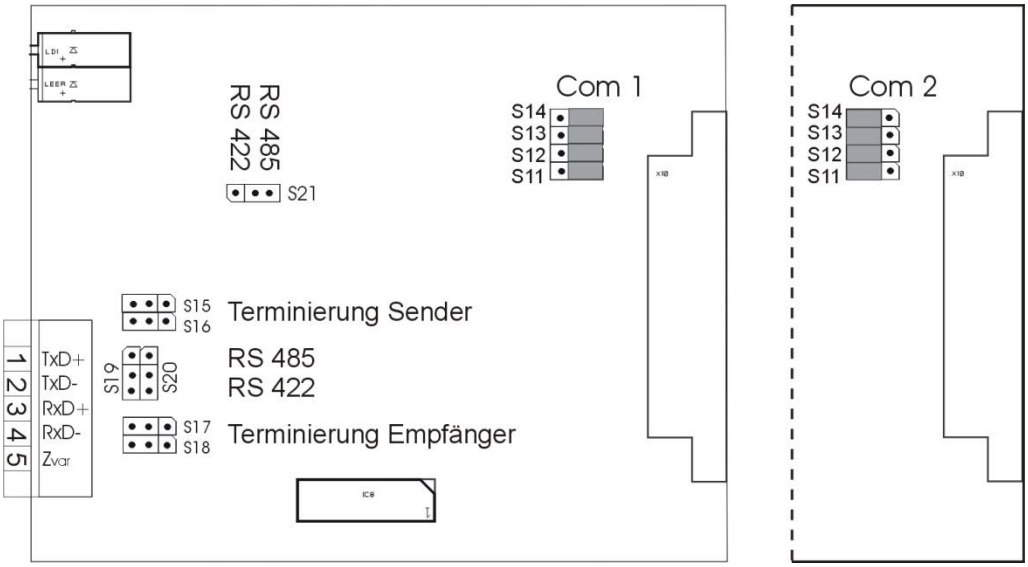
which are selected via jumpers can be implemented. The factory settings of these cards are shown on the name plate. Transforming an RS-485-2 to a RS-422-2 is performed with a few jumpers.

Furthermore, the jumpers are available to activate the integrated termination resistors (150 Ω, alternatively Tx and Rx), with simultaneous termination for noise signal rejection in the half duplex mode for MODBUS and IEC protocol.

RS485-2 / RS422-2	**Interface RS/EIA/TIA-485 / -422**
Operating methods	Full duplex, point-to-point or half-duplex, bus mode
Line	2x2 conductors, twisted pair and shielded e.g. LiYCY 2x2x0.25 mm
Transmission mode	Symmetrical
Baud rate	300 - 64k bits/s
Range	1200 m
Function indicator	Green TD/RD/ RTS LEDs at the front
Signal without load	Max. +/- 5.0 V
Signal with load	Max. +/- 1.5 V
Short circuit power	Max. +/- 70 mA
Signal level	Permissible range - 7 to + 12 V
Signal sensitivity	+/- 200 mV
Electrical isolation	Between logic and transmission line
Test voltage	3000 V AC
Power consumption	30 mA typically (at +Ub=24 V DC)
Operating temperature	0 to +50°C
Relative humidity	95% at 25°C without condensation (class F)

LED 1●●●●4	**Colour**	**Function**
1●	Green	"TD" Transmission signal
2●	Green	"RD" Received signal
3●	Green	"RTS"Request To Send signal

Configuration plan RS485-2 / RS422-2



Selection of serial interface (COMx) via jumpers S11 - S14, see p. 109

Operating methods

Interface type	S19 + S20	S21	Comment
RS485	**1-2**	**2-3**	Function such as RS 485-1
RS422	2-3	1-2	Function such as RS422-1
RS422, pressed	2-3	2-3	Setting the driver at RS485

Transforming a RS485-2 into to a RS422-2

It is easy to change the operating method of a RS-485-2 in the RS-422 mode by inserting a few jumpers. There is label on the card, which states the jumper positions for RS-422.

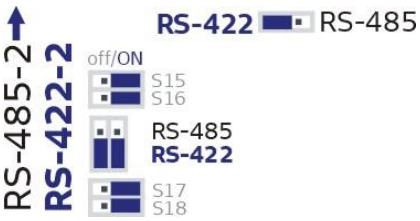
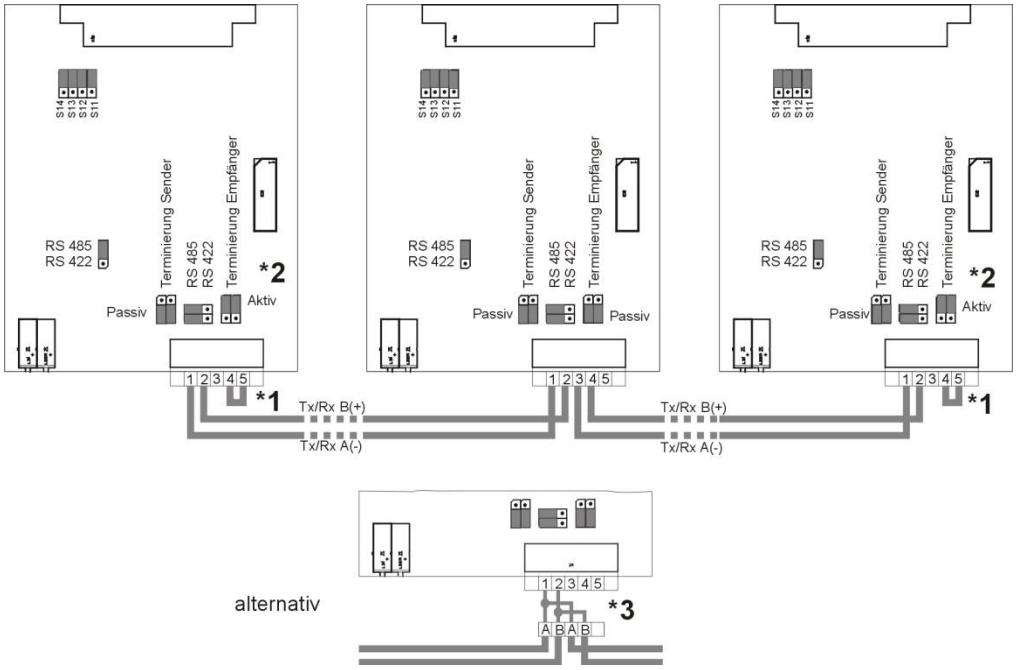


Figure 25: Switching to operating method RS-422

Line connector RS 485-2



The termination of the lines (270 Ohm resistance) is achieved via bridge circuit *1. This bridge circuit must be configured on the first and last card in the system. A noise signal rejection is not achieved through this termination. This version is compatible with card RS 485-1.

Termination with interference rejection

The RS 485-2 modules offer the option of activating a termination with interference rejection (*2). In doing so the line is concluded with 150 Ohm and simultaneously pulled to a defined level via pull up/pull down resistors (1 kΩ); this rejects the noise signal. This is absolute necessary for some protocols (such as Modbus, IEC ...). The respective jumpers (S17/S18) are already inserted in the delivery status. In the case of several participants, **only the first and last station must be terminated**; the termination in the other stations must be deactivated accordingly.

Attention: Only use one type of termination (*1 or *2).
An alternative connector option is presented in the switchboard at position *3. Essentially, it only offers the option of replaced the card in a running system.

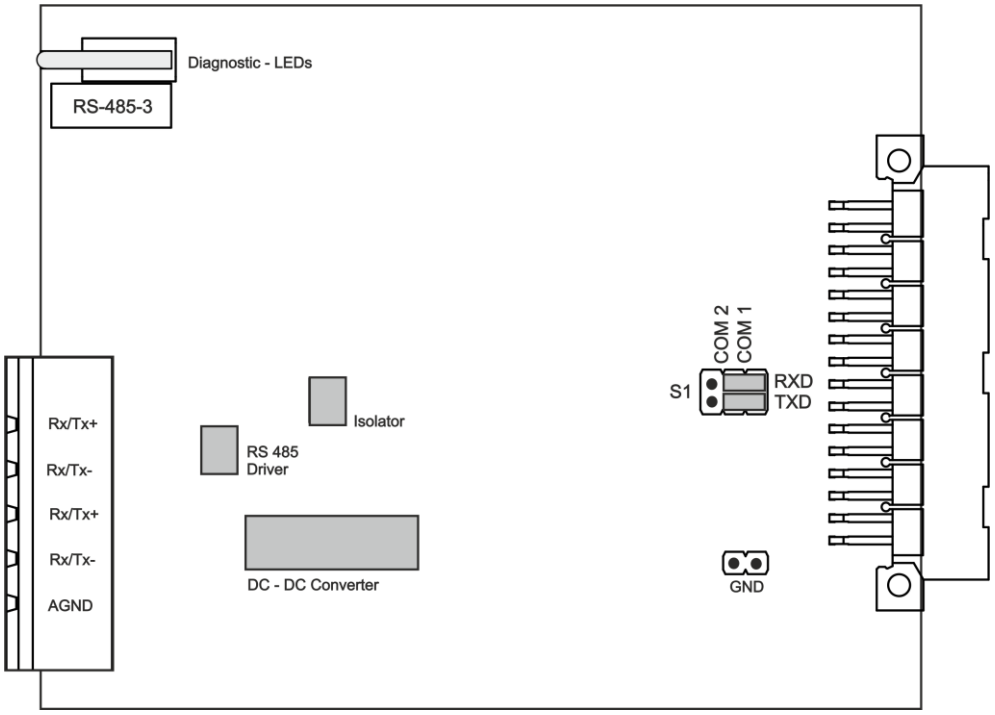
Interface card RS485-3

The interface card RS485-3 makes an 2-line connection according to the standard TIA/EIA/RS-485 with automatic keying available.
To achieve minimum key times in time-critical transmission protocols, such as Modbus or DSfG, the asynchronous data transfer is controlled via hardware; it is sampled with each transmission dada byte. A configuration of the key times is therefore not possible.
The scheduling for characters corrupting the structure of the file in half-duplex mode for Modbus and IEC protocol is firmly activated.

RS485-3	**Interface RS/EIA/TIA-485**
Operating methods	Point-to-point or half-duplex, bus mode
Line	2 Conductors, drilled as a pair and shielded (LiYCY 2 x 0.25 mm2)
Transmission mode	symmetrical
Key times	automatic keying in & blanking out time synchronously with transmission data byte, wire/signal charging pulse type 5 µs
Transmission rate	300 to 115.2 kbit/s
Line length	depending on transmission rate and cable type max. 1000 m
Number of participants	with RS485-3 max. 6/with RS485-2 max. 31 participants
Function indicator	LED's TxD, RxD (active green with data stream)
Output signal level	± 4 V
Input voltage	max. - 7 to + 12 V
Input sensitivity	+/- 200 mV
Terminating resistor	220 Ω (integrated resistance)
EMC Protection	ESD to 15 kV/max. 400 watt pulse (tp = 8/20 µs)
Electrical isolation	between logic and transmission line
Isolation	Signal/logic 2500 V AC / air & creepage distance >4 mm
Power consumption	225 mW from internal 5 V supply
Operating temperature	-20 to 60°C (short-term 70°C)
Relative air humidity	95% at 40 °C without condensation (Class F)

LED 1●●○○4	**Colour**	**Function**
1●	green	"TD" Transmission signal
2●	green	"RD" Received signal

Mounting diagram RS485-3



Selection of a serial interface (COMx) through jumpers S1/S2

S1/S2	COM of the ser. Card	Slots for FW-50	Comment
1-2	COM1	**X101** and **X102**	**Default setting**
2-3	COM2	X103 and X104	

Line interface RS485-3

The cable connection is made as for RS-485-2 with further pairs of X10n.3/X10n.4, but without terminating resistor bridge. see **Fehler! Verweisquelle konnte nicht gefunden werden.** p. **Fehler! Textmarke nicht definiert.**.

X10n	Function	Comment
1	Rx/Tx+	**RS-485 Level A** arriving conductor
2	Rx/Tx-	**RS-485 Level B** arriving conductor
3	Rx/Tx+	RS-485 Level A departing conductor
4	Rx/Tx-	RS-485 Level B departing conductor
5	AGND	Analogue ground (no shield)

Interface board media converter LWL-2

The interface board LWL-2 is a media converter for serial signal on fibre optics FO with a set of special features:

- Each board LWL-2 carries two pairs of receiver/transceiver
  thus coupling 2 FO lines
- Up to 7 LWL-2 may be assembled on a bus segment in a BGT rack (upper/lower bus)
- Each board may be assigned to COM1 or COM2 individually
- Every multi-point serial bus protocol with a tolerant response time may be used
- The idle level of light in line may be set

The board operates like a star coupler device already integrated into the rack. The LWL-2 board works in multi-point (party-line) bus mode. All transceivers dedicated to the same COM interface will transmit the same signal via FO-line, but only the addressed device shall respond. This corresponds to a party-line operation on a RS-485 line; but no common wire will be commissioned to the device but separated fibre lines in a star infrastructure. Each LWL-2 links to two e.g. protection devices, using both bus segment upper/lower, 7 slots and 2 links, a set of 2*7*2 = 28 protection devices may be linked to a BGT rack via FO serially.

Operation of a LWL-2 as starcoupler in project

The LWL-2 interface may be operated used as a single media-converter or as a combined star-coupler. The full integration of LWL-2 interface, a setIT from V5.005 is required. From this release, the interfaces may be commissioned to the slots as usual in the assembly of the station hardware. Just reserve the number of slots needed for the interfaces; the amount of interfaces is not restricted to four but may be set up to the full load of 7 for each bus-segment. Each board may be commissioned individually to COM1 or COM2 of the bus segment via jumper but setIT assumes a declaration in a group setting, starting with COM1.
But the LWL-2 may be used as well in combination with every setIT release. Just assemble virtually a RS-485 interface board for each COM used and assign the devices to the interfaces, assuming it might be a RS-485. Set the amount of reserved slots for communication in setIT but don't select other interfaces. Use the reserved hardware slots to plug in the LWL-2 interfaces needed. In elder releases only the visual presentation and the corresponding stations to the interface is missing.

Technical data LWL-2

LWL-2	**Optic media converter**
Operating modes	half duplex, bus operation
Glass Fibre	Wavelength 820 nm, Faser Ø: 50/125 µm, 62,5/125 µm, 100/140 µm, 200 µm HCS®
Optical power sending	50/125 µm: -19 dBm, 62,5/125 µm: -16 dBm
Optical power receiving	-24 dBm
Connection length	1400 m
Plug connectors	ST with bayonet BFOC- connection / IEC 60874-10-1
Status displays	LEDs in front panel TxD, RxD,
Potential separation	Between logic and transmission line
Power consumtion	30 mA
Ambient temperature	-20° bis +70°C, advised max. 55°C
Relative humidity	<95% at 25°C without condensation

Layout diagram LWL-2

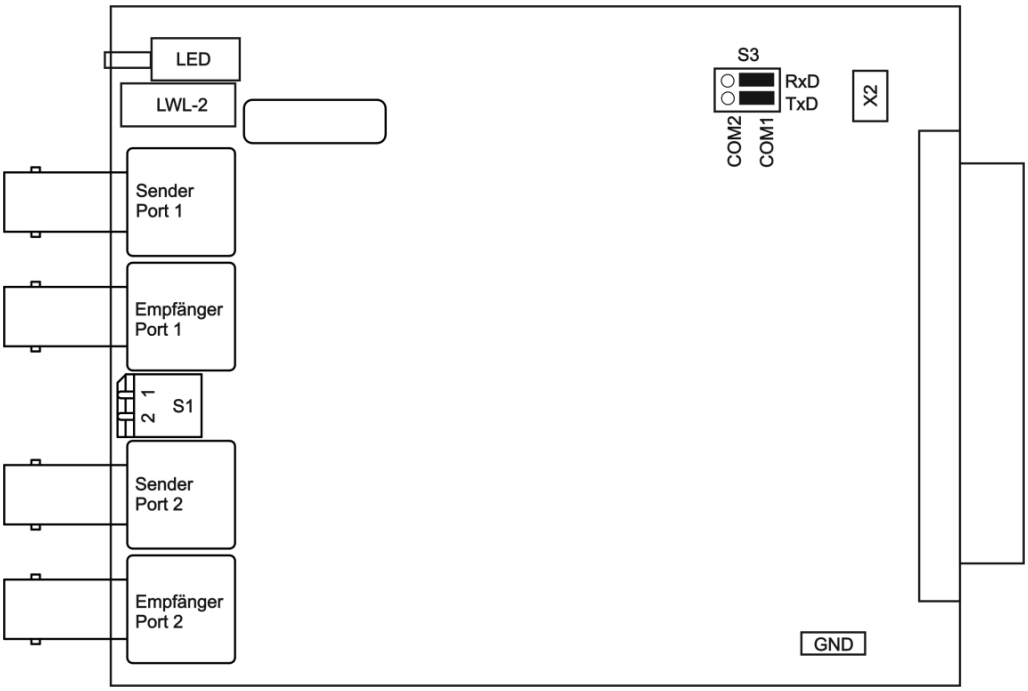


Abbildung 26: Layout LWL-2; Sender=transmitter, Empfänger=receiver

Interface selection

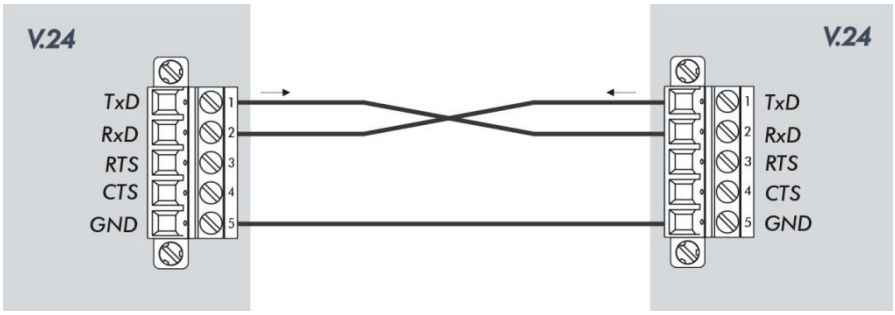
S3	Serial channel	comment
1-2	COM1	**Default position** COM1 grouped in front slots
2-3	COM2	COM2 grouped in rear slots

Operating mode – idle level

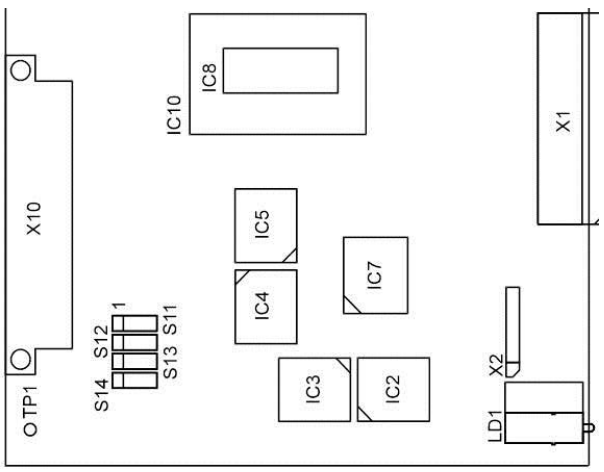
interface	S1	comment
Idle level P1	**S1-1 off**/right	Idle level light on Port 1
	S1-1 on/left	Idel level light off, no monitoring possible
Idle level P2	**S1-2 off**/ right	Idle level light on Port 2
	S1-2 on/ left	Idel level light off, no monitoring possible

Interface card V.24-1/-2

V24-1 / V24-2	RS-232 interface
Operating methods	Full duplex, point-to-point
Line	Shielded cable, min. 3-wire
Transmission mode	Asymmetric point-to-point
Baud rate	300 - 19200 bits/s
Range	Typically 20 m max. 100 m
Function indicator	Green LED in front TD, RD, RTS, CD (CTS)
Signal without load	+/- 15 V
Signal with load	+/- 5 V
Permissible load	3 to 7 kΩ
input voltage	Permissible range +/- 15 V
input sensitivity	+/- 3 V
Electrical isolation	Between logic and transmission line
Test voltage	500 V AC / 3000 V DC for V.24-2
Power consumption	30 mA typically (at +Ub=24 V DC)
Operating temperature	0 to +50°C
Relative humidity	95% at 25°C without condensation (class F)



Mounting diagram

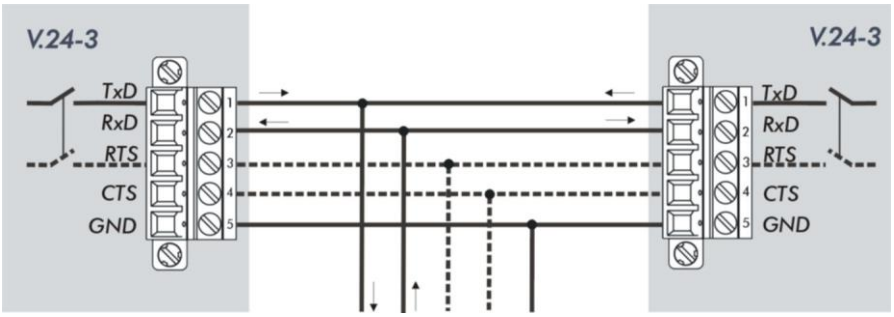


Selection of serial interface (COMx) via jumpers S11 - S14, see p. 109

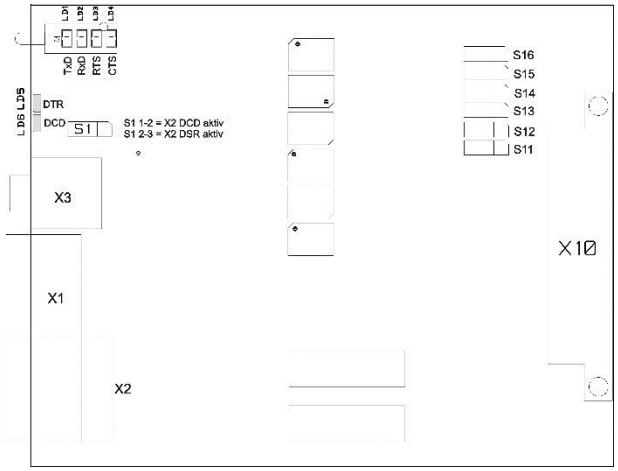
Interface card V.24-3

This card corresponds to a V.24-2 with switchable transmission data for the direct parallel activation on the duplicated heads. There is a pressed, party-line compatible interface where more than two V.24 interfaces can be interconnected. The TxD transmission line and the trigger signal are switched with high impedance via RTS. This prevents a complex cabling via the T-coupler or change over switch.

V24-3	**V.24 (RS-232 , ANSI/EIA/TIA-232-F-1997) with monitoring interface**
Operating methods	Full duplex, asymmetric, point-to-point and party-line via RTS keying
Line	Shielded cable, min. 3-wire
Baud rate	300 to 115 kbit/s
Range	Typically 20 m max. 100 m
Function indicator	Green LED in front TD, RD, RTS, CD (CTS)
Signal without load	+/- 7 V
Signal with load	+/- 5 V
Permissible load	3 to 7 kΩ
input voltage	Permissible range +/- 15 V
input sensitivity	+/- 3 V
Electrical isolation	Between logic and transmission line
Test voltage	3000 V DC
Power consumption	30 mA typically (at +Ub=24 V DC)
Operating temperature	0 to +70°C
Relative humidity	95% at 25°C without condensation (class F)



Mounting diagram V24-3 /V24-4



Selection of serial interface (COMx) via jumpers S11 - S14, see p. 109

Jumpers of the serial interfaces

The V24-3/V24-4 cards are equipped with 6 jumpers to select the interface. Both of the additional jumpers S15/S16 have been added to select the extended handshake signals DCD/DTR.

S11 - S14	COM of the serial Card	Slots	Comment
1-2	COM1	**X101** and **X102**	Default setting
2-3	COM2	X103 and X104	

S15 - S16	COM	Slots	Comment
Open			Open
Open			Open

Both of these jumpers must NOT be inserted into the existing racks of the FW-50 series.

Diagnostic interface (V.24)

see Diagnostic interface (V.24) p. 127

Attention

When changing a V.24-3 the module should **be supplied with a voltage before the data line is** inserted. The analogue switch of the card required energy to be activated; this would be retrieved from the data line and could result in brief communication interferences.

Interface card V.24-4

V24-4	**V.24 (RS-232 , ANSI/EIA/TIA-232-F-1997) with monitoring interface**
Operating methods	Asymmetric, full duplex, point-to-point
Line	RJ-45 PATCH cable, adapter cable e.g. VB213
Baud rate	300 to 115 kbit/s
Range	Typically 20 m max. 100 m
Plug	RJ-45 bushing according to ETSI EN 300-392-5 DEE
Function indicator	Green LED in front TD, RD, RTS, CD (CTS)
Signal without load	+/- 12 V
Signal with load	+/- 5 V
Permissible load	3 to 7 kΩ
Input voltage	Permissible range +/- 15 V
Input sensitivity	+/- 3 V
Electrical isolation	Between logic and transmission line
Test voltage	3000 V DC
Power consumption	30 mA typically (at +Ub=24 V DC)
Operating temperature	0 to +70°C
Relative humidity	95% at 25°C without condensation (class F)

RJ-45 connected according to EN ETSI 300 392-5 DEE

	Pin	*Name*		*To ETSI EN 300 392-5 DTE*
	1	DSR/PWR	◀	Data Set Ready
RxD	2	DCD	◀	Data·Carrier·Detect·
	3	DTR	▶	Data ·terminal· ready
	4	GND	-	Ground
	5	RxD	◀	Receive Data
TxD	6	TxD	▶	Transmit Data
	7	CTS	◀	Clear· to ·send·
	8	RTS	▶	Request To Send keying

The RJ-45 occupation is designed so that an external WT module (SWT-12, SWT-96), TETRA-1 or GPRS-1 can be connected 1:1 with a patch cable.

Mounting diagram

Corresponds to Mounting diagram V24-3 /V24-4 p. 121.
Selection of serial interface via jumpers S11-S16, see p. 121

Diagnostic interface (V.24)

see Diagnostic interface (V.24) p. 127

Interface card modem WT12

The WT12 modem is used in telecontrol systems, if independent current paths are used (fixed connection) as wire paths or if private copper-bound wire paths have to be bridged with distances of more than 1000 m.
For data transmission according to CCITT V.23, the WT12 can be used in the two-wire half duplex (WT12-2) as well as in a four wire full duplex operation (WT12-4).
It is compatible with MOD12-x and can be used point-to-point and party-line in the same line with Mod12-x (MOD12 keying times are used).
Due to the optional monitoring function on X2, it is possible carry out a data analysis with external auxiliary means on the transmission layer (layer 1 ISO model) without interfering or affecting the internal software.

Brief profile WT12

Function:	VFT dedicated line modem · upward compatible with MOD12-2 according to R&TTE guideline, CCITT V.23
WT12-2/WT12-3	2-wire half-duplex, party-line up to 15 participants
WT12-4,WT12-5	4-wire full duplex Line: Telecommunication line, public and private, control cable
Speed:	1200 bits/s, keying-on time 10 ms
Range:	Typically 20 to 30 km

Variants

Variant	*Item number*	*Function*
WT12-2	310000538100	2-wire FSK modem 1200 bps half-duplex
WT12-3	310000538110	2-wire FSK Modem 1200 bit/s half duplex with monitoring function in front panel * (X2)
WT12-4	310000538120	4-wire FSK modem 1200 bps full duplex
WT12-5	310000538130	4-wire FSK Modem 1200 bit/s half duplex with monitoring function in front panel * (X2)

* Accessories monitoring cable VB-212, item: 310000068500

Use on public current paths (fixed connection -SFV)

Capable of approval according to European R&TTE directive

- 2-wire 1200 bit/s half-duplex (point-to-point and multi-point mode)
- 4-wire 1200 bit/s full-duplex (point-to-point)

For usage on **private transmission routes**

- 2-wire 1200 bit/s half-duplex (point-to-point and multi-point mode)
- 4-wire 1200 bit/s full-duplex (point-to-point)

A faster link at 9600 bits/s is possible with the WT96 modem.

Technical data WT-12

WT-12	WT-dedicated line modem for public and private networks
Data transmission rate	1200 bit/s joint operation/party-line possible
Modulation	Frequency shift keying (FSK) Centre frequency 1700 Hz, frequency deviation ± 400 Hz, Modulation index 0.66666
Range	Up to 30 km with 2-wire Cu-line ∅ 0.8mm
Operating method	Half duplex (2-wire),frequency equation full duplex (4-wire)
Transmission line	2-wire Cu / 4-wire Cu
Galvanic isolation	Through 1:1 transformer
Surge protection	Varistor
Plug-in connection	5-pole terminal connection
input impedance	Selectable via jumper: seen from the line in the module open: high-impedance (Transmitter = current source) closed: Line impedance (600 Ω)
output level	-6 dBm (with line termination)
Channel predistorter	Signal with higher frequency can be selected with jumpers 0 %, 20 %, 40 %, 60 % amplification
Reduced transmission power	- 20 dB attenuation selectable
Turning on and off	With RTS signal
input sensitivity	Typically UEIN, Eff = 3 mV, max. UEIN, Eff = 10 mV
input amplification	Adjustable via jumpers to 0, 10, 20, 30 and 40 dB
Bridgeable attenuation	Typically 50 dB, min. 40 dB
Data interface	TTL level, control signals RTS and CTS with TTL levels
Signal propagation delay	1 ms between transmitter and receiver
Voltage limitation	150 V VDR via line interfaces
Insulation voltage	2500 V DC
Interference immunity:	3.0 kV between telecommunication circuit and control electronics
Immunity	According to EN 61000-6-2 (08/2002) in industrial environments
Transient emissions	According to EN 61000-6-4 (08/2002) in industrial environments,
Power supply	Max. 50 mA (from power supply 24 V DC) approx. 250 mA (at +5 V internally)
Temperature range	0°C to +70°C

Keying times for WT12-2 and WT12-3

- Pre-keying time Tv 15 ms (before keying wait for reception)
- Keying time Te 10 ms (before transmission wait for keying-in)
- Blanking time Ta 3 ms (before keying-out waiting for transmission)
- Reception delay Tev 20 ms (first reception after blanking)

Control and display elements

Interface selection

Jumpers S11 and S14 are used to set the serial channel on which the module should be operated.

S11 - S14	Interface selection COM of the serial card
1-2	**COM1 ***
2-3	COM2

Amplification of transmission level

The signal with the higher frequency can be increased by 20%, 40% or 60% compared to the signal with the lower frequency.

S100	S101	Amplification of transmission level in transmitter
Open	Open	No change (0%) / -6 dBm
Closed	**Open**	**20% amplified / -4 dBm ***
Open	Closed	40% amplified / -3 dBm
Closed	Closed	60 % amplified / -1.5 dBm

Reducing the transmission level

S102	Reducing the transmission level
Open	**No reduction ***
Closed	- 20 dB attenuation with centre nearby

Line termination, 2-wire, half-duplex

S200	Line termination for transmitter and receiver
Open	No termination Station located in the joint operation/party-line and not at the end of the cable
Closed	**Termination of line with 600 Ω ***

Line termination, 4-wire, full duplex

S200 / S201	S200 termination for transmitter, S201 termination for receiver
Open	No termination Station located in the joint operation/party-line and not at the end of the cable
Closed	**Termination of line with 600 Ω ***

Input amplification

Amplification factors of the input amplifier in the receiver are set via jumpers S301 - S304:

input amplification	Jumper	Amplification factor	Sensitivity of carrier detection
0 dB	--	&0	> -24 dBm
10 dB	**S301**	**+10%**	**> -34 dBm ***
20 dB	S302	+20%	> -44 dBm
30 dB	S303	+30%	> -54 dBm
40 dB	S304	+40%	> -60 dBm

Carrier detection (CD)

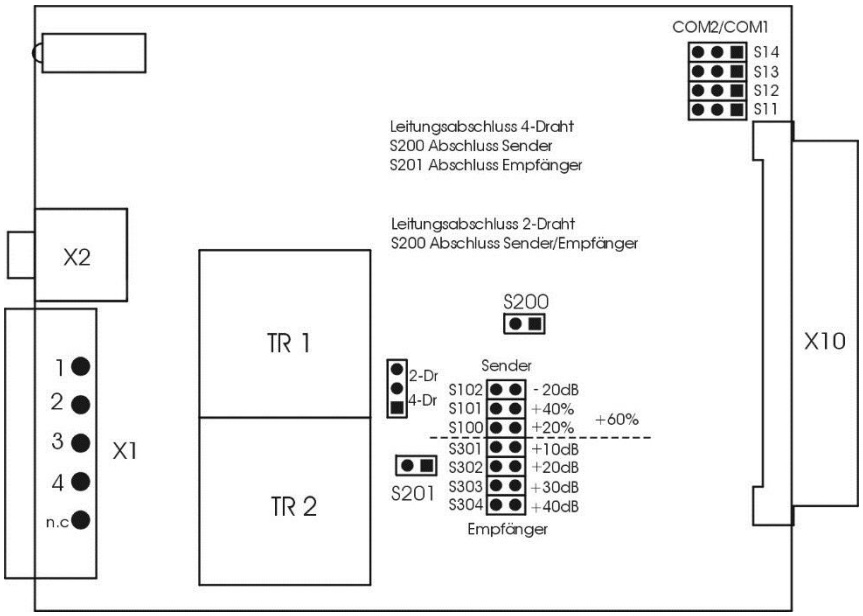
The input sensitivity data refers to the useful signals without injected interference signals.

* Default (factory setting)

Light-emitting diodes

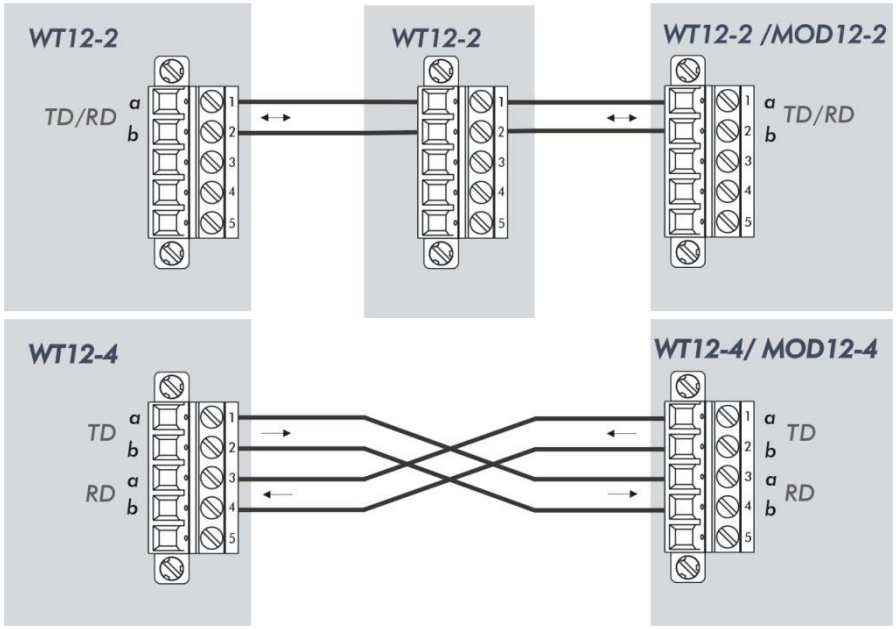
LED 1●●●●4	Colour	Function
1●	Green	"TD" Transmission signal
2●	Green	"RD" Received signal
3●	Green	"RTS" Request To Send signal
4●	Green	"CD" Received signal level, valid LW input signal

Component mounting plan



Selection of serial interface (COMx) via jumpers S11 - S14, see p. 109

Line interface



Diagnostic interface (V.24)

see Diagnostic interface (V.24) p. 127

Interface card modem WT96

The WT96 modem is used in telecontrol systems for point-to-point and multipoint operation, if private copper lines are used as wire paths to cover distances of more of 1000 m quickly. WT96 can be used in both the two-wire half duplex (WT96-2) as well as in the four-wire full duplex operation (WT96-4).
Due to the optional monitoring function on X2, it is possible carry out a data analysis with external auxiliary means on the transmission layer (layer 1 ISO model) without interfering or affecting the internal software.

Brief profile

WT96	VFT dedicated line modem for quick transmission (FSK)
WT96-2/WT96-3	2-wire half-duplex, party-line up to 15 units
WT96-4,WT96-5	4-wire full duplex line: private telecommunication line, control cable
Speed:	9600 bit/s, keying-in time 3 ms operation also possible with 4800 bit/s, 2400 bit/s
Range:	Typically 15 to 20 km

Variants

Variant	Item number	Function
WT96-2	310000538200	2-wire FSK modem 9600 bps half-duplex
WT96-3	310000538210	2-wire FSK Modem 9600 bit/s half duplex with monitoring function in front panel * (X2)
WT96-4	310000538220	4-wire FSK modem 9600 bps full duplex
WT96-5	310000538230	4-wire FSK Modem 9600 bit/s half duplex with monitoring function in front panel * (X2)

* Accessories monitoring cable VB-212, item: 310000068500

For usage on **private transmission routes**

- 2-wire 9600 bit/s half-duplex
  (point-to-point and multi-point mode)
- 4-wire 9600 bit/s full-duplex
  (point-to-point)

Diagnostic interface (V.24)

On the diagnostic interface the TxD and RxD signals are brought out at V.24 level as test signal/test tap for monitoring purposes. The signals are available via a 3.5 m ratchet coupling in the front panel, which are configured depending on the variant. By using the VB-212 accessory monitoring cable, these signals are available on two 9-pole D-SUB jumpers (bushings)

X2	Signal	Comment
R	Tx	Transmit signal
T	Rx	Receive signal
S	GND	Signal ground

Technical details

WT96	fast FVT dedicated line modem (FSK)
Data transmission rate	9600 bit/s joint operation/party-line possible
Modulation	Frequency shift keying (FSK), centre frequency 13600 Hz, frequency deviation ± 4400 Hz, modulation index 0.91666
Range	Up to 20 km with 2-wire Cu-line ∅ 0.8mm
Mode	Half duplex (2-wire),frequency equation full duplex (4-wire)
Transmission line	2-wire Cu / 4-wire Cu
Galvanic isolation	Through 1:1 transformer
Surge protection	Varistor
Plug-in connection	5-pole terminal connection
input impedance	Selectable via jumper: seen from the line in the module open: high-impedance (transmitter = current source) closed: line impedance (complex termination: 931 Ω parallel to RC unit with 130 Ω and 150 nF in series)
output level	-1 dBm (with line termination)
Channel predistorter	Signal with higher frequency can be selected with jumpers 0 %, 20 %, 40 %, 60 % amplification
Reduced transmission power	- 20 dB attenuation selectable
Turning on and off	With RTS signal
input sensitivity	Typically UEIN, Eff = 3 mV, max. UEIN, Eff = 10 mV
input amplification	Adjustable via jumpers to 0, 10, 20, 30 and 40 dB
Bridgeable attenuation	Typically 50 dB, min. 40 dB
Data interface	TTL level, RTS and CTS with TTL levels
Signal propagation delay	0.085 ms between transmitter and receiver
Voltage limitation	150 V VDR via line interfaces
Insulation voltage	2500 V DC
Interference immunity:	3.0 kV between telecommunication line and control electronics
EMC immunity	Acc. to EN 61000-6-2 (08/2002) in industrial environments
EMC emission	According to EN 61000-6-4 (08/2002) in industrial environments,
Power supply	Max. 50 mA (from power supply 24 V DC) approx. 250 mA (at +5 V internally)
Temperature range	-20°C to +70°C

Keying times for WT96-2 and WT96-3

- Pre-keying time Tv 6ms before keying wait for reception
- Keying time Te 3 ms before transmission wait for keying-in
- Blanking time Ta 3 ms before keying-out wait for transmission
- Reception delay Tev 10 ms first reception after blanking

Control and display elements

Interface selection

Jumpers S11 and S14 are used to set the serial channel on which the module should be operated.

S11 - S14	Selection of the serial card's COM interface
1-2	**COM1 ***
2-3	COM2

Amplification of transmission level

The signal with the higher frequency can be increased by 20%, 40% or 60% compared to the signal with the lower frequency.

S100	S101	Amplification of transmission level in transmitter
Open	Open	No change (0%) / -1 dBm
Closed	**Open**	**20 % amplified / +0.4 dBm***
Open	Closed	40% amplified / +1.8 dBm
Closed	Closed	60 % amplified / +3.0 dBm

Reduction of transmission level

S102	Reduction of transmission level
Open	**No reduction ***
Closed	- 20 dB attenuation with centre nearby

Line termination, 2-wire, half-duplex

S200	Line termination for transmitter and receiver
Open	No termination Station located in the joint operation/party-line and not at the end of the cable
Closed	**Termination of line with complex resistor ***

Line termination, 4-wire, full duplex

S200 / S201	S200 termination for transmitter, S201 termination for receiver
Open	No termination Station located in the joint operation/party-line and not at the end of the cable
Closed	**Termination of line with complex resistor ***

Input amplification

Amplification factors for the input amplifier in the receiver are set via jumper S301 - S304.

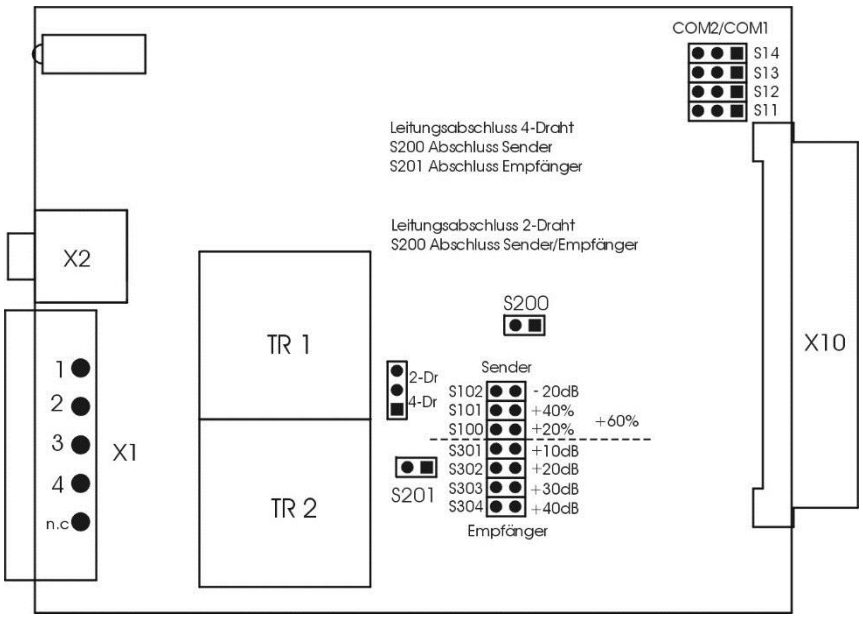
Input amplification	Jumper	Amplification factor
0 dB	--	&0
10 dB	**S301**	**+10% ***
20 dB	S302	+20%
30 dB	S303	+30%
40 dB	S304	+40%

* Default (factory setting)

Light-emitting diodes

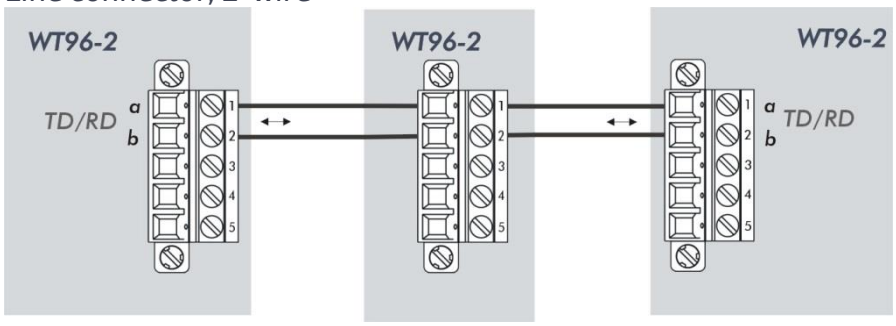
LED 1●●●●4	Colour	Function
1●	Green	"TD" Transmission signal
2●	Green	"RD" Received signal
3●	Green	"RTS" Request To Send signal
4●	Green	"CD" Received signal level valid AF input signal

Mounting diagram

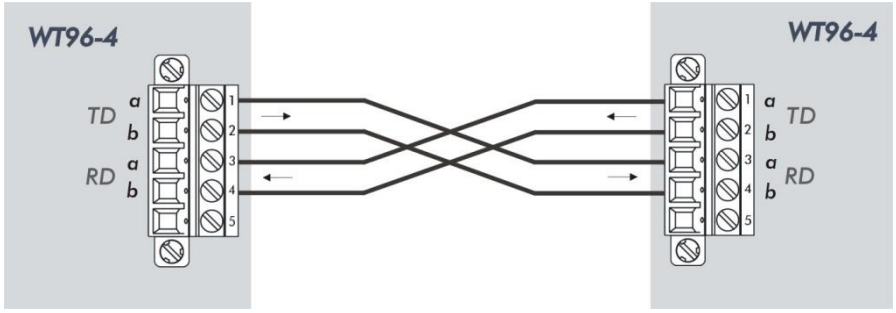


Selection of serial interface (COMx) via jumpers S11 - S14, see p. 109

Line connector, 2-wire



Line connector, 4-wire



Interface for dial-up lines (PSTN)

Dial-up modems WM144-1/WM336-1 /WM336-3

The dial-up modems

- WM144-1 (Dial-up modem max. 14.4 kbit/s)
- WM336-1 (Dial-up modem max. 33.6 kbit/s)
- WM336-3 (Dial-up modem max. 33.6 kbit/s)

are designed to be used in all expandable SAE telecontrol stations, data concentrators and telecontrol centres. The dial-up modems are designed as plug-in cards in 1/2 Euro-format and are integrated within the unit.

The modems are suited to be connected to the analogue dial-up connectors (PSTN) and based on industrial-suited socket modems. They have a serial interface with TTL levels (TxD, RxD, RTS, CTS). The connector to the switch network is established via a 6-pole Western connector at the front with a standard TAE connector cable.

The modems are designed for data transmissions up to 14.4 kbit/s and/or 33.6 kbit/s, depending on the version delivered. Control is based on an extensive AT command repertoire.

The dial-up modems have an EC-approval according to CTR21, whereby the dual-tone multi-frequency signalling (DTMF) is determined for the selection.

Function LEDS

At the front there are 4 green LEDs to indicate the operating states of the modems.

LED 1●●●●4	Colour	Function
1●	Green	"TD" Transmission signal
2●	Green	"RD" Received signal
3●	Green	"RTS" Request To Send signal
4●	Green	"CTS" Received signal level

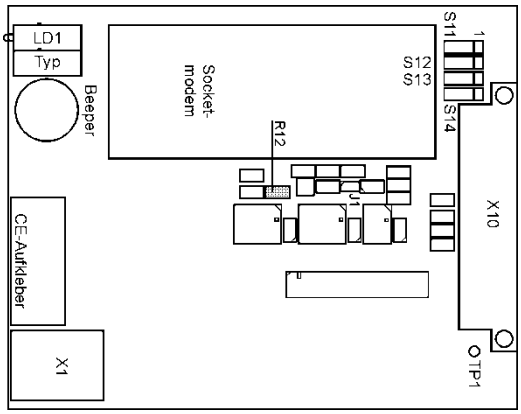
Technical data dial-up modem

WM144-1 **WM336-1** **WM336-3**	Analogue dial-up model for dial mode in public or private telephone networks (PTSN)
Data transmission:	300Bd, V.21 / 1200Bd, V.22 / 2400Bd, V.22bis / 9600Bd, V.32 / 14.4kbit/s, V.32bis 28.8kBit/s, V.34 depending on version 33.6kBit/s, V.34 depending on version 56kBit/s, V.90 depending on version
Fax operation	9600 bit/s, V.29, transmitting + receiving, 14.4 kbit/s, V.17, transmitting + receiving, fax class 2
Error correction/compression	V42.bis, MNP 5, MNP 10EC
Command repertoire	AT command, Hayes compatible
Dialling function	Frequency selection (DTMF), flash key
Line interface	According to CTR 21
Return loss	> 18 dB
Symmetry	> 55 dB
Direct current resistance	Approx. 300Ω
Max. loop current	60 mA
Flash duration	Approx. 80 ms
Level	Transmission level -4..-10dBm DTMF level -4..-6dBm
input sensitivity	-4..-43 dBm
Connection	Western socket (RJ12, 6-pole.).
Approval	EC approval CE 0506 X (CTR 21)
Electrical isolation	Between logic and transmission line
Test voltage	3000 VDC (at WM336-3 1500 V DC)
Serial interface to CPU	TTL level, TxD, RxD, RTS, CD
Baud rate to DTE	300 bit/s...57.6 kbit/s to CPU (DEE)
Power consumption	Supply with 24 VDC: typically 60 mA, max. 120 mA Internal power supply + 5V: typically 25 mA, max. 200 mA
Function indicator	4 green LEDs in front panel
Controls	4 internal jumpers, changeover COM1, COM2
Design	Board in half Euro-format , upright, 100 mm* 80 mm, plug connector according to DIN 41612 , structural shape C/2, plug assignment of interface cards
Ambient temperature	0..+50° C
Relative humidity	< 80%, without condensation

LED dial-up modem WM-xx

LED 1●●●●4	Colour	Function
1●	Green	"TD" Transmission signal
2●	Green	"RD" Received signal
3●	Green	"RTS" Request To Send signal
4●	Green	"CD" Carrier recognised

Mounting diagram



Selection of serial interface (COMx) via jumpers S11 - S14, see p. 109

Activation instructions

The dial-up modems

- WM144 (Dial-up modem max. 14.4 kbit/s)
- WM336 (Dial-up modem max. 33.6 kbit/s)

are connected with a 6 pole TAE connector cable to a TAE socket F coding. A western plug socket (RJ12, 6-pole) is located on the side of the unit.

Telephone connection

An external automatic telephone changeover switch is required if a telephone needs to be connected alongside the modem. The modem has an F-coded TAE socket and therefore, unable to **interconnect the telephone line directly to the telephone**.

Note: A filter to block the charge pulses must be switched between the modem and TAE connector when operating the dial-up modem on a connector with active charge pulses. This case is likely to be extremely rare, because these charge pulses have to be requested from the system operator and are subject to a charge.

Pin assignment

Signal name	TAE plug, F-coding	Modem connector RJ12
a	1	4
b	2	3

Connection cable

SAE dial-up modems must be connected with the supplied TAE cable because a correct function of the modems cannot be guaranteed with other cables.

Cable length: 3m
Cable colour: Black

Interfaces mobile radio GSM/GPRS/EDGE

GSM & GPRS modem GSM-2

The GSM-2 is a wireless module for cost-efficient mobile applications on public and private digital GSM-standard mobile networks (German networks) with low safety standards. It is inserted into the telecontrol station as an interface. It is powered and integrated into the communication processes via a plug-in connector.
The GSM-2 uses an MC75i embedded quad-band GSM module with integrated GPRS/EDGE functionality, embedded in a compact top-hat rail housing designed with high EMC resistance for industrial use.

The wireless module supports data services as a dial-up modem via GSM using the CSD service circuit switched data or GPRS/EDGE packet transmission linked to TCP/IP networks over a 'quasi'-dedicated line modem via wireless signals.
The control and initialising of the wireless module in the command mode is carried out via AT commands.

For the operation within GSM networks, you need a 3V SIM card with activated data services. This is inserted behind the front panel. You only need to add an external antenna. No other external components need to be installed. The SIM card and antenna are accessible via the front.

Product	Designation
310000070000	GSM-2 interface
Accessories	
310004050300	Dual-band rod antenna 2dB 1.5 m, SMA indoor
310004050400	GPRS Triband antenna set 2 dB, 5 m, SMA indoor
310000056400	Antenna set for GSM modems, Triband rod antenna

The GSM/GPRS module can be operated in different operating methods. These operating methods must be pre-set via the jumpers S3 & S4 that are located on the module.

Function LEDs

LED 1●●●●4	Function
1	TxD Transmit data
2	RxD Receive data
3	Level field strength of radio
4	Status of wireless network
LED 5●●6	**Function**
5	DTR control signal, release board
6	DCD control signal transparent data link in radio network

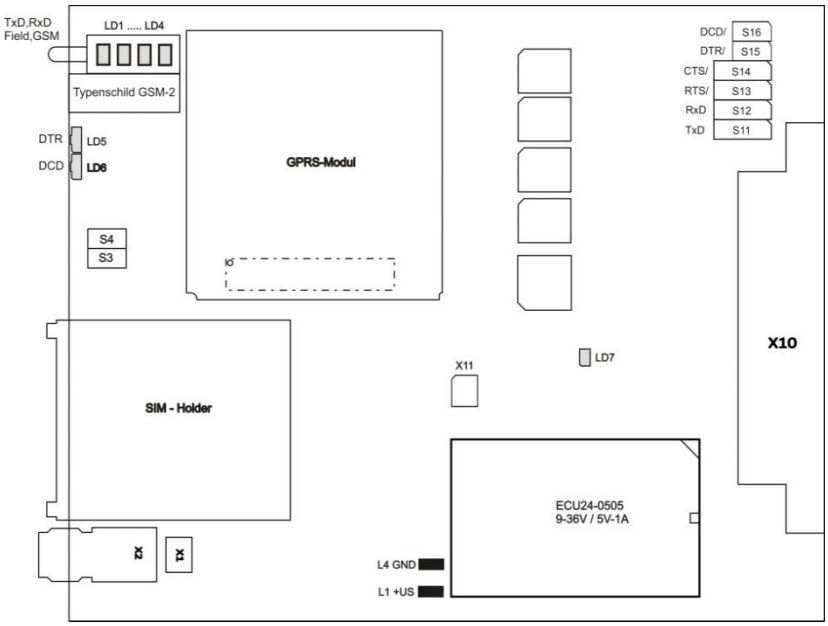
Field strength	LED 3	Function
Max field strength	●	static ON
sufficient field strength	✳	flashing, 1.5 s ON / 0.5 s OFF
low field strength other antenna needed	✳	flashing, 0.5 s O / 1.5 s OFF
field strength too low, no subscription to network available	○	static OFF

wireless status indication	LED 4	Function
Error: no data flow recognised by board processor	✳ 10 Hz	flashing, 10 Hz
missing data from wireless module, not subscirbed to mobile network	✳	flashing, 2 s ON / 0.1 s OFF
valid subscription to mobile network	✳ Flash	flashing, 0.1 s ON / 2 s OFF
Hook-up or call active	✳ 2 Hz	flashing, 2 Hz
transparent link	●	static ON

board status	LED 1	LED 2	LED 3	LED 4
subscribed to GSM network, max. field strength	○	○	●	✳ Flash
board in RESET (RTS/ or DTR/ active)	○	●	●	●
board released wireless module in reset	○	●	●	○
wireless module malfunction Reset requested	○	●	○	●
no available data stream between wireless-module and system CPU	○	○	✳ Flash	✳ Flash

operation status LD7	LED 7	Function
board inactive	○	board without function
normal operation mode	2 Hz	AT command & data transmission mode
board blocked via status signal RTS or DTR	4 Hz	The wireless module was inactivated via system driver
Initialisation phase of wireless module	10 Hz	The board initialises the wireless module according to jumper settings

Board layout



Interface selection

With jumpers S11 – S14 the interface COM1/COM2 of the internal bus is selected on which the board shall be operated. Please pay attention to the various interface assemblies of the desired product lines below.

S11 - S14	Function	Remark
S11	**BUS - TxD**	
S12	**BUS - RxD**	
S13	**BUS – RTS/**	In compatibility mode modem ON/OFF
S14	**BUS – CTS/**	In compatibility mode GSM-link (CSD data) active

All jumpers S11-S14 must be set to the same position.

S11 - S14	Interface FW-10, FW-40 , FW-50	Remark
1-2	COM1 ~ **X101**, **X102**	**Standard setting**
2-3	COM2 ~ **X103**, **X104**	

The additional control signals DTR & DCD via S15 – S16 are mandatory for a data transmission via GPRS/EDGE.

S15 - S16	Function	Remark
S15	**DTR/**	In compatibility mode GSM-1 without function
S16	**DCD/**	In compatibility mode GSM-1 without function

Control signals in telecontrol stations

S15 - S16	Interface in FW-50 BGT-USB	Remark
1-2	**X102, X104**	**Control signals active**
2-3		Control signals inactive

ATTENTION ! S15 & S16 shall only be used in racks of type BGT-x-USB.

Data format - setting the operation mode

The data format and the operation method are set with the S3 and S4 jumpers. The operating specifies the initialisation of the GSM/GPRS module and the system CPU bit rate.

In the GSM-1 interoperability mode (dial-up operation), the module is initialised to a fixed rate of 19.2 kbit/s.
GPRS requires a setting of 115 kbit/s. In addition, the control lines must be activated via S15-16. cf. r **Fehler! Verweisquelle konnte nicht gefunden werden.** p. **Fehler! Textmarke nicht definiert.**!

Jumpers

If the data format is set incorrectly, the output of the operation states (LED strength and status) may be inaccurate, or the function of the module may be blocked in the system.

Jumpers up to Firmware/PIC V103

P3	P4	Data format	Remark
open	**open**	115 kbit/s, 8-1-N	GPRS mode
open	closed	19,2 kbit/s, 8-1-E	GSM-1 interoperability for setIT
closed	closed	19,2 kbit/s, 8-1-n	GSM-1 interoperability for createIT

Jumpers with Firmware/PIC V104

P3	P4	Data format	Remark
open	**open**	115 kbit/s, 8-1-N	GPRS mode
closed	closed	19,2 kbit/s, 8-1-E	GSM-1 interoperability for setIT
open	closed	19,2 kbit/s, 8-1-n	GSM-1 interoperability for createIT

Jumpers up to Firmware/PIC V105

P3	P4	Data format	Remark
closed	**open**	115 kbit/s, 8-1-N	GPRS mode
open	closed	19,2 kbit/s, 8-1-E	GSM-1 interoperability for setIT
closed	closed	19,2 kbit/s, 8-1-n	GSM-1 interoperability for createIT

GSM-2 technical data

GSM-2	**Wireless data modem for integration into GSM/GPRS infrastructures** for telecontrol and substation control, automation and telemetry
Communication	**1** System-internal COM1/COM2 interface 1 GPRS antenna connection, **SMA connector max. 2 W**
Protocols	AT command repertoire for control and link establishment IEC 60870-5-101 for dial-up links IEC 60870-5-104 via GPRS/EDGE with a PPP protocol
GSM/GPRS core	Cinterion MC75i quad-band wireless module + embedded controller Quad-band 850 / 900 / 1800 / 1900 MHz GPRS multi-slot class 12, full PBCCH support, mobile station class B, coding scheme 1 -4 EDGE multi-slot class 12, mobile station class B, modulation and coding scheme MCS 1-9 CSD V.110, RLP, 2.4/4.8 / 9.6 /14.4 kbit/s, USSD SMS Point-to-point MT and MO, text and PDU-mode Transmission power 1 W with GSM 1800 /1900 Transmission power 2 W with EGSM 850 /900
Antenna	GPRS antenna **50 Ω, SMA connector (f)** Recommended distance between antenna and device: 50 cm
SIM card	supports SIM cards with 3V and 1.8 V, data activation
Status indicators	LED in front plate for link and system status
Command repertoire	AT commands according to Hayes 3GPP TS 27.007, TS 27.005, Cinterion
Supply voltage	**internal** max. 12 W, (24 V DC 0.5 A / 60 V DC 0.3 A) max. in transmit mode
Dielectric strength	5 kV impulse supply & process E/A to PE, **in accordance with class VW3** 2,5 kV impulse supply to measured values, EIA/RS-232, USB
Standards	EMC: EN61000-6-2 , EN55022, Isolation: DIN EN 60870-2-1, IEC 60255-5 R&TTE: ETSI EN 300328, EN 301489, NSRL: DIN EN 60950
Housing	micro housing, Polyamide V0, IP 20
dimensions	45 x 105 x 115 mm (W x H x D)
Installation	**DIN top-hat rail,** DIN-EN 60715 TH35
Terminals	MSTB screw terminal, 0.2 to 2.5 mm² or Combicon spring terminal, 0.2 to 2.5 mm²
Ambient temperature	**-20° ... +60° C** (Threshold +70° C at a control voltage of < 60 V DC, recommended +55°C)
relative air humidity	< 80 %, without condensation

8 Input/output cards

Overview of modules

Optocoupler inputs	
16IE-5-1 /16IE-5-2	16 quick wide range inputs 18 ... 72 V DC/48 ... 130 V DC
16OE-1	16 optocoupler inputs, 24 V DC
16OE-2-1 /16OE-2-2	16 optocoupler inputs 48 V DC/60 V DC
16OE-3-W	16 transient inputs, S0-compatible
16OE-5-1	16 wide-range inputs, 18 - 72 V DC
16OE-5-2 /16OE-5-3	16 wide range inputs 60 ... 130 V DC/220 V DC
16OE-6-1# /-2# /-3# ⚠*	16 Weitbereichseingänge 18 ... 72 V DC/ 110 V DC/AC / 220 V DC/AC
8OE-4-110	8 optocoupler inputs, 110 V AC/100 V DC
8OE-4-230	8 optocoupler inputs, 230 V AC/200 V DC
Relay outputs	
16RA-1	16 Relay outputs
6RA-4-AC	6 relay changeover contact, 230 V AC, 1 A
6RA-4-T	6 semiconductor outputs, changeover contact, isolated
16OA-1	16 optocoupler inputs, 24 V DC
Measure value inputs, 8-bit	
8AE8-1-1	8 analogue inputs, 0(4) to 20 mA, 500 V DC
8AE8-1-2	8 analogue inputs, 0 to 10 V, 500 V DC
8AE8-1-3	8 analogue inputs, 0 to 2.5 mA, 500 V DC
8AE8-2-1	8 analogue inputs, 0(4) to 20 mA, 3000 V DC
8AE8-2-2	8 analogue inputs, 0 to 10 V, 3000 V DC
8AE8-2-3	8 analogue inputs, 0 to 2.5 mA, 3000 V DC
8AE8-3-1	8 analogue inputs 0(4) up to 20 mA
8AE8-3-2	8 analogue inputs 0 to 10 V
Measured value inputs, 12-bit	
4AE12-1-1	4 analogue inputs, 12-bit, 0(4) to 20 mA
4AE12-1-2	4 analogue inputs, 12-bit, 0 to 10 V
4AE12-2-1	4 analogue inputs, 12-bit bipolar, -20 mA to +20 mA
4AE12-2-2	4 analogue inputs, 12-bit bipolar, -10 V to +10 V
4AE12-2-3	4 analogue inputs, 12-bit bipolar, -2.5 mA to +2.5 mA

Measured value inputs, 16-bit	
8AE16-1-1	8 analogue inputs, 12-/16-bit, 0(4) to 20 mA
8AE16-1-2	8 analogue inputs, 12-/16-bit, 0 to 10 V
8AE16-1-3	8 analogue inputs, 12-/16-bit, 0 to 2.5 mA

Measured value outputs, 8-bit	
8AA8-1-1	8 analogue outputs, 0(4) to 20 mA, 500 V DC
8AA8-1-2	8 analogue outputs, 0 to 10 V, 500 V DC
8AA8-2-1	8 analogue outputs, 0 to 20 mA, 3000 V DC

Measured value outputs, 12-bit	
4AA12-1-1	4 analogue outputs, 12-bit, 0 to 20 mA
4AA12-1-2	4 analogue outputs, 12-bit, 0 to 10 V
4AA12-2-1	4 analogue outputs, 12-bit, bipolar, -20 mA to +20 mA
4AA12-2-2	4 analogue outputs, 12-bit, bipolar, -10 V to +10 V
8AA12	8 analogue outputs, 12-bit, 0 to 20 mA

Combination and special cards	
OERA-1/OERA-5	8 optocoupler inputs, 8 relay outputs
AOERA-1	4 analogue inputs 8 bit, 4 optocoupler inputs, 2 relay outputs
EVU-1	Special card EVU, 4 optocoupler inputs, 4 relay outputs
EVU2-O	Special card EVU, 1 of n supervision, command relay and release relay for 16 single command, 1.5-pole/8 double commands 1.5 pole/4 double command 2-pole, inductor measure circuit
EVU2-I	Check-back indication card for command termination with EVU-2-O
CNT1-5 /CNT1-2	8 counter 1 kHz, 8 optocoupler inputs

fullfills requirements from IEC 61850-3
• legacy component, replaced by newer variant and may be EOL;
may be assembled, but is out of scope of this manual
s. https://saeit-de.sharefile.eu/d-sde3ad356c4648f28

General information using I/O-cards

General technical specification

All I/O cards from systems FW-10, FW-40, FW-50 or BCU-50 are designed to be plug-in boards. Every I/O-card used as a spare-device will be delivered including its front panel, if the designated system is known. The placement in the slots and the definition of the terminal numbers may be given by the stickers, delivered aside the racks.

Valid general specification - if not noticed otherwise:

Format	**I/O -plug-in board for FW-10 /FW-40 /FW-50 /BCU-50**
Dimensions	21 * 160 * 100 mm (W x H x D) Europe board portrait
Terminals	2 detachable terminals 9-pole als: Spring terminal FKC 0.2 up to 2.5 mm² or Screw terminal MSTB 0.2 up to 2.5 mm² **green terminal** Tension < 75 V DC **black terminal** Tension > 75 V DC ⚠*
Accessories	Cable GST-9: Plug, 9-pole, 2.5m cable Item: 310000050700 Cable GST-9-ST: Plug 9-pole with housing, 2.5 m cable Item: 310000054400

Service-LEDs of I/O-card

Every I/O-card shows the opertion state in the front with is LED.

LED 1●○○○4	colour	Function	
1●	red	**off**	**Card valid and released**
		2 Hz	Error, Card wrong or misplaced
		on	Card inhibited /not released
○ ○ ○		if assembled , additional card specific states	

Using indication boards or binary inputs, every input with its signal "0" and "1" is assigned to a green LED in the front. At most types, the LED are arranged in blocks.

LED-Matrix of I/O-cards

LED ● ● ● ●				Colour	Function	
1	2	3	4	green/inputs	off	Signal OFF "0"
5	6	7	8	yellow/outputs	on	Signal ON "1"
9	10	11	12			
13	14	15	16			

Binary outputs/command relays are signalised with yellow LED.
Analogue boards may not be visualised with LED.

*Using tension > 75 V DC please consider!

DANGER **Before starting work, break all pole, pull plugs and deenergize!**

Plugs have to carry a sign "Danger High Voltage" using tensions > 75 V.

Only use power signals with unique source.

Only use the given black terminals to prevent any swap with signals ≤ 75 V DC by different of colour.

Single braids have to be fixed mechanically to prevent a jump over of a energized braid to a neighboured board below 75 V DC.

WARNING **Inobservance may be harmful for the lives and health of personnel!**

CAUTION **To fulfill the requirements for an electrical safety, the mounting and operation of the devices only is allowed in a case or a housing with protection class IP 56 or better!**

Digital input card 16OE-5 (wide range)

Remark: This boards is discontinued , please use 16OE-6-x instead.

16OE-5	**16 wide range optocoupler inputs**
input ranges	18 - 72 V DC / 60 - 130 V DC / 150 - 240 V DC, see types
Electrical isolation	Optocoupler for logic
Root	Common reference potential per terminal for 8 channels each
Debouncing	Of the input circuit, max. 0.3 ms
Min. pulse width	10 ms
Power consumption	Typically 25 mA, max. 30 mA supplying the overall system with 24 V DC
Insulation	EN 60870-2-1 class VW3, Surge voltage 5 kV, power-frequency withstand voltage 2.5 kV eff./1 min.
EMC	CE, EN 61000-6-4: Emitted interference in industrial area EN 61000-6-2: Immunity industrial area, EN 60950
Temperature range	-20 to + 70° C system environment, Ø24h max. 55°C
Humidity	<95% at 25° C without condension (class F)
16OE-5-1	**Wide-range information inputs, 24 to 60 V DC ±20%**
input voltage	18 V DC ... 72 V DC
Switching point	Typically 17 V DC, 0.8 mA
input current	Signal "0" (Off) < 0.8 mA Signal "1" (On) > 1.0 mA, Typically + 1.2mA@24 V, 2.8 mA@48 V 3.7 mA@ 60 V DC
Compatibility	Replaces types 16OE-1, 16OE-2-1 (OE48) and 16OE-2-2 (OE60)
Item no.	310000036200
16OE-5-2	**Indication inputs, 110 V DC ±35%** ⚠*
input voltage	60 V DC ... 150 V DC
Switching point	Typically 37 V DC
input current	(On) max. 2 mA @ 150 V DC
Item no.	310000036300
16OE-5-3	**Indication inputs 220 V DC -30%/+10%** ⚠*
input voltage	150 V DC ... 240 V DC
Switching point	Typically 130 V DC
input current	(On) max. 1.2 mA @ 220 V DC
Item no.	310000036400

Terminals 16OE-5

Terminal X↑-up: Indication input 16OE-5

Terminal X↑	Signal name	Remarks
X↑.1	DE 1 des Moduls	Indiction input 1
X↑.2	DE 2	Indiction input 2
X↑.3	DE 3	Indiction input 3
X↑.4	DE 4	Indiction input 4
X↑.5	DE 5	Indiction input 5
X↑.6	DE 6	Indiction input 6
X↑.7	DE 7	Indiction input 7
X↑.8	DE 8	Indiction input 8
X↑.9	common 1-8	Masse 0 V

Terminal X↓-down: Indication input 16OE-5

Terminal X↓	Signal name	Remarks
X↓.1	DE 9 des Moduls	Indiction input 9
X↓.2	DE 10	Indiction input 10
X↓.3	DE 11	Indiction input 11
X↓.4	DE 12	Indiction input 12
X↓.5	DE 13	Indiction input 13
X↓.6	DE 14	Indiction input 14
X↓.7	DE 15	Indiction input 15
X↓.8	DE 16	Indiction input 16
X↓.9	common 9-16	Masse 0 V

Circuit of 16OE-5

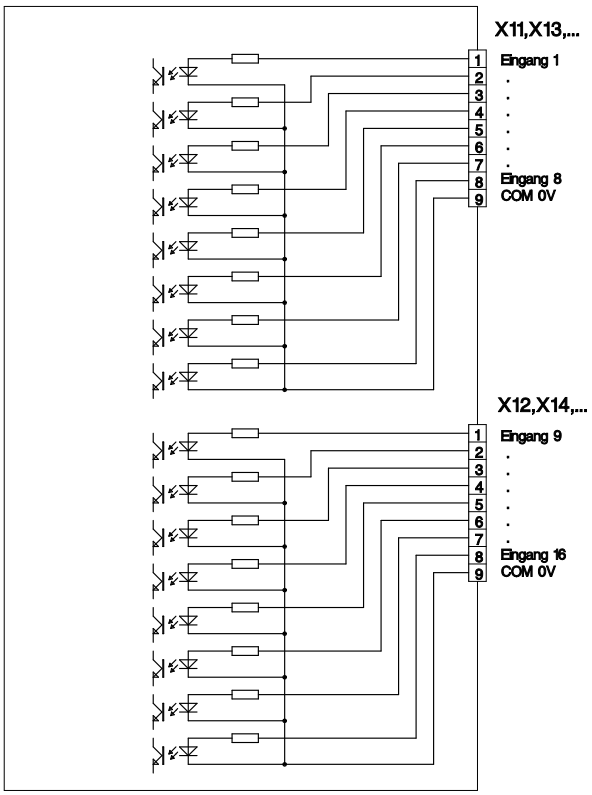


Figure 27: Input circuit of 16OE-5

*Using tension > 75 V DC please consider!

DANGER **Before starting work, break all pole, pull plugs and deenergize!**

Plugs have to carry a sign "Danger High Voltage" using tensions > 75 V.
Only use power signals with unique source.
Only use the given black terminals to prevent any swap with signals ≤ 75 V DC by different of colour.
Single braids have to be fixed mechanically to prevent a jump over of a energized braid to a neighboured board below 75 V DC.

WARNING **Inobservance may be harmful for the lives and health of personnel!**

CAUTION

To fulfill the requirements for an electrical safety, the mounting and operation of the devices only is allowed in a case or a housing with protection class IP 56 or better!

Digital input card 16OE-6 (wide range)

16OE-6	**16 wide range optocoupler inputs** permitted for connection to power switch gears
input ranges	18 - 72 V DC / 110 V DC / 220 V DC, see types
Electrical isolation	HV-Optocoupler for logic according to DIN EN 60747-5-5
Root	Common reference potential per terminal for 8 channels each may be connected to 0V/ground or processing supply
Debouncing	Of the input circuit, max. 0.5 ms
Min. pulse width	10 ms
Power consumption	Typically 20 mA, max. 25 mA supplying the overall system with 24 V DC
Insulation	EN 60870-2-1 class VW3, Surge voltage 5 kV, power-frequency withstand voltage 2.5 kV eff./1 min.
EMC	DIN EN 661850-3 (h), battery earth fault immunity 220 nF
Temperature range	-25 to + 70° C system environment, Ø24h max. 55°C
Humidity	<95% at 25° C without condension (class F)
16OE-6-1	**Wide-range information inputs, 24 to 60 V DC ±20%**
input voltage	18 V DC ... 72 V DC
Switching point	Typically 17 V DC
input current	Signal "0" (Off) < 0.8 mA Signal "1" (On) > 1.0 mA, @24 V Typically + 1.9 mA
Compatibility	Replaces 16OE-1, 16OE-2-x (OE48/OE60) 16OE-5-x
Terminal.	**green** MSTB 2,5/9-STF-5,08
Item no.	FW-50: 310000037300 BCU-50: 310050505010
16OE-6-2	**Indication inputs, 110 V DC ±20%** ⚠*
input voltage	max. ±150 V DC
Switching point	Typically ±80 V DC
input current	(On) max. 1,9 mA
Terminal.	**black** MSTB 2,5/9-STF-5,08 BK
Item no.	W-50: 310000037310 BCU-50: 310050505020
16OE-6-3	**Indication inputs 220 V DC ±20%** ⚠*
input voltage	max. ±240 V DC
Switching point	Typically ±165 V DC
input current	(On) max. 1.9 mA
Terminal.	**black** MSTB 2,5/9-STF-5,08 BK
Item no.	FW-50: 310000037320 BCU-50: 310050505030

Terminals 16OE-6

Terminal X↑-up: Indication input 16OE-6

Terminal X↑	Signal name	Remarks
X↑.1	DE 1 des Moduls	Indication input 1 ±
X↑.2	DE 2	Indication input 2 ±
X↑.3	DE 3	Indication input 3 ±
X↑.4	DE 4	Indication input 4 ±
X↑.5	DE 5	Indication input 5 ±
X↑.6	DE 6	Indication input 6 ±
X↑.7	DE 7	Indication input 7 ±
X↑.8	DE 8	Indication input 8 ±
X↑.9	common 1-8	common 0 V

Terminal X↓-down: Indication input 16OE-6

Terminal X↓	Signal name	Remarks
X↓.1	DE 9 des Moduls	Indication input 9 ±
X↓.2	DE 10	Indication input 10±
X↓.3	DE 11	Indication input 11±
X↓.4	DE 12	Indication input 12±
X↓.5	DE 13	Indication input 13±
X↓.6	DE 14	Indication input 14±
X↓.7	DE 15	Indication input 15±
X↓.8	DE 16	Indication input 16±
X↓.9	common 9-16	common 0 V

Circuit of 16OE-6

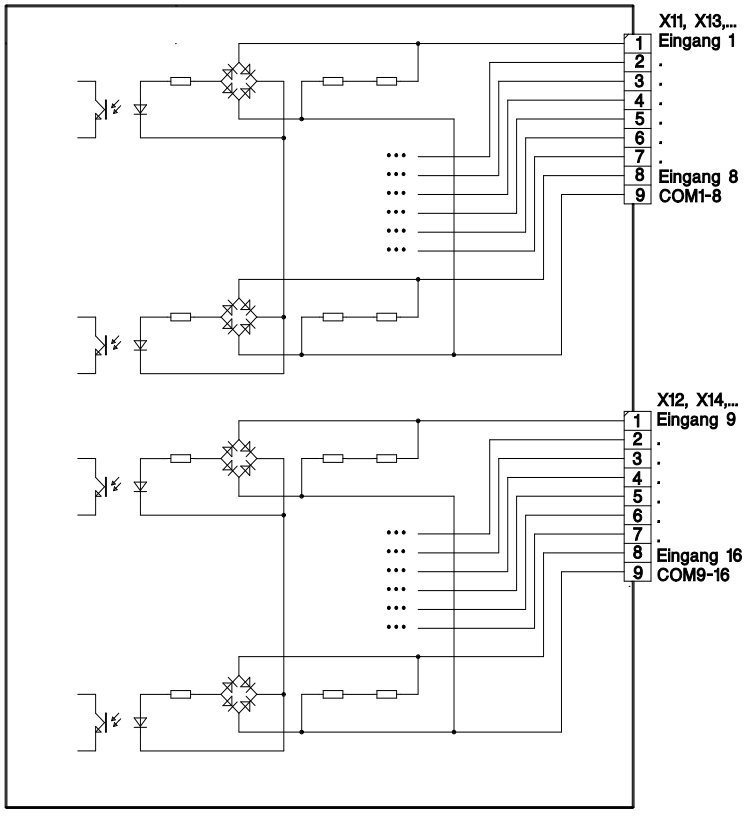


Figure 28: Input circuit of 16OE-6

*Using tension > 75 V DC please consider!

DANGER **Before starting work, break all pole, pull plugs and deenergize!**

Plugs have to carry a sign "Danger High Voltage" using tensions > 75 V.
Only use power signals with unique source.
Only use the given black terminals to prevent any swap with signals ≤ 75 V DC by different of colour.
Single braids have to be fixed mechanically to prevent a jump over of a energized braid to a neighboured board below 75 V DC.

WARNING **Inobservance may be harmful for the lives and health of personnel!**

CAUTION

To fulfill the requirements for an electrical safety, the mounting and operation of the devices only is allowed in a case or a housing with protection class IP 56 or better!

Fast binary Input card 16IE-5

16IE-5	Fast Indication inputs	
Indication inputs	16 inputs common root	
Scan cycle	250 µs	
16IE-5-1	input tension threshold current	18 ... 72 V DC ca. 17 V DC ca. 1,4 mA @ 24 V ca. 3,5 mA @ 60 V
16IE-5-2	input tension threshold current	60 ... 130 V DC ca. 37 V DC ca. 1,2 mA @ 60 V, ca. 2,4 mA @ 120 V
Isolation	Logic / inputs optional 3 kV	
Max current consumption	50 mA (@ + 5 V DC)	
Environment temperature	-20° up to +70° C	
Rel. humidity	80 % at 25° C without condension	

Circuitry of 16IE-5

Terminal	No	Remark
X11 X13 X15 ...	1	Input 1
	2	Input 2
	3	Input 3
	4	Input 4
	5	Input 5
	6	Input 6
	7	Input 7
	8	Input 8
	9	Common [-]
X12 X14 X16 ...	1	Input 9
	2	Input 10
	3	Input 11
	4	Input 12
	5	Input 13
	6	Input 14
	7	Input 15
	8	Input 16
	9	Common [-]

At voltages > 75 V the terminals have to be marked with the warning "Danger High Voltage".
Before maintenance, switch off all poles, remove terminals and discharge!

Integrated total card CNT-1

Acquisition of 8 fast integrated totals up to 1 kHz and 8 information inputs in the voltage ranges 24 V DC and 60 ... 110 V DC.
Support from setIT (from V 2.011) process data type 16-bit counter input

CNT-1	**Counter board and information card**
Counter inputs	8 pulse inputs for counters, 1 kHz, 8-bit cache,
Information inputs	8 digital inputs for information
Electrical isolation of measuring circuit	Via optocoupler according to root 1-8/9-16
Power-frequency withstand voltage	2500 V AC
Surge voltage	3 kV
Standards	EN 61000-6-2 (03/2000) EN 61000-6-4 (04/2002) DIN EN 60950 (12/2001)
Interrupt	Yellow LED at the front
Controls	6 internal jumpers
Maximum power consumption	50 mA (at 5 V DC)
Ambient temperature	20 to + 70° C
Relative humidity	80 % at 25°C without condensation
CNT-1-2	**Input voltage 60 ... 110 V DC**
Switching point	Approx. 35 V DC
input current	At 60 V approx. 1.2 mA, At 120 V approx. 2.4 mA
CNT-1-3	**Wide range 24 V DC acquisition 10 kHz**
input voltage	24 V DC
Switching point	Approx. 12 V DC
input current	Approx. 6 mA DC
Insulation	Process inputs against SELV circuit & process inputs against system earth
CNT-1-5	**Input voltage 18 ... 72 V DC**
Switching point	Approx. 15 V DC
Input current	At 24 V approx. 1.2 mA At 48 V approx. 2.8 mA At 60 V approx. 3.5 mA

Circuitry of CNT-1

Terminal	No.	Description
X11 X13 X15 ...	1	Counter 1
	2	Counter 2
	3	Counter 3
	4	Counter 4
	5	Counter 5
	6	Counter 6
	7	Counter 7
	8	Counter 8
	9	Common [-]
X12 X14 X16 ...	1	Input 1
	2	Input 2
	3	Input 3
	4	Input 4
	5	Input 5
	6	Input 6
	7	Input 7
	8	Input 8
	9	Common [-]

Relay output card 12RA-1

12RA-1	12 command outputs to switchgears
Process supply voltage	max. 250 V AC, max. 250 V DC ⚠*
Nominal load	8 A at 250 V AC ⚠* 5 A at 24 V DC resistive /0.7 A inductive 30 A DC for 500 ms
up time relay	typ. 8 ms
off time relay	typ. 2,5 ms
Inrush	1000 VA at L/R = 40 ms
Switch off capacity	0.5 A @ 110 V DC, 0.2 A@220 V DC at L/R = 50 ms ⚠* 8 A @ 230 V AC cosphi=1
Switching operations	100 ,000
Isolation	4000 Vrms coil/contact, 1000 Vrms open contacts 8 mm air gap coil/contact
Consumption	max. 265 mA (at 12 Relais ON +Ub=24V DC)
Operating temperature	-20° up to + 70° C ø24h max. +55°C
Relative humidity	<95% at 25° C without condensation (class F)

In case of nip voltages > 75 V, the terminals must be labelled with the warning "Caution high voltage".
Prior to working, switch of all poles, remove plug and discharge!

Terminals 12RA-1

Terminal X↑-upper: Command outputs12RA-1

Terminal X↑	Signal name	Remarks
X↑.1	RA 1 of module	14 Command output1
X↑.2	RA 2	24 Command output2
X↑.3	common 1-2	11/21 Process supply voltage
X↑.4	RA 3	34 Command output3
X↑.5	RA 4	44 Command output4
X↑.6	common 3-4	31/41 Process supply voltage
X↑.7	RA 5	54 Command output5
X↑.8	RA 6	64 Command output6
X↑.9	common 5-6	51/61 Process supply voltage

Terminal X↓-lower: Command outputs12RA-1

Terminal X↓	Signal name	Remarks
X↓.1	RA 7 of module	74 Command output7
X↓.2	RA 8	94 Command output8
X↓.3	common 7-8	71/81 Process supply voltage
X↓.4	RA 9	94 Command output9
X↓.5	RA 10	104 Command output10
X↓.6	common 9-10	91/101 Process supply voltage
X↓.7	RA 11	114 Command output11
X↓.8	RA 12	124 Command output12
X↓.9	common 11-12	111/121 Process supply voltage

Circuitry of 12RA-1

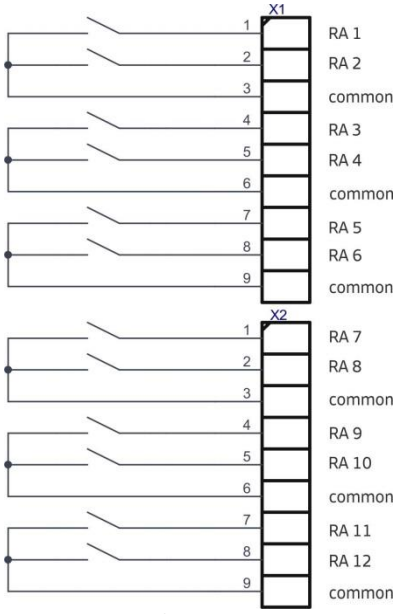


Figure 29: Circuitry 12RA-1

2-pole mode12RA-1

Activated in setIT the card may be operated in 2-pole mode to control external switchgear-motors using 2-pole power supply. The power up of supply voltage is done by 2 relays in grouping RA1/RA3, RA2/RA4, RA5/RA7, RA6/RA8, RA9/RA11, RA10/RA12. A checkback indication with automatic 1/N control or measuring circuit is only available with EVU2-O.

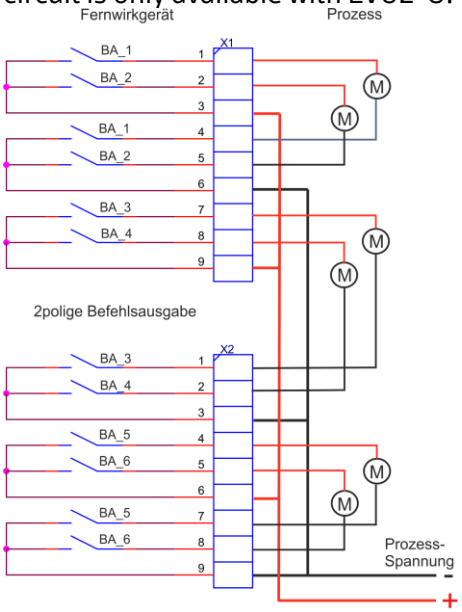
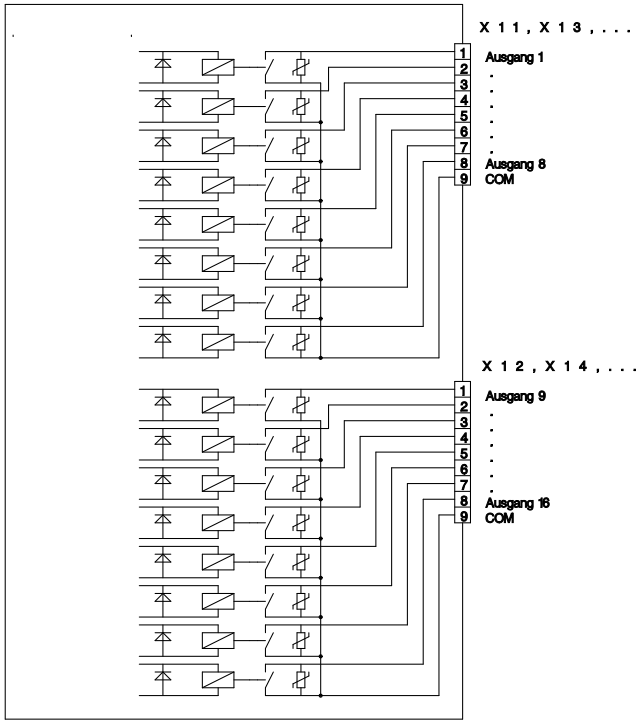


Figure 30: Cirtcuitry 12RA-1 2-pole

Relay output card 16RA-1

16RA-1	16 Relay outputs/commands
Nominal load	1 A at 230 V AC, 1 A at 24 V DC resistive/0.7 A inductive 0.5 A at 60 V DC resistive/0.4 A inductive 0.3 A at 220 V DC resistive However, max. 4.0 per group of 8, max. 125 VA / 50 W
Electrical isolation	via relay, according to root 1-8/9-16
Test voltage	2500 V
Nominal insulation voltage	250 V AC
Protective circuitry of contacts	Varistor 250 V VDR S07K250n
Switching voltage	Max. 250 V AC, max. 220 V DC
Reaction time relay	Approx. 6 ms
Switching operations	10,000,000
Maximum power consumption	250 mA typically (at +Ub=24V DC)
Operating temperature	0 to + 50° C
Relative humidity	95% at 25°C without condensation (class F)

Circuitry of 16RA-1

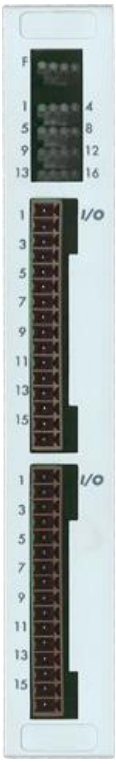


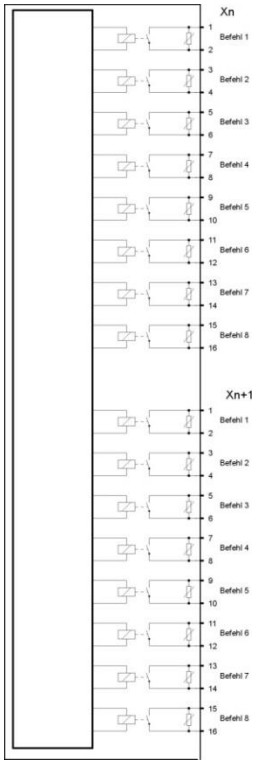
In case of nip voltages > 75 V, the terminals must be labelled with the warning "Caution high voltage".
Prior to working, switch of all poles, remove plug and discharge!

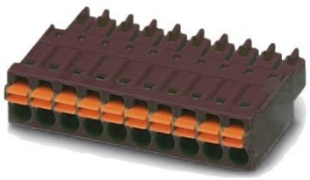
Relay output card 16RA-3

16RA-3	**16 relays/commands, make contact isolated** functional compatibility to 16RA-1 with setIT versions < V 4.8
Nominal load	1 A at 250 V AC, 1 A at 24 V DC resistive 0.7 A inductive 0.4 A at 60 V DC resistive 0.3 A inductive 0.25 A at 110 V DC resistive 0.2 A inductive 0.15 A at 220 V DC resistive. 0.1 A inductive
Electrical isolation	Yes, 2-pole connector for each channel
Test voltage	3000 V
Isolation relay	4000 Vrms AC/1 min, 6000 V Surge (1.2/250µs)
Protective circuitry of contacts	Varistor 250 V VDR S07K250n
Switching voltage	Max. 250 V DC/AC
Contacts	AgNi
Operate, dropout time	Max. 8 ms/4 ms
Switching operations	30,000,000 mechanical
Power consumption	160 mA typically (3.1 W at +Ub=24V DC)
Terminals	**2 * FMC 1.5/16-3.5 BK, 2* 16 pole black**
Operating temperature	0 to + 70° C
Relative humidity	95% at 25°C without condensation (class F)

Circuitry of 16RA-1







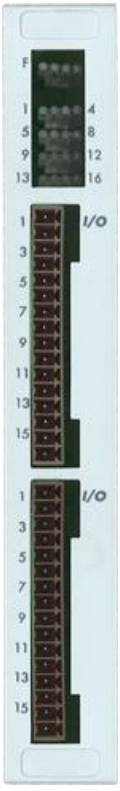
In case of nip voltages > 75 V, the terminals must be labelled with the warning "Caution high voltage". The terminals have been coloured black for visual purposes.

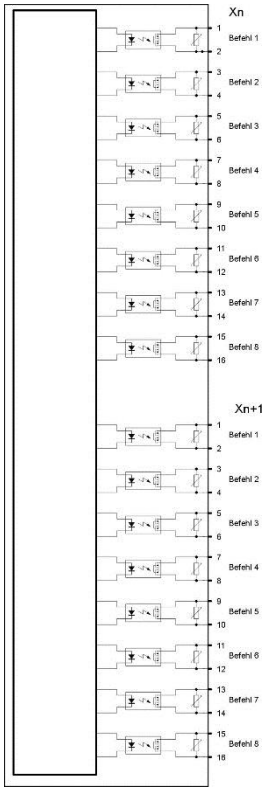
Prior to working, switch of all poles, remove plug and discharge!

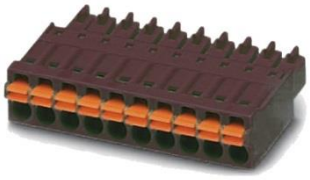
Output card 16OA-3

16OA-3	**16 optocoupler/transistor outputs** Isolation per channel Functional compatibility with 16OA-1 for setIT versions < V 4.8	
Switching voltage	16OA-3-1 16OA-3-2	max. 250 V DC/AC, max. 23 Ω max. 100 V DC/AC, max. 2.3 Ω
Electrical isolation	Yes, 2-pole connector for each channel	
Test voltage	3000 V	
Isolation relay	1500 Vrms AC/1 min	
Protective circuitry of contacts	Varistor 250 V VDR S07K250n	
Nominal load	16OA-3-1 16OA-3-2	130 mA AC/DC 320 mA AC/DC
Operate time/dropout time	< 1 ms/< 1 ms	
switching cycles	Electrically unrestricted	
Maximum power consumption	140 mA typically (0.8 W at +Ub=24V DC)	
Terminals	**2 * FMC 1.5/16-3.5 BK, 2* 16 pole black**	
Operating temperature	0 to + 70° C, Last derating 75% @60°, 50% @80°	
Relative humidity	95% at 25°C without condensation (class F)	

Circuitry of 16OA-3







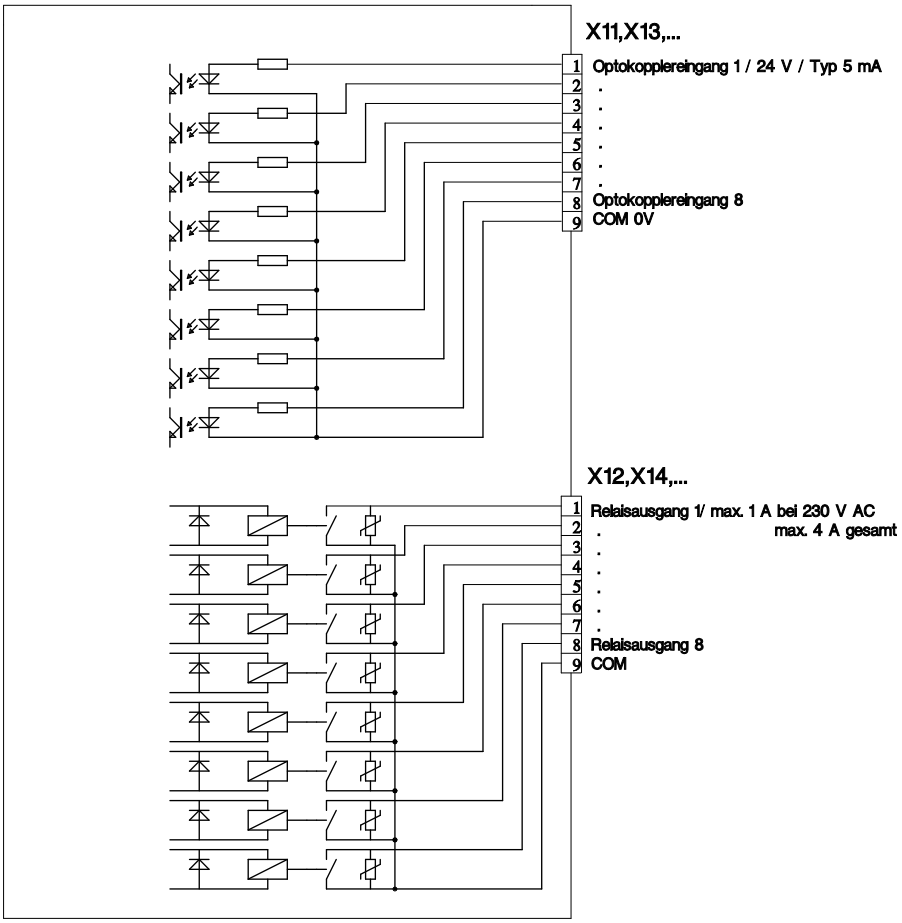
In case of nip voltages > 75 V, the terminals must be labelled with the warning "Caution high voltage".
The terminals have been coloured black for visual purposes.

Prior to working, switch of all poles, remove plug and discharge**!**

Digital input/output card OERA-5

OERA-5:	8 optocoupler inputs - 8 relay outputs
Optocoupler inputs	8 information inputs, wide range 18 to 72 V DC
Electrical isolation	Via optocoupler
Root	mutual reference potential for 8 channels
Input voltage	Wide range 18 to 72 V DC
Signal "0" off	0 to 16 V DC
Signal "1" on	> 17 V DC typically 0.8 mA
Input current signal "1"	Typically 1.2 mA (at 24 V DC)
Delay time	Approx. 0.3 ms
Test voltage	2500 V
Relay outputs	8 command relay make contact, according to root 1-8
Electrical isolation	Yes
Test voltage	2500 V
Nominal insulation voltage	250 V AC
Protective circuitry of contacts	Varistor 250 V, VDR S07K250
Nominal current contact	1 A at 230 V AC
Switching voltage	Max. 250 V AC, max. 30 V DC
Switched current	Max. 1.0 A/channel, however max. 4.0 A total max. 125 VA / 50 W
Operate time, dropout time	Approx. 6 ms
Switching operations, mechanical	30,000,000
Maximum power consumption	150 mA typically (at +Ub=24V DC)
EMC	CE, EN 61000-6-4: Emitted interference industry EN 61000-6-2: Immunity industry, EN 60950
Operating temperature	0 to + 60° C
Relative humidity	95% at 25°C without condensation (class F)

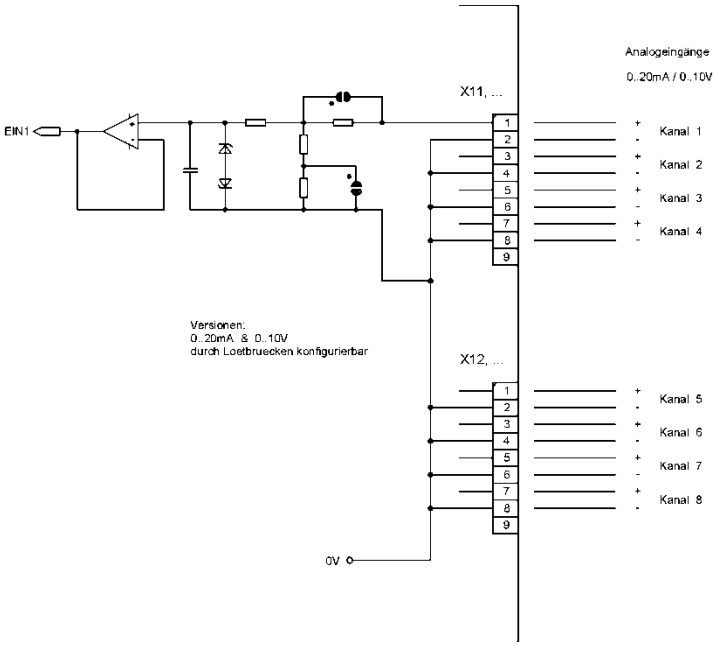
Circuitry of OERA-5



Analogue input card 8AE16-1

8AE16-1	8 analogue inputs 12/16 bit 0 - 20 mA /2.5 mA /10 V	
Input signal:	8AE16-1-1 8AE16-1-2 8AE16-1-3	0 (4) to 20 mA max. 30 mA 0 to 10 V max. 15 V 0 to 2.5 mA max. 5 mA
Resolution	12-bit/16-bit selectable via jumper	
Accuracy	+/-0.1% in the temperature range 0...50°C in relation to the measuring range end value	
Electrical isolation	Via optocoupler according to root 1-8	
Root	Common reference potential	
Insulation resistance	Surge voltage 3 kV 1.2/50 µs Power-frequency withstand voltage 2000 V eff. /1 min.	
Input impedance:	8AE16-1-1 8AE16-1-2 8AE16-1-3	62 Ω 100 kΩ 470 Ω
Maximum power consumption	100 mA typically (at +Ub = 24 V DC)	
Operating temperature	0 to + 50° C	
Relative humidity	95% at 25°C without condensation (class F)	

Circuitry of 8AE16-1



Jumpers		Mode
S3	**Closed**/inserted	**Averaging active** (8 measured values)
S4	**Closed**/inserted	**Unipolar acquisition***
S1, S2, S5-S8		No function

* *Standard S4 = inserted*

Analogue input card 8AE16-2

The 8AE16-2 card replaces the 8AE16-1 type and other sub-variants. Furthermore, it offers isolation per channel and analogue inputs one below the other and a ripple rejection which can be selected with jumpers.
In the compatibility mode the card behaves like 8AE16-1 on the outside. Therefore, it can also be used compatibly in older projects without changing the position on 8AE16-1.

8AE16-2	8 analogue inputs 12 bit, isolated per channel 0 to 20 mA /2.5 mA /10 mA /10 V
input signal:	8AE16-2-1 0 (4) to 20 mA Max. 30 mA 8AE16-2-2 0 to 10 V Max. 15 V upon request 8AE16-2-3 0 to 2.5 mA Max. 5 mA 8AE16-2-4 0 to 10 mA Max. 15 mA
Resolution	12 bit
Accuracy	± 0,15% in the range of -5°C to + 55° C, in addition 0.05% per 5 K in the range of -20°C to --5°C and +55°C to +70°C
Isolation	Via optocoupler isolation of the measured values per channel
Insulation resistance	Surge voltage 3 kV 1.2/50 µs power-frequency withstand voltage 2000 V eff. /1 min.
input impedance:	100 Ω
Maximum power consumption	100 mA typically (at +Ub = 24 V DC)
Operating temperature	20° to 70° C
Relative humidity	95% at 25°C without condensation (class F)

Circuitry of 8AE16-2

Terminal	No.	Description
X11 *X13* *X15* ...	1	Measured value 1 +
	2	Measured value 1-
	3	Measured value 2 +
	4	Measured value 2-
	5	Measured value 3 +
	6	Measured value 3-
	7	Measured value 4 +
	8	Measured value 4-
	9	n.c.· /unused
X12 *X14* *X16* ...	1	Measured value 5 +
	2	Measured value 5-
	3	Measured value 6 +
	4	Measured value 6-
	5	Measured value 7 +
	6	Measured value 7-
	7	Measured value 8 +
	8	Measured value 8-
	9	n.c.· /unused

Note: Unused voltage inputs (0 - 10 V) should be short-circuited in order to avoid negative effects on the high-impedance inputs.

Diagnostic LED and jumpers

Function LEDS

the front there are 4 LEDs to indicate the operating states.

LED 1●●●●4	Colour	Function
1●	Red	OFF Card OK and approved 2 Hz Error, card inserted incorrectly ON Card locked/not approved
2●	Yellow	OFF Valid measurement operation ON Calibration necessary, no measurement operation possible
3●	Green	OFF 8AE16-3 multi-range, uni-/bipolar on 8AE16-2 compatibility mode 8AE16-1
4●	Red	OFF fault-free operation ON internal transformer error

Operational LEDs

This module has 2 LEDs to indicate the card status.

LED 5● ●6	*Colour*	*Function*
5●	Green	2 Hz fault-free operation of the module
6●	Green	Free

Measuring range selection

The 8AE16-2 card is based on the hardware of the 8AE16-3 card which is used switch to 8AE16-1 by using the S9 jumper in the compatibility mode.

S9	S10	Mode	Card type
Closed/inserted	**Open**	**Compatibility mode**	**8AE16-2-x**
Closed/inserted	closed/inserted	Calibration	8AE16-2-x

The measuring range is preset using jumper depending on the type delivered. The setting is valid for all channels of 8AE16-2:

S1	S2	Mode	Card type
Open	Open	0 (4) to 20 mA	8AE16-2-1
Closed/inserted	Open	0 to 10 mA	8AE16-2-4
Open	Closed/inserted	0 to 2.5 mA	8AE16-2-3

Measuring range 0 to 10 V upon request

Ripple rejection

The filter setting is valid for all channels of 8AE16-2:

S3	S4	S5	Mode		Transformer rate f ADC
Open	Open	Open	50/60 Hz	65 dB	16.6 Hz
Open	Open	Closed	50 Hz	80 dB	16.7 Hz
Closed	Open	Closed	50 Hz	25 dB	100 Hz
Open	Closed	Closed	60 Hz	80 dB	20 Hz
Closed	Closed	Closed	60 Hz	25 dB	120 Hz

S6/S7/S8 are reserved for calibration function..

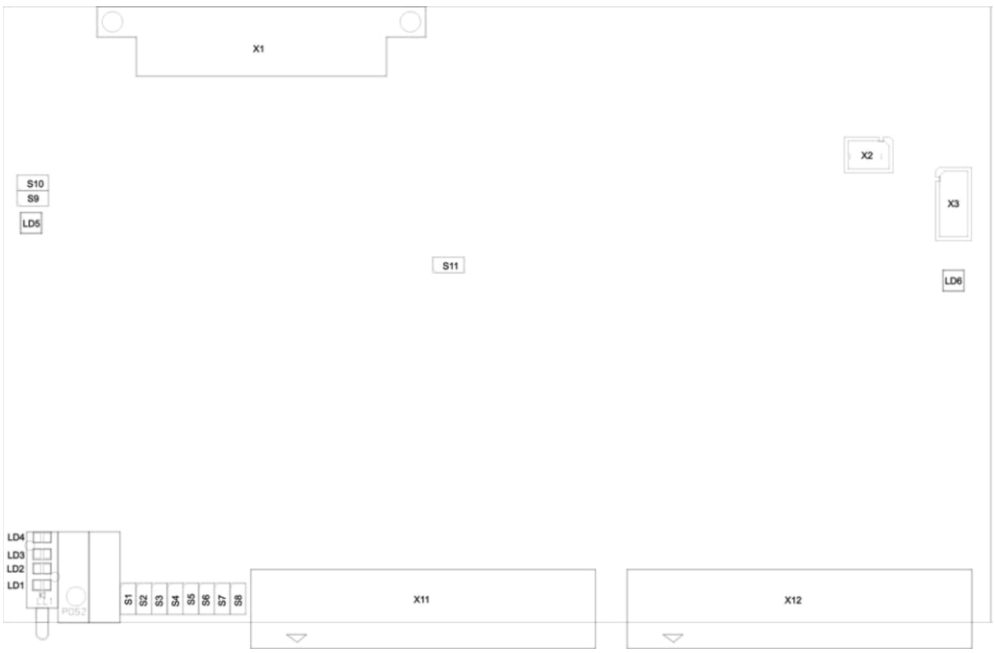


Figure 31: Jumpers and LED of 8ZE16-2

Analogue input card 8AE16-3

The 8AE16-3 card offers an optimal integration of different analogue inputs by carrying out adjustments per channel, multi-range selection of the measuring range, selectable ripple rejection and electrical isolation per channel. The overrun detection expands the measuring range to 100% and provides for better acquisition of transmitter errors. Furthermore, the card enables unipolar and bipolar measured value acquisition.

These functions are only available for the series5 systems from setIT V4.004.05.

- Measuring range multi-range
- Ripple rejection filter level
- Polarity unipolar/bipolar
- Overrun

The settings for each input can be carried out by right clicking the card image under 'Edit card parameters' or in the station configuration under 'Analogue transformer':

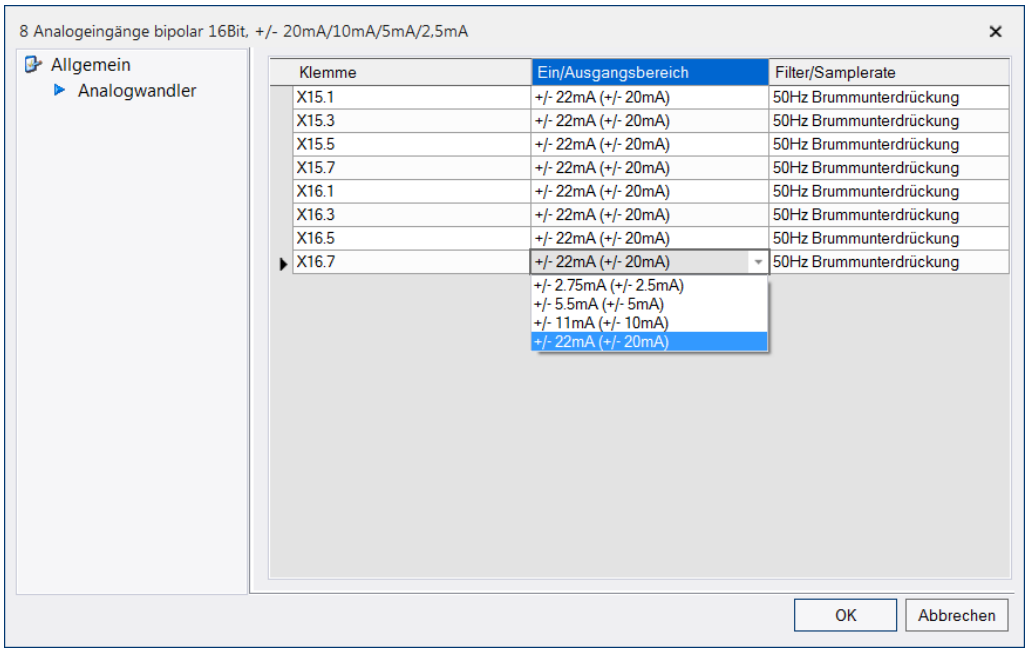


Figure 32: Multi-range selection of measuring ranges and ripple rejection per channel

The 8AE16-3 card can be moved into a compatibility mode which simulates cards 8AE16-1 and 8AE16-2. Through the improved output module, these older cards can be replaced in a compatible manner by an appropriately set 8AE16-3, see Compatibility mode & operating modes p. 172.

Technical details 8AE16-3

8AE16-3	8 analogue inputs 16 bit multi-range Isolated per channel
Input signal	Multi-range switchable per channel: 8AE16-3-1 ±20 / ±10 mA/ ±5 mA / ±2,5 mA 8AE16-3-2 ±10 V Nominal, upon request
Resolution	16 bit bipolar
Measuring range	Multi-range uni-/bipolar Overrun/underrun detection 110%
Accuracy	Core area: ± 0.1% at 5° to +55°C Expanded area: max. ±0,25% at -20 to +70°C
Ripple rejection	ON: 50Hz / 80dBm ; f_{ADC} = 16,7Hz OFF: 50Hz / 25dBm ; f_{ADC} = 120Hz
Electrical isolation	Isolation of the measured values per channel against and for logic via optocoupler
Insulation resistance	Surge voltage 3 kV 1.2/50 µs Power-frequency withstand voltage 2000 V eff. /1 min.
Input load	8AE16-3-1 100 Ω
Maximum power consumption	100 mA typically (at +Ub = 24 V DC)
Operating temperature	20° to 70° C
Relative humidity	95% at 25°C without condensation (class F)

Circuitry of 8AE16-3

Terminal	No.	Description
X11 *X13* *X15* ...	1	Measured value 1 +
	2	Measured value 1-
	3	Measured value 2 +
	4	Measured value 2-
	5	Measured value 3 +
	6	Measured value 3-
	7	Measured value 4 +
	8	Measured value 4-
	9	n.c.· /unused
X12 *X14* *X16* ...	1	Measured value 5 +
	2	Measured value 5-
	3	Measured value 6 +
	4	Measured value 6-
	5	Measured value 7 +
	6	Measured value 7-
	7	Measured value 8 +
	8	Measured value 8-
	9	n.c.· /unused

Note: **Unused voltage inputs (0 - 10 V) should be short-circuited in order to avoid negative effects on the high-impedance inputs.**

Diagnostic LED and jumpers

Function LEDS

There are 4 LEDs to indicate the operating states.

LED 1●●●●4	Colour	Function
1●	Red	**OFF** **Card OK and approved** 2 Hz Error, card inserted incorrectly ON Card locked/not approved
2●	Yellow	**OFF** **valid measurement operation** ON calibration necessary, no measurement operation possible
3●	Green	**OFF** **multi-range**, uni-/bipolar on compatibility mode 8AE16-1/8AE16-2
4●	Red	**OFF** **fault-free operation** ON internal transformer error

Operational LEDs

This module has 2 LEDs to indicate the card status.

LED 5● ●6	*Colour*	*Function*
5●	Green	2 Hz fault-free operation of the module
6●	Green	Free

Compatibility mode & operating modes

It is inserted with the S9 jumper and the card is moved into the compatibility mode which provides the replacement for 8AE16-1-1 or 8AE16-2-1 cards.

S9	S10	Mode
Open	**Open**	**Multi-range mode**
Open	Closed/inserted	Calibration
Inserted	Open	Compatibility mode 8AE16-3-1 => 8AE16-1-1 /8AE16-2-1 8AE16-3-2 => 8AE16-1-2 /8AE16-2-2

Measuring range multi-range

The measuring ranges of each analogue input can be set in the configuration. S9 and S10 must be open for the multi-range operation of 8AE16-3.

Input area 110 %	Measuring range	Comment
± 22 mA	20 mA	Basic setting
± 11 mA	10 mA	
± 5.5 mA	5 mA	from setIT V5.0
± 2.75 mA	2.5 mA	

Ripple rejection

Ripple rejection	Attenuation	Comment
50 Hz	80 dB	Basic setting
100 Hz		Max. sample rate

Range of values for PLC linking

Transmitting the data according to IEC 60870-5-10x takes places in the respectively configured range of values (normalised/scaled/IEEE); the raw values listed here are therefore not valid for a data transmission.
The values refer to the raw values of the analogue inputs in the internal memory of the system; when the codeIT-PLC is accessed 'statically', they must be observed during PLC applications.

A measuring range of e.g. ±22 mA displayed on 16 bit (65536 steps) is available:

Measured value/mA	Raw value/Hex	Raw value/decimal
-22	0000H	0
-20	**0BA2H**	2978
0	**8000H**	32768
20	**0F44AH**	62538
22	0FFFFH	65535

In the other measuring ranges, the raw values behave according to the measuring range end values (2.5 mA ~ 0F44AH, 2.75 mA ~ 0FFFFH).

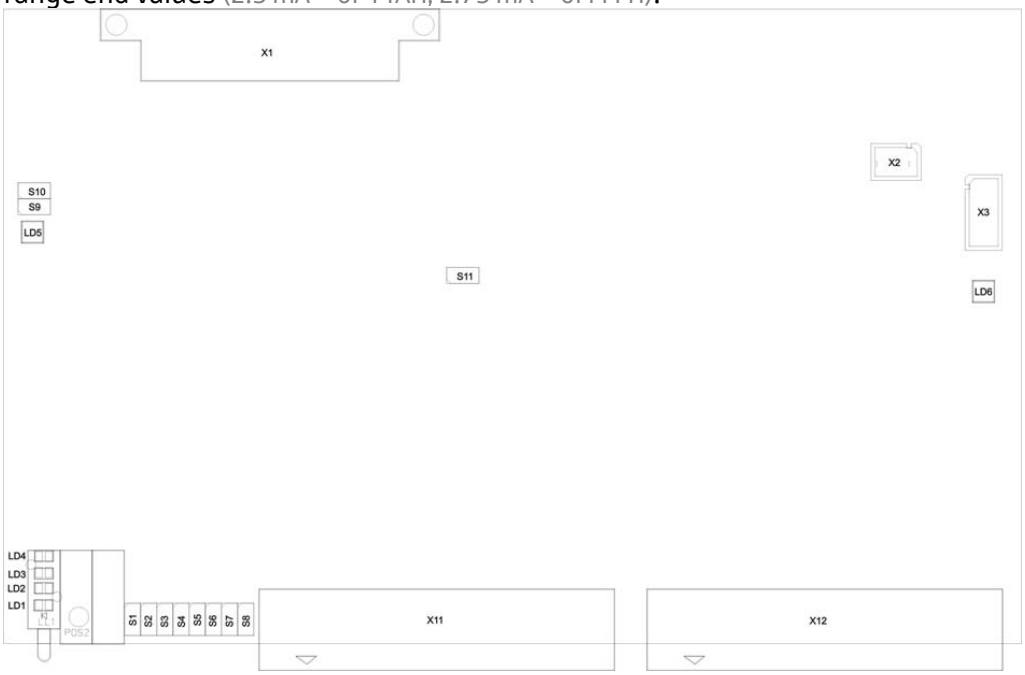
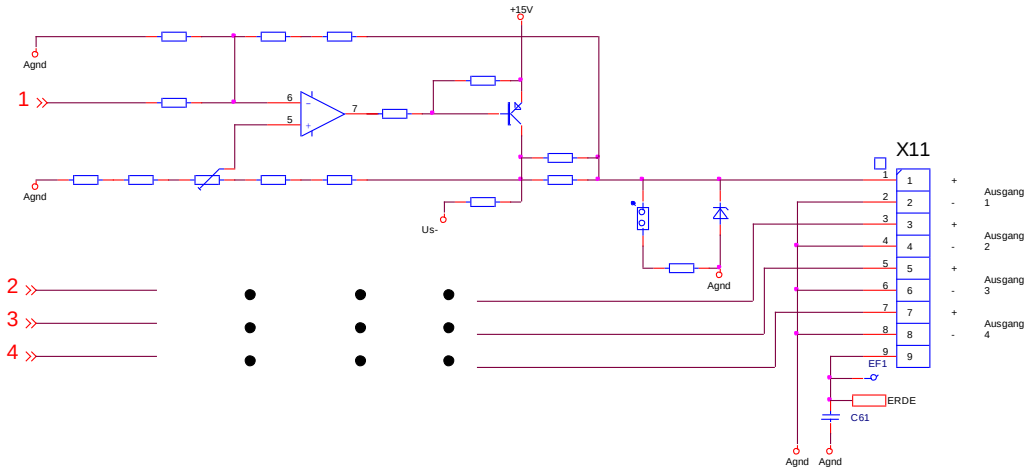


Figure 33: Jumpers and LED of 8ZE16-3

Analogue output card 8AA12-1

8AA12-1	**8 analogue outputs 12 bit, according to root**
output signal:	8AA12-1-1 0...20 mA 8AA12-1-2 0...10 V
Resolution	12 bit
Accuracy	+/- 0,1% / 10 K (at 25 °C related to total output range)
Electrical isolation	Via optocoupler, according to root
Insulation test voltage	Logic / outputs: 500 VDC (optional 3 kV)
Load	8AA12-1-1 300 Ω 8AA12-1-2 100 kΩ
additional status indicator	1 green SMD LED on the card
Controls	8 internal jumpers
Maximum power consumption	200 mA (at +Ub = 24 V DC)
Operating temperature	0° to + 50° C
Relative humidity	95% at 25°C without condensation (class F)

Circuitry of 8AA12-1



Output mode

The card is in output mode when all channels have been completely calibrated (offset and full-scale) and there is no hardware error. This is the main operating mode of the card, this is where the cyclical output of analogue values on the DACs and the operation of the system bus takes place.

	LD1A red	**LD1B** green	**LD1C** green	**LD1D** green	**LD2** green
Card disabled	●	●	●	○	○
Output mode	○	○	○	○	✳ 1 Hz
Rough calibration	○	✳ 2 Hz	✳ 2 Hz	✳ 2 Hz	✳ 2 Hz

Analogue output card 8AA16-1

Technical details

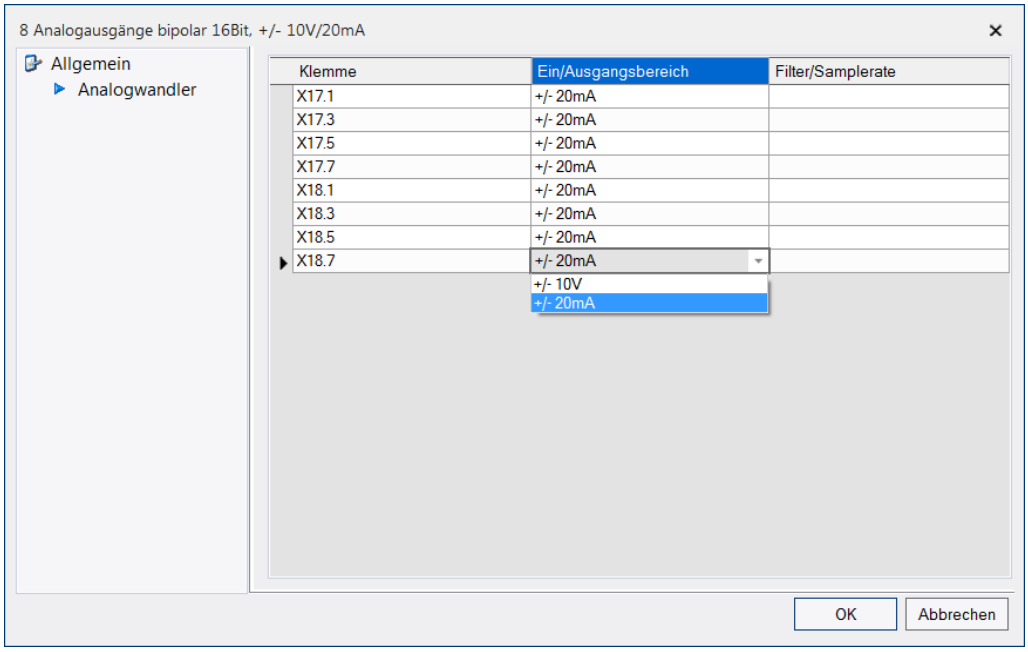
8AA16-1	8 analogue outputs 16 bit bipolar , isolated per channel, 0-20 m,A / 10 V switchable
Resolution	16 bit
output range	Uni-/bipolar ± 20 mA / ±10 V switchable per channel
Accuracy	±0.1% /10 K over entire range (2.5 mA: ± 0.25%)
Electrical isolation	Isolated per channel, 2-pole connector
Insulation test voltage	2500 VDC for power supply
Load	± 20 mA max. 500 Ω ± 10 V 100 kΩ
Maximum power consumption	300 mA (at +Ub = 24 V DC)
Operating temperature	20° to 70° C
Relative humidity	95% at 25°C without condensation (class F)

Circuitry of 8AA16-1

Terminal	No.	Description
X11 X13 X15 ...	1	Set point 1+
	2	Set point 1-
	3	Set point 2+
	4	Set point 2-
	5	Set point 3+
	6	Set point 3-
	7	Set point 4+
	8	Set point 4-
	9	n.c.· /unused
X12 X14 X16 ...	1	Set point 5+
	2	Set point 5-
	3	Set point 6+
	4	Set point 6-
	5	Set point 7+
	6	Set point 7-
	7	Set point 8+
	8	Set point 8-
	9	n.c.· /unused

Switching the output range per channel

The output/set point card 8AA16-1 can be separately switched for each set point/channel in the output range between ± 20 mA and ± 10 V. The setting is either carried out in the station view FW-50 in the card configuration or in the "Analogue transformer" menu of the station properties.
The bipolar/unipolar selection takes place in the output definition of the process data. Software carries out scaling process.



Check-back indication card EVU2-I

EVU-2-I	**Command check-back indication card** for EVU-2-O	
Check-back indication	16 inputs with common root	
Electrical isolation of measuring circuit	Via optocoupler	
EVU2-I-1	Input voltage Switching point Input current	24 V DC approx. 12 V DC at 20 V approx. 2.8 mA
EVU2-I-5	Input voltage Switching point Input current	18 ... 72 V DC approx. 17 V DC at 24 V approx. 1.4 mA at 60 V approx. 3.5 mA
EVU2-I-2	Input voltage Switching point Input current	60 ... 130 V DC approx. 37 V DC at 60 V approx. 1.2 mA, at 120 V approx. 2.4 mA
EVU2-I-3	Input voltage Switching point Input current	220 V DC approx. 135 V DC at 220 V approx. 1.3 mA
Insulation test voltage:	Logic/outputs optionally 3 kV	
Controls	6 internal jumpers	
Maximum power consumption	50 mA (at 5 V DC)	
Ambient temperature	-20° to +70° C	
Relative humidity	80 % at 25°C without condensation	

Circuitry of EVU2-I

Terminal	No.	Description
X11 *X13* *X15* ...	1	Input 1
	2	Input 2
	3	Input 3
	4	Input 4
	5	Input 5
	6	Input 6
	7	Input 7
	8	Input 8
	9	Common [-]
X12 *X14* *X16* ...	1	Input 9
	2	Input 10
	3	Input 11
	4	Input 12
	5	Input 13
	6	Input 14
	7	Input 15
	8	Input 16
	9	Common [-]

In case of nip voltages > 75 V, the terminals must be labelled with the warning "Caution high voltage".
Prior to working, switch of all poles, remove plug and discharge!

Command card EVU2-O

EVU2-O-1 / EVU2-O-3	Command termination 1.5 pole, max. 8 double commands or 16 single commands
EVU2-O-2 / EVU2-O-4	Command termination 2 pole, max. 4 double commands or 8 single commands
Command relay	16 relay outputs, 2 release relays
Monitoring times	0 .. steps of 100 ms between 0 ..
Electrical isolation of measuring circuit	Via optocoupler
EVU2-O-1/ EVU2-O-2	Control voltage to 60 V Dc
External coil resistance	100 Ω ... - 20 kΩ
Accuracy of measuring circuit	+/- 10 %
EVU2-O-3/ EVU2-O-4	Control voltage 60 V Dc
External coil resistance	1 k Ω ... - 100 kΩ
Accuracy of measuring circuit	+/- 15 %
Allowed switching voltage	Max. 220 V DC
Allowed switched current	Max. 2 A at 24 V DC 60 V DC 0.4 A 110 V DC 0.2 A 220 V DC 0.1 A
Maximum power consumption	23 mA at +Ub 24 V DC (with 1.5-pole command output)
Protective circuitry of contacts	250 V varistors
Ambient temperature	-20° to +70° C
Relative humidity	80% at 25°C without condensation

Note

If 1 ½ pole (EVU2-O-1) and 2-pole (EVU2-O-2) commands are used simultaneously, it is necessary to use separate cards, which can however, be used in the same command group (rack). Single and double commands can be mixed on one card.

In case of nip voltages > 75 V, the terminals must be labelled with the warning "Caution high voltage".
Prior to working, switch of all poles, remove plug and discharge**!**

Circuitry of EVU2-O for double commands

Terminal	No.	1½-pole	2-pole
X11 X13 X15 -	1	Command 1.1	Command 1.1 [+]
	2	Command 1.2	Command 1.1 [-]
	3	Command 2.1	Command 1.2 [+]
	4	Command 2.2	Command 1.2 [-]
	5	Command 3.1	Command 2.1 [+]
	6	Command 3.2	Command 2.1 [-]
	7	Command 4.1	Command 2.2 [+]
	8	Command 4.2	Command 2.2 [-]
	9	+Uext	+Uext
	10	-Uext	-Uext
X12 X14 X16	1	Command 5.1	Command 3.1 [+]
	2	Command 5.2	Command 3.2 [-]
	3	Command 6.1	Command 3.2 [+]
	4	Command 6.2	Command 3.2 [-]
	5	Command 7.1	Command 4.1 [+]
	6	Command 7.2	Command 4.1 [-]
	7	Command 8.1	Command 4.2 [+]
	8	Command 8.2	Command 4.2 [-]
	9	Common [U-]	Common [U-]
	10	Common [U-]	Common [U-]

2- x 10-pole terminal design

Circuitry of EVU2-O for single commands

Terminal	No.	1½-pole	2-pole
X11 X13 X15 -	1	Command 1	Command 1.1 [+]
	2	Command 2	Command 1.2 [-]
	3	Command 3	Command 2.1 [+]
	4	Command 4	Command 2.2 [-]
	5	Command 5	Command 3.1 [+]
	6	Command 6	Command 3.2 [-]
	7	Command 7	Command 4.1 [+]
	8	Command 8	Command 4.2 [-]
	9	+Uext	+Uext
	10	-Uext	-Uext
X12 X14 X16	1	Command 9	Command 3.1 [+]
	2	Command 10	Command 3.2 [-]
	3	Command 11	Command 3.2 [+]
	4	Command 12	Command 3.2 [-]
	5	Command 13	Command 4.1 [+]
	6	Command 14	Command 4.1 [-]
	7	Command 15	Command 4.2 [+]
	8	Command 16	Command 4.2 [-]
	9	Common [U-]	Common [U-]
	10	Common [U-]	Common [U-]

2- x 10-pole terminal design

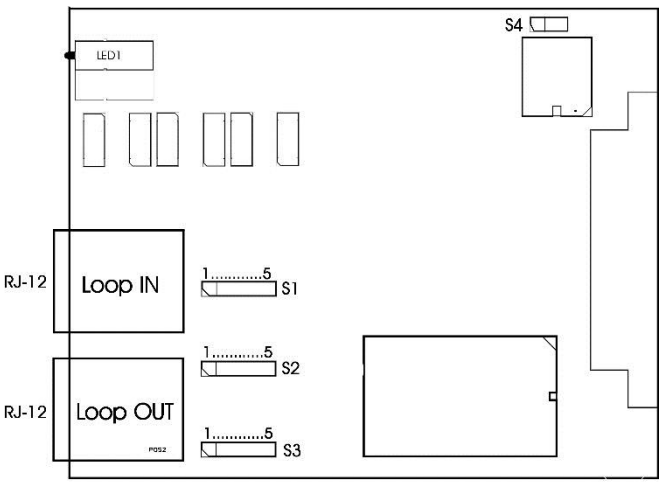
Coupling card EVU-X-1

Implementation of a rack overlapping command group for the joint use of EVU-cards in up to 7 racks. In this command group all commands are directly interconnected via hardware.

LED 1●●●●4		Function
1	Red	Card error / release
2	Green	Status signal "Command active"
3	Green	Status signal "Internal measuring circuit error"
4	Green	Reserved

Jumper	1-2 / 3-4 inserted	2-3 / 4-5 inserted
S1 = Loop for "Command active"	Active	Passive
S2 = Loop for "Internal measuring circuit error"	Active	Passive
S3 = Reserved for signal "End position reached"	Open	Open
S4 = Master / slave signalling	1-2 Master	2-3 Slave

Interface to DTE	3x TTL level, tri-state, Bi-directional transmission per current loop
Signals	Command active; internal measuring circuit error; end position reached (INT/)
DCE interface	3 current loops, 20mA. EVU-signalling line inactive (+5V) = 20mA, Active (Command active/interference) = 0mA
Load.	Approx. 3V / EVU-X card
DCE plug-in connection	2 6-pole Western connectors for loop-out and loop-in
Status indicator	3 green LEDs, status of 20 mA loops, 1 red LED card status
Controls	3 jumper for active/passive – adjustment of the respective current loops
Design	Board in 100 mm x 80 mm
Plug-in connector	2x 6-pole western connector (RJ12)
Insulation	3000 V surge for EVU applications 2000 V AC
Ambient temperature	0° ... +50° C
Relative humidity	80% at 25°C without condensation



Cable and connection of EVU-X cards

The closed current loop (LED lights up) indicates the inactive state of the respective bus signals in the interconnected command groups. An active command/error immediately interrupts the current loop.
If one current loop is faulty the EVU command output of all modules will be blocked.
The card is designed as an interface card and **must only be inserted in the "upper" bus**. Any slot position can be chosen on the upper bus.

A connection cable is provided with a "module ribbon cable for western connectors" with RJ12 plugs.

Figure 34: Cable EVU-X

The cable length is specified by the design.

A short connection of approx. 23 cm (17.7 cm + 2 * 3 cm) is anticipated because the racks are mounted below one another (~ 4HE). The exact dimensions need to be checked at the mounted rack frames.

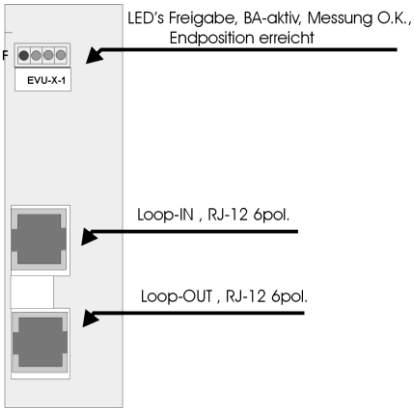
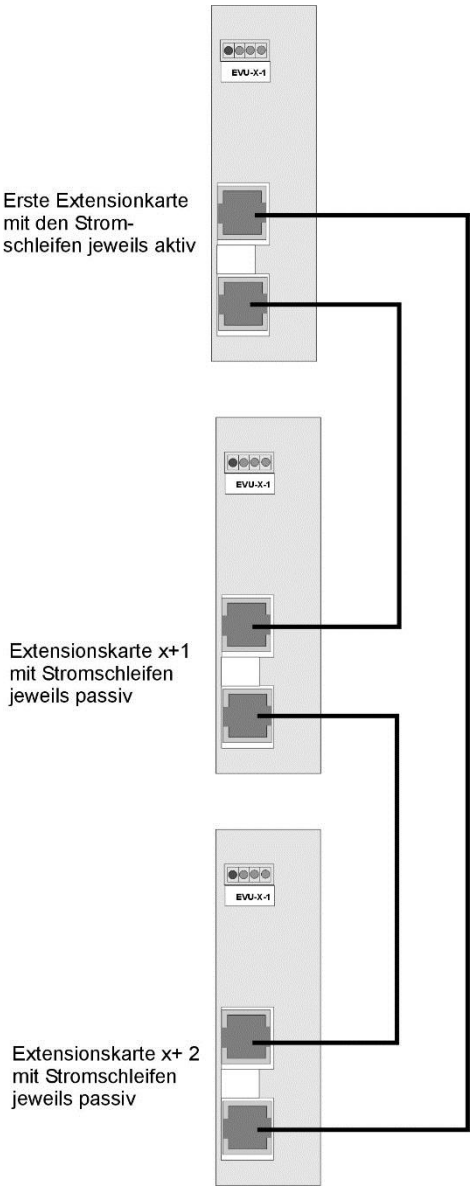


Figure 35: Circuitry EVU-X



The maximum cable length must not exceed **3m** due to EMC safety reasons.
Further information can be derived from the short description of EVU-X.

9 Power Supply

Internal power supplies

Intelligente Spannungsversorgung SV-6

Die Spannungsversorgung SV-6 wurde für den Einsatz im Bereich Feldleittechnik der Mittel- und Hochspannungsnetze entwickelt für die Systeme:

- net-line BCU-50
- net-line FW-50

Um den jeweiligen Anforderungskonzepten gerecht zu werden wurde sie für verschiedene Speisespannungen ausgelegt. Sie kann auch redundant im Baugruppenträger eingesetzt werden.

Als intelligente Spannungsversorgung erfüllt sie wesentliche Anforderungen. Zur Unterstützung eines intelligenten Spannungsausfallkonzeptes werden die Primärspannung, die Temperatur und die Stromlast der Baugruppe mit festen voreingestellten Grenzwerten überwacht. Die Karte erfüllt die hohen Anforderungen an Umgebungsbedingungen, Schock-, vibrations- und Spannungsfestigkeit der IEC 61850-3 für den Einsatzbereich (h/H).

Artikelliste

Artikelnr.	Name	Funktion
310050040400	SV-6-24-LC	Stromversorgung 24 V DC für FW-50
310050040410	SV-6-48#	Stromversorgung 24 /48 V DC für FW-50
310050040420	SV-6-60#	Stromversorgung 24 /60V DC für FW-50
310050040421	SV-6-60-LC	Stromversorgung 48 /60V DC für FW-50
310050503400	SV-6-24-LC BCU	Stromversorgung 24 /48 V DC für BCU
310050503410	SV-6-48 BCU#	Stromversorgung 24 /48 V DC für BCU
310050503420	SV-6-60 BCU#	Stromversorgung 24 /60 V DC für BCU
310050503421	SV-6-60-LC BCU	Stromversorgung 48 /60 V DC für BCU
310050503430	SV-6-110 BCU# ⚠*	Stromversorgung 110 V DC für BCU
310050503440	SV-6-220 BCU# ⚠*	Stromversorgung 220 V DC für BCU

Karte erfüllt die Anforderungen nach IEC 61850-3 (h)
Anmerkung: Beim Einsatz der -LC Varianten im BCU-50 reduziert sich der regulative Einsatzbereich.
*Bei Signalspannungen > 75 V DC ist zu beachten:

Der Betrieb mit einer Speisung > 60 V ist nur bei BCU-50 zugelassen!

Vor Arbeiten allpolig abschalten, Stecker ziehen und Entladen!

WARNUNG

Spaltspannungen > 75 V müssen die Klemmen mit dem Warnhinweis "Vorsicht Hochspannung" markiert sein.
Nur Steuersignale mit gleicher Signalspannung verwenden.
Nur die beiliegenden schwarzen Klemmen verwenden, um durch die farbliche Differenzierung eine Vertauschung mit Signalen DC ≤75V zu verhindern.
Einzeladern müssen zusätzlich miteinander mechanisch verbunden sein, z.B. mit einem Kabelbinder, um im Fehlerfall das Wandern einer mit gefährlicher Spannung führende Ader auf eine benachbarte Baugruppe mit DC ≤75 V zu verhindern.

WARNUNG

Nichtbeachtung kann Sach- oder Personenschäden zur Folge haben!

ACHTUNG

Zur Erfüllung der Vorgaben für die elektrische Sicherheit ist der Einbau- bzw. Betrieb der Baugruppe nur in einem Schrank, einem Gehäuse ab Schutzklasse IP 56 oder in einem geschlossenen Betriebsraum gestattet

Überwachung der Primärspannung

Eine leistungsfähige und innovative Anlagentechnik benötigt ein intelligentes Powermanagement zur optimalen Versorgung der Komponenten. Dabei ist nicht nur die Bereitstellung einer sauberen Versorgungsspannung gefordert, sondern gerade in den Grenzbereichen wird ein korrektes Verhalten bei Unterspannung, Überspannung und Überlast erwartet.
Die SV-6 ist mit einer intelligenten Überwachung der Primärspannung, der Last und der Temperatur der Baugruppe ausgestattet. Die Baugruppe stellt entsprechende Signale wie die Freigabe- und Powerfail-Signale der Kern-CPU bereit und ermöglicht so definierte Betriebszustände.

Um ein unkontrolliertes Laden- / Entladen der SSM-Batterie bis hin zur Tiefentladung zu vermeiden, ist ein intelligentes, mehrstufiges Spannungs-konzept realisiert, welches die Freigabe für die CPU bereitstellt. Bei Unterspannung wird ein Alarmrelais aktiviert, dass neben der Alarmierung auch als Schaltsperre für Befehle in der RTU genutzt werden kann, da die speisende Batterie ggf. nicht mehr genügend Energie für die Leistungsmotoren bereitstellt.

Die Grenzwerte sind in Abhängigkeit der Variante / Betriebsspannung voreingestellt. In Planung befindet sich eine parametrierbare Einstellung über die System-CPU setIT. Die Werte sind Netzausfallsicher EEprom auf der Baugruppe gespeichert.

Intelligentes Warnen und Abschalten bei abweichender Versorgungsspannung

- ≥115% (≥119% bei 110V DC) kritische Überspannung erreicht
- ≥110% Betriebsspannung sind erreicht
- ≥86% Start / Neustart
- ≤85%, kritische Unterspannung erreicht (powerfail Alarm)
- ≤80% Abschaltgrenzwert

Service- und Diagnose Schnittstelle i.V.

Die RS-485 Schnittstelle ist nur für den lokalen Betrieb in der Front des Gerätes zulässig.

Es können folgende Werte ausgelesen werden:
- Start / Neustart
- Abschaltgrenzwert
- Powerfail
- Primärspannung & Wandlerspannung
- Sekundärströme
- Temperatur

Technische Daten der Diagnoseschnittstelle

wie com_5C-485 Modul

Front-LED SV-6

LED	Farbe			Funktion
error ●	rot		an	Temperatur > 100°C, Primärspannung >115% der Betriebsspannung, Baugruppe gestört
			aus	Keine Fehler, Baugruppe aktiv
			blinken	Interner Fehler, keine oder ungültige Messdaten der Eingangsspannung/Temperatur
status ●	gelb	●	an	Reserviert für den Betrieb unter setIT*
			aus	Betrieb
			Blinken	Interner Kommunikationsfehler, keine Eingangsspannung
Umod ●	grün	●	an	Hilfsspannung 24 VDC aktiv*
			aus	Hilfsspannung abgeschaltet
com ●	grün	✱	blinken	Serielle Kommunikation aktiv (RS-485) *
		-	aus	Keine Kommunikation
powerfail ●	gelb	●	an	Primärspannung <85% % der jeweiligen Betriebsspannung
		-	aus	Primärspannung im gültigen Bereich
alarm ●	gelb	●	an	Temperatur > 90°C, Primärspannung >110% der jeweiligen Betriebsspannung*
		-	aus	Kein Alarm aktiv
DC out ●	grün	●	an	Sekundärspannungen aktiv
		-	aus	Sekundärspannungen abgeschaltet
DC in ●	grün	●	an	Primärspannung innerhalb der zulässigen Grenzen
		-	aus	Primärspannung zu gering

* nicht bei -LC Modellen; gültiger Betriebszustand, Fehlerhafter Betrieb

Wenn nur die LED powerfail aufleuchtet, signalisiert die SV-6 den aktiven Messbetrieb. Die gemessene Primärspannung liegt unterhalb der minimal erforderlichen Untergrenze.
Dieser Zustand kann auch im redundanten Betrieb an der SV-Baugruppe mit ausgefallender Primärspannung erkannt werden.

SV-6-24-LC 24 V DC Stromversorgung

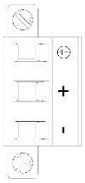
Die SV-6-24 ist eine preisreduzierte Variante der SV-6-Serie. Um eine kostengünstige Spannungsversorgung bereitstellen zu können, wurde gegenüber der übrigen SV-6-x Varianten auf einige Funktionen verzichtet:

- keine Galvanische Trennung der Primär- und Sekundärspannung
- keine Strom- und Temperaturmessung
- keine Alarmausgänge
- keine Hilfsspannung U_{mod}

Die entsprechenden Front-LEDs sind damit bedeutungslos.

SV-6-24-LC	**Stromversorgung 24 V DC 48 W**
Nennspannung	24 V DC -15%/+20%
Betriebsspannung	21,2 ... 28,2 V DC
Stromaufnahme	max. 2,1 A @ 24 V DC, 50 W
Ausgangsspannung intern	Systemspeisespannungen 24 V DC, 5 V DC geregelt
Sekundärleistung	max. 48 W 1 A @ 5 V, 1,8 A @ 24 V
Wirkungsgrad	> 90 %
Wärmeverlustleistung	typ. 3 W
Redundanzbetrieb	Ja
Netzausfallüberbrückung	20 ms
Alarmausgänge	keine
Isolation	5 kV DC primär/Erde, EMV Level 3 primär/ sekundär keine
Schutzklasse	ohne (Schutzkleinspannung)
Anschlussklemmen	X_1, X_2: MC 1,5/4-STF-3,5 X_3: GMSTB 2,5/3-STF-7,62
Abmessung	FW-Systemkarte 20 x 160 x 100 mm (B x H x T)
Umwelt	-25° ... + 60°C

Spannungsanschluss X3: SV-6-24-LC



Schutzerde / Funktionserde	
+	24 V DC
-	GND

SV-6-60-LC 60 V DC Stromversorgung

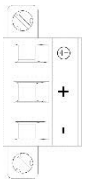
Die SV-6-60-LC ist eine preisreduzierte Variante der SV-6-Serie. Um eine kostengünstige Spannungsversorgung bereitstellen zu können, wurde gegenüber der übrigen SV-6-x Varianten auf einige Funktionen verzichtet:

- keine Galvanische Trennung der Primär- und Sekundärspannung
- keine Strom- und Temperaturmessung
- keine Alarmausgänge
- keine Hilfsspannung U_{mod}

Die entsprechenden Front-LEDs sind damit bedeutungslos.

SV-6-60-LC	**Stromversorgung 60 V DC 50 W**
Nennspannung	60 V DC -30%/+20%
Betriebsspannung	40 ... 72 V DC
Stromaufnahme	max. 0,9 A @ 60 V DC, 54 W
Ausgangsspannung intern	Systemspeisespannungen 24 V DC, 5 V DC geregelt
Sekundärleistung	max. 48 W 1 A @ 5 V, 1,8 A @ 24 V
Wirkungsgrad	> 90 %
Wärmeverlustleistung	typ. 5,8 W
Redundanzbetrieb	Ja
Netzausfallüberbrückung	20 ms @ 50% Last
Alarmausgänge	keine
Isolation	5 kV DC primär/Erde, EMV Level 3 primär/ sekundär keine
Schutz	ohne Klasse (Schutzkleinspannung) Verpolschutz und Überspannungsschutz Varistor
Anschlussklemmen	X_1, X_2: MC 1,5/4-STF-3,5 X_3: GMSTB 2,5/3-STF-7,62
Abmessung	FW-Systemkarte 20 x 160 x 100 mm (B x H x T)
Umwelt	-25° ... + 60°C

Spannungsanschluss X3: SV-6-60-LC



	Schutzerde / Funktionserde
+	**60** V DC
-	GND

SV-6-48 Weitbereichsstromversorgung

Die Variante SV-6-48 bietet sowohl 24 V DC Versorgung als auch 48 V DC mit allen Überwachungsfunktionen der SV-6.

SV-6-48	**Interne Stromversorgung 24 / 48 V DC 50 W**
Nennspannung	24 / 48 V DC ±20%
Betriebsspannung	21 ... 28 VDC / 41 ...55 VDC
Stromaufnahme	max. 2,5 A @ 24 VDC, max. 1,25 A @ 48 VDC
Ausgangsspannung intern	Systemspeisespannungen 24 V DC, 5 V DC geregelt
Sekundärleistung	max. 36 W
Redundanzbetrieb	Ja
Netzausfallüberbrückung	50 ms
Spannungsmessung	Primär- & Sekundärspannungen, Auflösung 1 V
Strommessung	Überwachung der sek. Stromlast (inkl. Hilfsspannung Umod)
Temperaturmessung	Überwachung der Baugruppentemperatur, Auflösung 1°C
Alarmausgänge /Relais	powerfail: max. 240 V DC 10µA ... 40 mA, Öffner alarm: max. 240 V DC 10µA..40 mA, Schließer
Hilfsspannung U_{mod}	0,4 A @ 24 VDC
Diagnoseschnittstelle RS-485	über Front verfügbar
Isolation / EMV	5 kV DC primär/Erde, 1,5 kV DC primär/sekundär, EMV Level 4
Schutzklasse	ohne (Schutzkleinspannung)
Anschlussklemmen	X_1, X_2: MC 1,5/4-STF-3,5 X_3: GMSTB 2,5/3-STF-7,62
Abmessung	FW-Systemkarte 20 x 160 x 100 mm (B x H x T)
Umwelt	-25° ... + 60°C (> 40°C derating)

Schaltschwellen 24 V Betrieb bei SV-6-48/SV-6-60

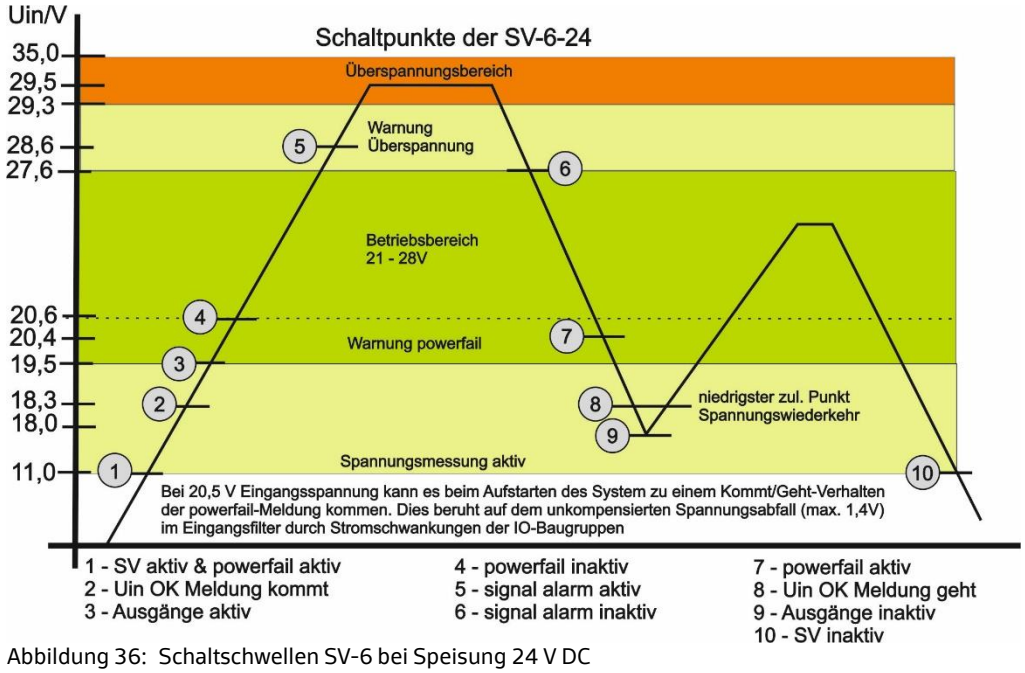


Abbildung 36: Schaltschwellen SV-6 bei Speisung 24 V DC

- Powerfail Meldeausgang AUS: 86 % U_B >20,6 V, die Station startet
- Powerfail Meldeausgang EIN: 85 % U_B <20,4 V
- Ausgangsspannung EIN: 81 % U_B >19,5 V
- Ausgangsspannung AUS: 75 % U_B < 18,0 V, die Station ist aus

Schaltschwellen SV-6-48

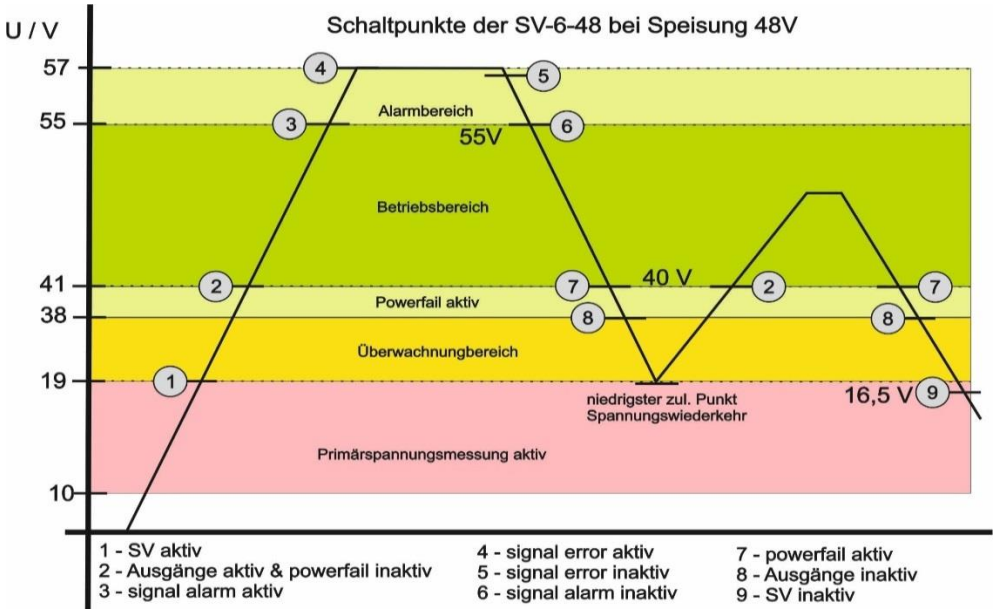


Abbildung 37: Schaltschwellen SV-6-48, Speisung 48 V DC

- Powerfail Meldeausgang AUS: 86 % U_B > 41 V, die Station startet
- Powerfail Meldeausgang EIN: 85 % U_B < 41 V
- Ausgangsspannung EIN: 80 % U_B > 38 V
- Ausgangsspannung AUS: 40 % U_B < 19 V, die Station ist aus

Anschlussklemmen SV-6-48

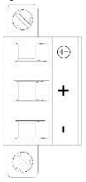
Service X1

	COM A RS-485
	COM B RS-485
	Umod + 24 V DC 0,4 A max.
	Umod -

Melderelais X2

	Powerfailsignal Relais 1 Öffner
	Powerfailsignal Relais 2
	Alarm Relais Kontakt 1 Schließer
	Alarm Relais Kontakt 2

Spannungsanschluss X3:



	Schutzerde / Funktionserde
+	24/48 V DC
-	GND

Blockschaltbild SV-6-48

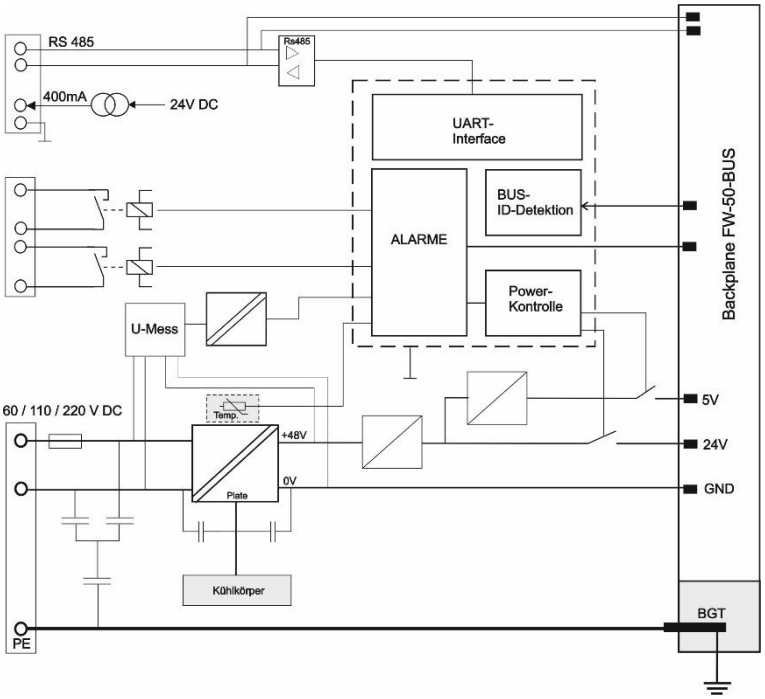


Abbildung 38: Blockschaltbild SV-6-48

SV-6-60 Wide range power supply

The variant SV-6-60 offers a supply with 24 V DC as well as a 60 V DC with full range of supervision of SV-6.

SV-6-60	**Internal power supply 24 / 60 V DC 50 W** for usage in BGT-L (Position PS)
Input voltage	24 / 60 V DC ±20%
Internal output voltage	System supply voltages 24 V DC, 5 V DC regulated
Output current	2.5 A, regulated
Power failure suppresion	50 ms
Isolation	2.5 kV PS-earth, 2.5 kV primary/secondary EMV Level 4
Connection	UE: 3-pole screw terminal Ua: internal
Dimension	FW system card 20 x 160 x 100 mm (W x H x D)
Environment	-25° ... + 50°C (> 40° C derating)

Thresholds SV-6-60

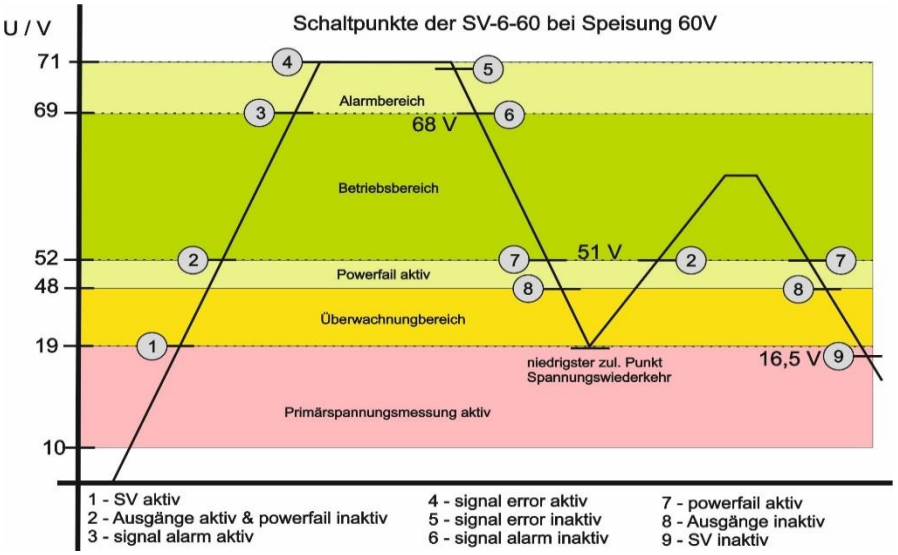


Abbildung 39: Schaltschwellen SV-6-60, Speisung 60 V DC

bei Speisung 24 V DC s. SV-6-48

Terminals SV-6-60

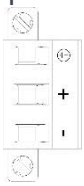
Service X1

COM A RS-485	
COM B RS-485	
Umod + 24 V DC 0,4 A max.	
Umod -	

Melderelais X2

Powerfailsignal Relais 1 Öffner	
Powerfailsignal Relais 2	
Alarm Relais Kontakt 1 Schließer	
Alarm Relais Kontakt 2	

Spannungsanschluss X3:



Schutzerde / Funktionserde	
+	24/60 V DC
-	GND

Blockschaltbild SV-6-60

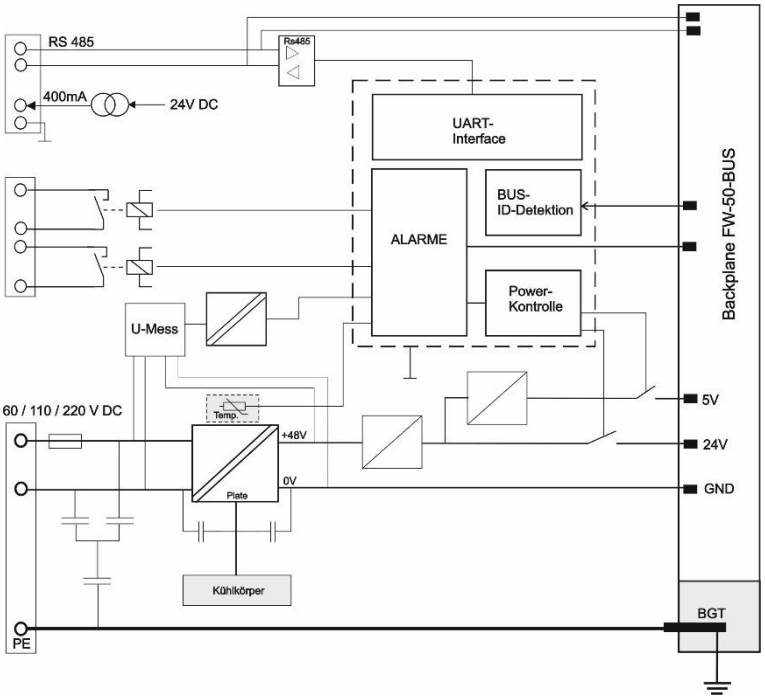


Abbildung 40: Blockschaltbild SV-6-60

10 PLC programming information

For the integrated use of the codeIT PLC programming tool under IEC 61131-3 programming, a dipswitch is available on the front that enables simple and "PLC-standard" operating mode selection.

IEC 61131-3 programming

Switch S1 with two operating methods: STOP / RUN
The access to programming mode was changed to a system command due to security issues; it may be performed remotely - thus the switch position PROG was omitted.

Switch position **RUN**
All programs running
The test functions are not active
When a test function is called that is only available in PROG mode,
"wrong operating method" is displayed.

Switch position **STOP**
PLC program has stopped
Communication programs continue
No output on the output modules

Function of the LED codeIT /PLC

		Colour	Function
codeIT	●	green	OFF = PLC stop; ON = PLC RUN; flashing = PLC- loading program
Stop	●	red	OFF = OK; ON = error; flashing = operating method PROG

Programming interface

Programming is only supported via LAN interface.

Memory accesses and addressing

The options of static and selective process data assignment between setIT and codeIT are available depending on the target system settings in codeIT. Up to series5, the static mode was still supported but newer systems only support the selective mode.

Targets and their run-time systems (target systems)

Since series5+ only the selective mode will be supported; it is easier and multifunctional.

- SAE_IT-systems_series5_static no longer supported
  series5 target system with static address assignment series5
- **SAE_IT-systems_series5_selective**
  target system with selective address assignment

Selective process data coupling of codeIT PLC

Operating method "selective" operates all process data in the process module and parallel provides them to the codeIT system for selection. The process data is fully processed by the telecontrol and can be forwarded directly to the control system, an additional cross-connection with codeIT is not required.
The process data is processed simultaneously. codeIT accesses the states of the values and is able to create additional information by means of 'virtual process data'.

The selective process data assignment for a PLC link is supported in series5 since setIT V4.005.x. In a codeIT project the target **SAE_IT-systems_series5_selective** has to be **installed and selected.**

In setIT the activation is done via the codeIT settings **selective** in the stations properties:

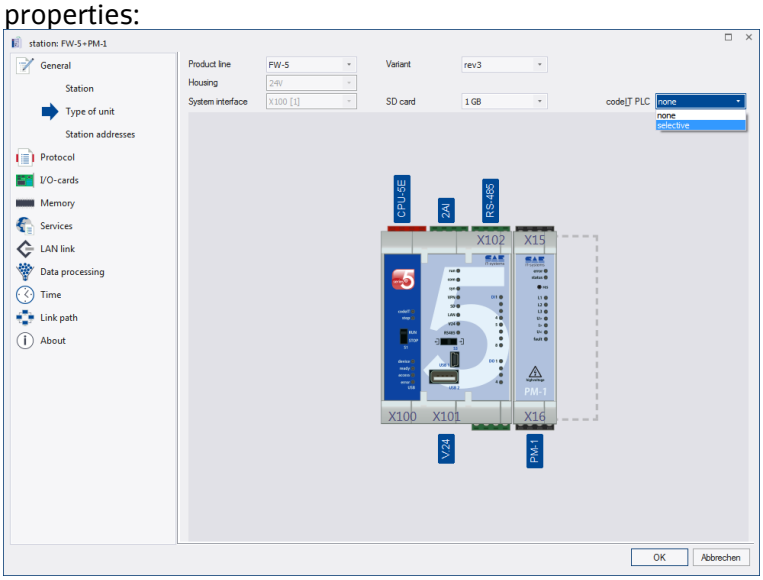


Figure 41: Selection of selective process data assignment to codeIT-PLC in sample station

The effective IO assignment is selected in the property page **codeIT-PLC/ Coupling to process module**. Only the marked process data will be launched to the PLC-shell, assigned to the memory area for codeIT and integrated in the list of variables for easy import in codeIT. All other values will be operated by the telecontrol device immediately.

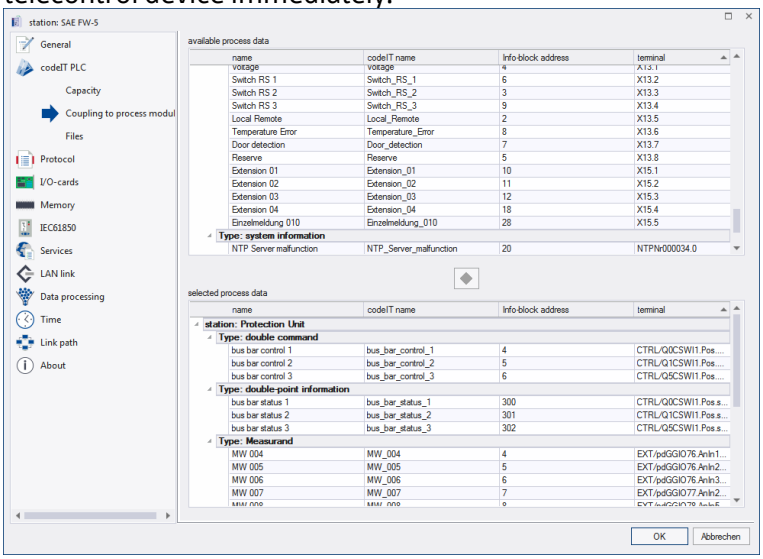
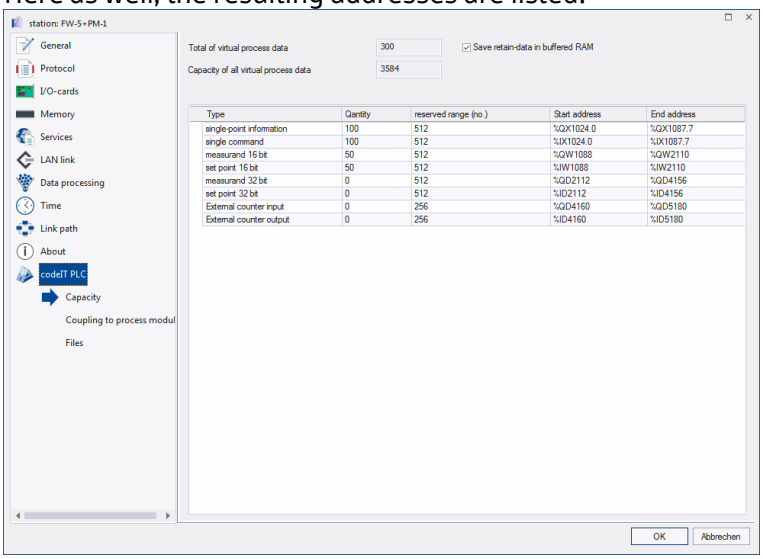


Figure 42: Selection of process data

The capacity may be supervised and modified in limits in **codeIT-PLC/Capacity**. Here as well, the resulting addresses are listed.



More information is available in the documentation Manual_codeIT_V23_GB.pdf.

11 Security settings

This section provides a summary of the measures that must be taken to implement rapid setup and verification according to the BDEW whitepaper. In order to achieve this, it takes a closer look at the general properties.

Application-specific settings for particular user profiles and execution instructions are contained in separate appendices.

To attain the highest security level according to the BDEW whitepaper, the general recommendation is to use the series5+ technology as a minimum, and to install the latest version of setIT. A free update service informs you of new versions and functions.

Default parameters for new project creation

For compatibility reasons, setIT is set so that – among other things – the following safety settings apply when a project is created:

- IP address monitoring is enabled for network communication
  - Communication only takes place between known addresses
- User management is disabled.
  - The "sae" and "root" default users are enabled for the WEB page. These are disabled or overwritten when user roles and super-admin roles are created.
- FTP/http access is enabled by default.
  - The FTPs/https protocol is recommended for safety reasons.
- The default Bluetooth selection "can be enabled" on CPU cards with Bluetooth module
  - Access can be activated locally by switch.
- USB Ethernet is enabled by default
  - Local access via USB cable is enabled and is accessible via DHCP server in address space 192.168.59.81/29.
- The firewall is not enabled.
  - Only configured ports are enabled on the station.
  - Users can also determine at the socket level what service/port (e.g. for diagnostic access) will be allowed on the corresponding socket via the enabled firewall. Moreover, the system runs more stably, even in the event of a brute force attack (traffic). From series5e, the socket is temporary disabled when an attack is detected.

These settings should be set to the required values at the first project station The inheritance of properties when additional stations are created then simplifies subsequent configuration.
The settings can be made using the following checklist as a reference.

Security features for the series

The essential features and their potential applications are listed in the product series:

	System4	series5	series5+	series5e
User management from setIT V4.008	-	●	●	●[e]
Bluetooth can be disabled	-	●	●	●[e]
Remote download can be disabled	-	●	●	●[e]
Firewall from setIT V5.0	-	-	●	●[e]
FTPs from setIT V5.0	-	●	●	●[e]
https from setIT V5.0	-	●	●	●[e]
IP address verification	●	●	●	●[e]
Port limitation on enabled communication	○	●	●	●[e]
Programming enable control command in codeIT from setIT V5.0	-	●	●	●[e]
USB device can be disabled from setIT V5.0	-	●	●	●[e]
VPN (end-end) from setIT V5.0	-	-	●	●[e]
IPsec IKEv2 from setIT V5.2	-	-	●	●[e]
Encrypted database from setIT V5.3	-	-	●	●[e]
Signed firmware from setIT V5.3	-	-	●	●[e]
Syslog from setIT V5.3	-	-	●	●[e]
Control command to enable accesses from V5.3 Web server, USB host, USB device, FTP, setIT diagnostics, Bluetooth	-	-	●	●[e]
Active defence against brute-force attacks	-	-	○	●[e]
Separated networks no Routing	-	●	●	●[e]

\- not possible ○ partially met ● met

[e]The series5e is supported from setIT V5.004.

Separated networks

The TCP telegram routing function is disabled, i.e. **direct TCP access from one network card to another within a station is blocked**. A gateway function is only enabled via implementation of the protocols from one interface to another (ISO/OSI model Level-7) according to the configuration in setIT.

Recommendations and specifications

- Use of secure and **enclosed networks:**
  - Operating an information technology (IT) system in an open or inadequately closed network potentially allows attackers to access the network and enables spying, manipulation and sabotage.
- Using technology within **enclosed**, non-accessible **areas:**
  - Local, free access to rooms or cabinets during installation offers manipulation opportunities
- Do **not** use **switched telephone lines:**
  - According to the BDEW white paper, switched telephone lines represent an open access point and must be avoided.
- Use services only if the safety concept allows this, e.g.:
  - Web server use of https and user management recommended
  - USB Ethernet DHCP service enabled - assignment of an IP address on diagnostics laptop
- **Enabling FTPs/https secure services** for firmware update and web server:
  - Secure services encrypt the information sent and make access much more difficult.
- **Only allow firmware updates in secure networks and only with https/FTPs:**
  - The firmware update via FTP or UNIP (UDP) must be activated only in networks that are sufficiently secure, if possible without public access.
  - FTPs secures the data transport and prevents content and access information from being eavesdropped.
- Use the **series5e technology** if possible:
  - On the series5 platform, not all the safety features can be provided without affecting the overall concept, and with it the basic function of the system.
  - The series5+ technology has very good features and the new series5e permits additional security features (refer to **Fehler! Verweisquelle konnte nicht gefunden werden.** on Page **Fehler! Textmarke nicht definiert.**).
- Use **the latest update** if possible:
  - From version setIT V4.008, essential components were upgraded to a higher safety level according to the BDEW white paper safety concept.
  - Other features have been improved in setIT V5.000.
  - The role concept has been refined.
  - The system password is disabled by editable super admin.
  - New patches have been introduced and certificates renewed.
  - Version V5.002 and higher also have IPsec with IKEv2.
  - Syslog, database encryption and firmware signature are provided in V5.003 and higher.

- **Enable user management** and set the roles to be as personal as possible:
  - Without user management and role allocation, the system is open and can be used in the same way by everyone
  - Without user management, no user-dependent activity logging is possible
  - With impersonal group assignment it is not possible to track the actions of an individual user
  - Without user management, the web service is also available to all users in the same way using the default password
- Create users with **secure passwords:**
  - Secure passwords comprise a minimum of 8 characters (uppercase and lowercase letters) as well as embedded special characters.
  - The longer and more cryptic a password, the safer its classification.
- **Creation of a super admin** in user management:
  - If the super admin is not set up, the general system user remains active and allows access to the system using the default password.
- **Creation of the database password** in user management:
  - A database password for the .sdbx database format stores it in encrypted form. External accesses to project content are only possible with the database password.
- **Creation of the system password** in user management:
  - A new system password overwrites the default passwords used by SAE. The firmware download is protected by this password; loading by an external project is prevented.
- **Enable Sign firmware** in user management:
  - Updates to stations are then only possible with a signature. All updates from other sources are rejected.
- **Disable insecure services** and accesses such as FTP (firmware update), http (web server) by activating https/FTPs:
  - FTP and HTTP allow eavesdropping of information, and so access and manipulation possibilities can be disclosed this way.
  - The access to the system with UNIP/UDP listed under the "service" designation in the firewall can be monitored via a network connection. It should only be enabled on secure network connections over which an access of this kind is required.

- **Create system information with a relevant to security** for alerting and archiving, as proposed in the system messages wizard, such as:
  - Redundancy messages
  - Time server fault
  - Station fault detection
  - Data overflow interface
  - Interface fault detection
  - Card fault detection
  - Expansion slot fault detection
  - Time server fault detection
  - SD card fault
  - Archive faults and overflows
  - Command output interlock
  - Change control group indication
  - PLC software statuses
- **Use IP address verification** and record fixed IP addresses everywhere:
  - When checking is disabled and the IP address 0.0.0.0 is assigned, all connections are accepted and the origins of these connections cannot be checked.
- **Store** the setIT database and **project files securely**
  - Project databases must be securely protected against unauthorised access because they contain essential access information
- **Set up multi-level backups:**
  - A potential malfunction or incorrect operation may require a roll-back to an older version in order to maintain operations.

Requirements for the series5+/ series5e

- **Enable the firewall**
  - The firewall detects attack situations outside normal operation and can filter/disconnect ports on individual paths.
- **Set the firewall**
  - Limiting services to accesses actually being used limits the potential attack target
- Setup of **end-to-end encryption** VPN client
  - When public or inadequately protected paths are used, information can be read and manipulated
- For the series5+, limit if possible the bandwidth of data connections via networks with public access to 3 Mbit/s
  - This limitation will ensure that DOS attacks no longer have any significant sabotaging effect. Any load over this rate can lead to the system having to be restarted in extreme cases.

Remark: Although high performance of the devices, we recommend not to declare more than 8 VPN-tunnels using higher data throughput if possible, not to jeopardise the system stability.

Recommendation for active web servers

- **Setting of the session timeout** for enabled web servers
  - If the selected timeout session is too large or is disconnected, an open web session can be taken over by another service PC user without renewed legitimisation.
- **Enabling the https protocol**
  - Prevents access and values from being eavesdropped
- **Enabling the user profile with secure passwords**
  - Prevents unwanted access to the system
  - Regulates access and functions via role profiles/settings

Recommendation for active PLC programming

- When using the PLC programming with codeIT, access to the programming interface should be disconnected or activatable via a system command.
  - With the programming interface and access to the network are open, access to the programming level cannot be excluded.
  - With series5+ / series5e systems, access can be disabled individually if the firewall is enabled.

Delivery status

New stations from stock are usually cold-started and have no configuration. On customer demand, e.g. in preconfigured projects or works tests, configured stations can be supplied on request. A cold-started station can be identified by the (flashing) running light of the top four status LEDs - "run, com, I/O and data", and "run, com, sys and VPN" for the series5e.

Defaults values in delivery status

The "configuration-less" operation does not yet have any telecontrol communication relationship and is therefore not accessible via the protocols; it has no valid function and therefore has only a minimal attack target.

IP addresses after cold start

The Ethernet socket standard addresses are set to the following values:

1. Ethernet Controller X100	192.168.1.111/24
2. Ethernet controller X102	10.0.6.177/16 if available
3. Ethernet controller X400	192.168.178.1/24 if available CPU-D5B/D5C
3. Ethernet controller X101	192.168.179.1/24 if available from CPU-5C/D5C
4. Ethernet controller X103	192.168.180.1/24 if available from CPU-5C/D5C
5th Ethernet controller X105	192.168.181.1/24 if available from CPU-5C/D5C
6th Ethernet controller X107	192.168.182.1/24 if available from CPU-5C/D5C
USB device	192.168.59.81/29

Ports after a cold start

In this state, the station can be loaded via a firmware update from setIT via FTP. A station configuration can be used to disconnect any of these ports. After a valid configuration acquisition, the system starts at the defined safety level. The selected communication drivers and services are started, the function of the configured I/O cards is checked and the process modules are started.
The output state of commands and set points is from 0 = OFF. A current target state "refresh" must be set via the communication.

Passwords after a cold start

In the cold-started state, resetting all the memory enables default passwords which permit initial access to the system (FTP, web server). These passwords are overwritten automatically when the super admin authorisation concept is activated or are overwritten by FTPs and are no longer available after configuration. On the series5+ onwards, it is possible to enable your own system password. Passwords are managed with salted hashes since setIT 5.004.

Services (port list and function)

After a cold start, i.e. in delivery status, a station does not yet have a current configuration. The following ports are accessible as standard:

Port	Protocol	Comment
23	Telnet	Console with password request (series5 only)
20/21	FTP	Access with password request
80	http	Port only provides FTP download

Station configuration allows any port to be disabled or enabled by selecting/deselecting the function. In a complete project, the following ports can also be enabled:

Port	Protocol	Comment
102	IEC 61850	Access control for client IP possible
123	NTP	Client time synchronisation
161/162	SNMP/v3 UDP/Traps	SNMP status queries
443	https	Port only provides FTP/FTPs download
502	Modbus TCP	Access control for client IP possible
514/1470	Syslog UDP/TCP	series5+ from V5.3
1200	3S	Proprietary (3S) for connection to codeIT
1293	IPSec IKEv1	series5+ from V5.0
500/4500	IPsec IKEv2	series5+ from V5.2
2404	IEC 60870-5-104	Access control for client IP possible
5980	UNIP	Proprietary (SAE) for connection to setIT
7259	SML	UDP/TCP access control for client IP possible
8000	IEC 62051-21 overIP	Access control for client IP possible
40000/40001	FTPs	Access with password request

A further limitation of the ports on the respective network segments/sockets is possible via the firewall (from the series5+ technology).

The Telnet console via ports 23 and 992 is not accessible from series5+ systems. Like the disabled FTP service, it is blocked with an unknown, cryptic 19-byte password.

12 Appendix

series5/series5+/series5e system comparison

Function	series5	series5+	series5e
CPU	ARM9 ARM920T	ARM9 SAM9G45	Cortex A8 TI3552
MHz	180	400	800
MIPS	200	400	1200
RAM /MB	32	128/256	512
ROM /MB	64	128/256	512
SD card max.	1 GB	1 GB	1 GB/8 GB*6
Real-time clock buffer	SuperCap 5 days	Li-Ion 30 days	Li-Ion 60 days
Functions/drivers			
codeIT IEC61131-3	O	O	O
visIT *3.5	-	O	O
IEC 60870-5-101	•1	•1	•
IEC 60870-5-103	O	O	•
IEC 60870-5-104	•1	•1	•
IEC 61850 client *0	-	O	O
IEC 61850 server *4	-	-	O
IEC 62056-21	-	O	O
SYM²/SML	-	O	O
DNP3 *3	-	O	O
DSfG *0	-	O	O
Modbus RTU/TCP	•1	•1	•
3964r/RK512	•1	•1	•
Profibus-DP	O	O	O
NTP/DCF	•	•	•
Firewall	-	•	•
brute-force Firewall *4	-	-	•
http/FTP	•	•	•
https/FTPs/IPsec	-	•	•
SNMP *1	-	•	•
SNMPv3 *3.5	-	•	•
VPN IKEv1	-	•	•
VPN IKEv2 *3	-	•	•
SYSLOG *2	-	•	•

• = included in standard, •1 = standard from 2017, O = expansion/option/licence, - = not available
from: *0 setIT V5.0, *1 setIT V5.1, *3 setIT V5.3, *3.5 setIT V5.3.05, *3.7 setIT V5.3.07, *4 setIT V5.004, *6 setIT V6

Information on using relays

Assemblies with relay outputs have been written with their core values in the technical data of the assembly. In order to give clearly more information about the possible uses, but to avoid multiple nomination, we have compiled additional information.

Glossary - switching with relays

AgNi	silver nickel is the standard material under MSR applications with good powers under resistive and weakly-inductive loads for average and higher switch operations (typical 2 A @24 V DC, 2 A @250 v AC).
$AgSiO_2$	silver tin oxide is a good choice for high switch operations, especially in network voltage applications under larger start-up currents. They feature low material creep under DC loads, good burn-off resistance with very low tendency for welding failures.
AgNi+Au	silver nickel meshed with a layer of gold the special contact for very small power values in the region of a few mA. The contacts remain fresh for the lowest loads due to their corrosion resistance and negligible material loss under low currents. However: once switched at high load, the gold layer will burn off and the normal AgNi contact remains. This contact can no longer switch the low power values cleanly.
Switching capacity	The switching capacity of a relay assembly is for the most part determined by the relay contact, number, mechanics, and the material of the relays. The entire switching capacity can be limited by the terminals and connections on the PCB of the assembly. The endurance load is rarely the same as the maximum load of the relay but the thermal load capacity of the conductor paths. The maximum load on this root applies when using common terminals.
Making capacity	The make/operate procedure for the relay is not as critical under a greater FC load as the contact material is barely affected. During the rebounding of the contacts, a melting loss may also arise here due to arcing.
Breaking capability	Under the breaking capability (brake/reset), the contacts are separated using mechanical movement; light arcs arise which damage the material and which can lead to a material displacement and even a change to the shape of the contact. When using AC, these light arcs are erased by the phase change. Under high DC load, considerable damage to the contact may arise, this may result in the minimization of the life of the contact to contact adhesives. The switching capacity is also dependent on the switching voltage; this non-linear switching curve is specified in the relay data in separate graphs, e.g. as ‘max. load breaking capacity’. These values usually relate to purely resistive loads unless indicated otherwise.
Resistive loads	do not have a phase displacement and no pulse-like side effects through asymmetric load displacement.
Inductive loads	such as engines and coils generate a high back voltage during the switching operation and an increasing phase displacement with the L/R factor. These counter-voltages are often limited by protective circuitry. These extend the break process however.
max. switching voltage	As well as the max. switching voltage of the relay, the maximum switchable voltage is specified by the switching voltage of the assembly. These response values of these switching operations are usually much smaller than the relay data and are therefore important for the field of application. Depending on the version, protection circuits can delay the breaking procedure.
Life	The life of a relay is often only specified as a mechanical life in switching cycles without load. Since the life of the contacts strongly depends on the switching capacity (voltage, current, L/R factor), the expected duration in the field of application can usually be read from separate graphs.

Technical data for relays

APF	monostable NO contact used on **FW-5, FW-5-230, 8DO, RES-1,DSO-1,DSO-2**
Contacts *	Contact AgNi
Switching voltage *	250 V AC, max. 300 V DC, max. 400 V AC
Making capacity	6.0 A, min. 100 mA > 5 V DC
Steady-state current *	6.0 A AC
Breaking capability	1500 VA, resistiv: 6,0 A @24 V DC/ 0,4 A @60 V DC / 0,2 A @110 V DC/ 0,17 A @220 V DC induktiv: 2 A @ 24 V DC, 3 A @ 250 V AC
Switching times ON/OFF	8 ms / 4 ms
switching cycles	> 5*106 mechanical EN 60947-5-1: 6000 under 24 V DC, 2 A, 25° C
Switching frequency	72000 h-1 without load /360 h-1 with load
Isolation	6000 V surge contact/coils, 4000 V rms 1 min
Safety *	EN IEC 61810-1: 8A 250 V AC (cosφ = 1) 25° C N.O. side / 6 A 250 V AC (cosφ = 1) 85° C UL508/ UL1604: 6A 24 V DC, general use B300, R300 (Pilot duty)
Environment *	- 40° + 85°C

* All information relate to the relay- the assembly data are important

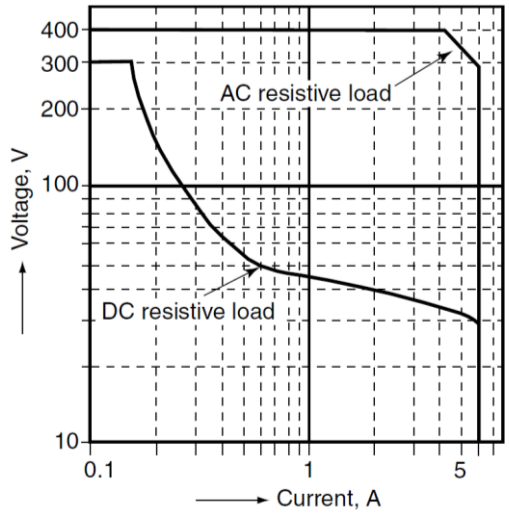


Figure 43: Switching capacity APF 30224
Source: Panasonic APF

G6RN	monostabile Schließer eingesetzt auf 16RA-1, OERA-5, AOERA-1
Kontakte *	1 Kontakte AgAlloy+Au 0,35µ
Schaltspannung *	250 V AC, max. 30 V DC, max. 400 V AC
Einschaltvermögen *	8,0 A AC, 5 A DC min 10 mA > 5 V DC
Dauerstrom *	8,0 A
Ausschaltvermögen	2000 VA, 150 W 8,0 A @250 V AC/ 5,0 A @30 V DC
Schaltzeiten EIN/AUS	15 ms typ. 6 ms / 5 ms typ. 3 ms
Schaltspiele	> $10*10^6$ mechanisch $50*10^3$ max. Last, typ. $100*10^3$
Schaltfrequenz	36000 h^{-1} ohne Last/ 360 h^{-1} mit Last
Isolation	10000 V surge 1,2 * 50 µs 4000 V AC Kontakt/Spule 1 min, > 8 mm 1000 V AC Kontakt/Kontakt 1 min, >3 mm
Sicherheit *	Schutzklasse II gem. VDE 0106 Part 1 Isolationsklasse C/250, B/360 gem. VDE 0110
Umgebung	- 40° + 85°C

* Alle Angaben beziehen sich auf das Relais, maßgeblich sind die Daten der Baugruppe

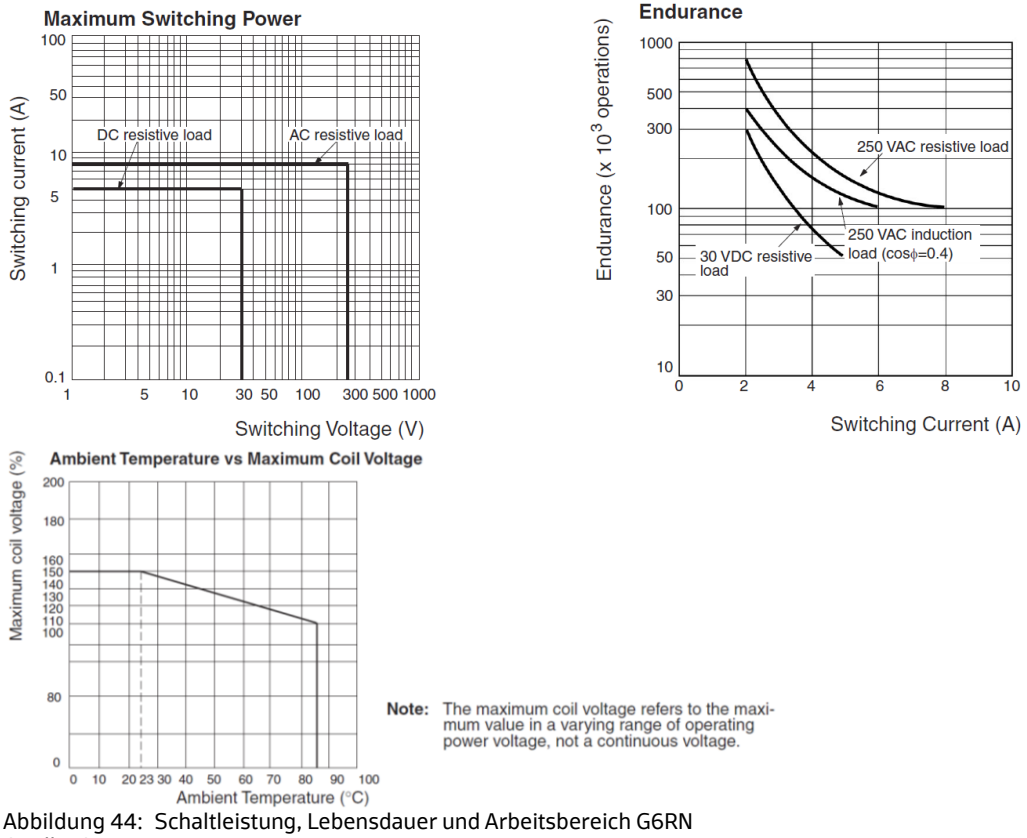


Abbildung 44: Schaltleistung, Lebensdauer und Arbeitsbereich G6RN
Quelle: Omron

AZ696	monostabile Schließer eingesetzt auf alten 16RA-1, OERA-1,AOERA-1
Kontakte *	1 Kontakte AgCdO
Schaltspannung *	440 V AC, max. 240 V DC
Einschaltvermögen *	10 A @250 V AC, 10 A @30 V DC resisitiv UL B300 min 10 W
Dauerstrom *	10 A
Ausschaltvermögen	2500 VA, 300 W
Schaltzeiten EIN/AUS	typ. 10 ms / typ. 5 ms
Schaltspiele	> $10*10^6$ mechanisch $10*10^3$ 10 A @250 V AC, resisitiv, 85° C VDE
Schaltfrequenz	max. 10 min^{-1} mit Last
Isolation	4000 V eff Kontakt/Spule > 8 mm 1000 V eff Kontakt/Kontakt C250, Überspannungskategorie III, Verschmutzungsgrad 3
Zulassungen *	VDE 0435, 0631, 0700UL E 44211, CSA LR 85 091 IP67
Umgebung	- 40° + 85°C

* Alle Angaben beziehen sich auf das Relais, maßgeblich sind die Daten der Baugruppe

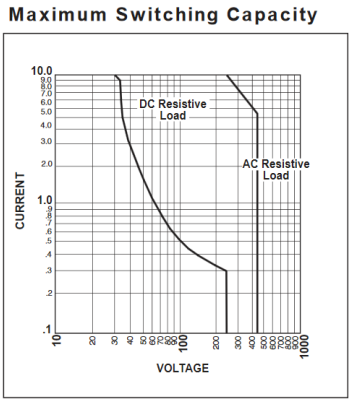
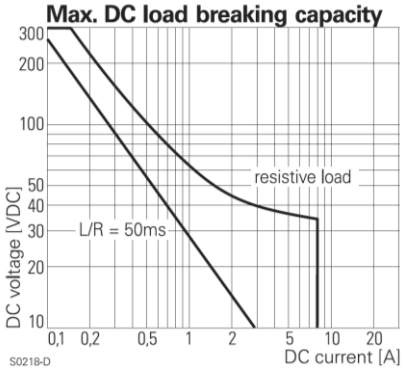
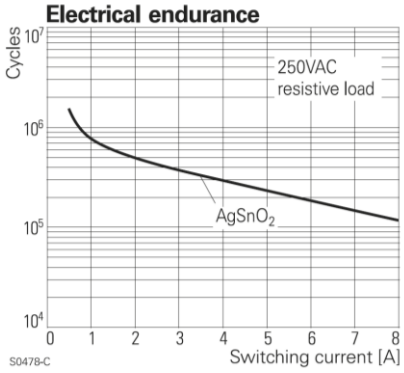


Abbildung 45: Schaltleistung, Lebensdauer und Arbeitsbereich AZ696
Quelle: Zettler

MSR V23061	monostabile Schließer eingesetzt auf 12RA-1
Kontakte *	Kontakt AgNi
Schaltspannung *	250 V AC, max. 300 V DC, max. 400 V AC
Einschaltvermögen	6,0 A, min. 100 mA > 5 V DC
Dauerstrom *	6,0 A AC
Ausschaltvermögen	1500 VA, 6,0 A @24 V DC/ 0,4 A @60 V DC / 0,2 A @110 V DC/ 0,17 A @220 V DC
Schaltzeiten EIN/AUS	8 ms / 4 ms
Schaltspiele	> 5*10^6 mechanisch EN 60947-5-1: 6000 bei 24 V DC, 2 A, 25° C
Schaltfrequenz	72000 h^{-1} ohne Last /360 h^{-1} mit Last
Isolation	6000 V surge Kontakt/Spule , 4000 V rms 1 min
Sicherheit *	EN IEC 61810-1: 8A 250 V AC (cosφ = 1) 25° C N.O. side / 6 A 250 V AC (cosφ = 1) 85° C UL508/ UL1604: 6A 24 V DC, general use B300, R300 (Pilot duty)
Umgebung *	- 40° + 85°C

* Alle Angaben beziehen sich auf das Relais, maßgeblich sind die Daten der Baugruppe





Figures

Literature

[1] **Online Help / Manual for setIT**, SAE IT-systems GmbH & Co. KG, 2018

[2] **Interoperability-IEC60870-5-101**; SAE IT-systems GmbH & Co. KG; 2016

[3] **Interoperability-IEC60870-5-104**; SAE IT-systems GmbH & Co. KG; 2016

[4] **IEC61850 Conformance Statements ACSI-PIXIT-PICS-TICS**; SAE IT-systems GmbH & Co. KG; 2015

[5] **Service overview net-line & setIT**; SAE IT-systems GmbH & Co. KG; 2018

[6] **codeIT Manual** V 2.3, SAE IT-systems GmbH & Co. KG, 2015

[7] **Integration and Update codeIT**, SAE IT-systems GmbH & Co. KG, 2010

[8] **codeIT Library**, SAE IT-systems GmbH & Co. KG, 2005

[9] **Checkliste IT-Security**; SAE IT-systems GmbH & Co. KG; 2017

History

09.11.18 Translation from German manual

Incomplete amendments

none

Terms of use for the tools

PLEASE READ THIS INFORMATION BEFORE YOU INSTALL THE SOFTWARE - the information represents the contractual conditions for the installation and use of the software between SAE IT-systems GmbH & Co. KG (SAE) and yourself as end user (licensee). If you do not agree, please contact us and do not install. TRANSFER OR RESALE OF THE SOFTWARE OUTSIDE THE SELECTED LICENSE MODEL IS NOT PERMITTED WITHOUT WRITTEN AUTHORISATION FROM SAE IT-systems.

Dear Sirs,
The program version that you have contains the latest features and entry screens created by our development team. Without any additional registration, it is a 30 day fully featured trial for evaluation purposes. After this period it has to be registered by entering a valid licence key, otherwise it will not boot. Please note that you may not start to operate a PROJECT OR OPERATE IT OUTSIDE THE TEST PHASE WITHOUT SPECIAL AUTHORITY WHEN USING A DEMO INSTALLATION. We would be pleased to issue a demo extended licence to extend the test phase on request. You have no claims on functioning, warranty or other liabilities during the test phase.
Installation
The right to use the software is granted to you when the licence key is issued.
BY INSTALLING THE SOFTWARE, YOU AGREE TO BE BOUND TO OUR TERMS OF USE.
The installation tool will support you during the installation process. It will perform the essential system checks and supports the installation of add-ons for proper operation. Follow the installation instructions - we advise you to accept the default settings. If necessary, the installation tool will also help you to de-install the software completely.

If the version number includes a ß, then the software a beta release. It has already undergone extensive testing and exhibited no variations. However, it is still in the validation phase and has therefore not been finally released. If you notice any misbehaviour of the program, we would be pleased to hear from you so that we can make the program package even more stable and user-friendly. However, we are unfortunately unable to assume liability for any failures or damage arising from this beta release and its use.

Technical information subject to modification without notice. The software is not allowed to be extracted or modified. We draw your attention to the fact that, although high-level state of the art programming, it is almost impossible to create an accurate software without any malfunctions to cover all cases of operation and combination. The subject is therefore only a software which is generally usable in the sense of program description and instructions.

Projects created with the software provided are subject to the copyright, liability and warranty of the licensee.

If single parts of conditions conflict with national laws, or are specially regulated, the remainder of the conditions remain unchanged. The general principle is acting in the interest of the customer and, by means of the software, providing functions and properties that can be implemented and marketed with reasonable commercial means.

Your SAE IT-systems GmbH & Co. KG

License models

Registration with a licence is required to use the tools. The creation of projects might incur additional run-time licences for every functional unit in the target systems.

Single user licence (SUL)

This is a single user license (). A single-user-licence, released by a licence key, authorizes only one simultaneous usage. Installation may only be carried out once on one single workplace. Installing it on a laptop or notebook at the same time is only permitted under the proviso that the two installations are not used simultaneously. A demo installation without registration is always a SUL professional for 30 days duration. It may be installed and used freely within the limitation period. Copying and forwarding the program to third parties is explicitly requested, but is permitted only in accordance with the interests of SAE IT-systems and when the appropriate copyrights are observed.

Multiple user licence (MUL)

The multiple user license () authorises simultaneous usage by number of workplaces/copies (N) authorised by the purchase. Here, installation on other computers, laptops or notebooks is only allowed providing this does not cause the number of installations to exceed N. Licensing is by means of a shared key, generally issued to the company name / workgroup of the end user.
A grant of a multi-user-licence is based on mutual trust. When the software is used on a shared network, the licence tool checks for simultaneous usage N times.

Company user licence (CUL)

The company user licence (CUL) allows free, unlimited use of the tools within a specific company (legal entity). The tools may be copied, installed and used as often as needed. Installation or usage in consolidated companies or a holding is allowed only by a special contract or written agreement between SAE IT-systems and the licensee. Licensing is by means of a shared key, generally issued to the company name / workgroup of the end user.
The price of a company user licence is subject to negotiation because a fair cost/benefit ratio is always the aim. The CUL is supplemented with a 12-month maintenance agreement. The costs for the first 12-month of this service are covered by the CUL professional licence fee.

Update / upgrade

The updating of licensed software within the third version number group (e.g. V 5.01.xxx) is free of charge. It is always possible to swap a licence for another licence model (upgrade) or to switch to a higher version (update) by reaching an agreement and paying the surcharge. The licence key is retained in the event of an update within the version number (first digit). An upgrade or jump in the first version number requires a new licence key on the basis of the licence exchange. By installing an update, you voluntarily relinquish the previous licence and return it with all rights. Handling is the same as in the case of a new delivery.

Return of a licence

A wholly or partly return of a licence (downgrading) may only be granted by a special agreement with SAE IT-systems. The licensee has to assure in written form, neither having installed the purchased features nor using them anymore. There can be no return if any of the named functions or installations is still in operation.

Exclusion of liability

SAE IT-systems assumes no liability for indirect or consequential damage (including the loss of business or profit) and excludes any other contractual or non-contractual liability for whatever legal reason. This is covered even if SAE IT-systems or their representatives were informed about the potential occurrence of a loss or if fault elimination was not carried out successfully. This disclaimer is invalid if the loss was intentionally induced by SAE IT-systems or its executive staff, or may be replaced by Product Liability Act. It would be impossible for SAE IT-systems to viably sell the software without these restrictions. Place of jurisdiction is Cologne, Germany.

OpenSource-Lizenzen

Firmware mit Open-Source openBSD/GPL/LGPL
Die Firmware enthält open source code gemäß der openBSD/GPL/LGPL Lizenzen. Bei Bedarf stellen wir Ihnen den Sourcecode gemäß der Sektionen Section 3b of GPL und Section 6b of LGPL zur Verfügung. Dieser kann aus unserem Servicecenter geladen werden https://www.sae-it.com/Servicecenter.html. Alternativ senden wir Ihnen eine CD zu; senden Sie hierzu bitte eine Mail an marketing@sae-it.de.

openBSD/BSD

Quelle/Source: https://www.openbsd.org/policy.html

GPL2

GNU GENERAL PUBLIC LICENSE
Version 2, June 1991

Preamble

The licenses for most software are designed to take away your freedom to share and change it. By contrast, the GNU General Public License is intended to guarantee your freedom to share and change free software--to make sure the software is free for all its users. This General Public License applies to most of the Free Software Foundation's software and to any other program whose authors commit to using it. (Some other Free Software Foundation software is covered by the GNU Lesser General Public License instead.) You can apply it to your programs, too.

When we speak of free software, we are referring to freedom, not price. Our General Public Licenses are designed to make sure that you have the freedom to distribute copies of free software (and charge for this service if you wish), that you receive source code or can get it if you want it, that you can change the software or use pieces of it in new free programs; and that you know you can do these things.

To protect your rights, we need to make restrictions that forbid anyone to deny you these rights or to ask you to surrender the rights. These restrictions translate to certain responsibilities for you if you distribute copies of the software, or if you modify it.

For example, if you distribute copies of such a program, whether gratis or for a fee, you must give the recipients all the rights that you have. You must make sure that they, too, receive or can get the source code. And you must show them these terms so they know their rights.

We protect your rights with two steps: (1) copyright the software, and (2) offer you this license which gives you legal permission to copy, distribute and/or modify the software.

Also, for each author's protection and ours, we want to make certain that everyone understands that there is no warranty for this free software. If the software is modified by someone else and passed on, we want its recipients to know that what they have is not the original, so that any problems introduced by others will not reflect on the original authors' reputations.

Finally, any free program is threatened constantly by software patents. We wish to avoid the danger that redistributors of a free program will individually obtain patent licenses, in effect making the program proprietary. To prevent this, we have made it clear that any patent must be licensed for everyone's free use or not licensed at all.

The precise terms and conditions for copying, distribution and modification follow.

TERMS AND CONDITIONS FOR COPYING, DISTRIBUTION AND MODIFICATION

0. This License applies to any program or other work which contains a notice placed by the copyright holder saying it may be distributed under the terms of this General Public License. The "Program", below, refers to any such program or work, and a "work based on the Program" means either the Program or any derivative work under copyright law: that is to say, a work containing the Program or a portion of it, either verbatim or with modifications and/or translated into another language. (Hereinafter, translation is included without limitation in the term "modification".) Each licensee is addressed as "you".

Activities other than copying, distribution and modification are not covered by this License; they are outside its scope. The act of running the Program is not restricted, and the output from the Program is covered only if its contents constitute a work based on the Program (independent of having been made by running the Program). Whether that is true depends on what the Program does.

1. You may copy and distribute verbatim copies of the Program's source code as you receive it, in any medium, provided that you conspicuously and appropriately publish on each copy an appropriate copyright notice and disclaimer of warranty; keep intact all the notices that refer to this License and to the absence of any warranty; and give any other recipients of the Program a copy of this License along with the Program.

You may charge a fee for the physical act of transferring a copy, and you may at your option offer warranty protection in exchange for a fee.

2. You may modify your copy or copies of the Program or any portion of it, thus forming a work based on the Program, and copy and distribute such modifications or work under the terms of Section 1 above, provided that you also meet all of these conditions:

a) You must cause the modified files to carry prominent notices stating that you changed the files and the date of any change.

b) You must cause any work that you distribute or publish, that in whole or in part contains or is derived from the Program or any part thereof, to be licensed as a whole at no charge to all third parties under the terms of this License.

c) If the modified program normally reads commands interactively when run, you must cause it, when started running for such interactive use in the most ordinary way, to print or display an announcement including an appropriate copyright notice and a notice that there is no warranty (or else, saying that you provide a warranty) and that users may redistribute the program under these conditions, and telling the user how to view a copy of this License. (Exception: if the Program itself is interactive but does not normally print such an announcement, your work based on the Program is not required to print an announcement.)

These requirements apply to the modified work as a whole. If identifiable sections of that work are not derived from the Program, and can be reasonably considered independent and separate works in themselves, then this License, and its terms, do not apply to those sections when you distribute them as separate works. But when you distribute the same sections as part of a whole which is a work based on the Program, the distribution of the whole must be on the terms of this License, whose permissions for other licensees extend to the entire whole, and thus to each and every part regardless of who wrote it.
Thus, it is not the intent of this section to claim rights or contest your rights to work written entirely by you; rather, the intent is to exercise the right to control the distribution of derivative or collective works based on the Program.
In addition, mere aggregation of another work not based on the Program with the Program (or with a work based on the Program) on a volume of a storage or distribution medium does not bring the other work under the scope of this License.
3. You may copy and distribute the Program (or a work based on it, under Section 2) in object code or executable form under the terms of Sections 1 and 2 above provided that you also do one of the following:

a) Accompany it with the complete corresponding machine-readable source code, which must be distributed under the terms of Sections 1 and 2 above on a medium customarily used for software interchange; or,

b) Accompany it with a written offer, valid for at least three years, to give any third party, for a charge no more than your cost of physically performing source distribution, a complete machine-readable copy of the corresponding source code, to be distributed under the terms of Sections 1 and 2 above on a medium customarily used for software interchange; or,

c) Accompany it with the information you received as to the offer to distribute corresponding source code. (This alternative is allowed only for noncommercial distribution and only if you received the program in object code or executable form with such an offer, in accord with Subsection b above.)
The source code for a work means the preferred form of the work for making modifications to it. For an executable work, complete source code means all the source code for all modules it contains, plus any associated interface definition files, plus the scripts used to control compilation and installation of the executable. However, as a special exception, the source code distributed need not include anything that is normally distributed (in either source or binary form) with the major components (compiler, kernel, and so on) of the operating system on which the executable runs, unless that component itself accompanies the executable.
If distribution of executable or object code is made by offering access to copy from a designated place, then offering equivalent access to copy the source code from the same place counts as distribution of the source code, even though third parties are not compelled to copy the source along with the object code.
4. You may not copy, modify, sublicense, or distribute the Program except as expressly provided under this License. Any attempt otherwise to copy, modify, sublicense or distribute the Program is void, and will automatically terminate your rights under this License. However, parties who have received copies, or rights, from you under this License will not have their licenses terminated so long as such parties remain in full compliance.
5. You are not required to accept this License, since you have not signed it. However, nothing else grants you permission to modify or distribute the Program or its derivative works. These actions are prohibited by law if you do not accept this License. Therefore, by modifying or distributing the Program (or any work based on the Program), you indicate your acceptance of this License to do so, and all its terms and conditions for copying, distributing or modifying the Program or works based on it.
6. Each time you redistribute the Program (or any work based on the Program), the recipient automatically receives a license from the original licensor to copy, distribute or modify the Program subject to these terms and conditions. You may not impose any further restrictions on the recipients' exercise of the rights granted herein. You are not responsible for enforcing compliance by third parties to this License.
7. If, as a consequence of a court judgment or allegation of patent infringement or for any other reason (not limited to patent issues), conditions are imposed on you (whether by court order, agreement or otherwise) that contradict the conditions of this License, they do not excuse you from the conditions of this License. If you cannot distribute so as to satisfy simultaneously your obligations under this License and any other pertinent obligations, then as a consequence you may not distribute the Program at all. For example, if a patent license would not permit royalty-free redistribution of the Program by all those who receive copies directly or indirectly through you, then the only way you could satisfy both it and this License would be to refrain entirely from distribution of the Program.
If any portion of this section is held invalid or unenforceable under any particular circumstance, the balance of the section is intended to apply and the section as a whole is intended to apply in other circumstances.
It is not the purpose of this section to induce you to infringe any patents or other property right claims or to contest validity of any such claims; this section has the sole purpose of protecting the integrity of the free software distribution system, which is implemented by public license practices. Many people have made generous contributions to the wide range of software distributed through that system in reliance on consistent application of that system; it is up to the author/donor to decide if he or she is willing to distribute software through any other system and a licensee cannot impose that choice.
This section is intended to make thoroughly clear what is believed to be a consequence of the rest of this License.
8. If the distribution and/or use of the Program is restricted in certain countries either by patents or by copyrighted interfaces, the original copyright holder who places the Program under this License may add an explicit geographical distribution limitation excluding those countries, so that distribution is permitted only in or among countries not thus excluded. In such case, this License incorporates the limitation as if written in the body of this License.
9. The Free Software Foundation may publish revised and/or new versions of the General Public License from time to time. Such new versions will be similar in spirit to the present version, but may differ in detail to address new problems or concerns.
Each version is given a distinguishing version number. If the Program specifies a version number of this License which applies to it and "any later version", you have the option of following the terms and conditions either of that version or of any later version published by the Free Software Foundation. If the Program does not specify a version number of this License, you may choose any version ever published by the Free Software Foundation.

10. If you wish to incorporate parts of the Program into other free programs whose distribution conditions are different, write to the author to ask for permission. For software which is copyrighted by the Free Software Foundation, write to the

Free Software Foundation; we sometimes make exceptions for this. Our decision will be guided by the two goals of preserving the free status of all derivatives of our free software and of promoting the sharing and reuse of software generally.

NO WARRANTY

11. BECAUSE THE PROGRAM IS LICENSED FREE OF CHARGE, THERE IS NO WARRANTY FOR THE PROGRAM, TO THE EXTENT PERMITTED BY APPLICABLE LAW. EXCEPT WHEN OTHERWISE STATED IN WRITING THE COPYRIGHT HOLDERS AND/OR OTHER PARTIES PROVIDE THE PROGRAM "AS IS" WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. THE ENTIRE RISK AS TO THE QUALITY AND PERFORMANCE OF THE PROGRAM IS WITH YOU. SHOULD THE PROGRAM PROVE DEFECTIVE, YOU ASSUME THE COST OF ALL NECESSARY SERVICING, REPAIR OR CORRECTION.

12. IN NO EVENT UNLESS REQUIRED BY APPLICABLE LAW OR AGREED TO IN WRITING WILL ANY COPYRIGHT HOLDER, OR ANY OTHER PARTY WHO MAY MODIFY AND/OR REDISTRIBUTE THE PROGRAM AS PERMITTED ABOVE, BE LIABLE TO YOU FOR DAMAGES, INCLUDING ANY GENERAL, SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF THE USE OR INABILITY TO USE THE PROGRAM (INCLUDING BUT NOT LIMITED TO LOSS OF DATA OR DATA BEING RENDERED INACCURATE OR LOSSES SUSTAINED BY YOU OR THIRD PARTIES OR A FAILURE OF THE PROGRAM TO OPERATE WITH ANY OTHER PROGRAMS), EVEN IF SUCH HOLDER OR OTHER PARTY HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

END OF TERMS AND CONDITIONS

Source/Quelle: http://www.gnu.org/licenses/old-licenses/gpl-2.0.html

GPL3

GNU GENERAL PUBLIC LICENSE
Version 3, 29 June 2007

Preamble
The GNU General Public License is a free, copyleft license for software and other kinds of works.
The licenses for most software and other practical works are designed to take away your freedom to share and change the works. By contrast, the GNU General Public License is intended to guarantee your freedom to share and change all versions of a program--to make sure it remains free software for all its users. We, the Free Software Foundation, use the GNU General Public License for most of our software; it applies also to any other work released this way by its authors. You can apply it to your programs, too.
When we speak of free software, we are referring to freedom, not price. Our General Public Licenses are designed to make sure that you have the freedom to distribute copies of free software (and charge for them if you wish), that you receive source code or can get it if you want it, that you can change the software or use pieces of it in new free programs, and that you know you can do these things.
To protect your rights, we need to prevent others from denying you these rights or asking you to surrender the rights. Therefore, you have certain responsibilities if you distribute copies of the software, or if you modify it: responsibilities to respect the freedom of others.
For example, if you distribute copies of such a program, whether gratis or for a fee, you must pass on to the recipients the same freedoms that you received. You must make sure that they, too, receive or can get the source code. And you must show them these terms so they know their rights.
Developers that use the GNU GPL protect your rights with two steps: (1) assert copyright on the software, and (2) offer you this License giving you legal permission to copy, distribute and/or modify it.
For the developers' and authors' protection, the GPL clearly explains that there is no warranty for this free software. For both users' and authors' sake, the GPL requires that modified versions be marked as changed, so that their problems will not be attributed erroneously to authors of previous versions.
Some devices are designed to deny users access to install or run modified versions of the software inside them, although the manufacturer can do so. This is fundamentally incompatible with the aim of protecting users' freedom to change the software. The systematic pattern of such abuse occurs in the area of products for individuals to use, which is precisely where it is most unacceptable. Therefore, we have designed this version of the GPL to prohibit the practice for those products. If such problems arise substantially in other domains, we stand ready to extend this provision to those domains in future versions of the GPL, as needed to protect the freedom of users.
Finally, every program is threatened constantly by software patents. States should not allow patents to restrict development and use of software on general-purpose computers, but in those that do, we wish to avoid the special danger that patents applied to a free program could make it effectively proprietary. To prevent this, the GPL assures that patents cannot be used to render the program non-free.
The precise terms and conditions for copying, distribution and modification follow.
TERMS AND CONDITIONS
0. Definitions.
“This License” refers to version 3 of the GNU General Public License.
“Copyright” also means copyright-like laws that apply to other kinds of works, such as semiconductor masks.
“The Program” refers to any copyrightable work licensed under this License. Each licensee is addressed as “you”.
“Licensees” and “recipients” may be individuals or organizations.
To “modify” a work means to copy from or adapt all or part of the work in a fashion requiring copyright permission, other than the making of an exact copy. The resulting work is called a “modified version” of the earlier work or a work “based on” the earlier work.
A “covered work” means either the unmodified Program or a work based on the Program.
To “propagate” a work means to do anything with it that, without permission, would make you directly or secondarily liable for infringement under applicable copyright law, except executing it on a computer or modifying a private copy. Propagation includes copying, distribution (with or without modification), making available to the public, and in some countries other activities as well.
To “convey” a work means any kind of propagation that enables other parties to make or receive copies. Mere interaction with a user through a computer network, with no transfer of a copy, is not conveying.
An interactive user interface displays “Appropriate Legal Notices” to the extent that it includes a convenient and prominently visible feature that (1) displays an appropriate copyright notice, and (2) tells the user that there is no warranty for the work (except to the extent that warranties are provided), that licensees may convey the work under this License, and how to view a copy of this License. If the interface presents a list of user commands or options, such as a menu, a prominent item in the list meets this criterion.
1. Source Code.
The “source code” for a work means the preferred form of the work for making modifications to it. “Object code” means any non-source form of a work.
A “Standard Interface” means an interface that either is an official standard defined by a recognized standards body, or, in the case of interfaces specified for a particular programming language, one that is widely used among developers working in that language.
The “System Libraries” of an executable work include anything, other than the work as a whole, that (a) is included in the normal form of packaging a Major Component, but which is not part of that Major Component, and (b) serves only to enable use of the work with that Major Component, or to implement a Standard Interface for which an implementation is available to the public in source code form. A “Major Component”, in this context, means a major essential component (kernel, window system, and so on) of the specific operating system (if any) on which the executable work runs, or a compiler used to produce the work, or an object code interpreter used to run it.

The “Corresponding Source” for a work in object code form means all the source code needed to generate, install, and (for an executable work) run the object code and to modify the work, including scripts to control those activities. However, it does not include the work's System Libraries, or general-purpose tools or generally available free programs which are used unmodified in performing those activities but which are not part of the work. For example, Corresponding Source includes interface definition files associated with source files for the work, and the source code for shared libraries and dynamically linked subprograms that the work is specifically designed to require, such as by intimate data communication or control flow between those subprograms and other parts of the work.
The Corresponding Source need not include anything that users can regenerate automatically from other parts of the Corresponding Source.
The Corresponding Source for a work in source code form is that same work.

2. Basic Permissions.

All rights granted under this License are granted for the term of copyright on the Program, and are irrevocable provided the stated conditions are met. This License explicitly affirms your unlimited permission to run the unmodified Program. The output from running a covered work is covered by this License only if the output, given its content, constitutes a covered work. This License acknowledges your rights of fair use or other equivalent, as provided by copyright law.
You may make, run and propagate covered works that you do not convey, without conditions so long as your license otherwise remains in force. You may convey covered works to others for the sole purpose of having them make modifications exclusively for you, or provide you with facilities for running those works, provided that you comply with the terms of this License in conveying all material for which you do not control copyright. Those thus making or running the covered works for you must do so exclusively on your behalf, under your direction and control, on terms that prohibit them from making any copies of your copyrighted material outside their relationship with you.
Conveying under any other circumstances is permitted solely under the conditions stated below. Sublicensing is not allowed; section 10 makes it unnecessary.

3. Protecting Users' Legal Rights From Anti-Circumvention Law.

No covered work shall be deemed part of an effective technological measure under any applicable law fulfilling obligations under article 11 of the WIPO copyright treaty adopted on 20 December 1996, or similar laws prohibiting or restricting circumvention of such measures.
When you convey a covered work, you waive any legal power to forbid circumvention of technological measures to the extent such circumvention is effected by exercising rights under this License with respect to the covered work, and you disclaim any intention to limit operation or modification of the work as a means of enforcing, against the work's users, your or third parties' legal rights to forbid circumvention of technological measures.

4. Conveying Verbatim Copies.

You may convey verbatim copies of the Program's source code as you receive it, in any medium, provided that you conspicuously and appropriately publish on each copy an appropriate copyright notice; keep intact all notices stating that this License and any non-permissive terms added in accord with section 7 apply to the code; keep intact all notices of the absence of any warranty; and give all recipients a copy of this License along with the Program.
You may charge any price or no price for each copy that you convey, and you may offer support or warranty protection for a fee.

5. Conveying Modified Source Versions.

You may convey a work based on the Program, or the modifications to produce it from the Program, in the form of source code under the terms of section 4, provided that you also meet all of these conditions:

- a) The work must carry prominent notices stating that you modified it, and giving a relevant date.
- b) The work must carry prominent notices stating that it is released under this License and any conditions added under section 7. This requirement modifies the requirement in section 4 to “keep intact all notices”.
- c) You must license the entire work, as a whole, under this License to anyone who comes into possession of a copy. This License will therefore apply, along with any applicable section 7 additional terms, to the whole of the work, and all its parts, regardless of how they are packaged. This License gives no permission to license the work in any other way, but it does not invalidate such permission if you have separately received it.
- d) If the work has interactive user interfaces, each must display Appropriate Legal Notices; however, if the Program has interactive interfaces that do not display Appropriate Legal Notices, your work need not make them do so.

A compilation of a covered work with other separate and independent works, which are not by their nature extensions of the covered work, and which are not combined with it such as to form a larger program, in or on a volume of a storage or distribution medium, is called an “aggregate” if the compilation and its resulting copyright are not used to limit the access or legal rights of the compilation's users beyond what the individual works permit. Inclusion of a covered work in an aggregate does not cause this License to apply to the other parts of the aggregate.

6. Conveying Non-Source Forms.

You may convey a covered work in object code form under the terms of sections 4 and 5, provided that you also convey the machine-readable Corresponding Source under the terms of this License, in one of these ways:

- a) Convey the object code in, or embodied in, a physical product (including a physical distribution medium), accompanied by the Corresponding Source fixed on a durable physical medium customarily used for software interchange.
- b) Convey the object code in, or embodied in, a physical product (including a physical distribution medium), accompanied by a written offer, valid for at least three years and valid for as long as you offer spare parts or customer support for that product model, to give anyone who possesses the object code either (1) a copy of the Corresponding Source for all the software in the product that is covered by this License, on a durable physical medium customarily used for software interchange, for a price no more than your reasonable cost of physically performing this conveying of source, or (2) access to copy the Corresponding Source from a network server at no charge.
- c) Convey individual copies of the object code with a copy of the written offer to provide the Corresponding Source. This alternative is allowed only occasionally and noncommercially, and only if you received the object code with such an offer, in accord with subsection 6b.

- d) Convey the object code by offering access from a designated place (gratis or for a charge), and offer equivalent access to the Corresponding Source in the same way through the same place at no further charge. You need not require recipients to copy the Corresponding Source along with the object code. If the place to copy the object code is a network server, the Corresponding Source may be on a different server (operated by you or a third party) that supports equivalent copying facilities, provided you maintain clear directions next to the object code saying where to find the Corresponding Source. Regardless of what server hosts the Corresponding Source, you remain obligated to ensure that it is available for as long as needed to satisfy these requirements.
- e) Convey the object code using peer-to-peer transmission, provided you inform other peers where the object code and Corresponding Source of the work are being offered to the general public at no charge under subsection 6d.

A separable portion of the object code, whose source code is excluded from the Corresponding Source as a System Library, need not be included in conveying the object code work.
A "User Product" is either (1) a "consumer product", which means any tangible personal property which is normally used for personal, family, or household purposes, or (2) anything designed or sold for incorporation into a dwelling. In determining whether a product is a consumer product, doubtful cases shall be resolved in favor of coverage. For a particular product received by a particular user, "normally used" refers to a typical or common use of that class of product, regardless of the status of the particular user or of the way in which the particular user actually uses, or expects or is expected to use, the product. A product is a consumer product regardless of whether the product has substantial commercial, industrial or non-consumer uses, unless such uses represent the only significant mode of use of the product.
"Installation Information" for a User Product means any methods, procedures, authorization keys, or other information required to install and execute modified versions of a covered work in that User Product from a modified version of its Corresponding Source. The information must suffice to ensure that the continued functioning of the modified object code is in no case prevented or interfered with solely because modification has been made.
If you convey an object code work under this section in, or with, or specifically for use in, a User Product, and the conveying occurs as part of a transaction in which the right of possession and use of the User Product is transferred to the recipient in perpetuity or for a fixed term (regardless of how the transaction is characterized), the Corresponding Source conveyed under this section must be accompanied by the Installation Information. But this requirement does not apply if neither you nor any third party retains the ability to install modified object code on the User Product (for example, the work has been installed in ROM).
The requirement to provide Installation Information does not include a requirement to continue to provide support service, warranty, or updates for a work that has been modified or installed by the recipient, or for the User Product in which it has been modified or installed. Access to a network may be denied when the modification itself materially and adversely affects the operation of the network or violates the rules and protocols for communication across the network.
Corresponding Source conveyed, and Installation Information provided, in accord with this section must be in a format that is publicly documented (and with an implementation available to the public in source code form), and must require no special password or key for unpacking, reading or copying.

7. Additional Terms.

"Additional permissions" are terms that supplement the terms of this License by making exceptions from one or more of its conditions. Additional permissions that are applicable to the entire Program shall be treated as though they were included in this License, to the extent that they are valid under applicable law. If additional permissions apply only to part of the Program, that part may be used separately under those permissions, but the entire Program remains governed by this License without regard to the additional permissions.
When you convey a copy of a covered work, you may at your option remove any additional permissions from that copy, or from any part of it. (Additional permissions may be written to require their own removal in certain cases when you modify the work.) You may place additional permissions on material, added by you to a covered work, for which you have or can give appropriate copyright permission.
Notwithstanding any other provision of this License, for material you add to a covered work, you may (if authorized by the copyright holders of that material) supplement the terms of this License with terms:
- a) Disclaiming warranty or limiting liability differently from the terms of sections 15 and 16 of this License; or
- b) Requiring preservation of specified reasonable legal notices or author attributions in that material or in the Appropriate Legal Notices displayed by works containing it; or
- c) Prohibiting misrepresentation of the origin of that material, or requiring that modified versions of such material be marked in reasonable ways as different from the original version; or
- d) Limiting the use for publicity purposes of names of licensors or authors of the material; or
- e) Declining to grant rights under trademark law for use of some trade names, trademarks, or service marks; or
- f) Requiring indemnification of licensors and authors of that material by anyone who conveys the material (or modified versions of it) with contractual assumptions of liability to the recipient, for any liability that these contractual assumptions directly impose on those licensors and authors.

All other non-permissive additional terms are considered "further restrictions" within the meaning of section 10. If the Program as you received it, or any part of it, contains a notice stating that it is governed by this License along with a term that is a further restriction, you may remove that term. If a license document contains a further restriction but permits relicensing or conveying under this License, you may add to a covered work material governed by the terms of that license document, provided that the further restriction does not survive such relicensing or conveying.
If you add terms to a covered work in accord with this section, you must place, in the relevant source files, a statement of the additional terms that apply to those files, or a notice indicating where to find the applicable terms.
Additional terms, permissive or non-permissive, may be stated in the form of a separately written license, or stated as exceptions; the above requirements apply either way.

8. Termination.

You may not propagate or modify a covered work except as expressly provided under this License. Any attempt otherwise to propagate or modify it is void, and will automatically terminate your rights under this License (including any patent licenses granted under the third paragraph of section 11).
However, if you cease all violation of this License, then your license from a particular copyright holder is reinstated (a) provisionally, unless and until the copyright holder explicitly and finally terminates your license, and (b) permanently, if the copyright holder fails to notify you of the violation by some reasonable means prior to 60 days after the cessation.

Moreover, your license from a particular copyright holder is reinstated permanently if the copyright holder notifies you of the violation by some reasonable means, this is the first time you have received notice of violation of this License (for any work) from that copyright holder, and you cure the violation prior to 30 days after your receipt of the notice.
Termination of your rights under this section does not terminate the licenses of parties who have received copies or rights from you under this License. If your rights have been terminated and not permanently reinstated, you do not qualify to receive new licenses for the same material under section 10.

9. Acceptance Not Required for Having Copies.

You are not required to accept this License in order to receive or run a copy of the Program. Ancillary propagation of a covered work occurring solely as a consequence of using peer-to-peer transmission to receive a copy likewise does not require acceptance. However, nothing other than this License grants you permission to propagate or modify any covered work. These actions infringe copyright if you do not accept this License. Therefore, by modifying or propagating a covered work, you indicate your acceptance of this License to do so.

10. Automatic Licensing of Downstream Recipients.

Each time you convey a covered work, the recipient automatically receives a license from the original licensors, to run, modify and propagate that work, subject to this License. You are not responsible for enforcing compliance by third parties with this License.
An “entity transaction” is a transaction transferring control of an organization, or substantially all assets of one, or subdividing an organization, or merging organizations. If propagation of a covered work results from an entity transaction, each party to that transaction who receives a copy of the work also receives whatever licenses to the work the party's predecessor in interest had or could give under the previous paragraph, plus a right to possession of the Corresponding Source of the work from the predecessor in interest, if the predecessor has it or can get it with reasonable efforts.
You may not impose any further restrictions on the exercise of the rights granted or affirmed under this License. For example, you may not impose a license fee, royalty, or other charge for exercise of rights granted under this License, and you may not initiate litigation (including a cross-claim or counterclaim in a lawsuit) alleging that any patent claim is infringed by making, using, selling, offering for sale, or importing the Program or any portion of it.

11. Patents.

A “contributor” is a copyright holder who authorizes use under this License of the Program or a work on which the Program is based. The work thus licensed is called the contributor's “contributor version”.
A contributor's “essential patent claims” are all patent claims owned or controlled by the contributor, whether already acquired or hereafter acquired, that would be infringed by some manner, permitted by this License, of making, using, or selling its contributor version, but do not include claims that would be infringed only as a consequence of further modification of the contributor version. For purposes of this definition, “control” includes the right to grant patent sublicenses in a manner consistent with the requirements of this License.
Each contributor grants you a non-exclusive, worldwide, royalty-free patent license under the contributor's essential patent claims, to make, use, sell, offer for sale, import and otherwise run, modify and propagate the contents of its contributor version.
In the following three paragraphs, a “patent license” is any express agreement or commitment, however denominated, not to enforce a patent (such as an express permission to practice a patent or covenant not to sue for patent infringement). To “grant” such a patent license to a party means to make such an agreement or commitment not to enforce a patent against the party.
If you convey a covered work, knowingly relying on a patent license, and the Corresponding Source of the work is not available for anyone to copy, free of charge and under the terms of this License, through a publicly available network server or other readily accessible means, then you must either (1) cause the Corresponding Source to be so available, or (2) arrange to deprive yourself of the benefit of the patent license for this particular work, or (3) arrange, in a manner consistent with the requirements of this License, to extend the patent license to downstream recipients. “Knowingly relying” means you have actual knowledge that, but for the patent license, your conveying the covered work in a country, or your recipient's use of the covered work in a country, would infringe one or more identifiable patents in that country that you have reason to believe are valid.
If, pursuant to or in connection with a single transaction or arrangement, you convey, or propagate by procuring conveyance of, a covered work, and grant a patent license to some of the parties receiving the covered work authorizing them to use, propagate, modify or convey a specific copy of the covered work, then the patent license you grant is automatically extended to all recipients of the covered work and works based on it.
A patent license is “discriminatory” if it does not include within the scope of its coverage, prohibits the exercise of, or is conditioned on the non-exercise of one or more of the rights that are specifically granted under this License. You may not convey a covered work if you are a party to an arrangement with a third party that is in the business of distributing software, under which you make payment to the third party based on the extent of your activity of conveying the work, and under which the third party grants, to any of the parties who would receive the covered work from you, a discriminatory patent license (a) in connection with copies of the covered work conveyed by you (or copies made from those copies), or (b) primarily for and in connection with specific products or compilations that contain the covered work, unless you entered into that arrangement, or that patent license was granted, prior to 28 March 2007.
Nothing in this License shall be construed as excluding or limiting any implied license or other defenses to infringement that may otherwise be available to you under applicable patent law.

12. No Surrender of Others' Freedom.

If conditions are imposed on you (whether by court order, agreement or otherwise) that contradict the conditions of this License, they do not excuse you from the conditions of this License. If you cannot convey a covered work so as to satisfy simultaneously your obligations under this License and any other pertinent obligations, then as a consequence you may not convey it at all. For example, if you agree to terms that obligate you to collect a royalty for further conveying from those to whom you convey the Program, the only way you could satisfy both those terms and this License would be to refrain entirely from conveying the Program.

13. Use with the GNU Affero General Public License.

Notwithstanding any other provision of this License, you have permission to link or combine any covered work with a work licensed under version 3 of the GNU Affero General Public License into a single combined work, and to convey the resulting work. The terms of this License will continue to apply to the part which is the covered work, but the special requirements of the GNU Affero General Public License, section 13, concerning interaction through a network will apply to the combination as such.

14. Revised Versions of this License.

The Free Software Foundation may publish revised and/or new versions of the GNU General Public License from time to time. Such new versions will be similar in spirit to the present version, but may differ in detail to address new problems or concerns.

Each version is given a distinguishing version number. If the Program specifies that a certain numbered version of the GNU General Public License “or any later version” applies to it, you have the option of following the terms and conditions either of that numbered version or of any later version published by the Free Software Foundation. If the Program does not specify a version number of the GNU General Public License, you may choose any version ever published by the Free Software Foundation.

If the Program specifies that a proxy can decide which future versions of the GNU General Public License can be used, that proxy's public statement of acceptance of a version permanently authorizes you to choose that version for the Program. Later license versions may give you additional or different permissions. However, no additional obligations are imposed on any author or copyright holder as a result of your choosing to follow a later version.

15. Disclaimer of Warranty.

THERE IS NO WARRANTY FOR THE PROGRAM, TO THE EXTENT PERMITTED BY APPLICABLE LAW. EXCEPT WHEN OTHERWISE STATED IN WRITING THE COPYRIGHT HOLDERS AND/OR OTHER PARTIES PROVIDE THE PROGRAM “AS IS” WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. THE ENTIRE RISK AS TO THE QUALITY AND PERFORMANCE OF THE PROGRAM IS WITH YOU. SHOULD THE PROGRAM PROVE DEFECTIVE, YOU ASSUME THE COST OF ALL NECESSARY SERVICING, REPAIR OR CORRECTION.

16. Limitation of Liability.

IN NO EVENT UNLESS REQUIRED BY APPLICABLE LAW OR AGREED TO IN WRITING WILL ANY COPYRIGHT HOLDER, OR ANY OTHER PARTY WHO MODIFIES AND/OR CONVEYS THE PROGRAM AS PERMITTED ABOVE, BE LIABLE TO YOU FOR DAMAGES, INCLUDING ANY GENERAL, SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF THE USE OR INABILITY TO USE THE PROGRAM (INCLUDING BUT NOT LIMITED TO LOSS OF DATA OR DATA BEING RENDERED INACCURATE OR LOSSES SUSTAINED BY YOU OR THIRD PARTIES OR A FAILURE OF THE PROGRAM TO OPERATE WITH ANY OTHER PROGRAMS), EVEN IF SUCH HOLDER OR OTHER PARTY HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

17. Interpretation of Sections 15 and 16.

If the disclaimer of warranty and limitation of liability provided above cannot be given local legal effect according to their terms, reviewing courts shall apply local law that most closely approximates an absolute waiver of all civil liability in connection with the Program, unless a warranty or assumption of liability accompanies a copy of the Program in return for a fee.

END OF TERMS AND CONDITIONS

Source/Quelle: http://www.gnu.org/licenses/gpl.html

LGPL

GNU LESSER GENERAL PUBLIC LICENSE

Version 3, 29 June 2007

Everyone is permitted to copy and distribute verbatim copies of this license document, but changing it is not allowed.
This version of the GNU Lesser General Public License incorporates the terms and conditions of version 3 of the GNU General Public License, supplemented by the additional permissions listed below.

0. Additional Definitions.
As used herein, “this License” refers to version 3 of the GNU Lesser General Public License, and the “GNU GPL” refers to version 3 of the GNU General Public License.
“The Library” refers to a covered work governed by this License, other than an Application or a Combined Work as defined below.
An “Application” is any work that makes use of an interface provided by the Library, but which is not otherwise based on the Library. Defining a subclass of a class defined by the Library is deemed a mode of using an interface provided by the Library.
A “Combined Work” is a work produced by combining or linking an Application with the Library. The particular version of the Library with which the Combined Work was made is also called the “Linked Version”.
The “Minimal Corresponding Source” for a Combined Work means the Corresponding Source for the Combined Work, excluding any source code for portions of the Combined Work that, considered in isolation, are based on the Application, and not on the Linked Version.
The “Corresponding Application Code” for a Combined Work means the object code and/or source code for the Application, including any data and utility programs needed for reproducing the Combined Work from the Application, but excluding the System Libraries of the Combined Work.

1. Exception to Section 3 of the GNU GPL.
You may convey a covered work under sections 3 and 4 of this License without being bound by section 3 of the GNU GPL.

2. Conveying Modified Versions.
If you modify a copy of the Library, and, in your modifications, a facility refers to a function or data to be supplied by an Application that uses the facility (other than as an argument passed when the facility is invoked), then you may convey a copy of the modified version:

- a) under this License, provided that you make a good faith effort to ensure that, in the event an Application does not supply the function or data, the facility still operates, and performs whatever part of its purpose remains meaningful, or
- b) under the GNU GPL, with none of the additional permissions of this License applicable to that copy.

3. Object Code Incorporating Material from Library Header Files.
The object code form of an Application may incorporate material from a header file that is part of the Library. You may convey such object code under terms of your choice, provided that, if the incorporated material is not limited to numerical parameters, data structure layouts and accessors, or small macros, inline functions and templates (ten or fewer lines in length), you do both of the following:

- a) Give prominent notice with each copy of the object code that the Library is used in it and that the Library and its use are covered by this License.
- b) Accompany the object code with a copy of the GNU GPL and this license document.

4. Combined Works.
You may convey a Combined Work under terms of your choice that, taken together, effectively do not restrict modification of the portions of the Library contained in the Combined Work and reverse engineering for debugging such modifications, if you also do each of the following:

- a) Give prominent notice with each copy of the Combined Work that the Library is used in it and that the Library and its use are covered by this License.
- b) Accompany the Combined Work with a copy of the GNU GPL and this license document.
- c) For a Combined Work that displays copyright notices during execution, include the copyright notice for the Library among these notices, as well as a reference directing the user to the copies of the GNU GPL and this license document.
- d) Do one of the following:

    - 0) Convey the Minimal Corresponding Source under the terms of this License, and the Corresponding Application Code in a form suitable for, and under terms that permit, the user to recombine or relink the Application with a modified version of the Linked Version to produce a modified Combined Work, in the manner specified by section 6 of the GNU GPL for conveying Corresponding Source.
    - 1) Use a suitable shared library mechanism for linking with the Library. A suitable mechanism is one that (a) uses at run time a copy of the Library already present on the user's computer system, and (b) will operate properly with a modified version of the Library that is interface-compatible with the Linked Version.
- e) Provide Installation Information, but only if you would otherwise be required to provide such information under section 6 of the GNU GPL, and only to the extent that such information is necessary to install and execute a modified version of the Combined Work produced by recombining or relinking the Application with a modified version of the Linked Version. (If you use option 4d0, the Installation Information must accompany the Minimal Corresponding Source and Corresponding Application Code. If you use option 4d1, you must provide the Installation Information in the manner specified by section 6 of the GNU GPL for conveying Corresponding Source.)

5. Combined Libraries.

You may place library facilities that are a work based on the Library side by side in a single library together with other library facilities that are not Applications and are not covered by this License, and convey such a combined library under terms of your choice, if you do both of the following:

- a) Accompany the combined library with a copy of the same work based on the Library, uncombined with any other library facilities, conveyed under the terms of this License.
- b) Give prominent notice with the combined library that part of it is a work based on the Library, and explaining where to find the accompanying uncombined form of the same work.

6. Revised Versions of the GNU Lesser General Public License.

The Free Software Foundation may publish revised and/or new versions of the GNU Lesser General Public License from time to time. Such new versions will be similar in spirit to the present version, but may differ in detail to address new problems or concerns.
Each version is given a distinguishing version number. If the Library as you received it specifies that a certain numbered version of the GNU Lesser General Public License “or any later version” applies to it, you have the option of following the terms and conditions either of that published version or of any later version published by the Free Software Foundation. If the Library as you received it does not specify a version number of the GNU Lesser General Public License, you may choose any version of the GNU Lesser General Public License ever published by the Free Software Foundation.
If the Library as you received it specifies that a proxy can decide whether future versions of the GNU Lesser General Public License shall apply, that proxy's public statement of acceptance of any version is permanent authorization for you to choose that version for the Library.

Index

E

F

G

H

I

L

M

N

O

P

R

S

T

U

V

W

X

Certificates / DOC

Declarations of Conformity - DOC

Erklärung der EG - Konformität
Declaration of EC - Conformity
Attestation de Conformité CE

Wir /We /Nous

SAE IT-systems GmbH & Co. KG
Im Gewerbegebiet Pesch 14
50767 Köln

erklären in alleiniger Verantwortung, dass unser Produkt,
declare under our sole responsibility that the product
attestons sous notre responsabilité que le produit

FW-50

auf welches sich diese Erkärung bezieht, mit der /den folgenden Norm(en) oder normativen Dokumenten übereinstimmt:
which is the subject of this declaration, is in conformity with the following standard(s) or normative documents:
auquel cette déclaration se rapporte, est conforme aux norme(s) ou aux documents normatifs suivants:

Bestimmung der Richtlinie *Terms of the directive* Prescription de la directive	**Titel und/oder Nr. sowie Ausgabedatum der Norm** *Titel and/or no. and date of issue of the standard* Titre et/ou no. ainsi que date démission des normes
2006/95/EG : Niederspannungsrichtlinie *2006/95/EC: Low Voltage Directiv*	**DIN EN 60950 (2006)**
2004/108/EG : **Elektromagnetische Verträglichkeit** *2004/108/EC: Electromagnetic compatibility*	**DIN EN 61000-6-2 (2006)** **DIN EN 61000-6-4 (2007)** **DIN EN 60870-2-1 (1997)**

SAE IT-systems GmbH & Co. KG
Im Gewerbegebiet Pesch 14 • D-50767 Köln
Tel: 0221-59808-0 • Fax:0221-59808-60

Köln, 15.07.2008
Ort und Datum
Place and date
lieu et date

i.V. **Jürgen Venhaus**
Produkt Manager
SAE IT-systems GmbH & Co. KG

i.V. **Ulrich Werner**
Quality Manager
SAE IT-systems GmbH & Co. KG

SAE IT-systems GmbH & Co. KG
Zentrale Köln
Im Gewerbegebiet Pesch 14
D-50767 Köln
Tel +49 (0)221 59808-0
Fax +49 (0)221 59808-60
Sitz Köln
Amtsgericht Köln HRA15207
e-mail: info@sae-it.de
http://: www.sae-it.de

Bank Sparkasse Köln-Bonn
BLZ 370 501 98
Kto. 1008422618
BIC: COLSDE33
IBAN: DE96 370 501 98 100 842 2618

Ust-IDnr DE812996839
Steuernr 223/5818/2459

Pers. haft. Gesellschafterin
SAE IT-Verwaltungs GmbH
Sitz Köln AG Köln HRB 33731
Geschäftsführer:
Dipl.-Ing. Joachim Schuster

IEC 60870-5-104

KEMA

SAE IT-systems GmbH & Co. KG
Herrn Callegari
Im Gewerbegebiet Pesch 14

50767 Köln

EINGEGANGEN
04. Nov. 2008

Ihre Zeichen
Unsere Zeichen l-smx-ev
Bearbeiter Günter Schmid
Telefon +49 351 871 92 70
Telefax +49 351 871 92 23
E-Mail guenter.schmid@kema.com

Dresden, den 03. 11. 2008

Fernwirkgerät net-line FW50

Sehr geehrter Herr Callegari,

für die schnelle und unkomplizierte Bereitstellung Ihres Fernwirkgerätes net-line FW50 bedanken wir uns sehr herzlich.

Wir haben das Gerät im Rahmen der Entwicklung unserer Prüf- und Testsoftware für das Protokoll nach IEC 61870-5-104 eingesetzt. Dabei arbeitete die FW50 in den Prozeduren Verbindungsaufbau und Datenübertragung gemäß 104 und den von uns genutzten Funktionen Digitaleingang und –ausgang sowie Analogeingang fehlerfrei.

Wir bitten Sie, uns ein Angebot zur Übernahme des Gerätes in unseren Bestand zu unterbreiten. —> Si

Mit freundlichen Grüßen

KEMA
IEV - Ingenieurunternehmen
für Energieversorgung GmbH

i. V. fb i.A. Schmid

KEMA
IEV – Ingenieurunternehmen
für Energieversorgung GmbH
Gostritzer Str. 61-63
D-01217 Dresden

Tel. +49 351 871 92 00
Fax +49 351 871 92 31
dresden@kema.com
www.kema-iev.de
www.kema.com

Geschäftsführer: Dr.-Ing. Gunnar Heymann
Sitz: Dresden
Eingetragen: Amtsgericht Dresden HRB 9187
Ust-IdNr.: DE 161410895
SWIFT Code (BIC): DEUTDE8C

Bankverbindung:
Deutsche Bank AG Filiale Dresden
Kontonummer 519 904 700
Bankleitzahl 870 700 00
IBAN DE43 8707 0000 0519 9047 00

TÜV CERT DIN EN ISO 9001: 2000 Zertifikat: 01 100 011034

ZERTIFIKAT ◆ CERTIFICATE ◆ 認証証書 ◆ СЕРТИФИКАТ ◆ CERTIFICADO ◆ CERTIFICAT

Product Service

CERTIFICATE

No. ZE 14 09 89920 001

Holder of Certificate: **SAE IT-systems Gmbh & Co KG**

Im Gewerbegebiet Pesch 14
50767 Köln
GERMANY

Certification Mark:

Product: **Communication interfaces**

The conformance test has been performed according to the standard IEC 61850-10, the actual UCA International Users Group Test Procedures and TPCL version for the according device type. As basis were used the product's protocol, model and technical issue implementation conformance statements provided by the customer. The certification mark shown above can be affixed on the product with the installed SW version named above. It is not permitted to alter the certification mark in any way. In addition the certification holder must not transfer the certificate to third parties. See also notes overleaf.

Test report no.: 713045778-TR05

Valid until: 2022-09-21

Date, 2014-09-22
Page 1 of 2

(Antonello Gaviano)

A1 / 04.11

TÜV SÜD Product Service GmbH · Zertifizierstelle · Ridlerstraße 65 · 80339 München · Germany

ZERTIFIKAT ◆ CERTIFICATE ◆ 認証証書 ◆ СЕРТИФИКАТ ◆ CERTIFICADO ◆ CERTIFICAT

Product Service

CERTIFICATE
No. ZE 14 09 89920 001

Model(s):

FW-50
IEC 61850 Firmware / Library Version: 4.009.00

Parameters:

This certificate includes a summary of the test results executed in Munich (Germany) using the following tools:

SERVER SIMULATOR: TMW Anvil v. 3.5.59.0
ANALYZER: Wireshark 1.10.3

according to UCAIug Conformance Test Procedures for Client Devices with IEC 61850-8-1 interface, Edition 1, Revision 1.1, with TPCL 1.2.2

Passed Test Cases:

CB 01: cAss1, cAss2, cAss3, cAss4, cAssN1, cAssN4, cAssN5, cAssN6 cAssN7, cSrv1, cSrv2, cSrv3, cSrv4, cSrv5, cSrvN5, cSrvN6
CB 02: cDs1, cDs2, cDs5, cDsN1a, cDsN1b
CB 02+: cDs6, cDsN4, cDsN5
CB 05: cRp3, cRp4, cRp5, cRp8, cRp9, cRpN2, cRpN3, cRpN7,cRpN8, cRp1, cRp2, cRp7, cRpN1, cRpN4, cRpN5
CB 06: cBr3, cBr4, cBr5, cBr8, cBr9, cBr11, cBr12, cBrN2, cBrN3, cBrN7,cBrN8, cBrN9 cBr1, cBr2, cBrN1, cBrN4
CB 12a: cCtl4, cCtlN1, cDOns1, cDOns2, cCtl2
CB 12b: cCtl4, cCtlN1, cSBOns1, cSBOns2, cSBOns3, cCtl2, cSBOns4
CB 12c: cCtl4, cCtlN1, cDOes1, cDOes2, cCtl2
CB 12d: cCtl4, cCtlN1, cSBOes1, cSBOes2, cSBOes3, cCtl2, cSBOes4
CB 13: cTm1

Tested according to:

IEC 61850-6:2004
IEC 61850-7-1:2003
IEC 61850-7-2:2003
IEC 61850-7-3:2003
IEC 61850-7-4:2003
IEC 61850-8-1:2004

Page 2 of 2

A1 / 04.11

TÜV SÜD Product Service GmbH · Zertifizierstelle · Ridlerstraße 65 · 80339 München · Germany

TÜV®

ZERTIFIKAT ◆ CERTIFICATE ◆ 認証書 ◆ СЕРТИФИКАТ ◆ CERTIFICADO ◆ CERTIFICAT

UCA International Users Group

IEC 61850 Certificate
Level A[1]

TÜV SÜD Product Service

No. ZE 14 09 89920 001

Issued to:

SAE IT-systems GmbH & Co. KG
Im Gewerbegebiet Pesch 14
Germany

For the client system:

FW-50
4.009.00
RTU

Issued by:

TÜV SÜD Product Service GmbH
Communication Protocols
Barthstrasse 16
D-80339 Munich
Germany

Certification Mark:

This certification mark can only be used for the product defined above.

The client system has not shown to be non-conforming to:

IEC 61850 First Edition Parts 6, 7-1, 7-2, 7-3, 7-4 and 8-1

Communication networks and systems in substations.

The conformance test has been performed according to IEC 61850-10 and UCA IUG Conformance Test Procedures for Client System with IEC 61850-8-1 interface, revision 1.1 with TPCL version 1.2.2 with client system's protocol, model and technical issue implementation conformance statements: "IEC61850 Conformance Statements ACSI-PIXIT-MICS-PICS-TICS V1.10 (Chapter PICS)", "IEC61850 Conformance Statements ACSI-PIXIT-MICS-PICS-TICS V1.10 (Chapter MICS)", "IEC61850 Conformance Statements ACSI-PIXIT-MICS-PICS-TICS V1.10 (Chapter TICS)" and product's extra information for testing: "IEC61850 Conformance Statements ACSI-PIXIT-MICS-PICS-TICS V1.10 (Chapter PIXIT)".

The following IEC 61850 conformance blocks have been tested with a positive result (number of relevant and executed test cases / total number of test cases):

1	Basic Exchange (18/22)	12a	Direct Control (5/7)
2	Data Sets(5/9)	12b	SBO Control (7/9)
2+	Data Set Definition (4/4)	12c	Enhanced Direct Control (5/7)
5	Unbuffered Reporting (16/18)	12d	Enhanced SBO Control (7/9)
6	Buffered Reporting (18/22)	13	Time Synchronization (1/4)

This certificate includes a summary of the test results as carried out at TÜV SÜD Product Service GmbH in Germany with Anvil version 3.5.59.0 and Wireshark version 1.10.3. This document has been issued for information purposes only, and the original paper copy of the TÜV SÜD Product Service GmbH test report: No. **713045778-TR05**, version **1.0** will prevail.

Munich, 22.09.2014

Antonello Gaviano
Technical Certifier

Albi Kospiri
Test Engineer

1 Level A - Independent Test lab with certified ISO 17025 Quality System
2 TPCL - Test procedures change list

A1 / 04.11

According to the "TÜV SÜD Group Certification Rules" please see reverse side.

TÜV SÜD Product Service GmbH · Zertifizierstelle · Ridlerstraße 65 · 80339 München · Germany

TÜV®

ZERTIFIKAT ◆ CERTIFICATE ◆ 認証書 ◆ СЕРТИФИКАТ ◆ CERTIFICADO ◆ CERTIFICAT

UCA International Users Group

TÜV SÜD Product Service

No. ZE 14 09 89920 001

Applicable Test Procedures from the UCA International Users Group Test Procedures version 1.1 with TPCL version 1.2.2:

Conformance Block	Mandatory	Conditional
1: Basic Exchange	cAss1, cAss2, cAss3, cAss4, cAssN1, cAssN4, cAssN5, cAssN6, cSrv5	cAssN7 cSrv1, cSrv2, cSrv3, cSrv4 cSrvN1, cSrvN5, cSrvN6, cSrvN3
2: Data Sets		cDs1, cDs2, cDs5, cDsN1a, cDsN1b
2+: Data Set Definition	cDs6, cDsN4	cDs7, cDsN5
5: Unbuffered Reporting	cRp3, cRp4, cRp5, cRp8, cRp9, cRp10, cRpN2, cRpN3, cRpN7,cRpN8	cRp1, cRp2, cRp7 cRpN1, cRpN4, cRpN5
6: Buffered Reporting	cBr3, cBr4, cBr5, cBr8, cBr9, cBr10, cBr11, cBr12, cBrN2, cBrN3, cBrN7,cBrN8, cBrN9	cBr1, cBr2, cBrN1,cBrN4, cBrN5
12a: Direct control	cCtl4, cCtlN1, cDOns1, cDOns2	cCtl2
12b: SBO control	cCtl4, cCtlN1, cSBOns1, cSBOns2, cSBOns3	cCtl2, cSBOns4
12c: Enhanced Direct Control	cCtl4, cCtlN1, cDOes1, cDOes2	cCtl2
12d: Enhanced SBO control	cCtl4, cCtlN1, cSBOes1, cSBOes2, cSBOes3	cCtl2, cSBOes4
13: Time sync	cTm1	

A1 / 04.11

According to the "TÜV SÜD Group Certification Rules" please see reverse side.

TÜV SÜD Product Service GmbH · Zertifizierstelle · Ridlerstraße 65 · 80339 München · Germany

TÜV®

Zertifiziervertrag

Grundlage für die Zertifikatserteilung ist die Prüf- und Zertifizierordnung von TÜV SÜD Product Service.

Mit Erhalt des Zertifikates erkennt der Zertifikatsinhaber die jeweils gültige Fassung der Prüf- und Zertifizierordnung an (www.tuev-sued.de/ps_regulations) und wird somit Partner im Zertifiziersystem von TÜV SÜD Product Service.

Prinzipielle Voraussetzung für die Gültigkeit des Zertifikates:

– Gültigkeit der zitierten normativen Prüfgrundlage(n) ist gegeben

und zusätzlich bei Zertifikaten mit Berechtigung zur Verwendung eines Prüfzeichens bzw. bei Zertifikaten für QM-Systeme:

– Voraussetzungen für vorschriftsmäßige Fertigung werden eingehalten.

– Die Fertigungs- bzw. Betriebsstätten werden regelmäßig überwacht.

Certification contract

Certification is based on the TÜV SÜD Product Service Testing and Certification Regulations.

On receipt of the certificate the certificate holder agrees to the current version of the Testing and Certification Regulations (www.tuev-sued.de/ps_regulations) and thus becomes partner in the TÜV SÜD Product Service Certification System.

Requirements for the validity of the certificate in principle:

– Validity of the quoted test standard(s)

In addition for certificates with the right to use a certification mark and for QM certificates:

– Conditions for an adequate manufacturing are maintained

– Regular surveillance of the facility is performed

Akkreditierungen / Benennungen (Status 25.02.2010) /
Accreditations / notifications (as of 2010-02-25)

Deutschland / Germany

Geräte- und Produktsicherheitsgesetz (GPSG) /
Equipment and Product Safety Act (GPSG)

Europa / Europe

- Niederspannungsrichtlinie 2006/95/EG
- Spielzeugrichtlinie 2009/48/EG
- Richtlinie für aktive medizinische Implantate 90/385/EWG
- Richtlinie für Medizinprodukte 93/42/EWG
- Richtlinie für In-vitro-Diagnostika 98/79/EG
- Richtlinie für Gasverbrauchseinrichtungen 90/396/EWG
- Richtlinie für persönliche Schutzausrüstungen 89/686/EWG
- EMV-Richtlinie 2004/108/EG
- Richtlinie für Sportboote 94/25/EG + 2003/44/EG
- Richtlinie für Maschinen 2006/42/EG
- Richtlinie für Ex-Schutz Geräte 94/9/EG

- Low Voltage Directive 2006/95/EC
- Toys Directive 2009/48/EC
- Directive for Active Implantable Medical Devices 90/385/EEC
- Directive for Medical Devices 93/42/EEC
- Directive on In Vitro Diagnostic Medical Devices 98/79/EC
- Directive for Gas Appliances 90/396/EEC
- Directive for Personal Protective Equipment 89/686/EEC
- EMC Directive 2004/108/EC
- Directive for Recreational Craft 94/25/EC + 2003/44/EC
- Directive for Machinery 2006/42/EC
- Directive for Ex Safe Equipment 94/9/EC

- ENEC Agreement for luminaires and IT equipment

USA

- Nationally Recognized Testing Laboratory (NRTL) to 29 CFR 1910.7 by OSHA
- Accredited for FDA 510(k) Third Party Review
- Conformity Assessment Body to the MRA for Medical Devices; FDA QSReg Inspections, FDA 510(k) Third Party Review

Asien-Pazifik Region / Asia Pacific

- Recognized Certification Body to Electrical Products (Safety) Regulation; Hong Kong
- Konformitätsbewertungsstelle / Conformity Assessment Body to the MRA for Medical Devices; Australien / Australia
- Konformitätsbewertungsstelle / Conformity Assessment Body to the MRA for Medical Devices; Neuseeland / New Zealand

Weltweit / Worldwide

- NCB im CB-Scheme des IECEE /
  NCB in the CB Scheme of IECEE
- ExCB im IECEx-Scheme des IECEE /
  ExCB in the IECEx Scheme of IECEE
- TÜV SÜD Product Service Mark für Produkte / TÜV SÜD Product Service Mark for products DAP-ZE-1213.00
- Zertifizierung von QMS / Certification of QMS TGA-ZM-08-93-00
- Zertifizierung von QMS gemäß / Certification of QMS according to (DIN) EN ISO 13485 / ISO 13485

Zertifizierstelle für Produkte / Certification Body for Products • e-mail ps-zert@tuev-sued.de
Zertifizierstelle für Medizinprodukte / Certification Body for Medical Devices • e-mail ZASMAIL@tuev-sued.de
Kundenservice / Clients Services • Phone +49/89/50 08-42 61 • Fax +49/89/50 08-42 30 • e-mail ps-zert@tuev-sued.de

SAE IT-systems GmbH & Co. KG
Im Gewerbegebiet Pesch 14
50767 Köln (Cologne, Germany)
Tel.: +49(0)221/59808-0
Fax: +49(0)221/59808-60
info@sae-it.de
www.sae-it.com