SAE IT-SYSTEMS

FW-5-GATE-4G-3
Manual for mobile routers

Telecontrol system
Substation automation
Automation

internal

This document was classified: ■ intern | internal

It is aimed at system administrators and those involved with the operation, diagnostics and installation of FW-5-GATE-4G-3 bay station controllers. With FW-5-GATE-4G-3, series5X takes another step towards higher IT security. The standard variant FW-5-GATE-3 and the NB-IoT variant FW-5-GATE.NB-IoT are described in separate documents.

Please follow the safety notices.

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

Firmware using Open-Source openBSD/GPL/LGPL
The Firmware of mentioned products carries open source code according to openBSD/GPL/LGPL licenses. On demand we are obliged to deploy the source code according to Section 3b of GPL and Section 6b of LGPL. We will be happy to provide you with an offer for the delivery of the sources on data media; please send an e-mail to marketing@sae-it.de.

Telecontrol-RTU & Gateway FW-5-GATE-4G-3

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link: https://www.sae-it.com/fileadmin/en/Manual_FW-5-GATE-4G-3_series5X.pdf

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

The company SAE IT-systems® GmbH & Co. KG was certified to ISO 27001
Cert. reg. no.: 09 100 6152

Content

Appendix 163

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.

Read this documentation carefully, especially the safety instructions, the instructions for safe installation and commissioning and proper operation, as well as all other publications that must be consulted when working with this product. Observe all safety instructions and warnings when handling this product, otherwise personal injury or damage to the product may result. This also applies to any unauthorised modification and use of the unit that exceeds the mechanical, electrical or other operating limits.
When using the unit, the legal and safety regulations required for the respective application must also be observed.
This document contains the information required for the application and use of the product in the manner intended. It is intended for technically **qualified personnel** who have relevant knowledge in the field of automation technology or data transmission technology. Depending on the application, further qualifications such as working with dangerous voltages or natural gas may be required to regulate access to the system and reduce the hazard potential.

The appliance must only be installed, commissioned, operated and maintained by qualified personnel. Qualified technical personnel are:

- Persons who, due to their relevant training and experience, are capable of recognising dangers in good time and avoiding hazards.
- Persons who are authorised to access and work on equipment.
- Persons who have been trained as operating personnel in the handling of the equipment or the system and who know the required contents of this manual.
- Persons who have been trained as commissioning/service technicians on corresponding systems in accordance with the standards of safety technology.

Safe operation requires a detailed understanding and technically correct implementation of the installation guidelines, safety information and functions described in this manual.
Detailed knowledge and technically correct implementation of the installation guidelines / security instructions / functions described in this manual are a prerequisite for safe operation.
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.

Scope

This manual applies to work and installations with FW-5-GATE-4G-3 in the field Telecontrol-RTU & Gateway.

IT security according to BDEW whitepaper

Using a station within the scope of an ISMS or 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 regards 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 **Security relevant settings** or via 'Checklist IT-Security' https://www.sae-it.com/fileadmin/en/Checklist_IT-Security_@SAE_IT-systems.pdf.

It is imperative to follow the instructions in section Security relevant settings on page 149.

For specific questions in individual cases, please contact the support team on +49 221 59808-55 or PSIRT@sae-it.de.

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

Commissioning, operation and maintenance of the product and accessories is reserved exclusively for qualified personnel.

The product is not suitable for children of any age!

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.

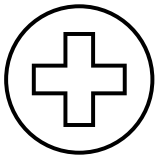
CAUTION

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

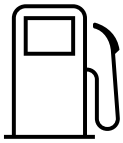
Hot swapping live system cards can result in blocking of the extension bus.

Safety information using mobile radio



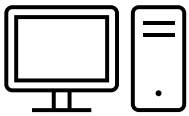
Electronics in medical equipment

The FW-5-GATE-4G-3 must not be used inside hospitals or near medical equipment. The function of pacemakers and hearing aids might be impaired



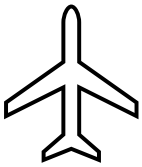
Environments with explosive materials

The FW-5-GATE-4G-3 should not be used in the vicinity of petrol stations, fuel depots, chemical plants or blasting operations.



Interference with electrical appliances

When not used in its proper operating conditions, the FW-5-GATE-4G-3 can interfere with the functioning of televisions, radios and PCs.



Air traffic safety

Radio transmitters such as the FW-5-GATE-4G-3 must not be used aboard aircraft. Ensure that unintentional activation on board is not possible.

CAUTION

Ensure that the antenna is installed correctly and appropriately!!!
Adequate antenna grounding is essential for magnetic base antennae.

The distance between antenna and product should be > 50 cm..

In order to avoid potential damage, we advise you to use only specified accessories. These have been tested thoroughly for functionality and approved by our test laboratories.
We cannot accept warranty claims that occur due to improper use.

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 entire 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 LACROIX Environment SAE IT-systems GmbH & Co. KG (SAE) may only be serviced by LACROIX/SAE customer support or authorised personnel / companies. Only genuine 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.

CE Conformity

The conformity of the products according to CE is declared in the CE conformity certificates Documents of Conformity DOC for each product, extension or combination of products. Relevant DOCs can be found in the appendix..

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.

Disclaimer

The product and its components must be installed as delivered in accordance with this manual and operated as intended. This applies to both the hardware and the software. Any unauthorised modification shall constitute "misuse" and/or "negligence" within the meaning of the warranty for the product and shall result in the exclusion of liability of LACROIX Environment SAE IT-systems GmbH & Co. KG.

If you wish to change the hardware or software properties, please contact SAE IT-systems GmbH & Co. KG, Cologne. For questions in specific individual cases, the support is available at +49 221 59808-55.

2 Installation notes

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 (Integrated earthing contact to the top-hat rail, own terminal or flat plug in the side panels).

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 mm²** 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, SWT12, SWT96... and the baseband modem, a combination of AF-line transformer NFLÜ/BBÜ/PCM-FLÜ AF line transformer and surge protection is recommended.

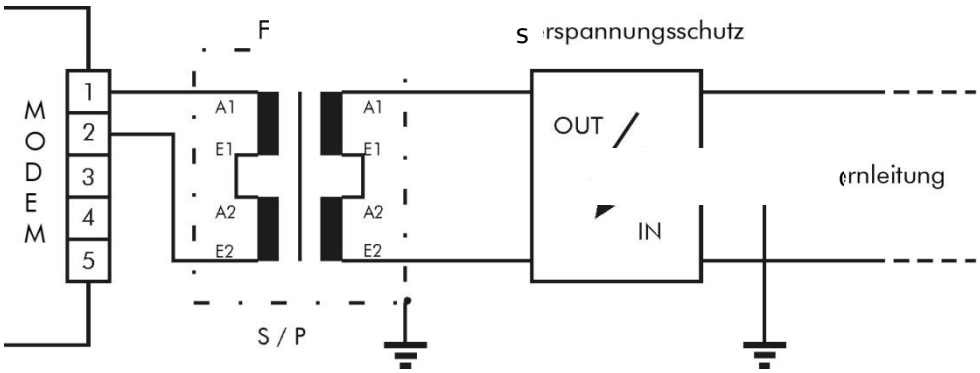


Figure 1: Example surge protection and baseband transformer in front of telecom modem

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 interfaces 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.

3 System design

High-performance field device

As a flexible field device, the net-line FW-5-GATE-4G-3 features the full performance of the new series5X generation plus flexible mobile connectivity. The extremely compact bay station controller in a sturdy DIN-rail housing comprises all the components for monitoring, controlling, data logging and transmission of a powerful telecontrol and automation system using mobile communications.

The integrated use of a LTE™ mobile module with fallback on 3G/2G networks* facilitates flexible integration into control systems and energy management systems. The series5X technology permits next-level of IT security as stipulated in the current requirement profiles in the BDEW whitepaper, ENCS and BSI German Federal Office for Information Security recommendations.

Configuration from setIT in Version 7.002 and higher, enjoying a high level of popularity on the market, and speedy startup from USB memory stick or SD card, are setting the standards in the bay station controller segment.

Figure 2: net-line FW-5-GATE-4G-3 (original size)
* Different functions are possible depending on configuration

Secure and stable

The net-line FW-5-GATE-4G-3 is based upon the FW-5-GATE series5X rev3. It is a general purpose, compact and extremely stable field device. It satisfies the most demanding of communication and automation applications. The concept offers great modularity thanks to plug-in assemblies with a high degree of interference immunity.
Its powerful function modules, such as convenient cross-connections, flexible PLC functionality and integration of external components such as connecting a protective unit via IEC61850 or IEC 60870-5-103 enable it to be put to optimum use as for example:

- **Station and bay controller**
  in medium and high-voltage switchgear in bay and power system control
- **Controller for feed-in management in line with REL** Renewable Energy Law
  Energy supplier and generator of regenerative energies
- **Monitoring and control device**
  for utilities, waste management and manufacturing industry
- **Data acquisition, communication system or protocol converter**
  in transport and infrastructure applications

As a base system, the net-line FW-5-GATE-4G-3 is fully configured with:

- Mobile radio router LTE™ 4G/3G/2G networks
- 2 separated Ethernet LAN network segments (TCP/IP)
- 2 x EIA/RS-485 field interfaces
- EIA/RS-232 /V.24 interface
- Configuration from USB, USB memory stick or SD card

Capacity may be expanded by interface and I/O modules.

The new series5X technology

The communication requirements for a telecontrol / station control system in an intelligent network are becoming ever greater. At the same time, higher demands are being placed on the security in the networks, because the increasing networking creates greater challenges through unintentional access and manipulation. In order to meet these requirements, we have implemented an even more powerful processor core in the series5X technology.

The series5X is fully downward compatible with series5e. With a more modern processor core, updated operating system, hardened hardware in many areas, secure-boot and an encrypted file system for the configuration partition, series5X offers significantly better protection against unwanted attacks.
The new technology is used in the telecontrol devices:

- net-line **m5 series5X** *23
- net-line **FW-5-4 series5X**
- net-line **FW-5-GATE-3 series5X**
- net-line **FW-5-GATE-4G-3 series5X**
- net-line **FW-5-GATE.NB-IoT series5X***23

Features of the series5X
Products of the series5X offer greater resilience against attacks to increase IT security and integration into central device management while reducing energy consumption:

- Current operating system Linux 5.4.101 LTS
- Secure-boot and signed basic system
- Unique device certificate for station authentication, protected in secure element
- Disable interfaces LAN-PHYs
- Encapsulation, hidden layers, BGA ... against physical information tapping tamper protection
- Encrypted file system of the configuration partition
- Signed configuration
- VPN, OpenVPN, TLS encryption
- Certificate exchange via EST (Enrollment over Secure Transport)
- Integration into central device management (CMS)
  - Basic system update (incl. kernel) via fleet management
  - Station software & configuration individually updateable
  - Fallback (AB system) for basic system and configuration
- Security by Design approach in setITV7 parameterisation
- Secure platform for high IT security according to BDEW-whitepaper, ENCS, gaining for SL-3 according to IEC 62443

*Please note the slightly adjusted range of services at m5. *23 expected in 2023

Note: **The use of the series5X requires at least a setIT version 7.002 or higher.**

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

Features of the setIT V7

In combination with setITV7, the products of the series5X offer more 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 outstation/master[#7]
- Protocol converter mode for conversion without process data configuration
- MQTT[#7] as publisher of information and subscriber of commands
- LACBUS-RTU integration[#7] using a GATE up to 50 subscribers
- SMART Meter link via SML or IEC 62056-21 Meter protocol
- DSfG-interface
- Various fieldbuses such as Modbus RTU/TCP, Profibus-DP, 3964R/MPI
- SNMPv3 Protocol for status messages from network components
- SNMP agent for integration into asset management[#7]
- Extensive extensions of the redundancy concepts
- Selective archive retrieval via IEC-101/-104
- Flexible archive exports
- Prerequisites for secure operation according to BDEW white paper, among others:
  - IPsec IKEv1/IKEv2 and OpenVPN[#6] for secure VPN tunnels
  - RBAC role based access control User administration for setIT and web server with role specifications according to BDEW whitepaper
  - Central user management for webserver via LDAP/RADIUS[#6]
  - SYLOG: central recording of operational messages and processes, syslog filtre[e] and syslog process messages[e]
  - Integration into central device management (CMS) for patch management [X#7]

  ...

[e] from series5e,[X] from series5X,[#6] from setIT V6,[#7] from setIT V7

Please refer to the version note enclosed with the software shipment for the extensive extensions.

net-line FW-5-GATE-4G-3

The net-line FW-5-GATE-4G-3 system is a combination of the compact FW-5-GATE rev 3 field device with the series5X technology, expanded by a 4th generation LTE™/4G mobile radio module. As a mobile router with all the functions and security features of a leading edge bay station controller, it combines the key features for setting up an intelligent infrastructure for supply networks such as a Smart Grid.

As an extremely compact bay station controller in a sturdy DIN-rail housing, it comprises all the components for monitoring, controlling, data logging and transmission of a powerful telecontrol and automation system. It is designed for use in grids such as the electrical supply network, and the internal LTE™ mobile radio module provides a secure, wireless data connection for sending data to control centres and master stations.
The FW-5-GATE-4G-3 establishes an IP link via the APN of the service provider. A fixed or dynamic IP is assigned depending on card type. One or more LAN services are started over this link - either encrypted VPN or unencrypted.

Compared to the FW-5 the FW-5-GATE-4G-3 has no inputs/outputs of its own on the base device but a mobile radio link, a 2nd Ethernet interface as an additional separated LAN segment and a 2nd serial port as EIA/RS-485 have been added. The CL interface current-loop will not be available in this product.

- More narrow design without its own I/O in the base device
- Mobile radio module LTE™ with diversity antenna/MISO, optional NB-IoT cat NB2/LTE catM1/LTE-450, DUAL-SIM
- 2nd separated Ethernet interface for 3rd independent LAN segment
- 2nd EIA/RS-485 interface
- Integrated temperature sensor, -25° to +100°C
- micro SD card (to 8 GB), on the front 1 GB until now
- Supply voltage 24 V DC without galvanic isolation
- High-performance CPU with 1 GB memory, fitted with Secure-Element and additional security features against attacs
- Secure-boot and additional system hardening
- optional integration of a central device-management system

Tailored upgrading of the FW-5-GATE-4G-3 is of course possible with up to 12 extension boards.

As an addition to the portfolio, FW-5-GATE-4G-3 can also be used with an upstream value range supply with galvanic isolation and redundant supply - see **Wide Range Supply with PS-60.**

- 24 V DC supply to the FW-5-GATE-4G-3
- Wide range supply (20 to 72 V DC) with galvanic isolation using PS-60
- Redundant supply possible using PS-60

Note: **setIT Version 7.002 or higher is required to use the FW-5-GATE-4G-3.**

Product features FW-5-GATE-4G-3

The FW-5-GATE-4G-3 is available as different variants. Further versions are possible following customers requests.

Design	**Substation control, telecontrol and automation system with LTE™ modem** in micro-housing, plastic with communication components, top-hat rail mounting
Input/output	**FW-5-GATE-4G-3 base station** Modular expansion using a maximum of 12 I/O modules
Communication	**FW-5-GATE-4G-3** **1** **LTE™ modem 4G*** with fallback 3G/2G, MISO, FOTA **2** **Ethernet LAN** TCP/IP, 10/100BaseTx, auto-MDIX, auto negotiation, monitored by Firewall **2** **RS-485** ports, galvanically isolated **1** **RS-232** /V.24 port
IT security	● **BDEW whitepaper** compliant implementation and integration ● **Firewall** with hardened operating system / kernel ● **End-to-end tunnel via VPN** IPsec IKEv1/IKEv2, OpenVPN , TLS ● **SYSLOG server** link ● **System commands** for temporary enabling of diagnostics access ● **Signed firmware and database** ● **Secure-element** protects unique device certificate ● **Secure-boot,** hidden Layer, BGA, add. tamper protection
Capacity	**Flexible process data declaration** for: Single/double-point and step position information, alarms, measured values, integrated totals, single / double and regulating step commands, integrated total outputs
Protocols	● **IEC 61850** Station bus client/server, ed2 [#7] ● **IEC 60870-5-101** Telecontrol, bay control technology ● **IEC 60870-5-103** Link of protective equipment ● **IEC 60870-5-104** Control centre link TCP/IP ● **DNP3** master/outstation, serial/TCP ● **Modbus** RTU/TCP master/slave, serial/TCP ● **MQTT**v3 Data server publisher/subscriber[#7] ● **IEC 62056-21** Meter interface (formerly IEC 1107) ● **SYM²**/SML Meter interface via network ● **DSfG** Interface for natural gas ● **LACBUS-RTU** Gateway Sofrel Datenlogger [#7] ● Profibus-DP slave ● **MPI /3964R**/RK512 S7 link ● **SNMP**v3 Status indications via Master/-Agent ● **https/FTPs** Secure communication ● **IPsec** IKEv1, IKEv2 Encryptions / VPN tunnel ● **OpenVPN**, TLS[#7] Encryptions / VPN tunnel ● **SYSLOG** Central information server ● **LDAP** Centrale user management ● **DHCP/DNS** dyn. IP-address [#7] ● **NTP**/DCF clock Synchronisation
PLC programming	● **straton** IEC 61131-3 Programming [#7] Memory 128 kB using setITV7-workbench license

* Different features can be provided depending on the module selected, [#7] from setITV7

Brief profile of the net-line FW-5-GATE-4G-3
Compact, maintenance-free bay station controller in micro housing for DIN top-hat rail mounting with mobile radio module for direct, secure communication to control centres and master stations, additional 2 independent Ethernet LAN 10/100BaseTx, 2*RS-485 field and meter interfaces and one RS-232/V.24. Integration with IEC 61850, IEC 60870-5-101/-104, -103 protective equipment coupling, DNP3, Modbus, DSfG, SNMPv3. Meter connection IEC 62065-21, SML. PLC programming via IEC 61131-3. Configuration via LAN, USB, memory stick or micro SD card. Additional expansion with external modem modules e.g. SWT-12/SWT-96. Expansion with up to 12 I/O modules. Supply voltage 24 V DC, extendible to wide range 20 to 72 V DC using PS-60.

Product overview

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

- FW-5-GATE-4G-3 module
- Base software for series5X runtime system
  with the equipment features stated. **Additional run-time licences may be required depending on usage**. A setIT licence is required for configuration see **Configuration & diagnostics** on Page 53.

Items net-line FW-5-GATE

Item no.	Item	Function
310050004000	net-line FW-5-GATE series5e	Router/Gateway/Protocol converter no I/O
31005000410	net-line FW-5-GATE-CL	RTU & Gateway, CL-Meter interface
310050004200	net-line FW-5-GATE-3 series5X	RTU & Gateway rev3 series5X
310051000500	net-line FW-5-GATE-4G	EOL: LTE™ Mobile radio-RTU series5e
310051000510	net-line FW-5-GATE-4G CL	EOL: LTE™ Mobile radio-RTU + CL series5e
310051000520	net-line FW-5-GATE-4G-2	LTE™ Mobile radio-RTU, series5e
310051000530	net-line FW-5-GATE-4G-2 CL	LTE™ Mobile radio-RTU + CL, series5e
310051000540	net-line FW-5-GATE-4G-450	CDMA450 Mobile radio-RTU#6 series5e
310051000550	net-line FW-5-GATE-4G-450 CL	CDMA450 Mobil.-RTU CL ... #6 series5e
310051000560	**net-line FW-5-GATE-4G-3**	**LTE™ Mobile radio-RTU, series5X**
310051000570	net-line FW-5-GATE.NB-IOT*	NB-IoT/LTE-M/LTE-450-RTU series5X

Item no.	Item	Function
310051001600	Device FW-5-GATE series5e	rev2 +4G 2*LAN, 2*RS485 series5e
310051001610	Device FW-5-GATE CL	rev2 +4G 2*LAN, 1*RS485,1*CL series5e
310051001630	Device FW-5-GATE-3 series5X	rev3 2*LAN, 2*RS485 series5X
310051001700	Device FW-5-GATE-4G	rev2 +4G 2*LAN, 2*RS485 series5e
310051001710	Device FW-5-GATE-4G CL	rev2 +4G 2*LAN, 1*RS485,1*CL series5e
310051001720	Device FW-5-GATE-4G-2	rev2 +4G EG21-G 2*LAN, 2*RS485 series5e
310051001730	Device FW-5-GATE-4G-2 CL	rev2 +4G EG21-G 2*LAN, 1*RS485,1*CL series5e
310051001740	Device FW-5-GATE-450	rev2 +4G CDMA-450 2*LAN, 1*RS485,1*CL series5e
310051001760	**Device FW-5-GATE-4G-3**	**rev3 +4G EG21-G 2*LAN, 2*RS485, series5X**
310051001770	Device FW-5-GATE.NB-IoT*	rev3 +4G BG95-M4 2*LAN, 2*RS485, series5X
310051002900	**PS-60 Power supply**	Wide range supply 20 to 72 V DC, isolation, from FW-5-GATE series5e, FW-5-GATE-4G

* expected in 2023

Software & Drivers

The actual drivers and functions used depend on the project. This list only presents the possibilities:

Item no.	Item	Function
310050015000	setIT V.5 DemoExtended 30 days *EOS	Demo version for setIT V5
310050015010	setIT V.5 single user licence (SUL) *EOS	Single user licence
310050015110	setIT V.5 multiple user (MUL) *EOS	Multiple user licence, per user
310050015210	setIT V.5 Company license (CUL) *EOS	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
310050017010	**setIT V.7 Einzelplatz-Lizenz (SUL)**	single user licence
310050017015	setIT V.7 INT Einzelplatz-Lizenz (SUL)#	single user licence International
310050017020	**setIT V.7 workbench (SUL)**	Einzelplatzlizenz mit SPS-Prog.
310050017025	setIT V.7 workbench INT (SUL) #	SULmit SPS-Prog. International
310050017210	**setIT V.7 Firmenlizenz (CUL)**	company user licence
310050017215	setIT V.7 INT Firmenlizenz (CUL) #	company user licence
310050017220	**setIT V.7 workbench (CUL)**	setIT & straton
310050017225	setIT V.7 workbench INT (CUL) #	setIT & straton international

#INT: Full version with facilitated component selection; old components removed.
*EOS item out of Service

Item no.	codeIT Articel	Function
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

Item no,	visIT Articel	Function
310050014000	visIT V6 Designer Demo	Demo Version visIT Designer
310050014010	**visIT V6 Designer** L-E	Designer SUL 1000 Tags per station
310050014050	visIT V6 Designer MUL	visIT Designer MUL, Network dongle

Item no.	Drivers & runtimes per unit	Function
310051000004	net-line series5e basic software	FW-5-GATE operating system, extended
310051000005	net-line series5e basic software	FW-5 operating system, extended
310051000006	net-line series5e basic software	FW-5-GATE-4G operating system, extended
310004010400	net-line driver **IEC-870-5-101/104**	Included in the basic software
310004010900	net-line driver for **Modbus**	Included in the basic software
310004012700	net-line IEC-870-5-103 selective	Protective link, IEC 60870-5-103
310050010020	net-line driver IEC-870-5-103	Protective link, IEC 60870-5-103
310050010101	net-line driver **IEC-61850** FW-5	For FW-5-xxx
310050010110	net-line driver IEC-61850 server	for FW-5 | FW-5-GATE | FW-50 | BCU-50
310050010400	net-line Treiber - **DNP3 outstation**	Telecontrol serial/TCP
310050010410	net-line Treiber - DNP3 master	Telecontrol serial/TCP
310004010800	net-line driver for 3964R/RK512	fieldbus MPI
310004010910	net-line driver for DSfG	Interconnection of external device
310004012900	net-line runtime Redundance	Redundance module FW-50
310050010030	net-line runtime control centre	IEC-transmission list and Router
310050010200	net-line driver for SML	meter reading
310050010300	net-line driver for IEC 62056-21	meter reading
310050010350	net-line LACBUS-RTU Gateway	runtime for max. 50 Sofrel data logger
310050011101	codeIT runtime IEC-61131-3) 3 *EOS	Runtime for codeIT (64 kB) Variant 2
310050011155	straton runtime IEC-61131-3	runtime straton for FW-5
310050010600	visIT runtime FW-5	Visualisation system runtime
310050010600	visIT runtime FW-5	Visualisation system runtime
310050010610	visIT runtime FW-50	Visualisation system runtime
310050501020	visIT runtime BCU-50	Visualisation system runtime
310050010630	visIT runtime FW-5000	Visualisation system runtime

<7 no longer in setITV7, *EOS Article out of Service/Maintenance

Extension and expansion modules

Mounting on a DIN top-hat rail and the particularly compact design mean the elements can be wired directly in the cabinet and be used when space is at a premium.

Figure 3: Example net-line FW-5-BT configuration with 10 expansion modules

Expansion modules

Item no.	FW-5 expansion	Function
310051002010	**8DI**	8 wide range signals
310051002100	**8DO**	8 relay outputs
310051002050	**4DI4DO-1**	4 wide range signals, ± DC, #3 4 monostable changeover contacts
310051002070	**4DI4DO-2**	4 wide range signals, ± DC, #3 4 bistable changeover contact
310051002001	**8DI2AI**	8 wide range signals, 2 multi-range measurands
310051002200	**4AI**	4 measurands, mA multi-range
310051002310	**2AO**	2 set points, mA #1
310051002300	**4AO**	4 set points, mA
310051002400	**DSO-1**	Command relay EVU, 1.5-pole
310051002410	**DSO-2**	Command relay DSO 2-pole.
310051002500	**RES-1**	4 S0 inputs, 2 multi-range measurands 4 relay outputs
310051002510	**VPP-1**	6 wide range signals, 5 relay outputs 2 multi-range measurands, 2 setpoints#5
310051002550	**ISO-1**	4 loops for leakage monitoring #6
310051002560	**PIT-1**	4 humidity- /level senors, 2 PT-100 temperature sensors 0° to 150°C 4 relay outputs#6
310051002600	**PM-1**	Power measurement terminal#1
310051002610	**PM-1-R**	PM-1 with Rogowski coil #3
310051002620	**PM-1-S**	PM-1 via sensors #3
310051002630	**PM-2**	Power measurement terminal #6

#1 ab setIT V5.001 , #3 ab setIT V5.003, #4 ab setIT V5.004.07, #6 ab setIT V6
* from setIT V5.001 , #from setIT V5.003, #5 from setIT V5.004.07

Special modules

Item no.	FW-5 expansion	Function
310051005000	**PDPS-1**	Profibus-DP slave *
310051002990	**PWR-1**	Additional power supply for T-BUS
310051006100	**TBUS-R**	TBUS remote I/O receiver
310051006200	**TBUS-T**	TBUS remote I/O transmitter
310051003500	**TEST-1**	Test card (8DI2AI) with 8 switches and 2 potentiometers

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 outstation/master
  - MQTT publisher[#7]
  - LACBUS-RTU Gateway[#7] using FW-5-GATE-x and setITV7
  - SML
  - Modbus TCP
  - http/https, FTP/FTPs
  - SNMP/SNMPv3
  - VPN tunnel IPsec, OpenVPN[#6], TLS[#7]...
  - 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
  - DNP3 outstation /master
  - 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*
  - FSK modem*
  - Serial GPRS link*
  - TETRA packet data* EOL
  - Profibus-DP slave* EOL2024
  - ...

* External module required, [#6] from setIT V6, [#7] from setIT V7

Mobile radio in Smart Grids

Modern infrastructures such as Smart Grids for wide-scale monitoring of large supply networks are barely realisable cost-effectively without mobile radio connections. One possibility for the number of stations is the Internet, such as for the Internet of Things IoT Internet of Things. For practical and security reasons, access via WLAN is only realisable in the private and industrial sectors because the range alone restricts usage. Across the board, mobile radio connections with data transmission from machine to machine M2M machine to machine offer key benefits, but conceal risks such as possible restricted availabilities and potentially being a larger target for attacks on the network.

Security in M2M

These risks can be minimised with intelligent and powerful technologies. In any case, communication for M2M connections requires safeguarding with a high degree of IT security protection. This is provided in the series5e and can be set up easily and quickly using the IT security checklist.
New generations such as LTE™ /4G but as well CDMA-450 in particular are giving rise to mobile radio connectivity by virtue of near region-wide coverage.

Transmissions within a protected network

Within a protected mobile radio connection, the path over a public network can be bypassed by the provider offering a closed technology suchas CDMA-450 or an enclosed mobile radio space with access to non-public access points APN Access Point Name. Services of this kind are available on the German market as CDA3 vodafone, IPsec Telekom, mdex, etc. Here, the IP addresses of the M2M modules are managed separately from the networks of other users using appropriate techniques on the provider side, to ensure they can only exchange data with each other. Also, a connection can and should be protected by a VPN tunnel with end-to-end encryption.

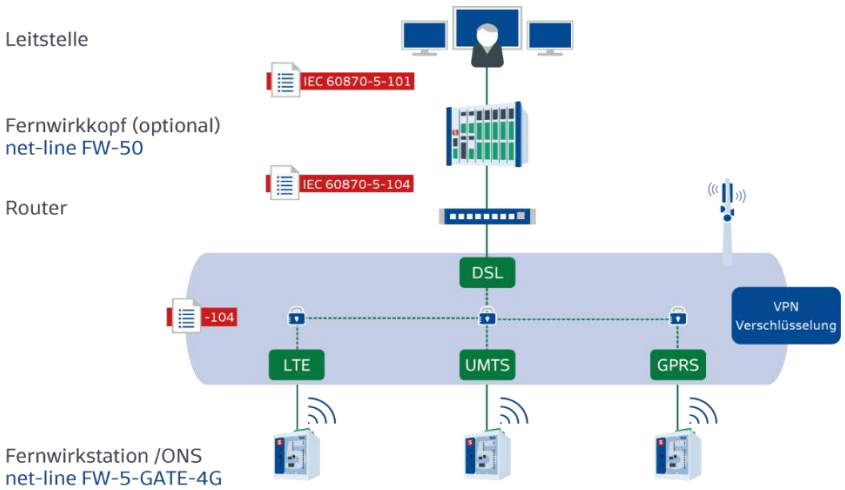


Figure 4: M2M network with end-to-end encryption over VPN

Mobile radio technologies

Different generations are available on the marketplace - a brief overview:

GPRS /EDGE: 2G

GPRS General Package Radio Service, also called 2G, is an extension of the GSM network that allows mobile access to the Internet and its extended range of services. To provide a cost-efficient service, it uses the transmission pauses of the GSM network and inserts data packets into those gaps at up to 80 Kbit/s. The data packages are transmitted to a central data server on the Internet via the TCP/IP protocol. However, the 2G technology is showing its age and is only still being maintained due its very widespread deployment. The technology is being discontinued in some countries, such as the USA and Switzerland. For low data volumes (in most cases), GPRS continues to be a well functioning technology however. EDGE is a variant of GPRS with higher transmission rates by using different modulation methods up to 230 Kbit/s.

UMTS /HSPA: 3G

UMTS/HSPA/HSDPA is a faster mobile radio standard with its own network and is used mainly in urban areas. Data transmission is essentially the same, but far faster - from typically 380 Kbit/s UMTS to about 42 Mbit/s HSPA+. In Germany, the 3G networks were switched off in 2021.

CDMA-450:

CDMA-450 is a separate radio network that is particularly suitable for critical applications, as it is only made available to a few providers. It can be regarded as a quasi-private network in 3G technology, which enables the advantages of mobile radio technology with significantly larger radio cells of up to 80 km. Download speeds of up to 14.7 MBit/s and upload speeds of up to 5.48 MBit/s can be achieved. In Germany, 450connect is the 'provider' of this frequency; it provides the access controls, the central data centre for switching the data and the secure VPN tunnels via backbone to its customers.

NB-IoT:

Narrow band IoT builds on the latest radio standards 3GPP rel14 and has a function already in its name. Narrow-band use of the air link makes it possible to connect a large number of units in parallel in order to get closer to the goals of the eMTC s.5G. This impacts a reduced throughput, which is in the range of ~150 kBit/s upload/download. Improved modulations significantly increase penetration and range. In addition, low power technologies are used to save energy. NB-IoT is ideal for infrequent transmission of small amounts of data, e.g. from sensors or small RTUs.

LTE™: 4G

LTE long term evolution, or 4G, is the most known mobile standard, with data transmission rates of 100 Mbit/s and latency times to 10 ms, which has a performance that can be as high as a separate LAN network. LTE™ developments are not yet complete despite it long being ready for the market. Developments continue at the 3GPP organisation responsible. To be able to address the field of IoT in particular, and the very large number of sensors with a low data volume, new categories are being created which provide for example (from 3GPP rel 11 in Class 1) smaller packets with bandwidths in the 10 Mbit/s range and even (from 3GPP rel13 with the LTE-M standard) data volumes in the 250 Kbit/s range, but which require far less power LPW low power wireless.

NR: 5G

The advertising messages of 5G promise a new era and in fact 5G NR new radio significantly expands the possibilities of M2M communication. The transition from 4G to 5G is smooth from the user's point of view, as the 3GPP rel13 definitions already meet specialised requirement profiles.

Goals of 5G are:

uRLLC	ultra Reliable Low Latency Communication Very short transmission times in stable radio network for Industry 4.0 applications
mMBB	massive Mobile Broad Band Transfer high data volumes for streaming, cloud, etc.
eMTC	enhanced Machine Type Communication Enable very high numbers of participants through narrowband technologies: LTE™-M catM1, NB-IoT

Source: https://www.3gpp.org; LTE™ and 5G-logo are trademarks of ETSI.

Mobile radio in telecontrol stations

To be able to realise modern M2M communication inexpensively and yet securely on a high performance level, a telecontrol station can be upgraded to a fully fledged mobile router with an mobile modem. 4G/3G/2G fallback to the previous communication standard is possible (depending on the module) to realise as broad a coverage and high availability levels as possible.

series5e products provide an internal VPN client based on IPsec, OpenVPN or TLS which safeguards data protection of an M2M connection with an end-to-end VPN tunnel, in line with the BDEW whitepaper recommendation.

M2M transmission with VPN tunnel

Secure data transmission can be set up at both ends of the data link with VPN encryption. Required for this in the field are special M2M modules with integrated VPN client and one or more VPN routers on the control centre side. The encryption mechanisms in the two phases of VPN setup (ISAKMP-SA: exchange of keys, IPsec-SA: VPN connection) can be set up separately.

The authentication methods:

- X.509v3 certificate /CA certificate
- Pre-Shared Key (PSK)

We recommend CA certificates.

The following can be selected as VPN encryption methods (not exhaustive):

- 3DES-192
- blowfish 128 /192 /256
- AES 128 /AES-192 /AES 256

with Hash algorithm MD5, SHA-1, SHA256, SHA384 or SHA512.
We recommend methods from 256 bit.

One of the biggest systems of this kind is a solution built redundantly over multiple levels.

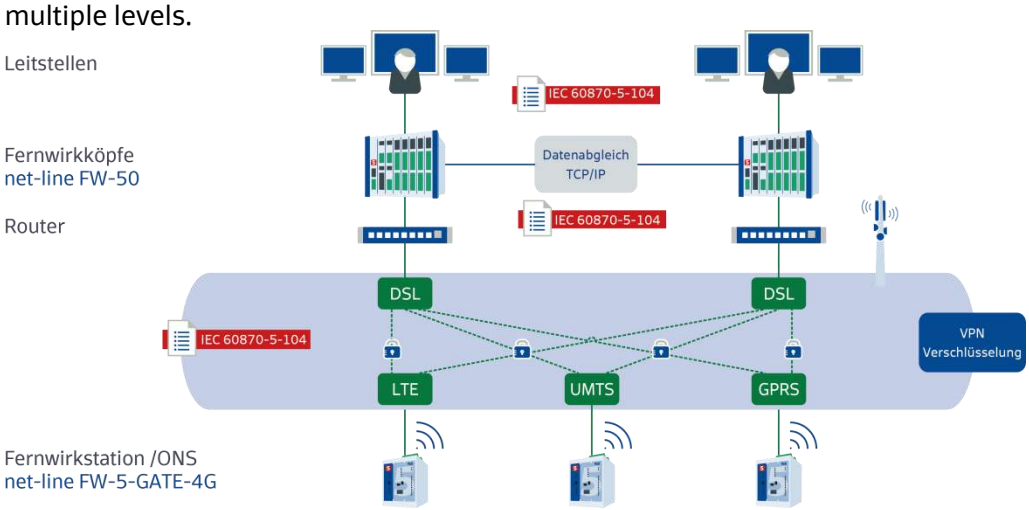


Figure 5: M2M network with redundant VPN links to redundant master station and control system

4 Installation of a telecontrol station

Installation guidelines

The housing of the FW-5-GATE-4G-3 is optimised for direct DIN top-hat rail mounting. The mounting dimensions can be derived from the following sections.

According to UL/CSA and EC Directive 2014/35/EC Low Voltage Directive for voltages exceeding 50 V AC / 75 V DC, 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.

Mounting to DIN top-hat rail

The FW-5-GATE-4G-3 is routed to the top-hat rail from **underneath**, hooked in **upwards** with slight pressure and engaged into the correct position by **rotation**. Engaging into place is discernible from the distinct click noise. A firm fitting can be checked by lightly pulling the device.

Earthing

The fixed position on the top-hat rail activates the earthing of the device.

CAUTION

Please ensure that the top-hat rail in the cabinet is earthed properly; it must be possible to adequately dissipate the energy of a transient source of interference refer to Troubleshooting & **installation guidelines** on Page 17**.**

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
- Empty enclosure standard IEC/EN 62208 for cabinet construction

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-5-GATE-4G-3 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 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.

Guidelines for operation

The product line FW-5 features a modular design with mainly detachable terminals on the base system and expansion modules. This results in the following guidelines:

DANGER

Workings on the device when it is live means parts to which dangerous voltage is being applied can be accessible. This applies in particular to signal and command system cards (relays) with an operational voltage exceeding 48V AC or 60V DC.

Procedure for replacing modules

1. Ensure that the supply voltage of the telecontrol system is switched off
2. Ensure that the process and switching voltages at signal and command terminals are shut-off
3. Remove the respective plug connectors of reporting and command channels
4. Release the lock of the modules at the top on the top-hat rail and remove the module from the bus system by tilting it **down** slightly
5. Snap in the new system card into the top-hat rail at the required position from below
6. Plug the system card into the telecontrol system by pressing the top connector of the card until the locking mechanism clicks into place at the top
7. Plug in the relevant connectors for the signal and command channels
8. Switch the process/switching voltage and supply voltages of the telecontrol system back on
9. Check the functionality of cards based on the LED status

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

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 signals and commands with voltages > 48 V AC or > 60 V DC

If information and command I/O are operated with dangerous voltages arrangements for the protection of individuals has got to be made. We use **black** terminals in the I/O area for colour coding of possible dangerous process voltages.

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 permitted in a case or a housing with protection class IP 56 or better or in an enclosed operating room!

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 burst and 2000 V surge AC.

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 NFLÜ for WT12/SWT12 or broadband transmission transformers PCM-FLÜ using WT96/SWT96.

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.

Supply voltage connection

Supply for FW-5-GATE-4G-3

Red terminal X3 (4-pole) provides power to the telecontrol system.
The integrated 24 V DC supply filters the input voltage and provides the internal voltages required for the system cards and expansion modules.

Supply voltage	**+24 V DC**, -15% + 20%, momentarily 35 V DC Power failure management with protection against mains disruption
	No galvanic isolation between supply and logic
Power consumption	typical 5 W, base station only (0.25 A @24 V DC) Maximum 12 W with expansion modules
Power outage protection	100 ms without expansion modules, 50% TBUS load min. 30 ms

An upstream PS-60 voltage supply can be used to power the FW-5-GATE-4G-3 with voltages > 24 V DC and galvanic isolation.

Refer the device nameplate for the connection values.For powering using other voltage ranges (especially V AC), a suitable upstream power supply unit or UPS can be used - refer to Page 145 and **UPS -** Uninterruptible power supplies on Page 146.

Nameplate on FW-5-GATE-4G-3

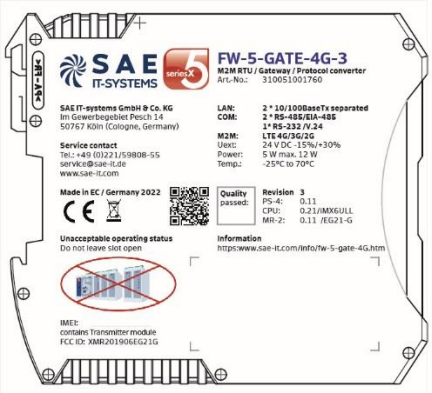


Figure 6: Example new nameplates on FW-5-GATE-4G-3 series5X

Note: **Using a PS-60 is required when the positive terminal is grounded.**

Isolation concept FW-5-GATE-4G-3

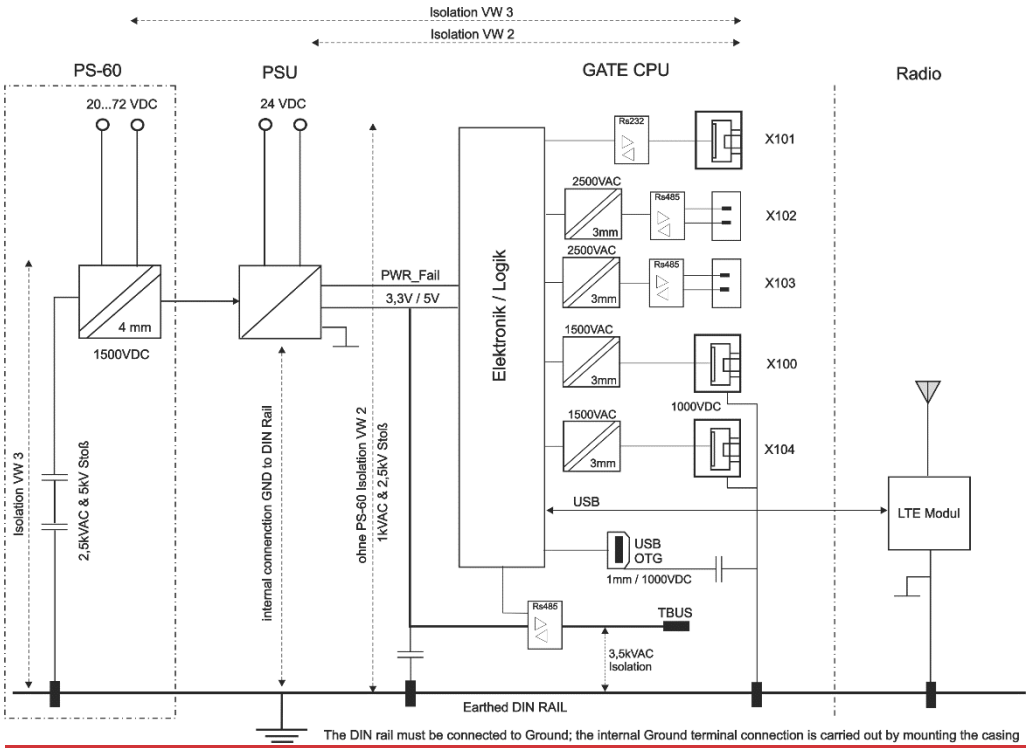


Figure 7: Isolation concept FW-5-GATE-4G-3 with recommended PS-60

Attention: **The lightning protection of the antenna to earth is routed via the shield to the module and thus the functional earth connection of the top-hat rail and the negative of the system; if galvanic isolation of power supply is desired, the use of a PS-60 is required.**

Wide range supply using PS-60

The PS-60 voltage supply enables a wide range supply of 20 to 72V DC, with galvanic isolation, to be provided for the FW-5-GATE-4G-3. The PS-60 is plugged in on the left of the base system and is connected to the base system with two black TBUS connectors.
Red terminal X3 (4-pole) provides power to the telecontrol system.
The integrated wide range power supply filters the input voltage and provides the internal voltages required for the system cards and expansion modules.
Galvanic isolation of the PS-60 also enables operation with grounded positive.

Supply voltage	**24 to 60 V DC** - 15% +20% Power failure management with protection against mains outage
Galvanically isolation	1500 V AC between supply and logic 2500 V AC supply to ground, Class VW3
Power consumption	typical 6 W, base station only (0.25 A @24 V DC / 0.1 A @60 V DC) Maximum 15 W with expansion modules (0.6 A @ 24 V DC)
Power failure protection	20 ms, 50 ms at 60V DC

PS-60 conversion set

Included with the PS-60 is a conversion set, comprising two black TBUS connectors and a red cover for the X3 terminal on the base system. The TBUS connectors are positioned next to each other on the DIN top-hat rail. The PS-60 and FW-5-GATE-4G-3 are clicked onto the left and right connector respectively, establishing the supply to the base system. There is no risk of short-circuit despite the black connectors interlinking into the grey expansion module TBUS connectors.
For voltages > 24V DC, the X3 terminal of the FW-5-GATE-4G-3 shall be covered by a red panel to prevent system damage from incorrect plugging.

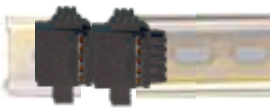


Figure 8: Positioning of the black TBUS connectors left of the grey TBUS

Figure 9: Positioning the FW-5-GATE base system

Figure 10: Plugging in the PS-60 to the left of the FW-5-GATE

Figure 11: Expansion modules can be configured using the grey TBUS

Redundant supply using PS-60

The PS-60 can be used as a redundant supply; the PS-60 and base system are then powered from the respective X3 terminals. If the 24V DC supply on the base system fails, the PS-60 is used.

Isolation plan

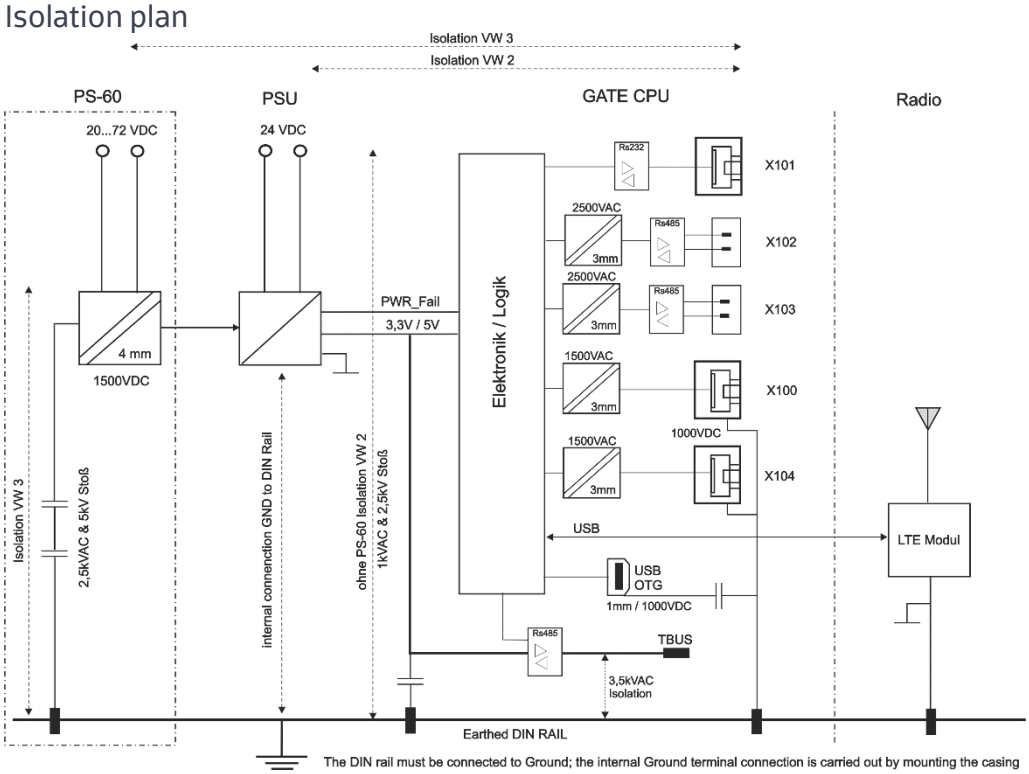


Figure 12: Isolation plan with optional PS-60, here FW-5-GATE-4G-3

NOTE: The USB ports are realised as service ports and are not galvanically isolated from the supply. The GND of the USB ports is connected to ground of the supply.

REMARK: **The USB interfaces are designed as service interfaces and are not galvanically isolated from the 24 V supply. The GND of the USB interfaces is coupled with the ground of the supply.**

ATTENTION: **Using a PS-60 is required when the positive terminal is grounded.**

Nameplate on PS-60

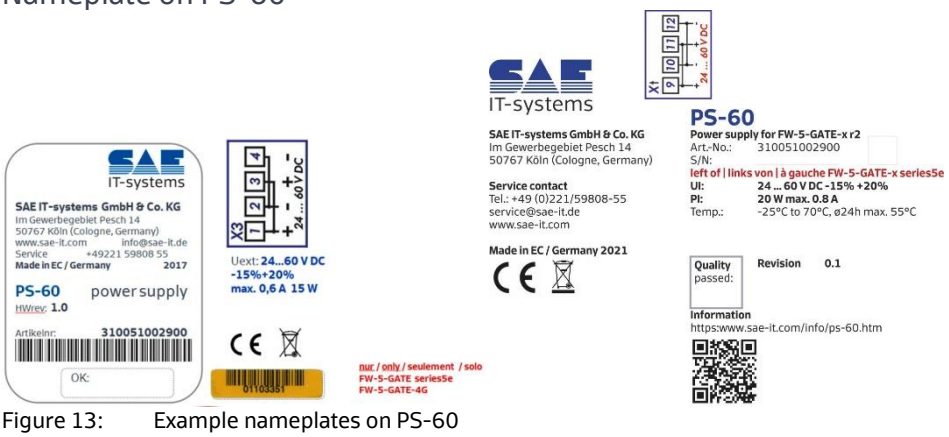


Figure 13: Example nameplates on PS-60

Fusing the supply to the FW-5-GATE-4G-3

Fusing of the respective supply current circuit must be external. The fusing value is determined using factor 2.1 of the maximum input current. This can be determined from the following table when the consumption values (on every supply level) are multiplied by the respective number:

$I_{tot} = I_{base} + \Sigma\ n*I_{expansionmodule}$

Base module	I_{24VDC}	I_{48VDC}	I_{60VDC}	$I_{TBUS\ supply}$
FW-5 series5e	200 mA	100 mA	80 mA	1200 mA
FW-5-GATE series5e	150 mA	75 mA	60 mA	1200 mA
FW-5-GATE-4G /4G-2	250 mA	125 mA	100 mA	1200 mA
FW-5-GATE-450	250 mA	125 mA	100 mA	1200 mA
FW-5-GATE-3 series5X	105 mA	55 mA	45 mA	1200 mA
FW-5-GATE-4G-3	210 mA	105 mA	85 mA	1200 mA
FW-5-GATE.NB-IoT	210 mA	105 mA	85 mA	1200 mA

Expansion module	I_{24VDC}	I_{48VDC}	I_{60VDC}	$I_{TBUS\ load}$
8DI	20 mA	10 mA	8 mA	85 mA
8DI-220	20 mA	10 mA	8 mA	85 mA
8DO	60 mA	30 mA	24 mA	200 mA*1
8DO-220	60 mA	30 mA	24 mA	200 mA*1
4DI4DO-1	45 mA	23 mA	18 mA	190 mA*1
4DI4DO-2	20 mA	10 mA	8 mA	75 mA
8DI2AI	30 mA	15 mA	12 mA	120 mA
4AI	40 mA	20 mA	16 mA	150 mA
2AO	80 mA	40 mA	32 mA	75 mA*2
4AO	160 mA	80 mA	64 mA	75 mA*2
DSO-1	70 mA	35 mA	28 mA	250 mA
DSO-2	70 mA	35 mA	28 mA	250 mA
RES-1	100 mA	50 mA	40 mA	400 mA*1
VPP-1	93 mA	48 mA	37 mA	390 mA*1
ISO-1	60 mA	30 mA	24 mA	215 mA
PIT-1	75 mA	37 mA	30 mA	285 mA*1
PM-1	40 mA	20 mA	16 mA	150 mA
PM-1-R	40 mA	20 mA	16 mA	150 mA
PM-1-S	40 mA	20 mA	16 mA	150 mA
PM-2	40 mA	20 mA	16 mA	150 mA
PDPS-1	70 mA	35 mA	28 mA	260 mA
TBUS-T	10 mA	5 mA	4 mA	40 mA
TEST-1	30 mA	15 mA	12 mA	120 mA
M2G-1	180 mA	90 mA	72 mA	- *2
IFX-485	5 mA	3 mA	2 mA	-

*1 40 mA +20 mA for each closed relay, *2 additional supply

Installation of antennae

HF cables should generally be kept as short as possible to minimise attenuation through the cables. However, it is better to position the antennas at a point with good reception than to necessarily use a short cable. Ideally, an antenna should have the correct plug (SMA-m) to prevent attenuation and contact faults in adapters. Cables can be extended; lengths exceeding 10 m are only advisable with an appropriate cable. When laying the cable, square corners with small radii should be avoided; similarly, over-long cables should not be coiled up, as air coils may occur.

- Installation tips:
  - An ideal installation location has a direct line of sight to the transmitter mast
  - Keep cables as short as possible
  - Ideally, avoid the use of extensions and adapters
    Attenuation per contact ~ 2 dB
  - Do not coil cables
  - Do not tilt antennae
    Exception: diversity antenna (MIMO) is fitted offset by 90°
  - Seal external couplings and ports
- The shield of the antenna cable must not be used as a PE, earth or equipotential bonding conductor.
- Protection of persons from contact with or approach to electrical heavy-current power distribution systems of up to 1 kV, paragraph 8 of the DIN EN 50083-1 standard. These values are defined differently in the national DIN VDE 50083-300:2000-04 standard.
  - The horizontal distance between antenna parts and the electrical power distribution systems (facilities and networks of up to 1 kV) must amount to d ≥1.0 m. In cases of high voltages, keep an accordingly larger distance. (Paragraph 8.1. DIN EN 50083-1)

Lightning conductor

Established lightning protection measures must be taken when installing antennae in outdoor areas. Proper installation of a surge arrester is recommended here. Please note that the shield of the antenna cable is usually connected to earth / ground.

Installing LTE™ antennae

With LTE™, it is generally recommended to use a MiMo antenna; here, the second antenna is already installed in the common housing; as a rule, two cables must then be connected. In this way you achieve higher data transmission due to lower bit error rates and better network availability due to MiMo antenna gain.
MiMo does not have to be, however, if the data connection via a single antenna is sufficient. Merely connecting a second antenna with the same orientation does not have the desired effect, as the reception quality is usually only slightly increased and depends very much on the exact mounting. You will find a recommendation for antennas in the appendix.

However, if a second antenna is used, the following applies:
With single-polarised antennas, the MIMO mode is only utilised if the LTE™ antennas are mounted with an **offset polarisation**, i.e. the main antenna is mounted vertically and the diversity antenna horizontally or at a 90° angle to it. In addition, the distances must be correct and the surroundings must be taken into account. Only then the advantage of MIMO technology may lead to an increase in the reception data rate. If the LTE™ antennas are mounted in the same orientation, the achievable data rate is lower because MIMO cannot be exploited. If directional antennas are used, the aperture angle would increase, which means that the alignment to the transmitter mast can be less precise in order to achieve the same sensitivities.

Distance between antennae

The recommended distance between LTE™ antennae is dependent on the frequency band used. This rule of thumb applies:
Distance between LTE™ antennae = n * wavelength
The bigger the distance, the lower the effect of the antennae on each other - because antennae uncoupling reduces with increasing distance.
This gives minimum distances between centre points of LTE antennae:
Minimum distance for LTE450 LTE™ antennae = 80 cm (450 MHz)
Minimum distance for LTE800 LTE™ antennae = 43 cm (800 MHz)
Minimum distance for LTE1800 LTE™ antennae = 19 cm (1800 MHz)
Minimum distance for LTE2600 LTE™ antennae = 13 cm (2600 MHz)

Recommendation : The distance between antennae should be ~40 cm or 80 cm, corresponding to a multiple of the possible wavelengths.
Source: http://www.lte800.com/anleitung-ausrichten-einer-lte-aussenantenne

Important: Never coil up HF cables. The air-core coil dampens.
Secure the SMA connector to a torque of about 4 Nm.

Aligning LTE™ directional antennae

Aligning antennae is only important for antennae with directivity. Omnidirectional antennae almost receive equally in all directions.

For the alignment of a directional antenna, the diagnostics interface of setIT is recommended to directly display the field strength. A valid SIM card must be inserted in the device and the data service enabled with the PIN as required.

The approximate direction to the nearest transmit mast is shown on the network coverage maps e.g. from German providers.

Telekom:	https://www.telekom.de/netz/mobilfunk-netzausbau
Vodafone:	https://www.vodafone.de/hilfe/netzabdeckung.html
O2 Telefónica:	https://www.o2online.de/netz/

Entering your address here specifies the direction to the next LTE™ location (usually in degrees and direction). An antenna can be positioned roughly using a compass, such as an app on a smartphone. Then slowly turn the LTE™ antenna by a few degrees and watch the diagnostics display in setIT.
Do not turn the antenna continually. Instead, for every position, wait at least 30 seconds to give the mobile handset enough time to display the correct signal strength values. Once the best antenna position has been determined, do not forget to tightly secure the LTE™ antennae / screw them to the mast.
More official information on network coverage is available here:

Germany:	https://breitbandmessung.de/kartenansicht
International:	https://www.cellmapper.net/map?lang=de,
	https://www.nperf.com/de/map/DE/
	https://www.opensignal.com/networks (APP)

SIM card

SIM cards enable authentication within a mobile radio network and provide the basic information for a mobile radio connection. For a data transfer, enabling of the data service must be defined with the relevant data volume within the band required. Telephone services and voice are not required but are generally also enabled.

Enter the PIN

SIM cards can be protected from misuse by using a PIN. The PIN personal identification number and PUK personal unblocking key required for security enabling are supplied by the provider with the SIM card. On standard mobile phones, the value of a PIN can be set to a individual value or be disabled. In the setIT project, this PIN must be entered under the Station properties. For every start process of the station, the PIN is only sent once - to prevent early unlocking by the PUK when the PIN is incorrect.

Inserting the SIM card

The SIM card is inserted into the front of the FW-5-GATE-4G-3. It must engage with an audible click and line up with the front. The recess/corner of the SIM must be **underneath** and facing the **front of the device** before placement. The contacts must be pointing **outwards** to the right. The card clicks into the holder perceptibly. To remove the SIM card, gently push it into the card holder.
The SIM card can be plugged in whilst the device is running - the mobile radio component then restarts.
In the DUAL-SIM variant, a second SIM card can be inserted under the top cover of the unit on the far right in the SIM2 slot. expected 2023

In the example on the left, a FW-5-GATE-4G

Please do not touch the SIM contacts.
A standard mini-SIM/UICC: Universal Integrated Circuit Card is used.

Format	**mini-SIM** /UICC	ISO 7810 ID-000 /2FF
Interface	**1.8 / 3.0 V**	ISO 7816-3 Class B, Class C

In the setIT project it is possible to select which mobile services may be used (2G, 3G and 4G). Also, switching to another provider (roaming) can be deselected. To reduce undesired cell changes, a preselection of the base station can be set up by suitable positioning of a directional antenna to the base station required.

5 Startup

Configuration & diagnostics

Parameterisation by selection with setIT

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:

- Loading the configuration from an SD card
- USB host for speedy transfer 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:

Article setITV7	License model	
310050017010	**setIT V.7 Single-user (SUL)**	Single user licence
310050017015	setIT V.7 INT Single-user SUL	Single user licence International
310050017020	**setIT V.7 workbench (SUL)**	Single-user +PLC Programming
310050017025	setIT V.7 workbench INT (SUL)	SUL+PLC Programming International
310050017210	setIT V.7 Company license (CUL)	Company user licence
310050017215	setIT V.7 INT Firmenlizenz (CUL)	Company user licence international
310050017220	setIT V.7 workbench (CUL)	setIT & straton - Company license
310050017225	setIT V.7 workbench INT (CUL)	setIT & straton -Company International

Licences with workbench allow integrated PLC programming with straton according to IEC 61131-3.
Licences with INT are optimised for international use with easier selection through reduction to current components.

The relevant usage and license conditions apply EULA.

The ease of 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 through straton workbench

From setITV7 workbench onwards, the optional soft PLC via straton offers additional flexibility through the implementation of diverse logical controls in PLC programs according to IEC 61131-3. The programming environment of straton Automation has been fully integrated into setIT workbench. The PLC data model and variable exchange is embedded in the I/O capacity of the telecontrol device. The integration of the PLC I/O subset is selective; only the assigned process points are integrated.

setIT workbench Licensing

For the permanent operation of PLC programming with straton, you need a licence key for the environment setIT workbench and a runtime licence for each target system. The runtime licence is assigned to a device and may be marked with a label:

Article	straton runtime	Function
310050011150	straton runtime IEC-61131-3	for FW-50, BCU-50 and FW-5000
310050011155	straton runtime IEC-61131-3 FW-5	runtime straton for FW-5
310050011156	straton runtime IEC-61131-3 m5	runtime straton for m5

Visualisation on site with visIT

visIT is a platform-independent visualisation tool for creating modern graphical browser based user interfaces. By importing all process variables from the setIT parameterisation tool, all relevant elements can be conveniently integrated with the help of the designer and quickly assembled into a custom-fit visualisation; here, either the symbol library provided can be used or completely individual drawing and dynamisation can be carried out.
The resulting visualisation is then loaded as part of the firmware file into the respective SAE telecontrol device and can be called up there under the IP address of the station. Practically all devices with HTML5-capable browsers can serve as end devices; in addition to permanently installed touch displays, this also includes compatible smartphones and tablets of the service personnel. By installing visIT on a separate server, it can also provide information for interogation by decentralised local control stations and thus even be used as a rudimentary control system.

- For the flexible creation of the graphics you need the visit-Designer
- For the runtime environment, a runtime licence is required in each station.

Article	Licensing model
310050014010	visIT V6 Designer L-E (SUL) - Single user licence Designer 1000 Tags
310050014000	visIT Designer Demo - test licence, limited to 5 tags
310050010640	visIT runtime m 5- Runtime Visualisation
310050010600	visIT runtime FW-5 - Runtime Visualisation
310050010610	visIT runtime FW-50 - Runtime Visualisation
310050501020	visIT runtime BCU-05 - Runtime Visualisation
301131002650	Training visIT

Licensing

You need a Designer licence to create the plant images. After installation without a valid registration, visIT is available to you in demo mode for an unlimited period of time but with reduced functionality. For the permanent operation of the Designer you need a licence key.
For the permanent operation of the plant visualisation on the target system from series5+ you need a runtime licence. The licence is granted by the following sticker on the device; a deviating licensing requires an additional written approval:

Configuration of station with USB stick

The FW-5-GATE-4G-3 is delivered in the cleared status (factory setting). Only the operating system is active, there are no system drivers of configuration in the memory! Only the device certificate is stored securely in the Secure Element.
Due to the extended security concept, a series5X unit requires a **pairing key** for initial commissioning. The pairing key is a kind of password that serves as a key between the project and the station used for identification. Without this key, the signature of the packets to be loaded cannot be verified. The pairing key is entered in setIT under the user administration or in the main tree of the project.
Since a cold-started station does not know this key, it must be transmitted or entered before initial loading. When loading via USB memory stick, this is done by entering it in a web browser.
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. Remember the pairing key entered for the project.
5. Start a usual web browser with the start address of the LAN connection used; on-site access via USB cable is activated after cold start and accessible via DHCP server in the address space 192.168.59.81/29.
6. Authenticate with the standard login data.
7. Enter the pairing key at ####.
8. Now plug the memory stick into Port USB2 of the FW-5-GATE-4G-3.
   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					
USB	●	green	●	ON	USB stick detected
		green	○	OFF	No data for loading on/detected on USB stick
		green	✳	flashing	USB data transfer automatically activated **Please do not pull the stick in this state**!
USB	●	yellow	●	ON	USB stick faulty or no or no new data for the station contained on the stick.
		yellow	✳	flashing	Automatic data transfer completed
2. Push service button for 3 s to update the station. Automatic performing on initial start.					
device	●	green	✳	flashing	USB/SD data transfer active: **Please do not remove the USB stick in this operating status.**
3. Possible results:					
USB	●	green	●	ON	Data transmission completed USB stick can be removed now. New data is activated after removal of USB stick
USB	●	yellow	✳	flashing	
			✳	ON	USB stick faulty and/or no new data for station on USB stick
USB	●	green	○	OFF	The USB stick which has been detected after cold starting contains no initial station files and can be removed.

4. Remove USB stick

LED lights: Diagnostics series5X operating state

run com sys VPN 1 4	Colour	LED state	Function
	green	LED1 flashing 4 Hz LED2...4 ON	secure-boot sequence max. 90 s
	green	LEDs 1 - 4 flashing simultaneously	Operating system OK, **No system or configuration.**
	green	LEDs 1 - 4 forming a chasing 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 chasing 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 reset to initial state with USB switch Operation USB switch on right: Factory setting 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 67

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 and series5X microSD at front

Activating an SD card

To allow an SD card to be checked, it must be enabled at the units property page. This setting enables system messages 'SD card error' and 'SD card not plugged in'. Additionally, the units configuration and firmware can also be synchronised as a backup on the card.

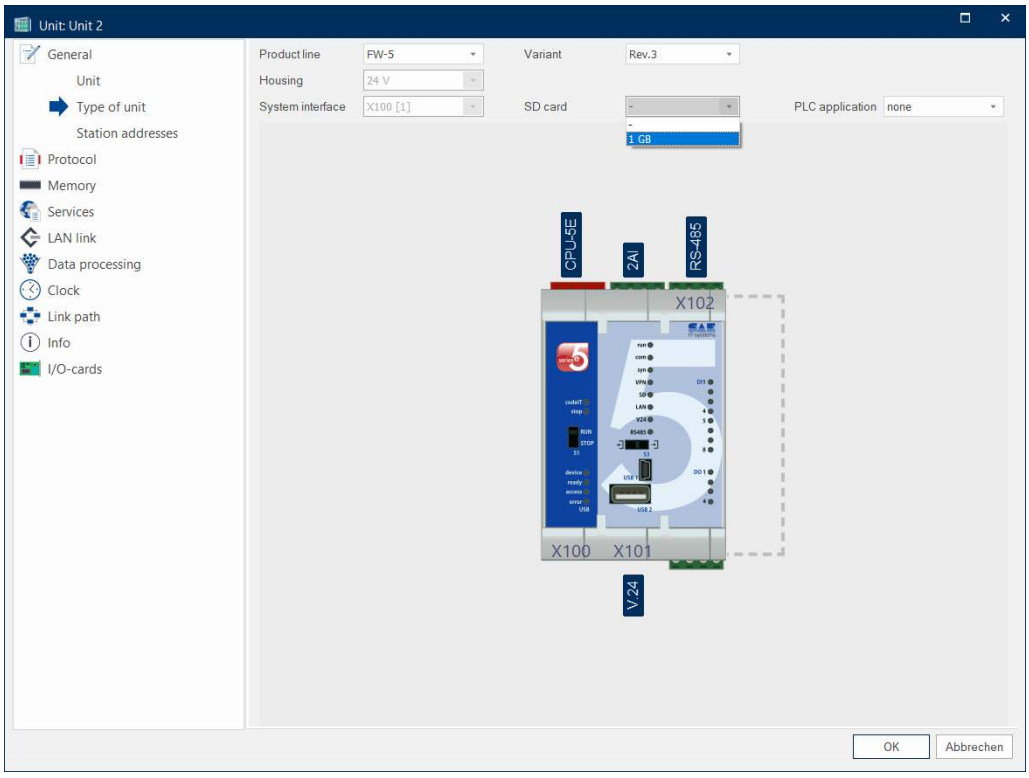


Figure 14: Enabling and selecting an SD card

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.

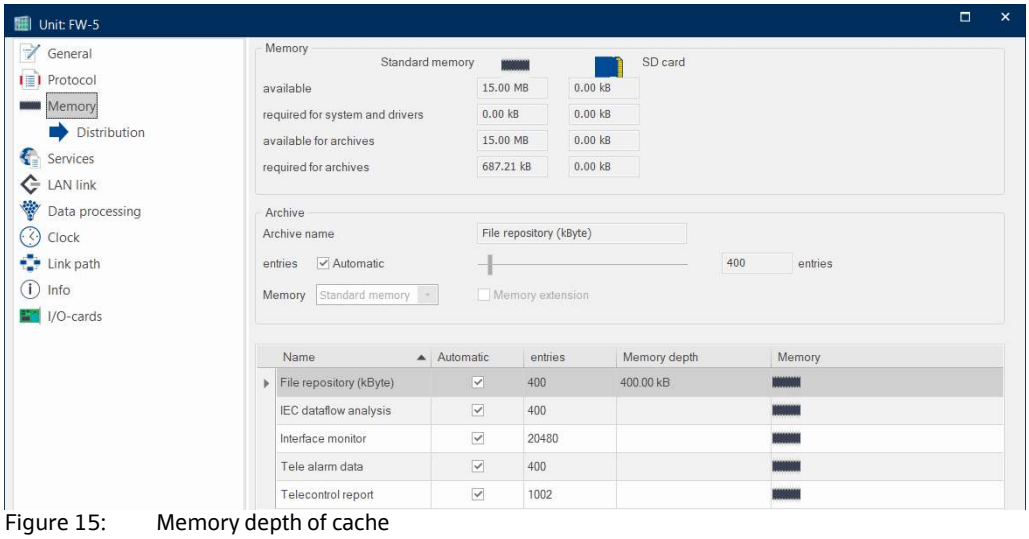


Figure 15: Memory depth of cache

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. From 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 'Backup system to 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.

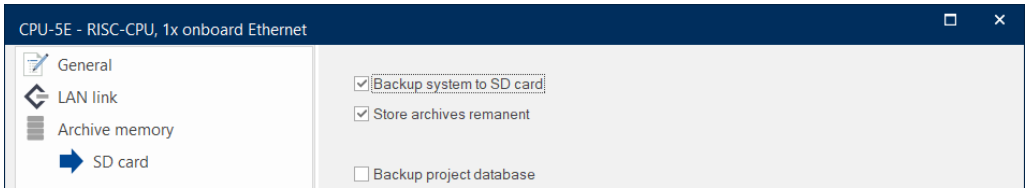


Figure 16: Backup of firmware on SD card

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).

Data stored on SD card

An overvew of data stored on the SD card and its protection is given in this table:

Data	Storage format	Protection	Condition
Archive	Sqlite3 Data base		Archives must be created and 'Archive resetfest' #1 must be activated
Firmware	ZIP	Symmetrically encrypted with SAE password or system password*.	Archives must be created and 'Backup system to SD card'#1 must be activated.
Telecontrol system & communication driver	Binary format		
Configuration (e.g. IP addresses, station and project name, VPN configuration & credentials)	Sqlite3 Data base / text		
Files for station website	Text		
User database	Sqlite3 database	Passwords as salted hashes	
System password	Binary format	Symmetrically encrypted with SAE password	'Sign Firmware'#2 and 'Backup system to SD Card'#1 must be activated
Public signature key	Text		'Sign Firmware'#2 and 'Backup system to SD Card'#1 must be activated

* Signed firmware must be activated, #1 Card parameters of CPU, #2 User management

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	~ 20,000 cycles writing/deleting per sector
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	~ 100,000 write/delete cycles
MTBF @25 °C	≥ 3,000,000 hours

Recommended SD card

Product	Name
310050011550	series5 memory/archive upgrade, micro SD, 1 GB

[+] microSD for FW-5-GATE and its variants

6 CPU modules FW-5-GATE-4G-3

The FW-5-GATE-4G-3 is an enhancement of the FW-5-GATE-4G in series5X technology with a new mobile chipset from Quectel, prepared for worldwide use through its global approval. Dispensing with integrated input/outputs lead to a reduced installation size.
In addition to the mobile radio connection for communication over 4G/3G/2G networks, the net-line FW-5-GATE-4G-3 also provides two LAN network segments 10/100 Mbit/s in separate TCP/IP controllers and three separate UARTs with up to 64 Byte FIFO and max. 921.6 kbit/s. For the connection of USB components, a USB-OTG connection with a transmission speed of up to 480 MBit/s according to the USB 2.0 standard is available. USB-OTG offers the USB-device and USB-host function on one port; a VB-5 cable is available for connecting a USB stick.

To achieve a maximum of stability and defined data backup in the event of power outage, a power management controller based on separated power fail signals is integrated. Separate voltage clusters ensure a maximum power failure protection time of up to 100 ms. Additional operational sutainability is provided by the integrated watchdog, which continually checks the functions of the latest operating system.
In conjunction with the PS-60, the earthing concept and division into isolation clusters offer high isolation resistance combined with maximum immunity. The systems has been especially developed for the demands of industry and DSO applications and fulfil all restriction and engineers standards of these sectors.

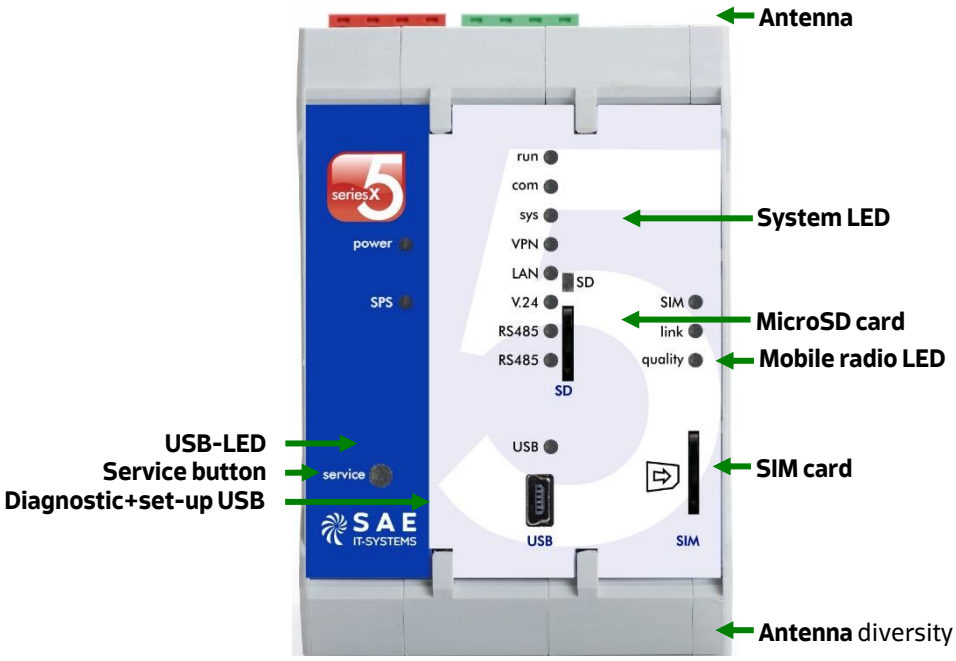


Figure 17: FW-5-GATE-4G-3 controls and displays of the standard configuration

NOTE: **The USB ports is realised as service ports and are not galvanically isolated from the supply.**

Features FW-5-GATE-4G-3

The series5X processor core with 800 MHz internal clock frequency enables a processing speed of 1000 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 FW-5-GATE-4G-3 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).
A secure element provides for the secure storage of the device certificate. Extensive hardening measures ensure a high level of tampering protection. The security features of the series5X can be found under **The new technology series5X** page 23.

The integrated mobile radio module provides a highly integrated and secure connection to infrastructures of supply networks such as Smart Grids; all security features in the series5X technology are used. M2M communication enables high receive quality with MISO receiver and state-of-the-art chip sets using the latest technology, with specialisation on IoT communication to the LTE™-M standard 3GPP release 11 with optimised LTE™-CAT1 data packets.

- series5X processor cortex-A7 mit 800 MHz
- 1 GB Memory:
  512 MB SDRAM, 512 MB SLC NAND Flash, 1 MB NOR ,
  128 kB SRAM buffered 60 days retain memory
- opt. memory expansion with micro SD card up to 8 GB
- LTE™ mobile radio interface, 4G/3G/2G fallback
- MISO antennas for increased receive quality
- 2·TCP/IP-Ethernet interface·10/100·BaseTx
- 1 RS-232/EIA-232/V.24 coupler interface, up to 115 kbit/s
- 2 RS-485/EIA-485 field interfaces ,up to 115 kbit/s
- Service button on front panel, e.g. for configuration transfer
- Real-time clock and SRAM backed up by rechargeable LiIon battery
- Display and diagnostics using 15 multi-coloured system LEDs on front

You can find further properties under **Fehler! Verweisquelle konnte nicht gefunden werden.**.

Note: **setIT Version 7.002 or higher is required to use the FW-5-GATE-4G-3**

Display and diagnostics

The display and diagnostics functions are identical for all FW-5-GATE-4G-3 models. Located on the front panel are LEDs to indicate the operating states of the CPU unit and the statuses of 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 or more SCADA	
		○	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	
LAN ●	green	●	static ON	link	communication active, X100
●	yellow	●	static ON	link	communication active, X104
●●	gre/yell	✳	alternating	link	communication active, X100 & X104
V24 ●	green	✳	flashing	"RxD"	receive signal X101
●	yellow	✳	flashing	"TxD"	transmit signal X101
RS485 ●	green	✳	flashing	"RxD"	receive signal X102
●	yellow	✳	flashing	"TxD"	transmit signal X102
RS485 ●	green	✳	flashing	"RxD"	receive signal X103
●	yellow	✳	flashing	"TxD"	transmit signal X103

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+VPN = cold start option by pushing switch service for 3 s.

PLC LED straton

PLC LED		Colour			Function
	●	green	●	ON	PLC RUN
			○	OFF	PLC STOP or inactive
			✳	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 for diagnosis will be shown. If the device LED is illuminated, a link was recognised. If the download will be performed via setIT or the webserver, the yellow ready LED is flashing. Refer to the figure in **Fehler! Verweisquelle konnte nicht gefunden werden.** on Page **Fehler! Textmarke nicht definiert.**.

USB-OTG automatically detects whether a device interface is used for diagnosis or a host function for a memory stick. With the VB-5 cable, connecting a memory stick is flexible and easy.

USB-LED		Farbe			Funktion
USB	●	grün	●	AN	USB link redognised/Transfer finished
		grün	○	AUS	passive state, no data, no USB link
		grün	✳	blinkt	USB-Data transfer activated automaically **Don't pull the stick in this case!**
USB	●	gelb	●	AN	Error: wrong type of device, wrong kernel, no new data found for unit
		gelb	✳	blinkt	Data transmission completed, ready

Operating functions

FW-5-GATE-4G-3 does without a PLC switch; the functions are replaced internally by system functions.

service-button

The function button is located in the front panel of the system. The setIT user interface offers further functions such as saving the archives to a USB memory stick or deleting the eMMC memory.

Aktivierung	Bezeichnung	Funktion
press < 1 s		Activate the system LED for 1 min
press > 3 s	configuration	Transfer of data from USB memory stick, if inserted
press > 3 s	Cold start	Resetting the system during chase light in start phase

Cold start/Initial-reset

During a restart, the system shows an alternating light of the system LED (run & VPN flash simultaneously). By pressing service for 3 s during this phase, you can initiate an **initial-reset** of the system memory and all IP addresses; 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.

Mobile radio LED

A chasing light of LED SIM/traffic/link/quality indicates the system start and the attempt to connect to the mobile radio module. A jumping light with 2 LED indicates a broken connection in-between CPU and mobile radio board.

LED	Colour		Function
SIM ●	green	● ON	OK: SIM1 logged in, connection search via LED link
		✳ once	No PIN: Wait for PIN entry
		✳ flashing 10 Hz	No SIM1, SIM not recognized
		○ OFF	SIM1 error: No login via SIM1
SIM* ●	yellow	● ON	OK: SIM2 logged in, connection search via LED link
		✳ once	No PIN: Wait for PIN entry
		✳ flashing 10Hz	No SIM2, SIM not recognized
		○ OFF	SIM2 error: No login via SIM2
traffic ●	green	✳ flashing	Wireless data transmission active Output dependent on radio module
link ●	green	● ON	Operating mode OK: when LED SIM is ON
		✳ flashing	Mode "Loading program"
		✳ twice	SIM ON: Connected but no IP received
		✳ once	SIM ON: Search for connection
		○ OFF	Error: Connection failed
quality ●	green	● ON	Maximum field strength CSQ 20 - 32
		✳ ○ ON / momentarily OFF	Signal strength good CSQ 12 - 19
		○ ✳ OFF / momentarily ON	Signal strength medium CSQ 8 - 11
		○ OFF	Signal strength poor CSQ <8 Error: field strength too low not logged in

*SIM2 only available on variant supporting DUAL-SIM

Signal strength using MR-1 Revision 2

To increase the diagnosis and operability of the FW-5-GATE-4G-3, the display of the quality signals has been improved with a two-colour LED; the other signals are identical:

quality ●	green	● ON	Signal strength max. CSQ 20 - 32: 75 - 100%
		✳ 1 Hz	Signal strength good CSQ 12 - 19: 50 - 75%
quality ●	yellow	● ON	Signal strength poo medium CSQ 8 - 11: 25 - 50%
		✳ 1 Hz	Signal strength poo CSQ <8 : 0 - 25%
		○ OFF	error: not connected

Service button S4

The service button S4 allows the following operating functions:

Action		Function
push	3 s	forced reset of mobile radio device, without system boot

Technical details FW-5-GATE-4G-3

FW-5-GATE-4G	**series5X RISC process core**, ARM Cortex A8, @800 MHz, FPU, watchdog, real-time clock, Secure-Element
Data memory	**1 GB memory**: 512 MB SDRAM, 512 MB SLC NAND Flash, 1 MB NOR flash, 1.8 GB pSLC eMMC-flash, 128 kB SRAM buffered, 60 days, Secure-Element
Memory extension	**microSD card** to 8 GB optional currently 1 GB usable
Capacity	**Modular expansion** using a maximum of 12 I/O modules **Expansion** via communication up to 10,000 process data **IEC 61850** up to 40 IED Temperature sensor internal Measuring range -25°C - +100°C , measuring fault ±3°C max.
Real-time clock	Accuracy max. ±10 ppm in use, buffered maintenance-free ±20 ppm 60 days @25°C, daylight saving/standard time changeover, leap year correction
Status indicators	**LED on front panel** for system, communication Web server integrated
Controls	**service button** for configuration / backup / recovery functions
Interfaces	**2** **Ethernet** LAN TCP/IP, 10/100BaseTx, 100 Mbit/s auto-MDIX, auto negotiation **1** **V.24**/RS-232, RJ-45, to 115 kbit/s, max. 20 m, galvanically connected to supply **2** **RS-485**, terminal, up to 115 kbit/s, max. 31 nodes, end termination, galvanically isolated **USB-OTG** device/host USB 2.0, 480 Mbit/s, mini type B socket,
Fault indication output	Configurable on relay of expansion module
Supply voltage	**+24 V DC** -15% +30%, momentarily to 35 V DC 5 W, base station only (0.25 A @24 V DC) 12 W with expansion modules, max. 0.5 A @24 V DC Power failure management with protection against outages **FW-5-GATE-4G-3 + PS-60: +24 to 60 V DC** -15% +20% 5 W, base station only (0.25 A @24 V DC / 0.1 A @60 V DC) 12 W with expansion modules, max. 0.5 A @24 V DC
Redundant supply	if simultaneous supplied using PS-60
Power failure protection	100 ms without extension boards, 50% TBUS load min. 30 ms
Supply TBUS	1200 mA max. for 12 EM Extension modules
Dielectric strength	**FW-5-GATE-4G-3**: 2,5 kV DC surge supply & RS-485 to PE, acc. C**lass VW2** 1,5 kV DC surge supply to LAN **FW-5-GATE-4G-3 + PS-60**: 5 kV DC surge supply & IO to PE, acc. C**lass VW 3** 2,5 kV DC surge supply to RS-232, USB

CE/DoC	Health&Safety:	IEC 62368-1 2014 + Corr.1 2015 / EN 62368-1 2014 + AC 2015, EN 62311: 2008
	EMC:	ETSI EN 301 489-1 [V2.2.1] ETSI EN 301 489-52 [V1.1.0 draft] EN 55032: 2016 Class B EN 61000-6-2: 2019
	Spectrum:	ETSI EN 301 511 [V12.5.1] ETSI 301 908-1 [V13.1.1] ETSI 301 908-2 [V13.1.1] ETSI TS 151 010-1 v12.8.0
	RoHS	DIN EN IEC 63000:2019-05 RoHS2
MTBF	64a @ 40°C / 18a @ 70°C	
Housing	FW-5 micro housing, polyamide V0, IP 20	
Dimension Basic System	68 x 105 x 115 mm (W x H x D)	
Installation	**DIN top-hat rail** DIN EN 60715 TH35 horizontal	
Weight	280 g excluding packaging	
Terminals	Screw terminal MSTBT, Spring terminal FKCT,	0.2 to 2.5 mm² or 0.2 to 2.5 mm²
Ambient temperature	**-25° ... +70° C** without EM**,** at full load without PWR-1 +60°C, storage -40°C ... +85°C	
Installation height	Max. 3000 m above sea level Pressure > 70 kPa	
Relative air humidity	< 95%, without condensation	

*Different features can be provided depending on the LTE™module selected

This variant of the FW-5-GATE-4G uses a newer release of the LTE™ development. It is designed for IoT operation, which enables cat 1 mode based on 3GPP rell 11 and thus sends smaller data packets on a lower bandwidth.

FW-5-GATE-4G-3	**Mobile radio router LTE™-IoT,**
Category	● **LTE™-IoT** Modul 3GPP **rel11**, **cat1** ● Region global
Transmission rates	● LTE™ 10 MBit/s download, 5 MBit/s upload ● HSPA+ 42 MBit/s down, 5,76 MBit/s up, WCDMA 384 kBit/s, ● EDGE 236,8 kBit/s, GPRS 85,6 kBit/s
Frequency bands	● 4G FDD LTE™:B1/B3/B5/B7/B8/B20 ● 3G WCDMA: B1/B5/B8 ● 2G GSM: B3/B8 900/1800 MHz
Transmitter power	● LTE™ FDD class3 (23 dBm±2 dB) ● UMTS class 3 (24 dBm+1/-3 dB) ● EDGE class E2 (26 dBm±3 dB) ● GSM 900 class 4 /33 dBm±2 dB), 1800 class 1 (30 dBm±2 dB)
Receive sensitivity	● MISO DL ● LTE™ -100 dBm ● UMTS -110 dBm ● GSM -109 dBm
Services	● DFOTA upgrades

7 Terminals FW-5-GATE-4G-3

Connections FW-5-GATE-4G-3

The terminal assignments on FW-5 systems are broadly identical. However, the positions of the two LAN interfaces on the new version of the FW-5-GATE have moved down and the V.24/RS-232 port has moved up.
Also note the changed voltage supply.
In order to offer a simple and space saving wiring the terminals have fixed positions at the top and bottom side of the compact system.

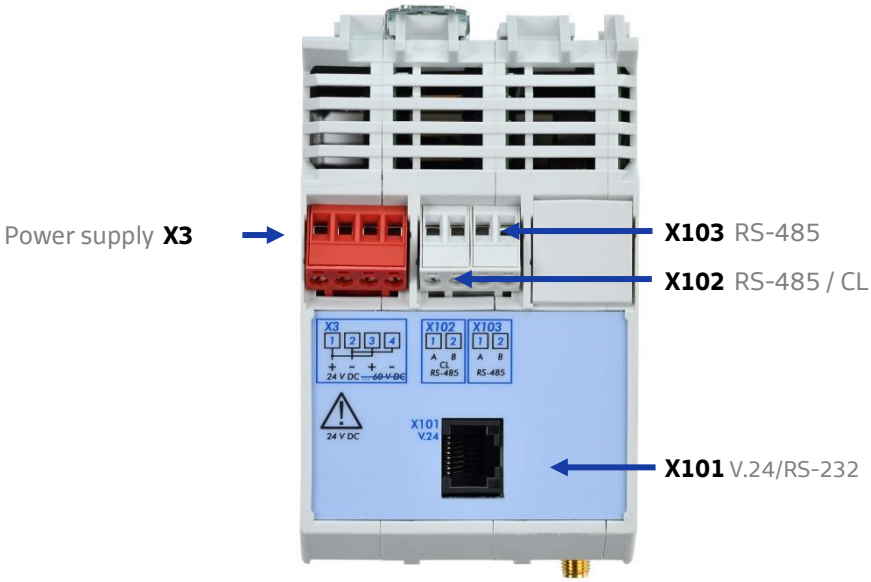


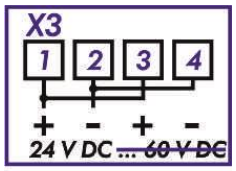
Figure 18: FW-5-GATE-4G-3 Terminal allocation, top

Figure 19: FW-5-GATE-4G-3 Terminal allocation, bottom

Power supply

The high power requirement means the voltage supply to the net-line FW-5-GATE-4G-3 is only realised as 24 V DC and not galvanically isolated.

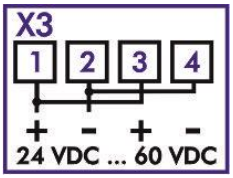
X3: Power supply for FW-5-GATE-4G-3



Terminal X3	Signal name	Remarks
X3.1	+ Ub	24 V DC, max. 12 W
X3.2	- mass	0V
X3.3	+ Ub	24 V DC, max. 12 W
X3.4	- mass	0V

Supply voltage	24 V DC -15% +30% max. 35 V DC momentarily
Power	max. 12 W depending on activation min 0.2 A@24 V DC, max. 0.5 A@24 V DC
Electrical isolation	No galvanic isolation
Power failure	<·19·V·DC··
Terminal X3	Screw terminal MSTB 4-pole, 0.2 to 2.5 mm²

X3: additional supply voltage PS-60



The PS-60 series voltage supply makes available a wide range supply 20 to 72 V DC and galvanic isolation. When 24 V DC is used, the PS-60 can also be used as a redundant supply for the FW-5-GATE-4G-3.
Please observe the assembly instructions under **PS-60** S. 46

Terminal X3	Signal name	Remarks
X3.1	+ Ub	24 V to 60 V DC ±20%, max. 12 W
X3.2	- mass	0V
X3.3	+ Ub	24 V to 60 V DC ±20%, max. 12 W
X3.4	- mass	0V

PS-60	20 V to 60 V DC -15% +20% (20 ... 72 V DC) Power failure management with protection against mains outage
Power consumption	typical 5 W, base station only (0.25 A @24 V DC / 0.1 A @60 V DC) max. 12 W with expansion modules (0.5 A @ 24 V DC / 0.2 A @60 V DC)
Galvanically isolation	1500 V AC between supply and logic 2500 V AC supply to ground, Class VW3
Power failure	<·19·V·DC··
Power failure protection	min. 20 ms, 50 ms at 60 V DC
Terminal X3	Screw terminal MSTB 4-pole, 0.2 to 2.5 mm²

The supply voltage can if required be protected against faulty plugging.

FW-5-GATE-4G-3 interfaces

The interface assignment is essentially the same for all types. The FW-5-GATE-4G-3 has two LAN connectors for separate network segments on X100 and X104 both at bottom. Both feature automatic 10/100 Mbit/s speed adjustment (auto-negotiation) and cable topology (auto-MDIX / cross-over detection).

LAN: X100/X104 LAN Ethernet connector

PIN	Function 1:1	cross	
1	Tx+	/Rx+	Transmit/receive data
2	Tx -	/Rx -	Transmit/receive data
3	Rx+	/Tx+	Receive/transmit data
4	RC1		Line termination 1
5	RC1		Line termination 1
6	Rx -	/Tx-	Receive/transmit data
7	RC2		Line termination 2
8	RC2		Line termination 2
shield	shield		RC combination to GND

The LED have been moved to the front for improved visibility. A bicolour LED LAN specifies the connection activities of the two interfaces:

LAN	Function
● Green	X100 link
● Yellow	X104 link

Note: Line termination to Bob Smith with RC combination for return attenuation at open wires. For a connection to networks with PoE (Power over Ethernet), this burns free.

V.24: X101 Interface RS-232 /EIA-232 ports

Interface	V.24 (RS-232, ANSI/EIA/TIA-232-F-1997)
Operating methods	Full duplex, point-to-point
Line	8-pin cable (RJ-45) according ETSI EN 300 392-5 DEE
Transmission mode	Asymmetric point-to-point
Baud rate	300 to 115 Kbit/s
Range	Typical 0.3 m, max. 20 m
Function indicator	LED at front (Tx Yellow, Rx Green)

The isolation of this interface is not realised as a field interface. The V.24 interface is located on the same isolation cluster as the USB ports. Galvanically isolation to field interfaces needs to be procured by external communication units.

V.24: X101 EIA-232 connector to RJ-45 socket

Pin	Name		according ETSI EN 300 392-5 DEE
1	DSR/PWR	◀	Ub+ 5 V (max. 0.15 A) for ext. module
2		◀	n.c.
3		▶	n.c.
4	GND	-	mass
5	RxD	◀	Receive Data Receive data
6	TxD	▶	Transmit Data Transmit data
7	CTS	◀	Clear To Send
8	RTS	▶	Request To Send Keying
Shield	Shield		RC combination to GND (2 kV)

The seizure of the RJ-45 allows the connection of external WT units (SWT-12·/·SWT-96)·via patch cable.

For special communication modules for which a direct power supply is not possible via T-BUS, a switchable supply voltage of 5V (max. 0.15 A) is provided in additional on Pin 1. In case of exceeding wattage or short-circuit this voltage is cut off in order to protect all components of the device.

V.24: X101 LED V24

On the front of the module are the LEDs for this interface

LED	Colour	Function	
V24 ●	green	"RxD"	receive signal X101
●	yellow	"TxD"	transmit signal X101

With the IFX-485 converter, the X101 interface can be used as another EIA/RS-485 interface. The IFX-485 is powered from the main system.

RS-485: X102 FW-5-GATE-4G-3

RS-485 : X102 field interface

The RS-485 (EIA-485) interface permits the simple and fail-safe serial connection of meters and other external components such as protective equipment, flow controllers, PLCs, star couplers and signal converters using just a few wires. The interface is constructed as 2-wire simplex.

RS-485: X102 connector line

RS-485 lines must have terminating resistors at the ends to prevent reflections. The termination must be on the first and last interface in the system.
The standard version of the FW-5-GATE is intended as data terminal equipment at the conductor end, meaning **termination of the line is enabled at all times**. For additional interference suppression, the line is terminated with 220 Ω, and at the same time is pulled to a defined level with pull up / pull-down resistors (1 kΩ). This is absolute necessary for some protocols (such as Modbus, IEC, ...).

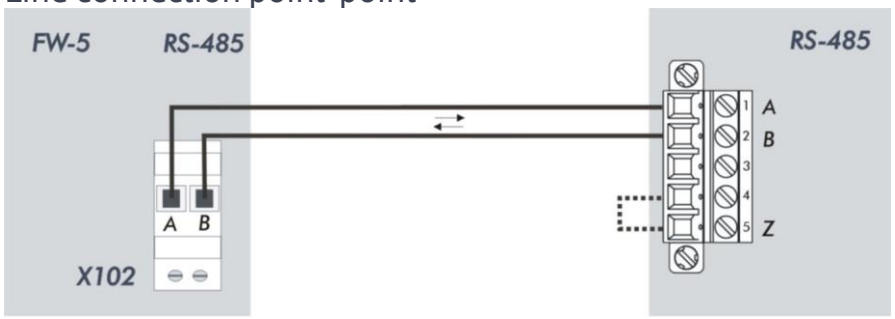
For cases in which the FW-5 is not used at the ends, and where termination would cause disturbance, termination can be permanently removed by our personnel.

RS-485 port	RS-485 (ANSI/TIA/EIA-485-A-98 R2003)
Operating methods	Half-duplex, Bus mode
Line	2 lines, twinned and shielded, e.g. LiYCY 2x2x0.25 mm
Transmission mode	symmetrical
Baud rate	300 to 115 kbit/s
Keying	Automatic, lead/lag times can be set in setIT
Range	1200 m
Function indicator	LED at front (Tx Yellow, Rx Green)
Signal sensitivity	± 200 mV
Termination	220 Ω, each with 1 kΩ pull-up/down for interference suppression
Electrical isolation	between logic and transmission line
Test voltage	2500V AC for USB, logic, X103 and RS-232

RS-485: X102 LED

LED	Colour	Function	
RS485 ●	green	"RxD"	receive signal RS485/X102
●	yellow	"TxD"	transmit signal RS485/X102

Line connection point-point

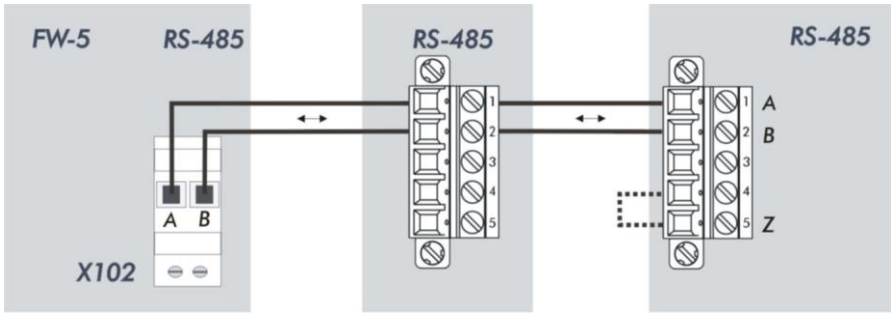


FW-5 should preferably be placed at the end of the line.

with RS-485-1 apply jumper
with RS-485-2, set S17/S18 to position 1-2 or apply jumper

Figure 20: Line connection RS-485 point-to-point

Line connection party line/multi-point operation



FW-5 should preferably be placed at the end of the line.

with RS-485-1 apply jumper
with RS-485-2, set S17/S18 to position 1-2 or apply jumper

Figure 21: Line connection RS-485 partyline/multi-point operation

RS-485: X103 field interface

This interface is identical to the RS-485 interface of the FW-5 base systems (given under X102) at the identical mechanical position.

The EIA/RS-485 interface enables simple and fail-safe connection of external components with just a few wires - such as protective equipment, short circuit/earth fault indicators, network analysis systems, flow controllers, PLCs, star couplers and signal converters. The interface is constructed as 2-wire simplex.

RS-485: X103 connector line

RS-485 lines must have terminating resistors at the ends to prevent reflections. The termination must be on the first and last interface in the system.
The standard version of the FW-5-GATE is intended as data terminal equipment at the conductor end, meaning **termination of the line is enabled at all times**. For additional interference suppression, the line is terminated with 220 Ω, and at the same time is pulled to a defined level with pull up / pull-down resistors (1 kΩ). This is absolute necessary for some protocols (such as Modbus, IEC, ...).

For cases in which the FW-5 is not used at the ends, and where termination would cause disturbance, termination can be permanently removed by our personnel.

RS-485 port	RS-485 (ANSI/TIA/EIA-485-A-98 R2003)
Operating methods	Half-duplex, Bus mode
Line	2 lines, twinned and shielded, e.g. LiYCY 2x2x0.25 mm
Transmission mode	symmetrical
Baud rate	300 to 115 kbit/s
Keying	adjustable in setIT
Range	1200 m
Function indicator	LED at front (Tx Yellow, Rx Green)
Signal sensitivity	± 200 mV
Termination	220 Ω, each with 1 kΩ pull-up/down for interference suppression
Electrical isolation	between logic and transmission line
Test voltage	2500V AC for USB, logic, X102 and RS-232

RS-485: X103 LED

On the front of the module are the LEDs for this interface

LED	Colour	Function	
RS485 ●	green	"RxD"	receive signal X103
●	yellow	"TxD"	transmit signal X103

8 Expansion Modules I/O

Expansion modules EM are mounted flush to the right of the base system on the top-hat rail. Each module is stored in an own housing and provides a fixed capacity of I/O channels. **Up to 12 expansion modules can be deployed depending on the power requirement of the modules.** The PWR-1 module enables an additional supply.

The expansion modules have their own intelligent controller which performs real-time acquisition and communicates with the base system. The T-BUS is used for the mechanical and electrical connection to the base system. The base unit establishes communication with the expansion modules over the bus system,and uses a special algorithm to determine their addresses and positions on the bus.

All FW-5 components are delivered with a T-BUS plug. The plug with module fits into the top-hat rail. Expansion modules are positioned flush to the right and connected to the previous by applying slight force. The modules are integrated into the system with a learn process. The position and type of expansion modules must correspond with the project.

Figure 22: T-BUS adapter for expansion modules

Supply of extension modules on the TBUS

The electronics of the expansion modules is supplied from the base system over the T-BUS, and supplied with a maximum load of 1.2 A. A special controller monitors the current requirement and switches off in the event of overload.
For configuration of the expansion boards to be as practical as possible, a current calculator in setIT monitors the maximum load.
External supply or control voltages may be required depending on card type.
The calculation of currents is realised as conservative in setIT. Because the current requirement is also dependent on the signal states (e.g. number of relays connected), the responsibility for preventing an overload is transferred to the user. Current calculations can be disabled with the "FW-5 bus extension" function. An additional supply can be provided with the PWR-1 module.

Terminal names

The expansion modules are 22.5 mm wide in a separate housing. In this housing model, each expansion module is to be fitted with a terminal strip at the top and possible bottom. Standardised naming of terminals was selected to facilitate simple numbering and documentation of all expansion modules.

Rules on terminal numbering

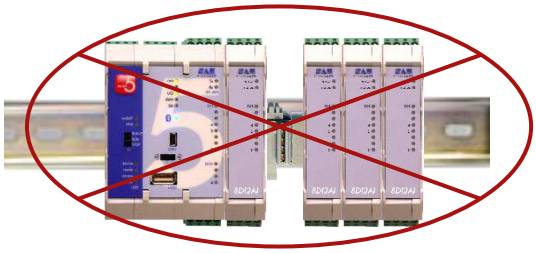
The position of an expansion card gives a unique name. The top row of an expansion module always has an odd X-number (X↑ at top for clarity). This is formed from the number of the module/terminal to the left +2.

Example:
The net-line FW-5 base system has designation X13 on the terminals in the top right. The next expansion module is assigned terminals X15, the second expansion module X17, etc. The lower terminal strip of an expansion module (X↓ at bottom) always shows the number following the top X terminal number (X↓ at bottom = X↑ at top +1). This is always even.

Figure 23: X terminal numbering of 10 expansion modules on the FW-5 series5+

WARNING

If the FW-5 is extended using expansion modules,
leaving slots free between the FW-5 and an expansion module, or between expansion modules themselves, is not permitted on the expansion bus (T-BUS).



In this case, SAE IT-systems GmbH & Co. KG assumes no guarantee for operation of the telecontrol system or any devices and functions connected.

8DI expansion module

Item no.	Item	Function
310051002010	8DI rev1	8 wide range signals
310051002011	**8DI rev2**	8 signals, wide range, root +/-

Technical data 8DI

8DI	FW-5 extension module I/O
Capacity	**8 digital wide range inputs**, 24 to 60 V DC, ±20%
Input range	18 ... 72 V DC, switching threshold 18 V DC, acquisition 1 ms rev1: 0.4 mA @ 15V, 2.8 mA @ 48V, 3.5 mA @ 60V, 4.3 mA @ 72V DC rev2: 1.8 mA
Counter acquisition	min. pulse width 1 ms, max. 10 Hz
Electrical isolation	Optocoupler, common root item 310051002011 with ± root
Communication	T-BUS
Supply	Internal via T-BUS, approx. 85 mA per module, up to 12 modules approx. 20 mA @ 24 V DC supply
Environment	-25°...+70°C, Ø24h max. 55°C, rel. humidity< 95%, without condensation
Terminal	Screw terminal, removable, MSTB 3* 4-pole, 0.2 to 2.5 mm²
Housing	Plastic with integrated I/O, top-hat rail installation 22.5 x 105 x 115 mm (W x H x D)
Weight	127 g excluding packaging

Display and diagnostics

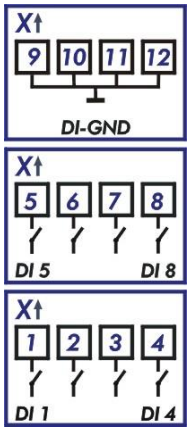
System LEDs

LED	Colour			Function
error ●	red	○	OFF	Operating mode: No-fault status
		●	static ON	Errors: EM disabled /malfunction
		✳	flashing 2 Hz	Errors: EM configured incorrectly / module defective
		✳	flashing 4 Hz	Errors: Number of modules or slot position not same as configuration
		✳	flashing 8Hz	Error: No communication to base system
status ●	yellow	○	OFF	Operating mode: No-fault status
		●	static ON	Errors: EPROM error
		✳	"Chasing light"	short pulse per assembly after Bus release only visible with several EMs

Status of signal inputs

LED	Colour		Function
DI1 ●	green	DI1	Status of signal at input DI1 on terminal X↑.1
...			
DI4 ●	green	DI4	Status of signal at input DI4 on terminal X↑.4
DI5 ●	green	DI5	Status of signal at input DI5 on terminal X↑.5
...			
DI8 ●	green	DI8	Status of signal at input DI8 on terminal X↑.8

Terminal assignment



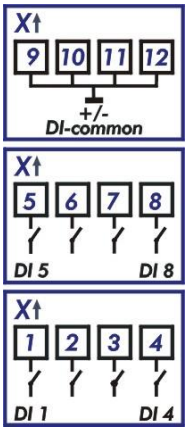
Terminal X↑-top: Signal inputs 8DI

Terminal X↑	Signal name	Remarks
X↑.1	DI 1 of module	Signal input 1 18 ... 72 V DC
X↑.2	DI 2	Signal input 2 18 ... 72 V DC
X↑.3	DI 3	Signal input 3 18 ... 72 V DC
X↑.4	DI 4	Signal input 4 18 ... 72 V DC
X↑.5	DI 5	Signal input 5 18 ... 72 V DC
X↑.6	DI 6	Signal input 6 18 ... 72 V DC
X↑.7	DI 7	Signal input 7 18 ... 72 V DC
X↑.8	DI 8	Signal input 8 18 ... 72 V DC
X↑.9-12	GND	Ground 0V

X↓-bottom: unused / not connected

Terminal X↑-top: Signal inputs 8DI rev2.2 /8DI-220#

Item 310051002011 with ± root, from 2016



Terminal X↑	Signal name	Remarks
X↑.1	DI 1 of module	Signal input 1 18 ... 72 V DC/0 V DC
X↑.2	DI 2	Signal input 2 18 ... 72 V DC/0 V DC
X↑.3	DI 3	Signal input 3 18 ... 72 V DC/0 V DC
X↑.4	DI 4	Signal input 4 18 ... 72 V DC/0 V DC
X↑.5	DI 5	Signal input 5 18 ... 72 V DC/0 V DC
X↑.6	DI 6	Signal input 6 18 ... 72 V DC/0 V DC
X↑.7	DI 7	Signal input 7 18 ... 72 V DC/0 V DC
X↑.8	DI 8	Signal input 8 18 ... 72 V DC/0 V DC
X↑.9-12	GND	Ground or switching voltage 18 ... 72 V DC

Terminal X↓-bottom: unused /not connected

8DI-220 expansion module

Item no.	Item	Function
310051002020	8DI-220# rev2	8 signals, ±110/±220V DC, root

Technical data 8DI-220

8DI-220#	FW-5 extension module I/O
Capacity	**8 digital inputs ±110 /±220V DC** ±20% ⚠
Input range	110 / 220V DC, switching threshold 88 V DC, acquisition 1 ms,
Input current	1.8 mA @ 90 up to 264 V DC
Counter acquisition	min. pulse width 1 ms, max. 10 Hz
Electrical isolation	Overvoltage class II / Pollution degree 2 EN 60664-1
Communication	T-BUS
Supply	Internal via T-BUS, approx. 85 mA per module, up to 12 modules approx. 20 mA @ 24 V DC supply
Environment	-25°...+70°C, Ø24h max. 55°C, rel. humidity< 95%, without condensation
Terminal	Screw terminal, removable, MSTB 3* 4-pole, 0.2 to 2.5 mm²
Housing	Plastic with integrated I/O, top-hat rail installation 22.5 x 105 x 115 mm (W x H x D)
Weight	127 g excluding packaging

#from setIT V5.003.07b22, series5+/series5e

Display and diagnostics

System LEDs

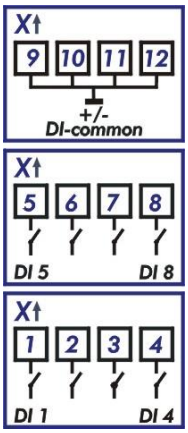
LED	Colour			Function
error ●	red	○	OFF	Operating mode: No-fault status
		●	static ON	Errors: EM disabled /malfunction
		✳	flashing 2 Hz	Errors: EM configured incorrectly / module defective
		✳	flashing 4 Hz	Errors: Number of modules or slot position not same as configuration
		✳	flashing 8Hz	Error: No communication to base system
Status ●	yellow	○	OFF	Operating mode: No-fault status
		●	static ON	Errors: EPROM error
		✳	"Chasing light"	short pulse per assembly after Bus release only visible with several EMs

Status of signal inputs

LED	Colour		Function
DI1 ●	green	DI1	Status of signal at input DI1 on terminal X↑.1
...			
DI4 ●	green	DI4	Status of signal at input DI4 on terminal X↑.4
DI5 ●	green	DI5	Status of signal at input DI5 on terminal X↑.5
...			
DI8 ●	green	DI8	Status of signal at input DI8 on terminal X↑.8

Connector assignment

Terminal X↑-top: 8DI-220



Terminal X↑	Signal name	Remarks
X↑.1	DI 1 of module	Signal input 1 110 / 220 / 0 V DC
X↑.2	DI 2	Signal input 2 110 / 220 / 0 V DC
X↑.3	DI 3	Signal input 3 110 / 220 / 0 V DC
X↑.4	DI 4	Signal input 4 110 / 220 / 0 V DC
X↑.5	DI 5	Signal input 5 110 / 220 / 0 V DC
X↑.6	DI 6	Signal input 6 110 / 220 / 0 V DC
X↑.7	DI 7	Signal input 7 110 / 220 / 0 V DC
X↑.8	DI 8	Signal input 8 110 / 220 / 0 V DC
X↑.9-12	GND	Ground or switching voltage 110/220 V

Terminal X↓-bottom: unused / not connected

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 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 fulfil 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!

8DO expansion module

Item no.	Item	Function
310051002100	8DO rev1	8 relay outputs
310051002101	**8DO** rev3	8 relay outputs

Technical data

8DO	FW-5 I/O expansion module		
Command outputs	**8 relay outputs** to 72V DC, 150V AC		
Electrical isolation	Individually isolated, 2-pole connector		
Switching range	rev1	DC:	2 A @24V DC / 0.6 A @48V DC / 0.4 A @60V DC res.
		AC:	2 A @ 150V AC
	rev3	DC:	2 A @24V DC / 2 A @48V DC / 1 A @60V DC resistive
		AC:	2 A @ 150V AC
Steady-state current	max. 2 A		
Communication	T-BUS		
Supply	Internal via T-BUS, up to 6 modules Approx. 200 mA per module base load ~40 mA + 20 mA/relay approx. 60 mA @ 24V DC supply		
Ambient conditions	-25°...+70°C, Ø24h max. 55°C, rel. humidity< 95%, without condensation		
Terminal	Screw terminal MSTB 4* 4-pole, 0.2 to 2.5 mm²		
Housing	Plastic with integrated I/O, top-hat rail installation 22.5 x 105 x 115 mm (W x H x D)		
Weight	153 g excluding packaging		

further technical data for relays, with instructions, are in the appendix.

Display and diagnostics

LED	Colour			Function
error ●	red	○	OFF	Operating mode: No-fault status
		●	static ON	Errors: EM disabled /malfunction
		✳	flashing 2 Hz	Errors: EM configured incorrectly / module defective
		✳	flashing 4 Hz	Errors: Number of modules or slot position not same as configuration
		✳	flashing 8Hz	Error: No communication to base system
status ●	yellow	○	OFF	Operating mode: No-fault status
		●	static ON	Errors: EPROM error
		✳	"Chasing light"	shortne-off pulse per assembly after Bus release only visible with several EMs

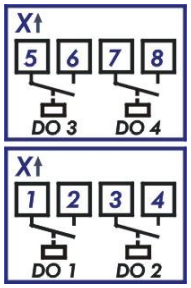
Status of command outputs

LED	Colour		Function
DO1 ●	yellow	DO1	Status of signal at input DO1 on terminal X↑.1/2
...			
DO4 ●	yellow	DO4	Status of signal at input DO4 on terminal X↑.7/8
DO5 ●	yellow	DO5	Status of signal at input DO5 on terminal X↓.1/2
...			

DO8 ●	yellow	DO8	Status of signal at input DO8 on terminal X↓.7/8

Connector assignment

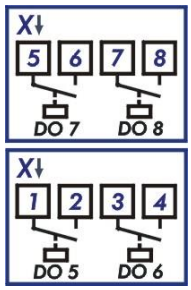
Terminal X↑-top: Command outputs 8DO



Terminal X↑	Signal name	Remarks
X↑.1	DO 1 of module	Relay output 1 13
X↑.2	DO 1	Relay output 1 14
X↑.3	DO 2	Relay output 2 23
X↑.4	DO 2	Relay output 2 24
X↑.5	DO 3	Relay output 3 33
X↑.6	DO 3	Relay output 3 34
X↑.7	DO 4	Relay output 4 43
X↑.8	DO 4	Relay output 4 44
X↑.9-12	n.c.	Unused

Relays 2-pole, isolated from each other

Terminal X↓-bottom: Command outputs 8DO



Terminal X↓	Signal name	Remarks
X↓.1	DO 5 of module	Relay output 5 53
X↓.2	DO 5	Relay output 5 54
X↓.3	DO 6	Relay output 6 63
X↓.4	DO 6	Relay output 6 64
X↓.5	DO 7	Relay output 7 73
X↓.6	DO 7	Relay output 7 74
X↓.7	DO 8	Relay output 8 83
X↓.8	DO 8	Relay output 8 84

8DO-220 expansion module

Item no.	Item	Function
310051002110	**8DO-220**#	8 relay outputs, 230V DC/AC

Technical data

8DO	FW-5 I/O expansion module
Command outputs	**8 relay outputs** to 72V DC, 150V AC ⚠
Electrical isolation	2-pole connector, iIndividually isolated,
Switching range	DC: 2 A @24V DC / 0.2 A @110V DC / 0.1 A @220V DC resistive AC: 2 A @ 230V AC
Steady-state current	max. 2 A
Communication	T-BUS
Supply	Internal via T-BUS, up to 6 modules Approx. 200 mA per module base load ~40 mA + 20 mA/relay approx. 60 mA @ 24V DC supply
Ambient conditions	-25°...+70°C, Ø24h max. 55°C, rel. humidity< 95%, without condensation
Terminal	Screw terminal MSTB 4* 4-pole, 0.2 to 2.5 mm²
Housing	Plastic with integrated I/O, top-hat rail installation 22.5 x 105 x 115 mm (W x H x D)
Weight	153 g excluding packaging

from setIT V5.003.07b22, series5+/series5e
further technical data for relays, with instructions, are in the appendix.

Display and diagnostics

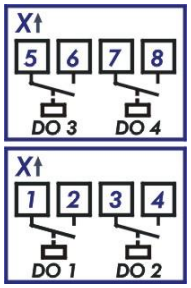
LED	Colour			Function
error ●	red	○	OFF	Operating mode: No-fault status
		●	static ON	Errors: EM disabled /malfunction
		✳	flashing 2 Hz	Errors: EM configured incorrectly / module defective
		✳	flashing 4 Hz	Errors: Number of modules or slot position not same as configuration
		✳	flashing 8Hz	Error: No communication to base system
status ●	yellow	○	OFF	Operating mode: No-fault status
		●	static ON	Errors: EPROM error
		✳	"Chasing light"	One-off pulse per assembly after Bus release only visible with several EMs

Status of command outputs

LED	Colour		Function
DO1 ●	yellow	DO1	Status of signal at input DO1 on terminal X↑.1/2
...			
DO4 ●	yellow	DO4	Status of signal at input DO4 on terminal X↑.7/8
DO5 ●	yellow	DO5	Status of signal at input DO5 on terminal X↓.1/2
...			
DO8 ●	yellow	DO8	Status of signal at input DO8 on terminal X↓.7/8

Connector assignment

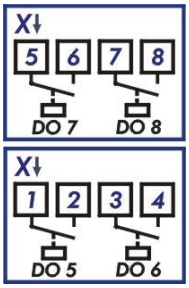
Terminal X↑-top: Command outputs 8DO-220



Terminal X↑	Signal name	Remarks
X↑.1	DO 1 of module	Relay output 1 13
X↑.2	DO 1	Relay output 1 14
X↑.3	DO 2	Relay output 2 23
X↑.4	DO 2	Relay output 2 24
X↑.5	DO 3	Relay output 3 33
X↑.6	DO 3	Relay output 3 34
X↑.7	DO 4	Relay output 4 43
X↑.8	DO 4	Relay output 4 44
X↑.9-12	n.c.	Unused

Relays 2-pole, isolated from each other

Terminal X↓-bottom: Command outputs 8DO-220



Terminal X↓	Signal name	Remarks
X↓.1	DO 5 of module	Relay output 5 53
X↓.2	DO 5	Relay output 5 54
X↓.3	DO 6	Relay output 6 63
X↓.4	DO 6	Relay output 6 64
X↓.5	DO 7	Relay output 7 73
X↓.6	DO 7	Relay output 7 74
X↓.7	DO 8	Relay output 8 83
X↓.8	DO 8	Relay output 8 84

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 fulfil 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!

4DI4DO-Expansion module

Item no.	Item	Function
310051002050	4DI4DO-1-1	4 wide range signals ± 4 changeover relays
310051002060	4DI4DO-1-2	4 signals 110 / 220 V DC/AC 4 changeover relays
310051002070	4DI4DO-2-1	4 wide range signals ± 4 bistable changeover relays
310051002080	4DI4DO-2-2	4 signals 110 / 220 V DC/AC 4 bistable changeover relays

Technical data

4DI4DO	FW-5 extension module I/O
Signal inputs	4 **Digital wide-range inputs**
Electrical isolation	Optocoupler, according to root
4DI4DO-x-**1**	±18 ... ±72 V DC, detection 1 ms
Switching thresholds	Default: 17 V DC, high: 40 V DC
Counter acquisition	min. pulse width 1 ms, max. 10 Hz
4DI4DO-x-**2**	110 / 220 V DC / AC, detection ON 20 ms, OFF 20 ms
Switching thresholds	Default: 85 V eff, high: 170 V eff
Command outputs	**4 Commands** monostable/bistable power changer
4DI4DO-**1**-x	Monostable changeover contact, 1 Contact
4DI4DO-**2**-x	Bistable changeover contact, 1 Contact
4DI4DO-x-1	Switching voltage max. 75 V DC, 50 V AC
4DI4DO-x-2	Switching voltage max. 110 V / 0,4 A und 220 V / 0,25 A
Making capacity	8.0 A, duration type. 5 ms
Steady-state current	2.0 A
EMC	according IEC 61850-3 (Class h)
Isolation	2500 Vrms inputs & outputs signal/logic (S/L) >4 mm between logic, relay contacts and signals
Supply	over T-BUS, with bistable & 1/N monostable) typical 75 mA , 12 modules monostable max. 190 mA, 6 modules, 12 with PWR-1 or TBUS-R typical 20 mA max. 45 mA @ 24V DC supply
Environment	- 25° + 70°C, Ø24h max. 55°C rel. humidity < 95% @ 40° C without condensation
Terminal	Screw terminal, removable, MSTB 3* 4-pole, 0.2 to 2.5 mm²
Housing	Plastic with integrated I/O, top-hat rail installation 22.5 x 105 x 115 mm (W x H x D)
Weight	160 g excluding packaging

Further technical data for relays, with instructions, are in the appendix.

Display and diagnostics

System LEDs

LED	Colour			Function
error ●	red	○	OFF	Operating mode: No-fault status
		●	static ON	Errors: Module disabled /malfunction
		✳	flashing 2 Hz	Errors: Module configured incorrectly / module defective
		✳	flashing 4 Hz	Errors: Number of modules or slot position not same as configuration
		✳	flashing 8Hz	Error: No communication to base system
status ●	yellow	○	OFF	Operating mode: No-fault status
		●	static ON	Errors: EPROM errors
		✳	"Chasing light"	One-off pulse per assembly after Bus release only visible with several EMs

Status of command outputs

LED	Colour		Function
DO1 ●	yellow	DO1	Status of signal at input DO1 on terminal X↑.1/5/9
DO2 ●	yellow	DO2	Status of signal at input DO2 on terminal X↑.2/6/10
DO3 ●	yellow	DO3	Status of signal at input DO3 on terminal X↑.3/7/11
DO4 ●	yellow	DO4	Status of signal at input DO4 on terminal X↑.4/8/12

Status of signal inputs

LED	Colour		Function
DI1 ●	green	DI1	Status of signal at input DI1 on terminal X↓.1/2
DI2 ●	green	DI2	Status of signal at input DI2 on terminal X↓.3/4
DI3 ●	green	DI3	Status of signal at input DI3 on terminal X↓.5/6
DI4 ●	green	DI4	Status of signal at input DI4 on terminal X↓.7/8

Signal processing

The signal inputs of the 4DI4DO module can be provisioned in an extended voltage band. The switching threshold can be selected between Default and High for all variants (refer to the Technical data on Page 91). The signal inputs have two isolated poles. The variant 4DI4DO-x-2 also detects AC signals. Due to the terminal assignment, the signal inputs are located on the lower terminals of the assembly.

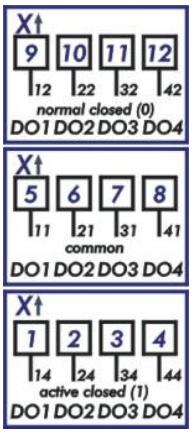
Command output

The extension module 4DI4DO is available with a monostable or bistable relay. The variants 4DI4DO-2 are equipped with bistable changeover contacts which maintain the command in the de-energized state too. The state of the relay can be retrieved via feedback and can be set via a reset command to the factory state n.c. = all N.C.s closed. A range of output operating modes for simple command termination are available, especially for feed-in management. Mode and latency of the commands under BBO/BAO can be selected separately for each module.

Direct	Default command output 1:1 multiple active commands at the same time are possible
BBO	all relays are opened before the new command is set 1/N through previous reset, brake before operate
BAO	Command is set then the remaining relays are opened overlapping command output, brake after operation, then 1/N

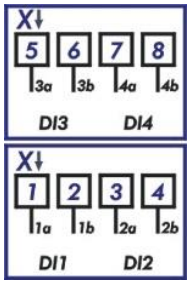
Connector assignment

Terminal X↑ top: Command relay 4DI4DO



Terminal X↑	Signal name	Remarks
X↑.1	14 DO 1of the module	Command output 1 closing contact n.o.
X↑.2	24 DO 2	Command output 2 closing contact n.o.
X↑.3	34 DO 3.	Command output 3 closing contact n.o.
X↑.4	44 DO 4	Command output 4 closing contact n.o.
X↑.5	11 DO 1	Command output 1 root common
X↑.6	21 DO 2	Command output 2 root common
X↑.7	31 DO 3	Command output 3 root common
X↑.8	41 DO 4	Command output 4 root common
X↑.9	12 DO 1	Command output 1 opening contact n.c.
X↑.10	22 DO 2	Command output 2 opening contact n.c.
X↑.11	32 DO 3	Command output 3 opening contact n.c.
X↑.12	42 DO 4	Command output 4 opening contacts n.c.

Terminal X↓-bottom: Signal inputs 4DI4DO-x-1



Terminal X↑	Signal name	Remarks
X↑.1	DI 1a	Signal input 1 ±18 ... ±72 V DC
X↑.2	DI 1b	Signal input 1 ±18 ... ±72 V DC
X↑.3	DI 2a	Signal input 2 ±18 ... ±72 V DC
X↑.4	DI 2b	Signal input 2 ±18 ... ±72 V DC
X↑.5	DI 3a	Signal input 3 ±18 ... ±72 V DC
X↑.6	DI 3b	Signal input 3 ±18 ... ±72 V DC
X↑.7	DI 4a	Signal input 4 ±18 ... ±72 V DC
X↑.8	DI 4b	Signal input 4 ±18 ... ±72 V DC

Terminal X↓-bottom: Signal inputs 4DI4DO-x-2

Terminal X↑	Signal name	Remarks
X↑.1	DI 1a	Signal input 1 110 /220 V DC/AC
X↑.2	DI 1b	Signal input 1 110 /220 V DC/AC
X↑.3	DI 2a	Signal input 2 110 /220 V DC/AC
X↑.4	DI 2b	Signal input 2 110 /220 V DC/AC
X↑.5	DI 3a	Signal input 3 110 /220 V DC/AC
X↑.6	DI 3b	Signal input 3 110 /220 V DC/AC
X↑.7	DI 4a	Signal input 4 110 /220 V DC/AC
X↑.8	DI 4b	Signal input 4 110 /220 V DC/AC

WARNING

In case of nip voltages > 75 V, the terminals must be labelled with the warning "Caution high voltage".

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

8DI2AI expansion module

Item no.	Item	Function
310051002000	8DI2AI rev1.0	8 signals, 2 measurands
310051002001	8DI2AI rev1.1	8 signals, 2 measurands, individual channel floating
310051002002	**8DI2AI** rev2.1	8 signals, 2 measurands, root ± individual channel floating
310051002030	8DI2AI-220# rev2.4	8 signals, 110/220V DC, root ± 2 measurands, individual isolation

Technical data

8DI2AI		FW-5 extension module I/O
Capacity		**8** **digital wide range inputs**, 24 to 60V DC, ±20% **2** **16-bit measurands**
Input range	**8DI**	8DI2AI: 18 ... 72V DC, switching threshold 18 V DC, acquisition 1 ms rev1: 0.4 mA @15V, 2.8 mA @48V, 3.5 mA @60V, 4.3 mA @72V DC rev2: 1.8 mA **8DI2AI-220:**# 110 / 220V DC, Switching threshold 88 V DC, acquisition 1 ms 1.8 mA
Counter acquisition		min. pulse width 1 ms, max. 10 Hz
Isolation 8DI		Optocoupler, as per root item 310051002002 with positive root
Input range	**2AI**	multi-range mA ±2.5 / ±5* / ±10 / ±20 mA uni/bipolar, overflow/underrun, acquisition 100 ms, load 75 Ω
Environment		-25°...+70°C, Ø24h max. 55°C, rel. humidity< 95%, without condensation
Terminals		Screw terminal MSTB 4-pole, 0.2 to 2.5 mm²
Supply		Internal via T-BUS, approx. 120 mA per module, up to 10 modules approx. 30 mA @ 24 V DC supply
Housing		Plastic with integrated I/O, top-hat rail installation 22.5 x 105 x 115 mm (W x H x D)
Weight		187 g excluding packaging

* from setIT V5.0, # on demand

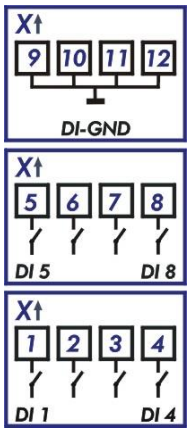
System LEDs

LED	Colour			Function
error ●	red	○	OFF	Operating mode: No-fault status
		●	static ON	Errors: EM disabled /malfunction
		✳	flashing 2 Hz	Errors: EM configured incorrectly / module defective
		✳	flashing 4 Hz	Errors: Number of modules or slot position not same as configuration
		✳	flashing 8Hz	Error: No communication to base system
status ●	yellow	○	OFF	Operating mode: No-fault status
		●	static ON	Errors: Missing or erroneous analogue calibration values / EPROM fault
		✳	flashing	Errors: Calibrating analogue values
		✳	"Chasing light"	Short pulse per assembly after Bus release only visible with several EMs

Status of signal inputs

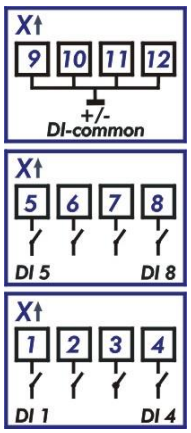
LED	Colour		Function
DI1 ●	green	DI1	Status of signal at input DI1 on terminal X↑.1
...			
DI4 ●	green	DI4	Status of signal at input DI4 on terminal X↑.4
DI5 ●	green	DI5	Status of signal at input DI5 on terminal X↑.5
...			
DI8 ●	green	DI8	Status of signal at input DI8 on terminal X↑.8

Connector assignment 8DI2AI rev1.0



Terminal X↑-top: Signal inputs 8DI2AI rev1.0

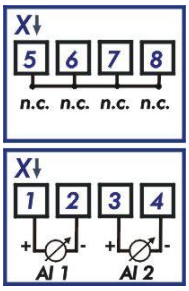
Terminal X↑	Signal name	Remarks
X↑.1	DI 1 of module	Signal input 1 18 ... 72 V DC
X↑.2	DI 2	Signal input 2 18 ... 72V DC
X↑.3	DI 3	Signal input 3 18 ... 72V DC
X↑.4	DI 4	Signal input 4 18 ... 72V DC
X↑.5	DI 5	Signal input 5 18 ... 72V DC
X↑.6	DI 6	Signal input 6 18 ... 72V DC
X↑.7	DI 7	Signal input 7 18 ... 72V DC
X↑.8	DI 8	Signal input 8 18 ... 72V DC
X↑.9-12	GND	Ground 0V



Terminal X↑-top: Signal inputs 8DI2AI since rev1.1 / 8DI2AI-220#

Item 310051002002 with positive root, from 2016

Terminal X↑	Signal name	Remarks
X↑.1	DI 1 of module	Signal input 1 ±
X↑.2	DI 2	Signal input 2 ±
X↑.3	DI 3	Signal input 3 ±
X↑.4	DI 4	Signal input 4 ±
X↑.5	DI 5	Signal input 5 ±
X↑.6	DI 6	Signal input 6 ±
X↑.7	DI 7	Signal input 7 ±
X↑.8	DI 8	Signal input 8 ±
X↑.9-12	GND	Ground 0V or switching voltage



Terminal X↓-bottom: Analogue inputs - 8DI2AI rev2 measurands

Terminal X↓	Signal name	Remarks
X↓.1	+ AI1 of module	Measurand input 1 multi-range ± 22 mA
X↓.2	- AI1	Measurand input 1
X↓.3	+ AI2	Measurand input 2 multi-range ± 22 mA
X↓.4	- AI2	Measurand input 2
X↓.5	n.c.	Unused
X↓.6	n.c.	Unused
X↓.7	n.c.	Unused
X↓.8	n.c.	Unused

from setITV5.004, series5e

Note: Item 310051002000 measurand inputs with common root.
Item 310051002001: measurand inputs isolated.
Item 310051002030: measurand inputs isolated.

WARNING

In case of nip voltages > 75 V, the terminals must be labelled with the warning "Caution high voltage".

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

4AI expansion module

Item no.	Item	Function
310051002200	4AI	4 measurands mA

Technical data

4AI	FW-5 extension module I/O
Capacity	**4** **16-bit measurands**
Input range	multi-range uni/bipolar ±2.5 / ±5* / ±10 / ±20 mA underrun /overflow at ±110%, ripple rejection Acquisition 100 ms, load 75 Ω
Accuracy	± 0.1% for 5°C to +55°C, max. fault ±0.25%
Electrical isolation	isolated individually, 2-pole connector
Communication	T-BUS
Supply	internal via T-BUS, approx. 150 mA per module, up to 8 modules, 12 adding PWR-1 or TBUS-R approx. 40 mA @ 24 V DC supply
Environment	-25°...+70°C, Ø24h max. 55°C, Rel. humidity< 95%, without condensation
Terminals	screw terminal MSTB 4-pole, 0.2 to 2.5 mm²
Housing	plastic with integrated I/O, top-hat rail installation 22.5 x 105 x 115 mm (W x H x D)
Weight	100 g excluding packaging

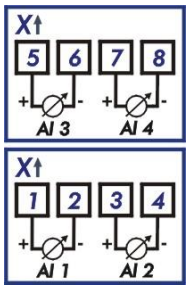
* from setIT V5.0

Display and diagnostics

System LEDs

LED	Colour			Function
error ●	red	○	OFF	Operating mode: no-fault status
		●	static ON	Error: EM disabled /malfunction
		✳	flashing 2 Hz	Error: EM configured incorrectly / module defective
		✳	flashing 4 Hz	Error: number of modules or slot position not same as configuration
		✳	flashing 8Hz	Error: no communication to base system
status ●	yellow	○	OFF	Operating mode: no-fault status
		●	static ON	Error: no or erroneous analogue calibration values / EPROM fault
		✳	flashing	Error: Calibrating analogue values
		✳	"chasing light"	one-off pulse per assembly after Bus release only visible with several EMs

Connector assignment



Terminal X↑ top: Analogue inputs - 4AI measurands

Terminal X↑	Signal name	Remarks
X↑.1	+ AI 1 of module	Measurand 1
X↑.2	- AI 1	Measurand 1
X↑.3	+ AI 2	Measurand 2
X↑.4	- AI 2	Measurand 2
X↑.5	+ AI 3	Measurand 3
X↑.6	- AI 3	Measurand 3
X↑.7	+ AI 4	Measurand 4
X↑.8	- AI 4	Measurand 4
X↑.9-12	n.c.	Unused, not connected

Terminal X↓-bottom: unused not connected

2AO expansion module

Item no.	Item	Function
310051002310	2AO	2 mA set points from setIT V5.001

Technical data

2AO	FW-5 extension module I/O
Capacity	**2 set points** 16-bit
output range	±20 mA
Accuracy	±0.15% @25° C, ±0.1% /10 K over entire range
Load	max. 400 Ω @25°C
Electrical isolation	isolated individually, 2-pole connector
Communication	T-BUS
Supply	internal via T-BUS, approx. 75 mA per module, up to 12 modules approx. 20 mA @ 24 V DC supply external supply also required on X↑.9/10 24... 60V DC ± 20%, wide range, max. 2.0 W
Environment	-25° + 70°C, @25°C max. 50°C, relative humidity < 95%, no condensation
Terminals	screw terminal MSTB 4-pole, 0.2 to 2.5 mm²
Housing	plastic with integrated I/O, top-hat rail installation 22.5 x 105 x 115 mm (W x H x D)
Weight	125 g excluding packaging

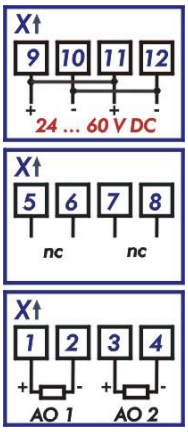
Display and diagnostics

System LEDs

LED	Colour			Function
error ●	red	○	OFF	Operating mode: no-fault status
		●	static ON	Error: EM disabled /malfunction
		✳	flashing 2 Hz	Error: EM configured incorrectly / module defective
		✳	flashing 4 Hz	Error: number of modules or slot position not same as configuration
		✳	flashing 8Hz	Error: no communication to base system
status ●	yellow	○	OFF	Operating mode: no-fault status
		●	static ON	Error: no or erroneous analogue calibration values / EPROM fault
		✳	flashing	Error: calibrating analogue values
		✳	"chasing light"	single pulse per assembly after Bus release only visible with several EMs
Uext ●	green	○	OFF	Error: no analogue output possible
		●	ON	Operating mode: process voltage available for analogue output (set points)

Note: The Uext LED is not visible on all modules. A lack of supply voltage must be recorded in a system alarm and be reported.

Connector assignment



Terminal X↑ top: Analogue outputs - 2AO set points

Terminal X↑	Signal name	Remarks
X↑.1	+ AO 1 of module	Set point 1
X↑.2	- AO 1	Set point 1
X↑.3	+ AO 2	Set point 2
X↑.4	- AO 2	Set point 2
X↑.5	n.c.	Unused / not connected
X↑.6	n.c.	Unused / not connected
X↑.7	n.c.	Unused / not connected
X↑.8	n.c.	Unused / not connected
X↑.9	+ 24 ... 60 V DC	Aux. supply /voltage
X↑.10	- GND	Aux. voltage Ground
X↑.11	+ 24 ... 60 V DC	Auxiliary supply connected with X3.1
X↑.12	- GND	Auxiliary ground connected with X3.2

Terminal X↓-bottom: unused / not connected

The extension module 2AO must be additionally supplied with 24 to 60 V DC (± 20 %) at terminal X↑.9/X↑.10. Additional extensions can be connected in the daisy chain via terminals X↑.11/X↑.12.

4AO expansion module

Item no.	Item	Function
310051002300	4AO	4 set points, mA

Technical data

4AO	FW-5 extension module I/O
Capacity	**4 set points** 16-bit
Output range	±20 mA
Accuracy	±0.15% @25° C, ±0.1% /10 K over entire range
Load	Max. 400 Ω, <hardware Rev 4.2: 500 Ω
Electrical isolation	isolated individually, 2-pole connector
Communication	T-BUS
Supply	internal via T-BUS, approx. 75 mA per module, up to 12 modules Approx. 20 mA @ 24 V DC supply External supply also required on X↑.9/10 24... 60V DC ± 20%, wide range, max 3.6 W
Environment	-25°...+70°C, Ø24h max. 50°C, relative humidity < 95%, no condensation
Terminals	Screw terminal MSTB 4-pole, 0.2 to 2.5 mm²
Housing	Plastic with integrated I/O, top-hat rail installation 22.5 x 105 x 115 mm (W x H x D)
Weight	125 g excluding packaging

Display and diagnostics

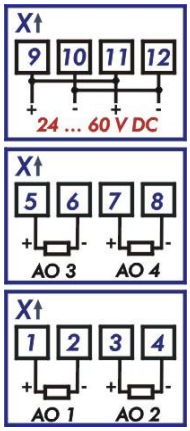
System LEDs

LED	Colour			Function
error ●	red	○	OFF	Operating mode: No-fault status
		●	static ON	Errors: EM disabled /malfunction
		✳	flashing 2 Hz	Errors: EM configured incorrectly / module defective
		✳	flashing 4 Hz	Errors: Number of modules or slot position not same as configuration
		✳	flashing 8Hz	Error: No communication to base system
Status ●	yellow	○	OFF	Operating mode: No-fault status
		●	static ON	Errors: No or erroneous analogue calibration values / EPROM fault
		✳	flashing	Errors: Calibrating analogue values
		✳	"chasing light"	One-off pulse per assembly after Bus release only visible with several EMs
Uext ●	green	○	OFF	Error: No analogue output possible
		●	ON	Operating mode: Process voltage available for analogue output (set points)

Note: The Uext LED is not visible on all modules. A lack of supply voltage must be recorded in a system alarm and be reported.

Connector assignment

Terminal X↑ top: Analogue outputs - 4AO set points



Terminal X↑	Signal name	Remarks
X↑.1	+ AO 1 of module	Set point 1
X↑.2	- AO 1	Set point 1
X↑.3	+ AO 2	Set point 2
X↑.4	- AO 2	Set point 2
X↑.5	+ AO 3	Set point 3
X↑.6	- AO 3	Set point 3
X↑.7	+ AO 4	Set point 4
X↑.8	- AO 4	Set point 4
X↑.9	+ 24 ... 60 V DC	Aux. supply /voltage
X↑.10	- GND	Aux. voltage Ground
X↑.11	+ 24 ... 60 V DC	Auxiliary supply connected with X3.1
X↑.12	- GND	Auxiliary ground connected with X3.2

Terminal X↓-bottom: unused / not connected

The extension module 2AO must be additionally supplied with 24 to 60 V DC (± 20 %) at terminal X↑.9/X↑.10. Additional extensions can be connected in the daisy chain via terminals X↑.11/X↑.12.

DSO-1 command termination, 1.5 pole

The DSO-1 module DSO = Distributed System Operator enables reliable switching of commands in power networks with 1 from N monitoring, measuring circuit testing and cascading to command groups. The command relays are 1.5-pole and routed via additional permissive relays. Activation can take place in single or double commands e.g. via intermediate relay:

- 1 of N supervisory of commands (multistage)
- Command release only by permissive relay
- Measuring circuit testing
  monitoring of coil resistance of external intermediate relay
- Individual adaptable values of coil resistance for each intermediate relay
- 1.5-pole variant of command and checkback indication card
- Individually adjustable suppression of imperfection time
- Individually adjustable post command lag time
- Cascading of multiple devices to command groups

Item no.	Item	Function
310051002400	DSO-1	6 command relays, double command, 1.5 pole, 6 x checkback indication

Technical data

DSO-1	FW-5 extension module I/O
Capacity	**6** **command relays, 1.5 pole**, up to 72V DC **6** **checkback indication inputs**, 24 - 60V DC ±20%
Switching range of DO	2 A @24V DC / 0.4 A @60V DC
Steady-state current	max. 2 A
Electrical isolation of DO	Individual channel floating, 1.5-pole connection Activation of common process voltage via permissive relay
Coil resistance	100 Ω ... 20 kΩ
Accuracy of circle	± 10 %
Input range of DI	18 ... 72 V DC, threshold 12 V DC
Electrical isolation of DI	Optocoupler, common root
Cascading	to command group via two 2-wire safety loops
Dielectric strength	As per EN60870-2-1 Class VW3 and EN60255-5
Communication	T-BUS
Supply	internal via T-BUS, approx. 250 mA per module, up to 4 modules approx. 70 mA @ 24V DC supply external process voltage required on X1.9/10
Environment	-25°...+70°C, Ø24h max. 55°C, rel. humidity< 95%, without condensation
Terminals	Screw terminal MSTB 4-pole, 0.2 to 2.5 mm²
Housing	Plastic with integrated I/O, top-hat rail installation 22.5 x 105 x 115 mm (W x H x D)
Weight	170 g excluding packaging

Further technical data for relays, with instructions, are in the appendix.

Display and diagnostics DSO-1

The DSO-1 module has 16 LEDs to indicate the operating status.
Valid Operating mode is shown by the following LED combination:

error	○ OFF	
status	○ Off	Operating mode
1/n	● On	No-fault status
cmd	● On	

LED	Colour	State		Function
error ●	red	○	OFF	Operating mode: No-fault status
		●	static ON	Errors: EM disabled /malfunction
		✳	flashing 2 Hz	Fault: Configured incorrectly / module defective
		✳	flashing 4 Hz	Errors: Number of modules or slot position not same as configuration
		✳	flashing 8Hz	Error: No communication to base system
status ●	yellow	○	OFF	Operating mode: Command acceptance possible
		●	static ON	Command abort: Card fault or cascade fault
		✳	flashing 4 Hz	Errors: Card not calibrated
		●●✳●	"Chasing light"	One-off pulse for every module after bus enable Only visible for multiple EMs
1/n ● cmd ●	green green	●●	both ON	Operating mode: Command acceptance possible
		✳ ✳	flashing / OFF	Command abort: Cascade fault or malfunction

Only applies when switched on and with TBUS installed

Status of checkback indications

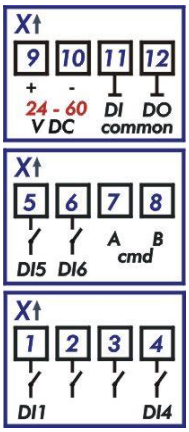
LED	Colour		Function
DI1 ●	green	DI1	Status of signal at input DI1 on terminal X↑.1
…			
DI6 ●	green	DI6	Status of signal at input DI6 on terminal X↑.6

Status of command outputs

LED	Colour		Function
DO1 ●	yellow	DO1	Status of signal at output DO1 on terminal X↓.1
…			
DO6 ●	yellow	DO6	Status of signal at output DO6 on terminal X↓.6

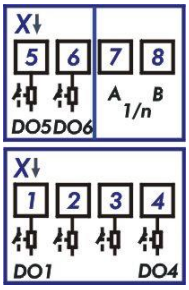
Connector assignment

Terminal X↑ top: Checkback on DSO-1



Terminal X↑	Signal name	Remarks
X↑.1	DI 1 of module	Checkback indication input 1 18 ... 72 V DC
X↑.2	DI 2	Checkback indication input 2 18 ... 72 V DC
X↑.3	DI 3	Checkback indication input 3 18 ... 72 V DC
X↑.4	DI 4	Checkback indication input 4 18 ... 72 V DC
X↑.5	DI 5	Checkback indication input 5 18 ... 72 V DC
X↑.6	DI 6	Checkback indication input 6 18 ... 72 V DC
X↑.7	CMD A	Command loop connect all CMD-A
X↑.8	CMD B	Command loop connect all CMD-B
X↑.9	Uext +	Switching voltage +
X↑.10	Uext -	Switching voltage -
X↑.11	Com DI	Root checkback indication DI1 to DI6
X↑.12	Com DO	Root command relays DO1 to DO6

Terminal X↓-bottom: Command outputs for DSO-1



Terminal X↓	Signal name	Remarks
X↓.1	DO 1 of module	Relay output 1
X↓.2	DO 2	Relay output 2
X↓.3	DO 3	Relay output 3
X↓.4	DO 4	Relay output 4
X↓.5	DO 5	Relay output 5
X↓.6	DO 6	Relay output 6
X↓.7	1/N A	Loop 1/N connect all 1/N-A
X↓.8	1/N B	Loop 1/N connect all 1/N-B

All terminals are removable: MSTBT 2.5/4-ST, /2-ST or FKCT 2.5/4-ST, /2-ST

Wiring Diagram DSO-1 double command 1.5 pole

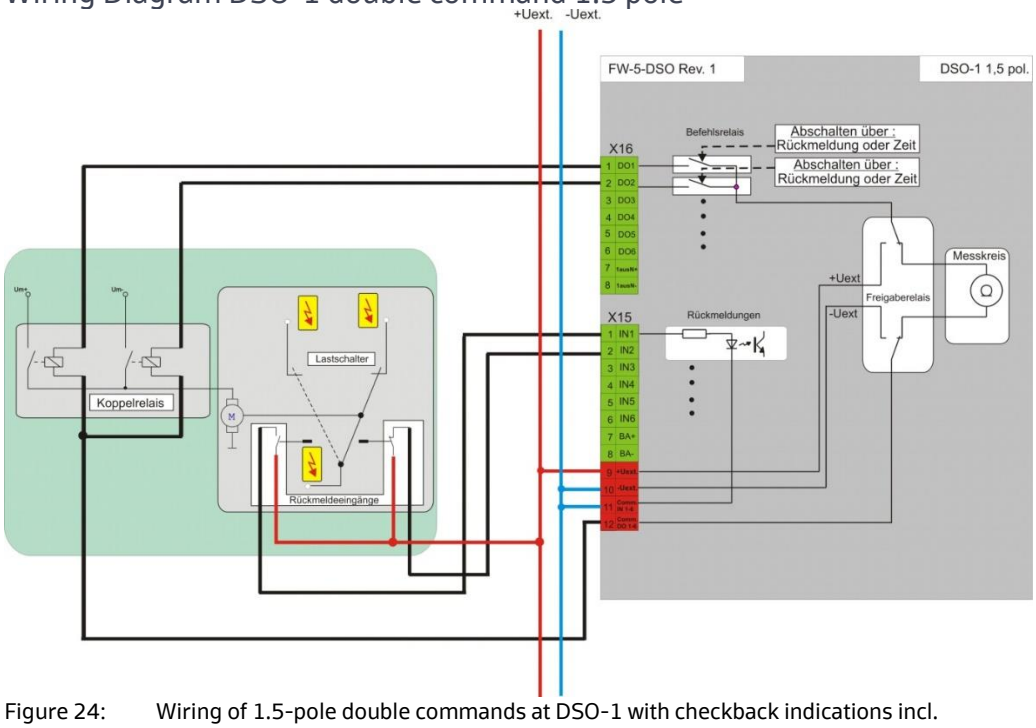


Figure 24: Wiring of 1.5-pole double commands at DSO-1 with checkback indications incl. measuring circuit a permissive relay, no cascading

Cascading of DSO-1 with double commands 1.5 pole

A larger number of commands in a group may be commissioned by a cascading of mutiple DSO-boards. Thus the control loops for command and 1 of N have to be connected via a bus signal. at the terminal pairs 1 /n X↓.7/8 and cmd X↑.7/.8; those are based on a 2-wire differential bus-signal.

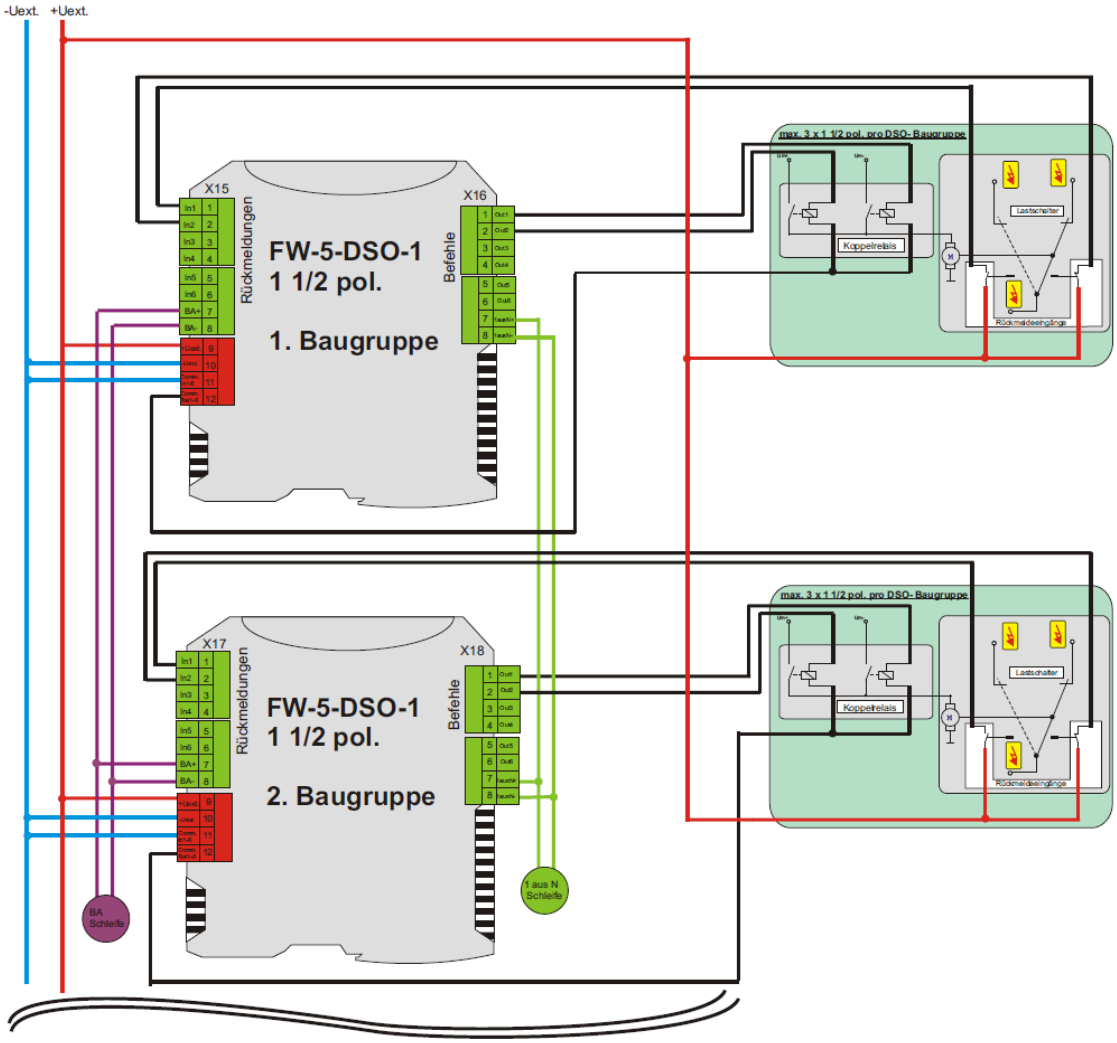


Figure 25: Cascading of multiple DSO-1 modules with a wiring of 1.5-pole double commands and checkback indication

Grouping of commands with control loops cmd & 1/N

Wiring the bus-signals of cmd and 1/N assures that only one single command may be in operation at a time. By cascading multiple DSO-modules to a collective command group, control lines may be in duty to indicate active commands to other extension modules.
Therefore the DSO modules grouped in a command group have to be connected at the bus-terminals: attach all terminals 1/N-A, 1/N-B of the designated command group with a twisted 2-pole wire (A-A, B-B), similar to a RS-485 bus-line - repeat this with a similar bus at the terminals cmd-A und cmd-B.

DSO-2 command termination, 2-pole

The DSO-2module DSO = Distributed System Operator enables reliable switching of commands in power networks with 1 from N monitoring, measuring circuit testing and cascading to command groups. The command relays are 2-pole and actuated via additional permissive relays. Actuation is typically with double commands e.g. via intermediate relays:

- 1 of N supervisory of commands (multistage)
- Command- and permissive relay
- Measuring circuit testing
  monitoring of coil resistance of external intermediate relay
- Individual adaptable values of coil resistance for each intermediate relay
- 2-pole variant of command and checkback indication card
- Individually adjustable suppression of imperfection time
- Individually adjustable post command lag time
- Cascading of multiple devices to command groups

Item no.	Item	Function
310051002410	DSO-2	4 command relays, double cmd, 2-pole, 2 x checkback indications

Technical data

DSO-2	FW-5 extension module I/O
Capacity	**4** **command relays 2-pole** for 1 double command, to 72V DC **2** **checkback indication** inputs, 24 - 60V DC ±20%
Switching range of DO	2 A @24V DC / 0.4 A @60V DC
Steady-state current	max. 2 A
Electrical isolation of DO	Individual channel floating, 2-pole connector Activation of common process voltage via permssive relay
Coil resistance	100 Ω ... 20 kΩ
Accuracy of circle	± 10 %
Input range of DI	18 ... 72 V DC, threshold 12 V DC
Electrical isolation of DI	Optocoupler common root
Cascading	To command group via two 2-wire safety loops
Dielectric strength	As per EN60870-2-1 Class VW3 and EN60255-5
Communication	T-BUS
Supply	internal via T-BUS, approx. 250 mA per module, up to 4 modules approx. 70 mA @ 24V DC supply external process voltage required on X↑.9/10
Environment	-25°...+70°C, Ø24h max. 55°C, rel. humidity< 95%, without condensation
Terminals	Screw terminal MSTB 4-pole, 0.2 to 2.5 mm²
Housing	Plastic with integrated I/O, top-hat rail installation 22.5 x 105 x 115 mm (W x H x D)
Weight	170 g excluding packaging

Further technical data for relays, with instructions, are in the appendix.

Display and diagnostics DSO-2

Valid Operating mode is shown by the following LED combination:

error	○ OFF	
status	○ OFF	Operating mode
1/n	● ON	No-fault status
CMD	● ON	

LED	Colour	State		Function
error ●	red	○	OFF	Operating mode: No-fault status
		●	static ON	Errors: EM disabled /malfunction
		✳	flashing 2 Hz	Fault: Configured incorrectly / module defective
		✳	flashing 4 Hz	Errors: Number of modules or slot position not same as configuration
		✳	flashing 8Hz	Error: No communication to base system
status ●	yellow	○	OFF	Operating mode: Command acceptance possible
		●	static ON	Command abort: Card fault or cascade fault
		✳	flashing 4 Hz	Errors: Card not calibrated
		●●✳●	"Chasing light"	One-off pulse for every module after bus enable Only visible for multiple EMs
1/n ● cmd ●	green green	●●	both ON	Operating mode: Command acceptance possible
		✳✳	flashing / OFF	Command abort: Cascade fault or malfunction

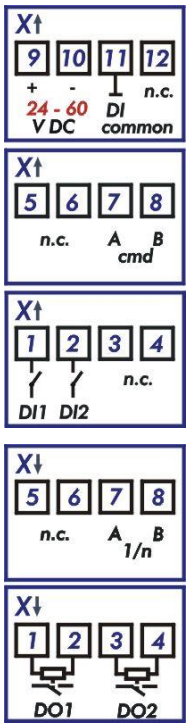
Status of checkback indication

LED	Colour		Function
DI1 ●	green	DI1	Status of signal at input DI1 on terminal X↑.1
DI2 ●	green	DI2	Status of signal at input DI2 on terminal X↑.2

Status of command outputs

LED	Colour		Function
DO1 ●	yellow	DO1a	Status of signal at output DO1a on X↓.1
DO2 ●	yellow	DO1b	Status of signal at output DO1b on X↓.2
DO3 ●	yellow	DO2a	Status of signal at output DO2a on X↓.3
DO4 ●	yellow	DO2b	Status of signal at output DO2b on X↓.4

Connector assignment



Terminal X↑ top: Checkback indication for DSO-2

Terminal X↑	Signal name	Remarks
X↑.1	DI 1 of module	Checkback indication input 1 18 ... 72 V DC
X↑.2	DI 2	Checkback indication input 2 18 ... 72V DC
X↑.3 - X↑.6		not connected
X↑.7	cmd A	Command loop connect all CMD-A
X↑.8	cmd B	Command loop connect all CMD-B
X↑.9	Uext +	Switching voltage +
X↑.10	Uext -	Switching voltage -
X↑.11	Com DI	Root checkback indication DI1 to DI2
X↑.12		not connected

Terminal X↓-bottom: Command outputs for DSO-2

Terminal X↓	Signal name	Remarks
X↓.1	DO 1a of module	Relay output 1
X↓.2	DO 1b	Relay output 2
X↓.3	DO 2a	Relay output 3
X↓.4	DO 2b	Relay output 4
X↓.5		not connected
X↓.6		not connected
X↓.7	1/N A	Loop 1/N connect all 1/N-A
X↓.8	1/N B	Loop 1/N connect all 1/N-B

All terminals are removable, models MSTBT 2,5/4-ST or FKCT 2,5/4-ST

Wiring DSO-2 double commands 2-pole

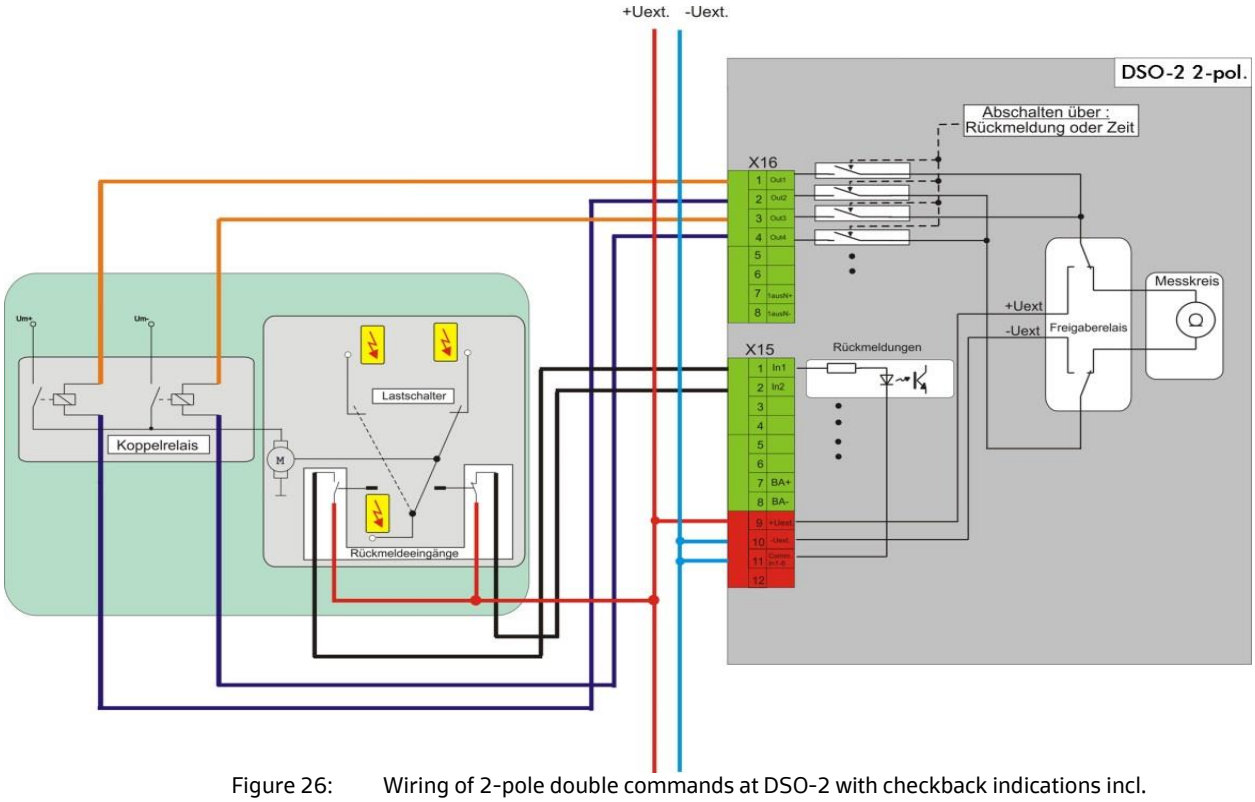


Figure 26: Wiring of 2-pole double commands at DSO-2 with checkback indications incl. measuring circuit a permissive relay, no cascading

RES-1 expansion module

The RES-1 module RES = Renewable Energy Sources extends the application area in renewable energies with additional provision of S0-compatible inputs for metered value, pulse and signal acquisition. Feed management of renewal energy installations with 100/60/30/0% adjusting commands with control of the actual fed-in with meters or measurands may be integrated in an intelligent manner in combination with a codeIT application.

Item no.	Item	Function
310051002500	RES-1	4 S0 inputs (active), 2 measurand, 4 relay outputs

Technical data

RES-1	FW-5 extension module I/O
Capacity	**4 S0 inputs** **2 16-bit measurands** **4 relay outputs**
Input range 4S0	S0-compatible inputs active to DIN 62053-31, acquisition 10 ms, meter pulse max. 10 Hz, 2-pole connector, common energy source
Input range 2AI	multi-range ±2.5 / ±5 / ±10 / ±20 mA uni-/bipolar, overflow/underrun, acquisition 100 ms individual channel floating, 2-pole connector, load 75 Ω
Command outputs 4DO	Relay, individual channel isolation, 2-pole connector, max. 60 V DC, 50 V AC
Switching range of DO	DC: 2 A @24V DC / 0.6 A @48V DC / 0.4 A @60V DC AC: 1 A @50V AC
Steady-state current	2 A
Environment	25°...+70°C, Ø24h max. 55°C, relative humidity < 95%, no condensation
Terminals	Screw terminal MSTB 4-pin, 0.2 to 2.5 mm2 ²
Communication	T-BUS
Supply	Internal over T-BUS, max. 400 mA per module, up to 3 modules approx. 100 mA @ 24 V DC supply
Housing	Plastic with integrated I/O, top-hat rail installation 22.5 x 105 x 115 mm (W x H x D)
Weight	146 g excluding packaging

Further technical data for relays, with instructions, are in the appendix.

Display and diagnostics for RES-1

System LEDs

LED	Colour			Function
error ●	red	○	OFF	Operating mode: No-fault status
		●	static ON	Errors: EM disabled /malfunction
		✳	flashing 2 Hz	Errors: EM configured incorrectly / module defective
		✳	flashing 4 Hz	Errors: Number of modules or slot position not same as configuration
		✳	flashing 8Hz	Error: No communication to base system
status ●	yellow	○	OFF	Operating mode: No-fault status
		●	static ON	Errors: No, or erroneous, analogue calibrating values / ROM fault
		✳	flashing	Errors: Calibrating analogue values loss of counter pulses, reset by restart
		✳	"Chasing light"	One-off pulse per assembly after Bus release only visible with several EMs

Status of the S0 pulse and information inputs

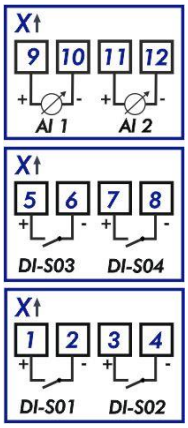
LED	Colour		Function
DI1 ●	green	DI-S01	Status of signal at input S0-DI1 on terminal X↑.1/.2
...			
DI4 ●	green	DI-S04	Status of signal at input S0-DI4 on terminal X↑.7/.8

Status of command outputs

LED	Colour		Function
DO1 ●	yellow	DO1	Status of signal at input DO1 on terminal X↓.1/2
...			
DO4 ●	yellow	DO4	Status of signal at input DO4 on terminal X↓.7/8

Connection assignment

Terminal X↑-top: S0 signal inputs, RES-1

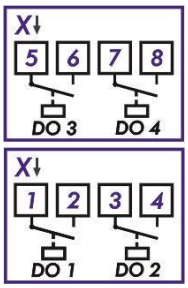


Terminal X↑	Signal name	Remarks
X↑.1	DI-S0+1 of module	Signal input 1 + S0 active to DIN 62053-31
X↑.2	DI-S0- 1	Signal input 1 -
X↑.3	DI-S0+2	Signal input 2 +
X↑.4	DI-S0- 2	Signal input 2 -
X↑.5	DI-S0+3	Signal input 3 +
X↑.6	DI-S0- 3	Signal input 3 -
X↑.7	DI-S0+4	Signal input 4 +
X↑.8	DI-S0- 4	Signal input 4 -

Terminal X↑ top: Analogue inputs - RES-1 measurands

Terminal X↑	Signal name	Remarks
X↑.9	AI 1 of module	Measurand 1 +
X↑.10	AI 1	Measurand 1-
X↑.11	AI 2	Measurand 2 +
X↑.12	AI 2	Measurand 2-

Terminal X↓-bottom: RES-1 command outputs



Terminal X↓	Signal name	Remarks
X↓.1	DO 1 of module	Relay output 1 13
X↓.2	DO 1	Relay output 1 14
X↓.3	DO 2	Relay output 2 23
X↓.4	DO 2	Relay output 2 24
X↓.5	DO 3	Relay output 3 33
X↓.6	DO 3	Relay output 3 34
X↓.7	DO 4	Relay output 4 43
X↓.8	DO 4	Relay output 4 44

VPP-1 Extension module

The extension module VPP-1 offers a quick integration of mixed types of signals e.g. for Virtual-Power-Plants, energy feeders or other sorts of applications. Feed management of renewal energy installations with 100/60/30/0% curtailing commands including separation with control of the actual fed-in with meters or measurands may be integrated in an intelligent manner without any PLC application. VPP-1 is supported by series5e from setIT V5.004.07.

Item no.	Item	Function
310051002510	VPP-1	6 indication inputs 24 to 60 V DC 5 relay ouputs 2 measurands 2 setpoints

Technical data

VPP-1	FW-5 I/O extension board
Capacity	**6** **digital wide-range inputs,** 24 to 60 V DC ±20% **5** **relay outputs**, NO contact as per root **2** **Measured values**, 12-bit, ±22 mA **2** **setpoints**, 12-bit, 20 mA
Input range **6DI**	18 ... 72 V DC, operating thresholds 17 V DC, 2 mA, data acquisition 1 ms, max 100 Hz
Input range **2AI**	±22 mA, overflow/underrun, data acquisition 100 ms, load 75 Ω individual floating, accuracy ±0.2% at -5°C to +55°C
Switching range of **5DO**	1 A bis 72 V DCC
Setpoint range **2AO**	20 mA, common root, max. , galv. isolated from logic load max: HR0.2x 500 Ω , HR0.1x 300 Ω, load > 400 Ω max. 50°C Accuracy ±0.25%@ 25 °C, ±0.1% per 10 K over entire range
Ambient conditions	--25°...+70°C, Ø24h max. 55°C, rel. humidity < 95%, no condensation
Terminals	Screw terminal MSTB 4-pin, 0.2 to 2.5 mm²
Supply	Internal over T-BUS, max. 390 mA per module, up to 3 modules approx. 93 mA @ 24 V DC supply
Housing	Plastic with integrated I/O, top-hat rail installation 22.5 x 105 x 115 mm (W x H x D)
Weight	146 g excluding packaging

Further technical details for relays, with instructions, are in the appendix.

Display and diagnostics for VPP-1

System LEDs

LED	Colour			Function
error ●	red	○	off	Operating mode: No-fault status
		●	static on	Errors: EM disabled /malfunction
		✳	flashing 2 Hz	Errors: EM configured incorrectly / module defective
		✳	flashing 4 Hz	Errors: Number of modules or slot position not same as configuration
		✳	flashing 8Hz	Error: No communication to base system
status ●	yellow	○	off	Operating mode: No-fault status
		●	static on	Errors: No, or erroneous, analogue calibrating values / EPROM fault
		✳	flashing	Errors: Calibrating analogue values
		✳	"Chasing light"	One-off pulse per assembly after Bus release only visible with several EMs

Status of the information inputs

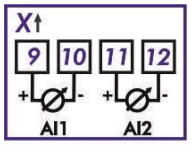
LED	Colour		Function
DI1 ●	green	DI-1	Status of signal at input DI1 on terminal X↑.1
...			
DI6 ●	green	DI-6	Status of signal at input DI6 on terminal X↑.6

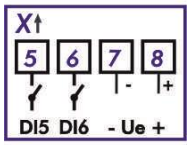
Status of command outputs

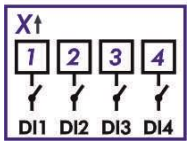
LED	Colour		Function
DO1 ●	yellow	DO1	Status of signal at input DO1 on terminal X↓.1
...			
DO5 ●	yellow	DO5	Status of signal at input DO5 on terminal X↓.5

Connector assignment

Terminal X↑-top: Signal inputs VPP-1





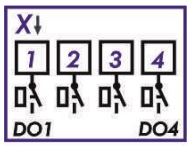


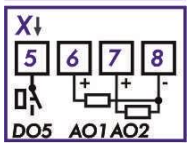
Terminal X↑	Signal name	Remarks
X↑.1	DI-1 of module	Signal input 1 18 ... 72 V DC
X↑.2	DI-2	Signal input2 18 ... 72 V DC
X↑.3	DI-3	Signal input 3 18 ... 72 V DC
X↑.4	DI-4	Signal input 4 18 ... 72 V DC
X↑.5	DI-5	Signal input 5 18 ... 72 V DC
X↑.6	DI-6	Signal input 6 18 ... 72 V DC
X↑.7	Ue -	common DI indication root 0 V
X↑.8	Ue +	common DO, control tension 18 ... 72 V DC

Terminal X↑-top: Analogue inputs - Measurands VPP-1

Terminal X↑	Signalname	Remarks
X↑.9	AI 1 of module	measurand 1 +
X↑.10	AI 1	measurand 1 -
X↑.11	AI 2	measurand +
X↑.12	AI 2	measurand -

Terminal X↓-bottom: Command relays VPP-1





Terminal X↓	Signal name	Remarks
X↓.1	DO 1 of module	Relay output 1 14
X↓.2	DO 2	Relay output 2 24
X↓.3	DO 3	Relay output 3 34
X↓.4	DO 4	Relay output 4 44
X↓.5	DO 5	Relay output 5 54

Terminal X↓-bottom: Setpoint VPP-1

Terminal X↓	Signal name	Remarks
X↓.6	AO 1 +	Setpoint 1 0-20 mA
X↓.7	AO 2 +	Setpoint 2 0-20 mA
X↓.8	AO -	common root setpoints

Further technical details for relays, with instructions, are in the appendix.

Command output

A range of output operating modes are available, especially for feed-in management, for simple command termination. Mode and dwell time of the commands under BBO/BAO can be selected separately for each module.

Direct Default command output 1:1 no sequence
multiple active commands at the same time are possible

BBO all relays are opened before the new command is set
1/N through previous reset, brake before operate

BAO Command is set then the remaining relays are opened
overlapping command output, brake after operation, then 1/N

ISO-1 expansion module

The ISO-1 module provides a continual monitoring of district heating networks and other pipelines with leak detection by measuring the isolation at foam isolated district heating pipes using Nordic/Cu or NiCr sensor cables to DIN EN ISO 14419 and HDW to some extend. The card measures the isolation resistance at the required measurement cycles between the sensor cable and the pipe, and also supervises the sensor loop for wire feeders and breaks. The card uses selectable thresholds to automatically detect the different operating states and reports them to the supervisory control centre via single-point information and collective alarms for straightforward signalling. Permanent monitoring means all states can be detected and reported - from exiting the guarantee area, slight loss of isolation of ageing plastic jacket pipes, moisture from outside, genuine leaks, to wire breaks (during construction work for example).
When there is a break in the loop, the card is able to switch automatically to Service mode, that protects the measuring equipment from surges caused by welding work. Service mode can also be enabled locally or from the control centre. All of the card alarms, as well as Service mode, can be reset with control commands locally or remotely.
The ISO-1 is available for series5e systems from setIT V6.000.

Item no.	Item	Function
310051002550	ISO-1	4 loops for isolation measurement Section length Cu to 2.5, NiCr to 1.5 km
310051002551	ISO-1-1	4 loops for isolation measurement HR 1.x Section length Cu bis 2.5 / NiCr to 1.5 km

Technical data

ISO-1	FW-5 extension module I/O HR0.x
Capacity	**4** **isolation measured values** between sensor and pipe **4** **loop resistors** **Signals and alarms** for off-limit conditions
Alerts	Signals and collective alarms, can be reset with control commands
Measurements	Isolation 0 kΩ to 60 MΩ, loop 200 Ω to 12 kΩ
Measuring voltage	≤ 24 V DC and < 100 mA according to EN 14419
Commands	Control commands internal for Service mode and resetting of alarms
Isolation	1500 V, loops isolated galvanically to logic and to each other
Protection	Gas discharge tube 75 V / 5 kA
Certifications	IEC/EN 61326-1, DIN EN 55032 class B
Environment	-25°...+70°C, Ø24h max. 55°C, relative humidity < 95%, no condensation
Terminals	Screw terminal MSTB 4-pin, 0.2 to 2.5 mm²
Communication	T-BUS
Supply	Internal over T-BUS, max. 215 mA per module, up to 5 modules approx. 60 mA @ 24 V DC supply
Housing	Plastic with integrated I/O, top-hat rail installation 22.5 x 105 x 115 mm (W x H x D)

Weight	146 g excluding packaging

Note for ISO-1-0 and Cu sensors: The resistance of the measuring loop is transferred as a measured value. With ISO-1-0 (HR0.x) the measuring accuracy > 1 kΩ is ±2%. Below 1 kΩ, deviations of up to ±5% can occur. Below 200 Ω, no meaningful detection is possible. For this reason, no monitoring of the measuring loop is recommended for Cu.

Examples of known plastic jacket pipe sensor loops

name	Sensor	max. length	L+	LP	L-	LG
Nordic /EMS /NKS	Cu	2500 m	bare	-	tinned	
IPS-Cu	Cu	2500 m	bare	-	tinned	
Isotronic	Cu	2500 m	bare	-	white	
Brandes®	NiCr	1300 m	red	-	green	
IPS-NiCr	NiCr	1300 m	yellow	-	black	
Data centre e.g.. BS-FKR/BS-FKW	NiCr	1300 m	rot	white	green	black

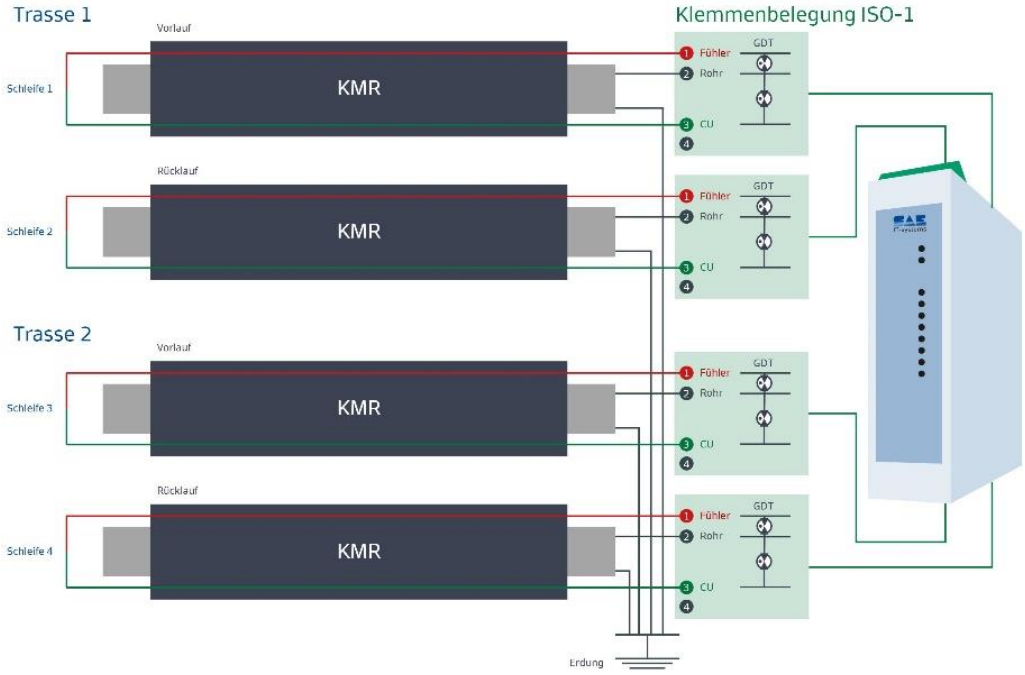


Figure 27: Connection of sensors using Cu/NiCr

Display and diagnostics ISO-1

System LEDs

LED	Colour			Function
Error ●	red	○	OFF	Operating mode: No-fault status
		●	ON	Error: EM blocked / defective
		✳	Flashing 2 Hz	Error: EM assembled incorrectly / unit defect
		✳	Flashing 4 Hz	Error: Number of modules or slot position not same as configuration
		✳	Flashing 8Hz	Error: No communication to base system
status ●	yellow	○	OFF	Operating mode: No-fault status
		●	ON	Error: No, or erroneous, analogue calibrating values / EPROM fault
		✳	Flashing	Calibrating analogue values
		✳	"Chasing light"	Single pulse per module after bus has been enabled only visible with several EMs

Statuses of loops

LED	Colour	Function
loop1 ●	green/red	Status of loop 1 on terminal X↑.1/- X↑.4
loop2 ●	green/red	Status of loop 2 on terminal X↑.5/- X↑.8
loop3 ●	green/red	Status of loop 3 on terminal X↓.1/- X↓.4
loop4 ●	green/red	Status of loop 4 on terminal X↓.5/- X↓.8
alarm ●	red	grouped alarm

LED	Colour		Function
Loop x ●	green	● ON	Monitoring active & collector loop resistance and insulation resistance within valid range
		✳ Flashing 1 Hz	Service mode: state of service relay may be declared
		✳ 10 Hz	Measuring
Loop x ●	red	● ON	Fault isolation resistor
		✳ 1 Hz	Fault: Loop interrupted
		✳ 1^0 Hz	Fault: pipe connection
Loop x ●		○ OFF	No monitoring or no valid measurement
alarm ●	red	● ON	Grouped indication malfunction active
		○ OFF	no alarm

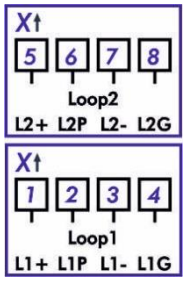
Service button

Service button S1 is used for Loop 1/2, button S2 for Loop 3/4

Action		Function
Press S1	1 s	Loop 1/2: Ack alarm and trigger measurement cycle
Press S1	>3 s	Loop 1/2: Switch between Service mode and operation
Press S2	1 s	Loop 3/4: Ack alarm and trigger measurement cycle
Press S2	>3 s	Loop 3/4: Switch between Service mode and operation

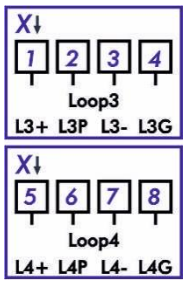
Pin assignment for ISO-1-0 HR0.x

Terminal-top X↑: Loops 1/2 ISO-1



Terminal X↑	Signal name	Remarks	
X↑.1	loop 1+	Measuring loop +	sensor (Cu/NiCr..)
X↑.2	loop 1P	Pipe	Pipe/ground
X↑.3	loop 1-	Measuring loop –	Cu
X↑.4	loop 1G	Ground	2. loop back
X↑.5	loop 2+	Measuring loop +	sensor (Cu/NiCr..)
X↑.6	loop 2P	Pipe	Pipe/ground
X↑.7	loop 2-	Measuring loop –	Cu
X↑.8	loop 2G	Ground	2. loop back

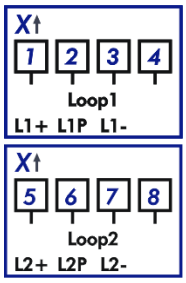
Terminal X↓ at bottom: Loops 3/4 ISO-1-0



Terminal X↓	Signal name	Remarks	
X↓.1	loop 3+	Measuring loop +	sensor (Cu/NiCr..)
X↓.2	loop 3P	Pipe	Pipe/ground
X↓.3	loop 3-	Measuring loop –	Cu
X↓.4	loop 3G	Ground	2. loop back
X↓.5	loop 4+	Measuring loop +	sensor (Cu/NiCr..)
X↓.6	loop 4P	Pipe	Pipe/ground
X↓.7	loop 4-	Measuring loop –	Cu
X↓.8	loop 4G	Ground	2. loop back

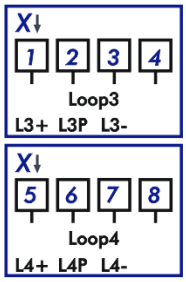
Anschlussbelegung ISO-1-1

Terminal X↑-top: Loops 1/2 ISO-1-1



Terminal X↑	Signal name	Remarks	
X↑.1	loop 1+	Measuring loop +	sensor (Cu/NiCr..)
X↑.2	loop 1P	Pipe	Pipe/ground
X↑.3	loop 1-	Measuring loop –	Cu
X↑.4	n.c.	not connected	
X↑.5	loop 2+	Measuring loop +	sensor (Cu/NiCr..)
X↑.6	loop 2P	Pipe	Pipe/ground
X↑.7	loop 2-	Measuring loop –	Cu
X↑.8	n.c.	not connected	

Terminal X↓-bottom: Loops 3/4 ISO-1-1



Terminal X↓	Signal name	Remarks	
X↓.1	loop 3+	Measuring loop +	sensor (Cu/NiCr..)
X↓.2	loop 3P	Pipe	Pipe/ground
X↓.3	loop 3-	Measuring loop –	Cu
X↓.4	n.c.	not connected	
X↓.5	loop 4+	Measuring loop +	sensor (Cu/NiCr..)
X↓.6	loop 4P	Pipe	Pipe/ground
X↓.7	loop 4-	Measuring loop –	Cu
X↓.8	n.c.	not connected	

PIT-1 expansion module

The PIT-1 module PIT = Pipeline Indication & Temperature extends the application area to monitoring shafts PIT for district heating networks and other supply networks. The special adaption to low point and moisture sensors enables sensors (from Jola for example) to be connected quickly without additional supply voltage. Float switches can also be read reliably. The two measured values are realised as PT-100 sensors in a 2-wire connector, thus permitting measurement of the shaft temperature, feed/return and other temperatures in range 0° to +150°C.
The PIT-1 is available for series5e systems from setIT V6.000.

Item no.	Item	Function
310051002560	PIT-1	4 moisture sensors / float switches 2 PT-100 temperature sensors 0°...150°C 4 relay outputs

Technical data

PIT-1	FW-5 extension module I/O
Capacity	**4** **signals** active inputs for moisture / low point sensors **2** **16-bit measured values** PT-100 temperature sensor 0°...150°C **4** **relay outputs**
Signals **4DI**	active inputs for moisture / low point sensors / float switches, acquisition 10 ms, counter max. 10 Hz, 2-pole connector
Input range	internal 24 V DC: >2.3 mA ON, <1.7 mA OFF*
Temperature **2AI**	PT-100 temperature sensors (0°...+150°C, 2-wire)
Command outputs **4DO**	Relay, 2-pole connector, individual channel floating max. 75 V DC, 50 V AC
Switching range	DC: 2 A @24 V DC / 0.6 A @48 V DC / 0.4 A @60 V DC AC: 1 A @50 V AC
Steady-state current	2 A
Isolation	circles and logic separated galvanically
Environment	-25°...+70°C, Ø24h max. 55°C, relative humidity < 95%, no condensation
Terminals	Screw terminal MSTB 4-pin, 0.2 to 2.5 mm²
Communication	T-BUS
Supply	Internal over T-BUS, max. 285 mA per module, up to 3 modules approx. 75 mA @ 24 V DC supply
Housing	Plastic with integrated I/O, top-hat rail installation 22.5 x 105 x 115 mm (W x H x D)
Weight	146 g excluding packaging

Further technical data for relays, with instructions, are in the appendix.
* Using sensors from Jola the states are: > 2.3 mA dry, < 1.7 mA tripped/wet.

Display and diagnostics PIT-1

System LEDs

LED	Colour			Function
Error ●	red	○	OFF	Operation mode: No-fault status
		●	ON	Error: EUs blocked / defective
		✳	Flashing at 2 Hz	Error: EUs assembled incorrectly / unit defect
		✳	Flashing at 4 Hz	Error: Number of modules or slot position not same as configuration
		✳	Flashing at 8Hz	Error: No communication to base system
status ●	yellow	○	OFF	Operating mode : No-fault status
		●	ON	Error: No, or erroneous, analogue calibrating values / EPROM fault
		✳	Flashing	Error: Calibrating analogue values
		✳	"Chasing light"	Single pulse per module after bus has been enabled only visible with several EUs

Status of information inputs

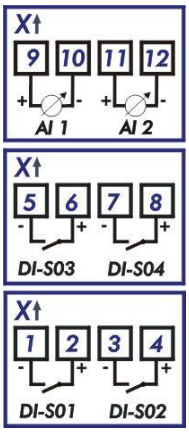
LED	Colour		Function
DI1 ●	green	DI1	Status of signal at input DI1 on terminal X↑.1/.2
...			
DI4 ●	green	DI4	Status of signal at input DI4 on terminal X↑.7/.8

Status of command outputs

LED	Colour		Function
DO1 ●	yellow	DO1	Status of signal at output DO1 on terminal X↓.1/2
...			
DO4 ●	yellow	DO4	Status of signal at output DO4 on terminal X↓.7/8

Pin assignment for PIT-1

Terminal-top X↑: Information inputs, PIT-1

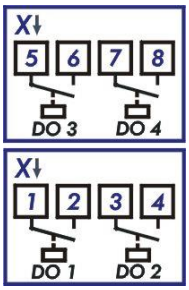


Terminal X↑	Signal name	Remarks
X↑.1	DI-1 + of the module	Information input 1 supply 24 V DC
X↑.2	DI-1 signal	Signal input 1
X↑.3	DI-2+	Information input 2 supply 24 V DC
X↑.4	DI-2 signal	Signal input 2
X↑.5	DI-3+	Information input 3 supply 24 V DC
X↑.6	DI-3 signal	Signal input 3
X↑.7	DI-4+	Information input 4 supply 24 V DC
X↑.8	DI-4 signal	Signal input 4

Terminal-top X↑: Analogue inputs - PIT-1 measured values

Terminal X↑	Signal name	Remarks
X↑.9	AI 1 of module	Measured value 1 PT-100 2-wire +
X↑.10	AI 1	Measurand 1-
X↑.11	AI 2	Measured value 2 PT-100 2-wire +
X↑.12	AI 2	Measurand 2-

Terminal X↓ at bottom: Command outputs PIT-1



Terminal X↓	Signal name	Remarks
X↓.1	DO 1 of module	Relay output 1 13
X↓.2	DO·1	Relay output 1 14
X↓.3	DO·2	Relay output 2 23
X↓.4	DO·2	Relay output 2 24
X↓.5	DO·3	Relay output 3 33
X↓.6	DO·3	Relay output 3 34
X↓.7	DO·4	Relay output 4 43
X↓.8	DO·4	Relay output 4 44

PM-1 Power measurement terminal

Module PM-1 allows cost-effective measurement of relevant values in low-voltage and medium-voltage grids for monitoring the power supply and loads on the primary systems using CT/VT, Rogowsky-coils or signals sensors. It also allows for measurement of characteristic values for power quality in accordance with DIN EN 50160 and provides basic data as per ISO 50001.

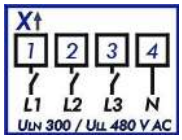
Grids are connected via measurement transformers ; in the LV network, the voltage can be measured directly in the LV network without needing expensive transformers. The values are integrated directly in the process data from FW-5/FW-5-GATE where they can be monitored, sent and recorded based on custom criteria.

Support from setIT V5.001

Item no.	Item	Function
310051002600	**PM-1**	**Measured values from LV/MV grids** U, I, P, S, Q, W, f, cos phi, THD ...
310051002610	PM-1-R	Measured values via **Rogowski coil**s, U, I, P, S, Q, W, f, cos phi, THD ...
310051002620	PM-1-S	Measured values via **sensors** U, I, P, S, Q, W, f, cos phi, THD ...

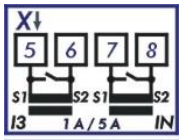
Terminal assignment

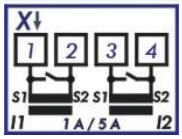
Terminal X↑-top: Voltage inputs PM-1



Terminal X↑	Signal name	Remarks
X↑.1	L1 Phase 1 of the grid	U1 Phase 1 or VT phase 1
X↑.2	L2 Phase 2 of the grid	U2 Phase 2 or VT phase 2
X↑.3	L3 Phase 3 of the grid	U3 Phase 3 or VT phase 3
X↑.4	N Neutral of the grid	Neutral wire /earth Reference potential

Terminal X↓-bottom: Current inputs PM-1





Terminal X↓	Signal name	Remarks
X↓.1	I1 Phase 1 S1	Transformer wire S1 of Phase 1
X↓.2	I1 Phase 1 S2	Transformer wire S2 of Phase 1
X↓.3	I2 Phase 2 S1	Transformer wire S1 of Phase 2
X↓.4	I2 Phase 2 S2	Transformer wire S2 of Phase 2
X↓.5	I3 Phase 3 S1	Transformer wire S1 of Phase 3
X↓.6	I3 Phase 3 S2	Transformer wire S2 of Phase 3
X↓.7	IN Neutral wire S1	Transformer wire S1 N
X↓.8	IN Neutral wire S2	Transformer wire S2 N

Note that current transformer must not run under no-load operation as high hazardous voltages can be present at secondary terminals. Current transformers are to be short-circuited on the secondary side when there is no connection to the power measurement terminal.

PM-1-R connectors

PM-1-R is a power measurement terminal with current measured using Rogowski coils. The voltage measurement Xtop is identical to PM-1.

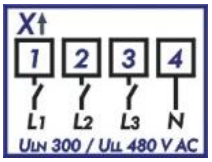


Figure 28: PM-1-R Terminal Xtop

The terminals on the upper side are used to connect measurement voltages. Direct voltage measurement up to 230 V U_{L-N} is possible. When connecting in higher voltage ranges, voltage transformers are needed.
You must use a omnipolar breaker with fuse

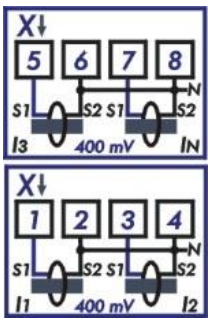


Figure 29: PM-1-R terminal Xbottom

The terminals on the bottom side of the PM-1-R are used to connect the Rogowski coils.
Under type PACT RCP place the
blue core of the coil to S1 and the
white one to S2. The
shield of the coil cable must be set to S2 (N).

PM-1-S connectors

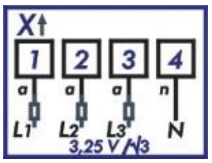


Figure 30: PM-1-S terminal Xtop

The terminals on the upper side are used to connect voltage sensors using small signal voltage. The conversion ratio for the sensor must be set up in the card properties.

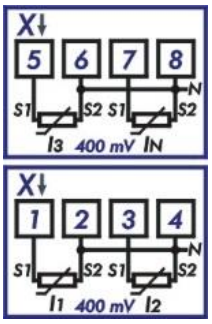


Figure 31: PM-1-S Terminal Xbottom

The terminals on the bottom side of the PM-1-S are used to connect the current sensors using small signal voltage.
The conversion ratios of the sensor must be configured in the card properties.

Technical data PM-1

PM-1	**FW-5 Power measurement terminal** for LV- and MV grids at telecontrol and substation automation in micro-housing, DIN top-hat rail	
Grids	Measurement at LV with current transformers, voltage direct Measurement at MV with current transformers, voltage transformers 4-conductor networks, 3-conductor networks, single-phase	
Measurement variables	5 Currents I_1, I_2, I_3, I_N, I_{ges} 6 Voltages U_1, U_2, U_3, U_{12}, U_{23}, U_{31} 12 Powers P_1, P_2,P_3, P_{ges}, S_1, S_2, S_3, S_{ges}, Q_1, Q_2, Q_3, Q_{ges} 4 Power factors PF_1, PF_2, PF_3, PF_{ges} 4 Frequencies f_1, f_2, f_3, f_{ges} 16 Energies W_1, W_2, W_3, W_{ges}, Wb1, Wb2, Wb3, Wbges, metered values 6 Distortion factors THDi1, THDi2, THDi3, THDv1, THDv2, THDv3 1 Temperature 3 Load flow directions	
Current inputs	**4 phases** (L_1-L_3, N)	
PM-1	CT/VT transformer 1 A / 5 A software-switched	
PM-1-R	Rogowski coil up to 4 kA, software-scaled 490 kΩ	
PM-1-S	Low signal sensors, software-scaled 490 kΩ	
Voltage inputs	**3 phases**, Neutral conductor/ground as reference point for measurement	
PM-1/PM-1-R	Direct measurement or transformer U_{L-N} = 300 V AC, U_{L-L} = 480 V AC, 1130 kΩ	
PM-1-S	Small signal sensors U_{L-N} = 3.25/ √3V AC, U_{L-L} calculated load 200 kΩ.e.g. Zelisko SMVS - UW1001/UW1002	
Frequency	45-66 Hz , resolution 0.01 Hz	
Signal processing	Trms, sampling 8 kHz	
Measuring accuracy	in relation to the measuring range value over the entire temperature range Voltage, current ± 0.2% acc. DIN EN 61557-12:2008 Powers ± 0.5% acc. DIN EN 61557-12:2008 Frequency ± 0.1% acc. DIN EN 61557-12:2008	
Harmonics V,I	Class 1, DIN EN 61000-4-7	
Harmonic analysis	up to 63rd harmonic	
Temperature	-20° ... 120°C ± 1 % (internal measurement sensor in underside)	
Supply	From TBUS, 150 mA / module, approx. 40 mA @ 24 V DC from 9th Add additional supply module with PWR-1 or TBUS-R	
Overvoltage category	4 kV CAT III (300 V)	
Standards	IEC/EN 61010-1:2011	Safety requirements for electrical equipment for measurement, control and laboratory use - Part 1: General requirements
	IEC/EN 61010-2-030:2011	Particular requirements for testing and measuring circuits
	IEC/EN 61326-1:2013	Electromagnetic compatibility
	DIN EN 55011:2011	Class A Industrial area
Status indicator	LED in front plate for voltage, load, rotary fields and system status	
Housing	FW-5 micro housing, polyamide V0, IP 20	
Dimensions	22.5 x 105 x 115 mm (W x H x D), 190g no packaging	
Terminals	Screw terminal, fixed MSTB, 0.2 to 2.5 mm²	
Installation	DIN top-hat rail DIN EN 60715 TH35 horizontal	
Environment	-25°...+70°C, Ø24h max. 55°C, rel. humidity< 95%, without condensation	

Display and diagnostics PM-1

Analysing LEDs

LED	Colour	State	Function
error ●	red	flashing 2 Hz	Type or sequential faults on the TBUS
		flashing 4 Hz	Internal module error or data transmission error on TBUS
		ON ●	Module error
		briefly OFF ●	Short interruption, CTRL line statically LOW
		OFF	No-fault status
status ●	yellow	ON ●	No calibration
		flashing 4 Hz	invalid calibration data
		flashing 8 Hz	Internal error (SPI) detected , indication remains remanent
			Display as chasing light for correct address assignment
		OFF	No-fault status
L1 ● L2 ● L3 ●	green	ON ●	Voltage on Phase L1 /L2/L3 in permissible range, no current can be measured in phase
		flashing	1 - 25% ⇨1200 ms : 300 ms (On : Off) 26 – 50% ⇨ 900 ms : 600 ms 51% - 75% ⇨ 600 ms : 900 ms 76% - 100% ⇨ 300 ms : 1200 ms
		OFF	configured lower voltage threshold fallen below
U> Alarm ●	red	flashing 8 Hz	Surge voltage at least one voltage input (U_{L-N} > 250 Vrms, U_{LL} > 480 Vrms), acknowledge with reset or command
		OFF	All voltage measurands in the permissible range
I> Alarm ●	red	flashing 8 Hz	Excess current on at least one current input (≥ 1.2 x I_N) , acknowledge with reset or command
		OFF	All current measurands in permissible range
U< Alarm ●	red	flashing 8 Hz	Voltage dropped below lower threshold, Alarm is automatically extinguished after reaching the valid range
		OFF	All voltage measurands in the permissible range
fault ●	yellow	ON ●	Connection fault rotary field direction L1-L2-L3
		OFF	Rotary field direction OK

CAUTION

To ensure correct measured value acquisition, the "N" connection of the voltage measurement inputs must be chosen as the benchmark for pure current measurement.

CAUTION

Do not mix up the current and voltage connections!

When performing connection work, be careful not to mix up the current and voltage path. A direct connection of mains voltages to the low-resistance current connections IL1 ... IL3 would destroy the measurement inputs.

Example connections

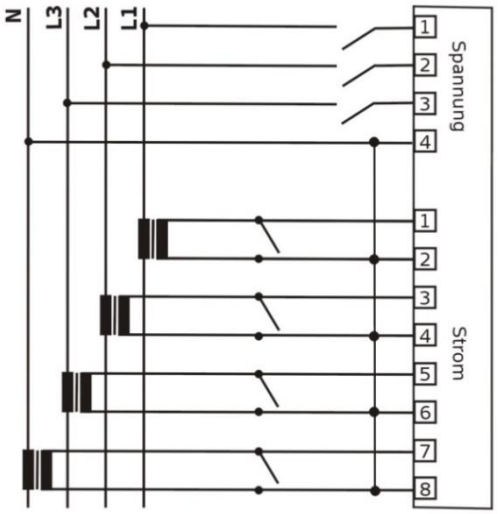
Network configuration	Connection diagram
Low voltage Three-phase four-wire system (TN-, TT grid)	

Figure 32: Connection in the TN- and TT network

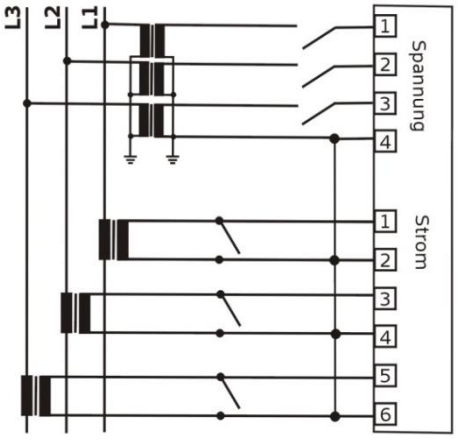
Medium voltage Three-phase three-wire system	

Figure 33: Connection in the medium voltage network

For more information, refer to Installation Manual_PM-1.

PM-2 Power measurement terminal

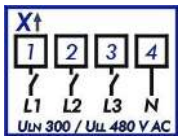
The PM-2 module enables the cost-effective measurement of relevant variables in low-voltage and medium-voltage grid for monitoring the power supply and load of the primary technology. In addition, it offers the recording of power quality parameters in accordance with DIN EN 50160 and provides basic data in accordance with ISO 50001 is provided.

The connection to the grids is made via instrument transformers; in the LV-grid, the voltage measurement can be can be carried out directly, thus eliminating the need for expensive transformers. The values are directly integrated into the quantity structure of the FW-5/FW-5-GATE and can be monitored, transmitted and recorded there in separate criteria. Single phase measurement of up to three feeders is allowed additionally to provide a cost-effective monitoring.

Support from setIT V6.000

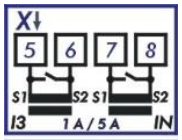
Item no.	Article	Function
310051002630	PM-2	**Measured values from LV/MV grids** U, I, P, S, Q, W, f, cos phi, ...

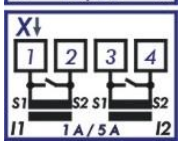
Terminal assignment



Terminal X↑ -top: Voltage inputs PM-2

Clamp X↑	Signal name	Comments
X↑ .1	L1 Phase 1 of the grid	U1 phase 1 or VT phase 1
X↑ .2	L2 Phase 2 of the grid	U2 phase 2 or VT phase 2
X↑ .3	L3 Phase 3 of the grid	U3 phase 3 or VT phase 3
X↑ .4	N Neutral conductor of the network	Neutral / earth Reference potential





X↓ -down: current inputs PM-2

Clamp X↓	Signal name	Comments
X↓ .1	I1 Phase 1 S1	Transformer connection S1 of phase 1
X↓ .2	I1 Phase 1 S2	Transformer connection S2 of phase 1
X↓ .3	I2 Phase 2 S1	Transformer connection S1 of phase 2
X↓ .4	I2 Phase 2 S2	Transformer connection S2 of phase 2
X↓ .5	I3 Phase 3 S1	Transformer connection S1 of phase 3
X↓ .6	I3 Phase 3 S2	Transformer connection S2 of phase 3
X↓ .7	IN Neutral conductor S1	Transformer connection S1 N
X↓ .8	IN Neutral conductor S2	Transformer connection S2 N

DANGER

Note that current transformer must not run under no-load operation as high hazardous voltages can be present at secondary terminals. Current transformers are to be short-circuited on the secondary side when there is no connection to the power measurement terminal.

Technical data PM-2

PM-2	FW-5 Power measuring terminal for LV- and MV grids to telecontrol and substation control technology in micro housing, DIN rail mounting	
Grids	Measurement at LV with current transformers, voltage directly Measurement at MV with current transformers, voltage transformers 4-wire systems, 3-wire systems, single-phase	
Measured variables	5 Currents I_1, I_2, I_3, I_N, I_{ges} 6 Voltages U_1, U_2, U_3, U_{12}, U_{23}, U_{31} 12 Power P_1, P_2,P_3, P_{ges}, S_1, S_2, S_3, S_{ges}, Q_1, Q_2, Q_3, Q_{ges} 4 Power factors PF_1, PF_2, PF_3, PF_{ges} 4 Frequencies f_1, f_2, f_3, f_{ges} 16 Energies W_1, W_2, W_3, W_{ges}, Wb1, Wb2, Wb3, Wbges, totals 6 Distortion factors $THDi_1$, $THDi_2$, $THDi_3$, $THDv_1$, $THDv_2$, $THDv_3$ 1 Temperature 3 Load flow directions	
Power inputs	**4 phases** (L_1-L_3, N)	
PM-2	Measuring transformer 1 A /5 A changeover via software	
Voltage inputs	**3 phases**, neutral/earth as reference point of the measurement	
PM-2	Direct measurement or VT U_{L-N} = 300 V AC, U_{L-L} = 480 V AC, 1130 kΩ	
Frequency	45-66 Hz , resolution 0.01 Hz	
Signal processing	Trms, sampling 8 kHz	
Accuracy	referred to measuring range end value over the entire temperature range Voltage, current ±0.2% according to DIN EN 61557-12:2008 Power ±0.5% according to DIN EN 61557-12:2008 Frequency ±0.1% according to DIN EN 61557-12:2008	
Harmonics U,I	Class 1, DIN EN 61000-4-7	
Harmonic analysis	up to the 63rd harmonic	
Temperature recording	-20° ... 120°C ± 1 % (internal sensor at the bottom)	
Supply	via TBUS, 150 mA /module, approx. 40 mA @ 24 V DC from 9th module additional supply with PWR-1 or TBUS-R supplement	
Overvoltage category	4 kV CAT III (300 V)	
CE/Standards	IEC/EN 61010-1:2011	Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 1 General requirements
	IEC/EN 61010-2-030:2011	Special provisions for test and measurement circuits
	IEC/EN 61326-1:2013	Electromagnetic compatibility
	DIN EN 55011:2011	Class A Industrial
Status display	LED in front for voltage, load, rotating field error and system status	
Housing	FW-5 Micro enclosure, polyamide V0, IP 20	
Dimensions	22.5 x 105 x 115 mm (W x H x D), 190g without packaging	
Terminals	Screw terminal fixed MSTBT, 0.2 to 2.5 mm²	
Mounting	DIN top-hat rail DIN EN 60715 TH35 horizontal	
Environment	-25°...+70°C, Ø24h max. 55°C, rel. humidity < 95% without condensation	

Display and diagnosis PM-2

Analysis of the LED

LED	Colour	State	Function
error ●	red	✳ flashing 2 Hz	Type or sequence error on the TBUS
		✳ flashing 4 Hz	Internal module error or data transmission error on T-BUS
		● ON	Module error
		briefly OFF	Short interruption, CTRL line static LOW
		OFF	fault-free operating status
status ●	yellow	● ON	Calibration missing
		✳ flashing 4 Hz	Calibration data invalid
		✳ flashing 8 Hz	Internal error (SPI) detected, message remains remanent
		✳	Display as chasing light for correct address assignment
		○ OFF	fault-free operating status
L1 ● L2 ● L3 ●	green	● ON	Voltage on phase L_1 /L_2/L_3 in permissible range, no current measurable on phase
		✳ flash	1 - 25% ⇨ ON 1200 ms : OFF 300 ms 26 - 50% ⇨ 900 ms : 600 ms 51 - 75% ⇨ 600 ms : 900 ms 76- 100% ⇨ 300 ms : 1200 ms
		○ OFF	Parameterised lower voltage limit not reached
U> Alarm ●	red	✳ flashing 8 Hz	Overvoltage on at least one voltage input (U_{L}-N > 250 Vrms, U_{LL} > 480 Vrms), acknowledge with reset or command
		○ OFF	All voltage readings within the permissible range
I> Alarm ●	red	✳ flashing 8 Hz	Overcurrent at least one current input (≥ 1.2 x I_N) , acknowledge with reset or command
		○ OFF	All current readings within the permissible range
U< Alarm ●	red	✳ flashing 8 Hz	Voltage has fallen below the lower limit, alarm goes off automatically after reaching the valid range.
		○ OFF	All voltage readings within the permissible range
fault ●	yellow	● ON	Connection error Rotary field direction L_1-L_2-L_3
		○ OFF	Rotating field direction OK

Schematic circuit diagram

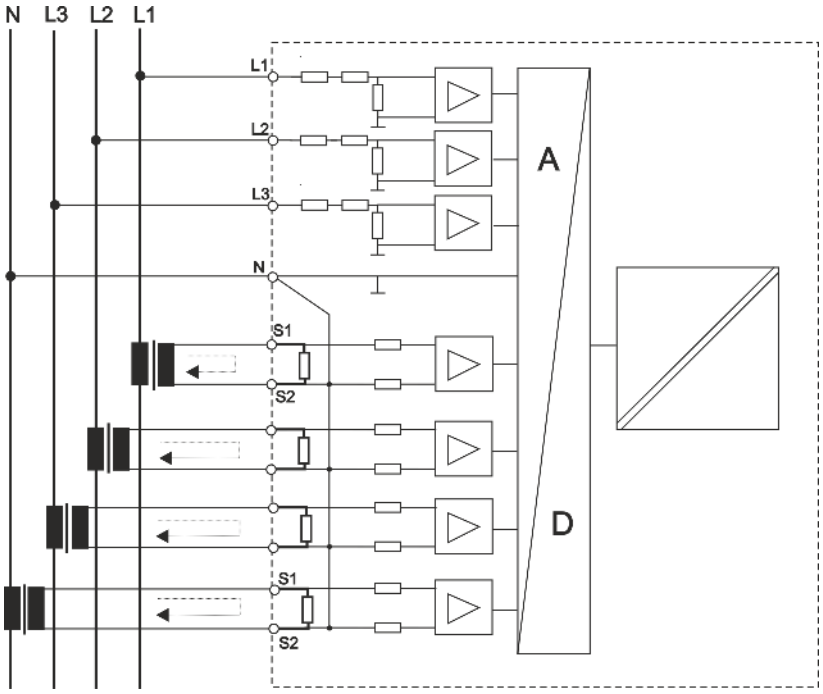


Figure 34 Circuit diagram for connection in the LV-network

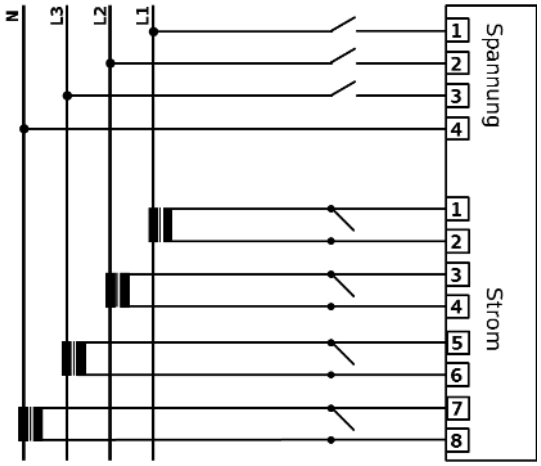
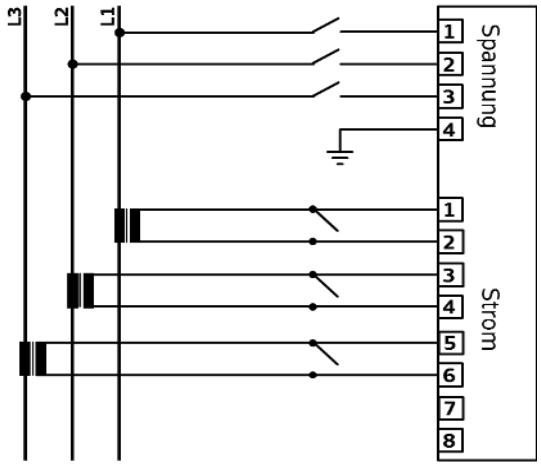
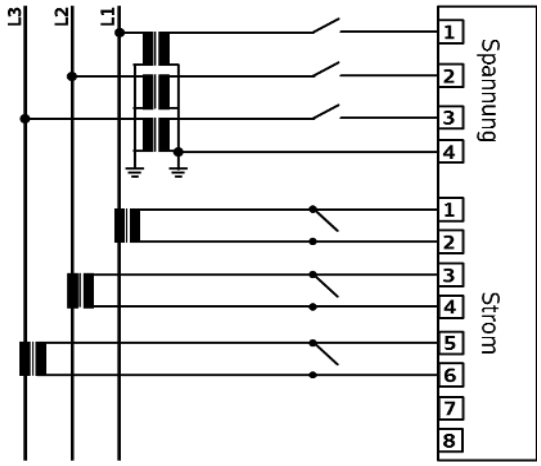
ATTENTION

For correct measured value acquisition, the "N" connection of the voltage measurement inputs must be selected as the reference point even with pure current measurement.

ATTENTION

Do not mix up current and voltage connections!
When connecting, make sure not to confuse the current and voltage paths, as direct connection of the mains voltages to the low-impedance current connections I_{L1} ... I_{L3} would destroy the measuring inputs!

Connection examples

Type of grid	Wiring diagram
Low voltage Three-phase four-wire TN/TT grid	
	Figure 35: PM-2 LV, three-phase four-wire
Low voltage Three-phase three-wire IT grid	
	Figure 36: PM-2 LV, three-phase four-wire
Medium voltage Three-phase three-wire	
	Figure 37 PM-2 MS, three-phase three-wire

For further information please refer to the
Installation Manual_PM-2: https://www.sae-it.com/fileadmin/en/Manual_PM-2.pdf.

PDPS-1 Profibus-DP slave

The PDPS-1 module allows for the cost-efficient, yet flexible integration of data points from PLC, regulators and other intelligent components into the station and telecontrol technology via the Profibus-DP protocol. The PDPS-1 is designed as a Profibus-DP Slave that only requires few configuration steps in order to operate successfully. The module can be placed in the bus chain or used as a termination device. The terminal resistor is comfortably activated via a switch on the front panel. The communication parameters and the capacity to be transferred are specified via setIT from V5.1 onward.

Item no.	Item	Function
310051005000	PDPS-1	Profibus-DP slave

Technical data

PDPS-1	FW-5 communication module Profibus-DP slave
Communication	**Profibus-DP Slave** service DP-V0
Data range	**max. 488 Bytes** in data blocks of 1 byte to 64 words Inputs max. 244 byte Outputs max. 244 bytes
Interface	Removable screw terminals MSTB switch-on terminal resistor 220 Ω
Speed	automatic detection by the master up to 1.5 Mbit/s
bus length	max. 1200 m at 9.6 kbit/s, 100 m at 1.5 Mbit/s
Diagnostics	USB device service interface USB 2.0, 12 Mbit/s behind front
Supply	internal via TBUS 260 mA @ TBUS, only 1 PDPS-1 per system
Dielectric strength	2.5 kV surge supply & process I/O for PE, as per Class VW2 Electrical isolation fieldbus to logic/TBUS 1000 V AC Electrical isolation Fieldbus to ground 1000 V AC
Shielding	shield connector clamp to fieldbus in & fieldbus out
Tests	EMC: DIN EN 61000-6-2:2006, DIN EN 61000-6-4:2011 Insulation: DIN EN 60870-2-1:1997
Environment	-25°...+70°C, Ø24h max. 55°C, rel. humidity <95% without condensing
Terminals	Screw terminal MSTB 4-pole, 0.2 to 2.5 mm²
Housing	Plastic with integrated I/O, top-hat rail installation 22.5 x 105 x 115 mm (W x H x D)
Weight	134 g excluding packaging

NOTE

The PDPS-1 inserts I/O data into the process data via the communication; it is therefore listed as a I/O module and plugged into the T-Bus as such.

Display and diagnostics PDPS-1

LED	Colour			Function
error ●	red		flashing 2 Hz	Error: Internal module fault or data transfer error on TBUS Flash frequency identical to run LED of base
			flashes 4 Hz	Error: Missing allocation double flash frequency cf. basis LED run
		●	static ON	Error: module error or no release of the module
		●	ON / briefly OFF	short interruption, CTRL line static LOW
		○	OFF	Operating mode: Release of the module
status ●	yellow	●	static ON	Error: Module not released
			flashing 4 Hz	Error: invalid calibration data
			flashing 8 Hz	Error: internal communication (SPI) error
			chase lights	Display with other EM: correct address allocation
		○	OFF	Operating mode No-fault status

LED	Colour			Function
RDY ●	yellow	●	static ON	Error: firmware missing
			flashing 0.5 s	internal configuration data transfer
		○	OFF	Operating mode: Slave ready to use
Run ●	green	●	static ON	Operating mode: Slave ready to use
			flashing	Error: parameter error
		○	OFF	Error: slave in reset mode
fault ●	red		flashing 2 Hz	Error: communication error / no master
		●	static ON	Error: Parametrisation error master / Configuration of IO module does not match
		○	OFF	Operating mode: Slave ready to use
data ●	green	●	static ON	data exchange active
		○	OFF	no data exchange

For further information, concerning diagnostics in particular, please refer to the brief description for the PDPS-1.

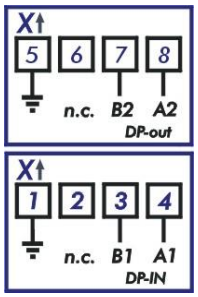
Connecting the Profibus interface

The standard cables can be used for integration into the Profibus-DP. As these cables cannot be connected directly to the used housing due to mechanical load, the link is established via MSTB plug-in screw terminals.

- The BUS connection must be made using original fieldbus cables
- The incoming Profibus-DP link must be attached to the front plug
- The outgoing Profibus-DP is connected to the rear plug
- Due to the terminal connection, we recommend not to select a transmission rate exceeding 1.5 Mbit/s.
- Terminate the bus via S1 when using it at the beginning or end of the line
- Use the shielding terminal for earthing and mechanical fixation

Connector assignment Fieldbus

The connection is made using a screw terminal with a shield connection.



Terminal X↑ top: PDPS-1 Profibus connection

Terminal X↑	Signal name	Remarks
X↑.1	**Shield**	Shielding
X↑.2	n.c.	unused / not connected
X↑.**3**	**B1**	Signal B1 Profibus incoming
X↑.**4**	**A1**	Signal A1 Profibus incoming
X↑.5	Shield	Shielding
X↑.6	n.c.	unused / not connected
X↑.7	B2	Signal B2 Profibus outgoing
X↑.8	A2	Signal A2 Profibus outgoing

Terminal X↓-bottom: not connected / unused

Attention: **Unplugging a terminal interrupts the fieldbus.**

Closing termination

If the module is the last Profibus participant on the cable, the terminal resistor must be activated. The closing termination must be carried out at 220 Ω via the S1 switch in the front of the module; set both switches to ON. Both switches must be in the same position.

S1	Position in bus	Position at the end of the bus: Terminating resistor active
1	OFF	ON right
2	OFF	ON right

PWR-1 power booster

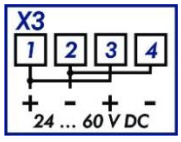
The PWR-1 is an additional T-BUS power supply which can be plugged into the block as required as the last expansion module. It broadens the application area of power-intensive expansion cards and lifts the current restriction by the base system. With an additional 2.8 A, a total of 4 A is available to power the expansion modules. Configuration is not required. The realisation of further expansion modules might not be possible however because the current calculation in setIT sets limits here. From setIT V5.001 onwards, current calculations can be disabled in the base system parameters with the "**FW-5 bus extension**" function.

Item no.	Item	Function
310051002990	PWR-1	Additional power supply for T-BUS

Technical data

PWR-1	FW-5 power supply for T-BUS
Supply voltage	+20 to 72V DC, 24 to 60V DC ±20%
Power consumption	Max. 15 W
TBUS supply	Maximum 2.8 A, load shedding when exceeded
Galvanically isolation	1500 V between supply and logic
Environment	-25°...+70°C, Ø24h max. 55°C, > 48V DC max. + 50°C, relative humidity < 95%, no condensation
Terminals	Screw terminal MSTB 4-pole, 0.2 to 2.5 mm²
Housing	Plastic with integrated I/O, top-hat rail installation 22.5 x 105 x 115 mm (W x H x D)
Weight	130 g excluding packaging

Connector assignment X3: PWR-1 power supply



Terminal X3	Signal name	Remarks
X3.1	+ Uext	+20 ... 72V DC, max. 15 W
X3.2	- mass	0V
X3.3	+ Uext	24 - 60V DC ±20% jumpered internally with X3.1
X3.4	- mass	0V jumpered internally with X3.2

NOTE **The power sources for the PWR-1 and base system must be identical.**
These supplies must be disconnected at the same time. If only the supply on X3 of the base system is disconnected, the PWR-1 continues to power the system, but is restarted by the active Powerfail signal and then transitions back to normal mode. So a redundant supply from different sources is not possible without a restart.

NOTE **The Uext LED indicates the voltage of the TBUS not the external supply**.

NOTE **The PWR-1 is plugged into the T-BUS as the last module**.

TBUS-T Transmitter remote IO

The TBUS-T and TBUS-R modules provide remote IO operation by remote FW-5 expansion modules in the field. A TBUS-T transmitter module is used as the last card in the block, and additional remote cards are connected with a TBUS-R receiver module. A standard Cat5e patch cable (or better) is used for communication. The remote block needs to be powered again on the TBUS-R because the power cannot be transported over the patch cable. Up to 10 clusters can be set up.

Communication must take place over separate routes; connecting into an Ethernet LAN is not possible.

Figure 38: TBUS remote-IO with max. 10 clusters

No configuration is necessary in setIT, meaning TBUS remote-IO can be used in all setIT versions. For a larger number of expansion modules, the current calculation can report an overload in setIT. Because the TBUS-R receiver module powers the cluster again, the current calculations can be disabled in the base system parameters with the "**FW-5 bus extension**" function.

Item no.	Item	Function
310051006000	TBUS-x set	**Transmitter**, **Receiver** + cable
310051006200	TBUS-T	Transmitter T-BUS extension

Display and diagnostics

System LEDs

System LED		Colour	State	Function
traffic	●	green	flash	Communication on the TBUS
			OFF	No connection, operating state
control	●	green	statically ON ●	Operating mode: : Cluster enabled
			briefly OFF	Cluster reset, break pulse active
			OFF	No connection, cluster blocked
cmd	●	green	statically ON ●	Safety loop wired and enabled
			briefly OFF	Command to DSO activated
			OFF	No connection
1/n	●	green	statically ON ●	Safety loop wired and enabled
			briefly OFF	Command to DSO activated
			OFF	No connection

Technical data for TBUS-T

TBUS-T	FW-5 transmitter module T-BUS extension
Communication	Receipt of TBUS signals and transfer to TBUS-R
Cable & connection	Patch cable min. CAT5e, RJ-45 connector
Range	Max. 10 clusters
Distance	**FW-5** 1000 m **FW-5-GATE** 150 m **FW-5-GATE rev2** 1000 m **FW-5-GATE rev3** 1000 m
Safety loops	Control loops for command termination cmd and 1/N via terminal Screw terminal MSTB 2-pin, 0.2 to 2.5 mm²
Environment	-25°...+70°C, Ø24h max. 55°C, rel. humidity < 95%, no condensation
Housing	Plastic with integrated I/O, top-hat rail installation 22.5 x 105 x 115 mm (W x H x D)
Weight	90 g excluding packaging

Connector assignment DSO command loops

To use the command loop, the signals must be connected locally to the same terminal of the associated DSO module.

Terminal X↑-top: Control loop cmd

Terminal X↑	Signal name	Remarks
X↑.A	Control loop A cmd	"Command running" loop
X↑.B	Control loop B cmd	"Command running" loop

Terminal X↓ at bottom: Control loop 1/N

Terminal X↓	Signal name	Remarks
X↓.A	Control loop A 1/N	"Command active" loop
X↓.B	Control loop A 1/N	"Command active" loop

TBUS-R Receiver remote IO

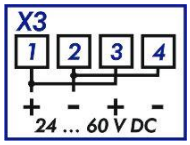
The TBUS-R module is the receiver module for the TBUS remote IO. It receives the TBUS data over a patch cable, incorporates the subsequent extension modules into the bus and provides them with power. Up to 10 clusters can be set up. No configuration is necessary in setIT, meaning the remote IO can be used in all setIT versions.
Powering the cluster again on X3 is an absolute requirement.

Item no.	Item	Function
310051006000	TBUS-x set	Transmitter, receiver and cables
310051006100	TBUS-R	Receiver T-BUS extension

Technical data

TBUS-R	FW-5 receiver module T-BUS
Supply voltage	**+20 to 72V DC,** 24 to 60 V DC ±20%
Supply	Maximum 2.8 A, load shedding when exceeded
Power consumption	Max. 15 W
Galvanically isolation	1500 V between supply and logic
Environment	-25°...+70°C, Ø24h max. 55°C, > 48 V DC max. + 50°C, relative humidity < 95%, no condensation
Terminals	Screw terminal MSTB 4-pole, 0.2 to 2.5 mm²
Housing	Plastic with integrated I/O, top-hat rail installation 22.5 x 105 x 115 mm (W x H x D)
Weight	140 g excluding packaging

Connector assignment X3: Supply voltage for TBUS-R



Terminal X3	Signal name	Remarks
X3.1	+ Ub	+20 ... 72 V DC, max. 15 W
X3.2	- mass	0V
X3.3	+ Ub	+20 ... 72 V DC connected with X3.1
X3.4	- mass	0V connected with X3.2

Connector assignment DSO command loops

To use the command loop, the signals must be connected locally to the same terminal of the associated DSO module.

Terminal X↑ top: Control loop cmd

Terminal X↑	Signal name	Remarks
X↑.A	Control loop A cmd	"Command running" loop
X↑.B	Control loop B cmd	"Command running" loop

Terminal X↓-bottom: Control loop 1/N

Terminal X↓	Signal name	Remarks
X↓.A	Control loop A 1/N	"Command active" loop
X↓.B	Control loop B 1/N	"Command active" loop

Display and diagnostics for TBUS-R

System LEDs

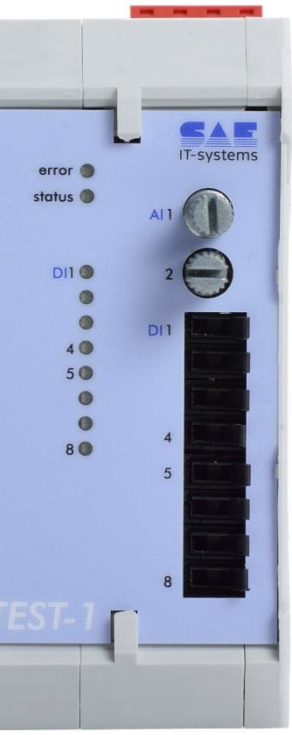
System LED	Colour	State	Function
error	red	statically ON ●	Cable fault detected
		OFF	Operating mode: No-fault status
status	yellow	statically ON ●	Overall current permitted exceeded
		OFF	Operating mode: No-fault status
Uext	green	statically ON ●	Supply OK
		OFF	No supply

System LED	Colour	State	Function
traffic	green	flash	Communication on the TBUS
		OFF	No connection, operating state
control	green	statically ON ●	Operating mode: : Cluster enabled
		briefly OFF	Cluster reset, break pulse active
		OFF	No connection, cluster blocked
cmd	green	statically ON ●	Safety loop wired and enabled
		briefly OFF	Command to DSO activated
		OFF	No connection
1/n	green	statically ON ●	Safety loop wired and enabled
		briefly OFF	Command to DSO activated
		OFF	No connection

Behaviour when communication is disrupted

Behind the front bar of the TBUS-R is a switch for selecting operation when communication is disrupted or there is a cable fault.

Switches	Position	Function
S1	**OFF / left**	The extension modules in the cluster transition to timeout when a fault occurs Restarting the base station is not required
	ON / right	The extension modules in the cluster, and all the subsequent ones, are permanently blocked Restarting the base station is required



TEST-1 test module

The TEST-1 test module is a converted 8DI2AI card. Eight switches and two potentiometers have simply been added in the housing to stimulate process values. In setIT, this card is configured as a 8DI2AI card.

Item no.	Item	Function
310051003500	TEST-1	Eight switches, two potentiometers

System LEDs

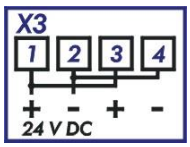
LED	Colour			Function
error ●	red	○	OFF	Operating mode: No-fault status
		●	static ON	Error: EM disabled /malfunction
		✳	flashing 2 Hz	Error: EM configured incorrectly / module defective
		✳	flashing 4 Hz	Error: Number of modules or slot position not same as configuration
		✳	flashing 8Hz	Error: No communication to base system
status ●	yellow	○	OFF	Operating mode: No-fault status
		●	static ON	Error: No, or erroneous, analogue calibrating values / EPROM fault
		✳	flashing	Error: Calibrating analogue values
		✳	"Chasing light"	One-off pulse per assembly after Bus release only visible with several EMs

Status of information inputs

LED	Colour		Function
DI1 ●	green	DI1	Signal state of switch DI1
...			
DI4 ●	green	DI4	Signal state of switch DI4
DI5 ●	green	DI5	Signal state of switch DI5
...			
DI8 ●	green	DI8	Signal state of switch DI8

Connector assignment X3: Supply voltage for TEST-1

A voltage supply is required for the process voltage supply.



Terminal X3	Signal name	Remarks
X3.1	+ Ub	+24V DC -15% +20%
X3.2	- mass	0V
X3.3	+ Ub	+24V DC jumpered internally with X3.1
X3.4	- mass	0V jumpered internally with X3.2

NOTE **The card is for training and test purposes only. It is not suitable for using in the field.**

9 Communication modules

Types of interfaces

GPRS/EDGE

M2G-1	ext. Quad Band	GPRS/EDGE Quad Band M2M with integration field strength
GPRS-1	ext. Quad Band	GPRS/EDGE Quad Band M2M
GMOD-V3	ext. GPRS+VPN	GPRS modem with VPN client
E75i*	ext. GPRS/EDGE+VPN	GPRS/EDGE modem with VPN client

*not applicable using FW-5-GATE-4G

Switched lines (GSM)

GPRS-1	ext. Quad Band GSM	GSM Quad Band to 9600 bit/s
M2G-1	ext. Quad Band GSM	GSM Quad Band to 9600 bit/s

Switched lines, analogue/ISDN(PSTN)

TDW-33	ext. Dial-up modem	Dial-up modem to 33.6 Kbit/s 3 kV
IDW-90	ext. ISDN adapter	ISDN terminal adapter, 64 Kbit/s

Dedicated line

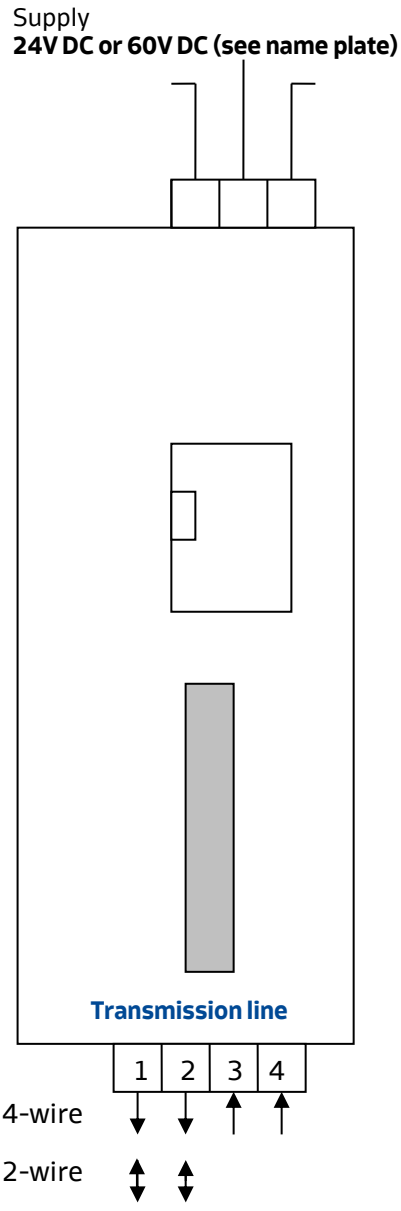
V.24	EIA-/RS-232	Asymmetric, max. 115 Kbit/s, 20 m, point-to-point
RS-485	EIA-/RS-485	Symmetric, max. 56 Kbit/s, 1.2 km, up to 31 nodes
IFX-485	EIA-/RS-485	Conversion of RS-232/V.24 from X102 to RS-485
CL	Current loop	Max. 9.6 Kbit/s, 100 m, up to 3 nodes
SWT12	ext. FSK modem	BZT authorization (now German BNetzA), 1200 Bit/s max. 30 km, up to 17 participants
SWT96	ext. FSK modem	9600 bit/s max. 20 km, up to 17 participants
PDPS-1	Extension module	Profibus-DP slave

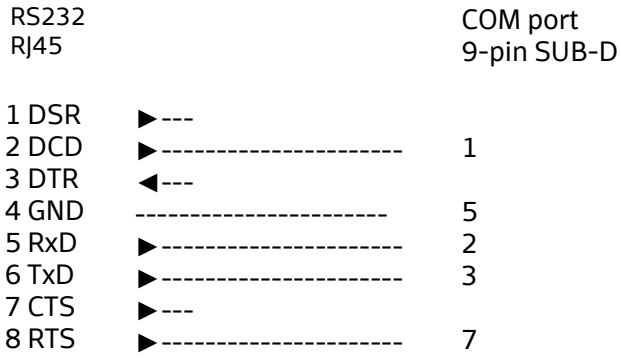
Dedicated line

SWT-1200 / SWT-9600

The assemblies are listed under these designations, but are identical::

Naming SAE	other listings
SWT-1200	new: 500 FSD10, old: SWT-12, HY-101 SWT-12
SWT-9600	new: 500 FSD11, old: SWT-96, HY-101 SWT-96





DIL switch	Position, left	Position, right
C-1	No function	No function
C-2	RTS for 2-wire half-duplex mode	RTS = ON for 4-wire full-duplex mode
2-W	**4-wire** mode	**2-wire** mode
-20 dB	Normal transmission level	Reduced transmission level
20%	Both on "ON": 60% predistortion	20% predistortion Transmission level
40%		40% predistortion Transmission level
10 dB	Only one amplifier may be switched on at any one time.	10 dB amplification Receive level
20 dB		20 dB amplification Receive level
30 dB		30 dB amplification Receive level
40 dB		40 dB amplification Receive level
T-T	Termination TxDinactive	Active termination transmitter
T-R	termination for Rx inactive	Active termination receiver

Default 2-wire = grey area

10 External power supplies

In addition to the 24 V DC supply of the FW-5-GATE-4G-3, wide range supply with galvanic isolation is also possible with the PS-60.

PSU 24V DC 2.1 A (DPP50-24)

Input voltage	85...264 VAC, 50/60 Hz /90...375 VDC
Output voltage	24 V DC adjustable, 2.1 A
Fuse	T2AH/250 V
Backup time	> 25 ms (at 230 V AC)
Efficiency	typical 86%
MTBF	273,000 hours (according to MIL-HDBK-217F.GF25)
EMC emissions	EN61000-6-3, EN55011, EN55022, Class B including Appendix A
EMC immunity	EN61000-6-2, EN61000-4-2 Lev. 4, EN61000-4-3 Lev. 3, EN61000-4-6 Lev. 3 EN61000-4-4 Lev.4 input, Lev.3 output, EN61000-4-5 Lev. 4
Protection class	EN 60950-1 / IP20
Installation	DIN profile, free space at top/bottom 25 mm, right 10 mm
dimensions	45 x 75 x 91 mm (W x H x D) + rail
Weight	260 g without packaging
Connection	Screw-type terminal, 0.5 - 2.5 mm² (AWG 24-12)
Environment	-10°C ... +60°C, 90% without condensation

PSU 24V DC 4.2 A (DPP100-24)

Input voltage	85...132 /176...264 V AC, 50/60 Hz /210...375 V DC
output voltage	24V DC adjustable, 4.2 A
Fuse	T3.15 AH/250 V
Backup time	> 25 ms (at 230 V AC)
Efficiency	typical 87%
MTBF	239,000 hours (according to MIL-HDBK-217F.GF25)
EMC emissions	EN61000-6-3, EN55011, EN55022, Class B including Appendix A
EMC immunity	EN61000-6-2, EN61000-4-2 Lev. 4, EN61000-4-3 Lev. 3, EN61000-4-6 Lev. 3 EN61000-4-4 Lev.4 input, Lev.3 output, EN61000-4-5 Lev. 4
Protection class	EN 60950-1 / IP20
Installation	DIN profile, free space at top/bottom 25 mm, right 10 mm
Dimensions	72.5 x 75 x 96.7 mm (W x H x D) + rail
Weight	390 g without packaging
Connection	Screw-type terminal, 0.5 - 2.5 mm² (AWG 24-12)
Environment	-10°C ... +60°C, 90% without condensation

UPS - Uninterruptible power supplies

UPS Akkutec 2403-0

Nominal input voltage	**230 V AC ±15%** 47/63 Hz
Rated output voltage	**26.8 V DC ± 0.4%** (without battery) with battery depending on state of charge 19.8...26.8 V DC ± 0.4%
Nominal output current	**2.85 A** at 100% ED
Protection class	IP 20
Safety	according to EN61558-2-17 (VDE 0570 2-17) (safety separation between input and output)
Operating temperature	0 - 45°C, recommended for batteries 0 - 25° C optimum storage temperature for battery 20°C. In storage condition, charge battery every 6 months.
Short-circuit protection	Electronic, short-circuit proof output
Battery	external, e.g. battery NBBH 2407
Autonomy	Depending on battery and power
Charging characteristic	I/U DIN 41773 Part 1
Charging end voltage	26.8 V DC
Charging current	0.25 A at 100% load2 .25 A at 0% load
Deep discharge protection	Switching off the battery at a battery voltage of 19≤.8 V ±0.4%.
LED indicators	Mains OK' green LED lights up UPS-Operation LED green on, flashes when battery is low
Relay outputs	Mains/operation 0.5 A /30 V DC
UPS/-Operation	0.5 A /30 V DC
Battery management	Battery management via internal microcontroller
Interference emission	EN 61000-3-2 and EN 61000-3-3 class A, EN 55011 class B
Sensitivity to interference	EN 61000-6-2, EN 61000-4-2 (4kV), EN 61000-4-3 (10 mV/m), EN 61000-4-4 (input 2 kV, output 1 kV), EN 61000-4-5 (mains 2 /4kV, output 0.5 kV), EN 61000-4-6 (10V, 150 kHz-80 MHz)EN 61000-4-11 (bridging by accumulator)
Overall unit	EN50178 /EN 60950
Mounting	Surface-mounted unit, DIN top-hat rail
Connection	via terminals 1.5 mm²
Dimensions	60 x 92.5 x 116 mm (WxHxD)

Battery NBBH 2401

Rated voltage	**24 V DC**
Capacity	**1 Ah** , maintenance-free lead accumulators
Fuse	3 A FK2
Autonomy	30 min at 2 A load, 9 min at 2.85 A
Structure	DIN rail or wall bracket
Dimensions	69 x 120 x 103 mm (WxHxD)

Battery NBBH 2407

Recommended battery for UPS Akkutec 2403 with wall bracket and battery fuse:

Rated voltage	**24 V DC**
Capacity	**7 Ah**
Autonomy	140 min at 2.85 A load
Batteries	2 pieces in series connection a 12 V DC
Structure	Wall mount
Dimensions	159 x 115 x 158.5 mm (WxHxD)
Weight	approx. 7 kg without packaging

11 Security relevant 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.

In order to achieve the highest security level according to the BDEW whitepaper, it is generally recommended to use the new technology series5e and the newest release of setIT. A free update service informs you about new releases and features.

Default parameters for project set up

For compatibility reasons, setIT presets a default of security settings, which 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 until release V5.003.07 by default.
  - The FTPs/https protocol is recommended for security reasons.
- The default Bluetooth selection is "activatable"
  at CPU cards that have a 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 the 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 which 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).

Minimum settings of safety-relevant functions

As of version setITV7, the minimum settings for IT security are requested for each new project. Settings activated here are already checked during project planning and an adjustment is requested in the event of deviation.

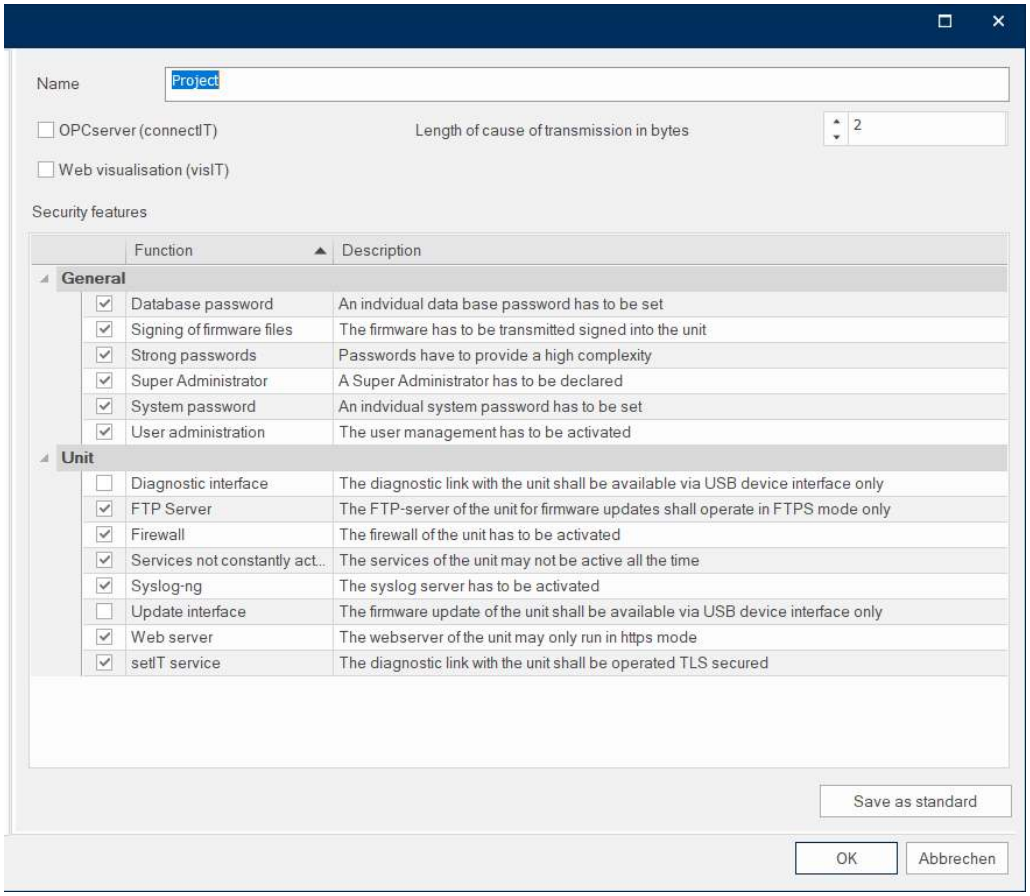


Figure 39: Minimum settings of safety-related functions as of setITV7

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

Security related issues of the series

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

	System4	series5	series5+	series5e	series5X
User management from setIT V4.008	-	●	●	●e	●x
LDAP/Radius from setIT V6	-	-	-	●e	●x
Firewall from setIT V5.0	-	-	●	●e	●x
FTPs/https from setIT V5.0	-	●	●	●e	●x
IP address verification	●	●	●	●e	●x
Port limitation on enabled communication	○	●	●	●e	●x
Disabling unused interfaces from setIT V7.0	-	-	-	-	●x
Enabling PLC programming from setIT V5.0	-	●	●	●e	●x
Disabled USB device from setIT V5.0	-	●	●	●e	●x
VPN (end-ende) from setIT V5.0	-	-	●	●e	●x
IPsec IKEv2 from setIT V5.2	-	-	●	●e	●x
TLS (IEC 870-5-104, DNP3) from setIT V7.0	-	-	-	●e	●x
Encrypted database from setIT V5.3	-	-	-	●e	●x
Signed firmware from setIT V5.3	-	-	●	●e	●x
Syslog from setIT V5.3	-	-	●	●e	●x
Disabled remote download	-	-	●	●e	●x
Disabled Bluetooth #1	-	●	●	-	-
Control commands for services from V5.3 webserver, USB-host/-device, FTP, diagnostic,	-	-	●	●e	●x
Defence of brute-force attacks	-	-	○	●e	●x
Separated LAN segments, no routing	●	●	●	●e	●x
EST key exchange IEC 62351-9	-	-	-	●e	●x
Secure boot	-	-	-	-	●x
Unique device certificate in Secure-Element	-	-	-	-	●x
Encrypted file system for configuration	-	-	-	-	●x

- not possible ○ partially available ● available

[e]The technology series5e will be supported from setIT V5.004, [x]series5X from setITV7.002, #1 if available

Separated network segments

Any function of routing of IP-frames is inhibited, thus **a direct access via TCP/IP from one network port to another is blocked in the device with an active firewall**. A gateway functionality from one interface to another is only available using cross connection of process data operated by self-sustaining protocols according to the specific configuration.

Checklist

This checklist is intended to facilitate the establishment of a project with specifications according to the BDEW whitepaper. It in no way replaces requirements profiles and execution instructions, as required by the customer in the BDEW whitepaper. Essential standards can nevertheless be realised in a few steps. Your selection may deviate from this checklist provided that the deviations meet your security requirements.

Definitions at the project start

- ☐ Define the name and storage location of the project database
- ☐ Organise a backup system for the project database
- ☐ Define components (PCs, laptops, control systems, etc.) that may be used in the project.
- ☐ Align current malware test programs to these components (if possible) and check the components against infection.
- ☐ Define the updating cycle of the operating system and malware of the components.

Network and communication

- ☐ Define the project topology. When doing so, avoid public networks and switched telephone lines if possible.
- ☐ Define the protection of all communication paths;
  in series5 devices from setIT V5.0, VPN end-to-end encryption is available from the inside of the telecontrol station.
- ☐ Define remote maintenance access and their protection level
- ☐ Obtain/determine the IP addresses of the network and the planned stations with TCP-IP access.

User administration

- ☐ Define the **users** that should have access to the project, configuration or station.
- ☐ Define **responsibilities** internally and externally.
- ☐ Define responsibilities and **access rights** for each user.
- ☐ Define the **password quality**.
- ☐ Set the users profiles and responsibilities in the user management in setIT. Use individual profiles an avoid group declarations.
- ☐ Set a **database password**.
- ☐ Set a **system password**.
- ☐ Activate **signed firmware**.
- ☐ Set the '**super admin**' role for the main coordinator. Only this coordinator can set the system password and users globally.

Start of project

- ☐ Find out about new version releases and patches for the components used.
- ☐ Conduct IT security information sessions with the project participants and present the specifications.
- ☐ From setITV7: Define your minimum requirements of security-related settings.
- ☐ Set the project with the first station/head and make the following settings. The properties set here are automatically inherited to new stations, where they can be modified.

Settings in the dialogue station/services

- ☐ Lock the service **Memorystick-Transfer** if no update shall be available on site via stick or set to activatable via control command.
- ☐ Lock the **USB Ethernet** service if the device must not be accessed via USB cable or set to activatable via control command.
- ☐ Lock the **FTP server/ firmware update** if no remote downloads are allowed or set to activatable via control command.
- ☐ Enable **https** and **FTPs** in the 'Services' station dialogue.
  by default from setITV6.003
- ☐ Lock the service **setIT diagnostic** if no service shall be available or set to activatable via control command.
- ☐ Using service setIT diagnostic, select **TCP(TLS secured)** for communication.
- ☐ Lock the **web server** if no network access may be used via browsers or set to activatable via control command.
- ☐ If available, disable Bluetooth® if no wireless access must be used or select to activatable.
- ☐ Lock the **console** for series5 devices (series5 only)
- ☐ Enable the **firewall** from series5+ devices and restrict the services in the connections/sockets to the desired minimum.
  by default from setITV6.003
- ☐ Enable **IPsec (IKEv1/IKEv2)** or select a TLS-link if VPN end-to- end encryption is to be established.
- ☐ Enable **Syslog-ng** if a centralised server shall collect system indications.
- ☐ Set your own **user certificates** if your IT policy requires this.

Settings in the station/LAN connection dialogue

- ☐ Enter the **IP addresses** and **subnet mask** of the station and the gateway according to the topology.
- ☐ With the firewall enabled, disable **unwanted services** on the link layers and accesses according to the specifications. This process must be repeated after configuration of the station has been completed, since the connections and services only be selected after the station has been set-up. When doing so, please also remember the **expanded firewall rules** for each activated service and link.
- ☐ Using a release < V5.002, please take care to use only automatically generated routing commands and no additional entries in section routing are declared will be set automatically from setIT V5.002.

During the project

- ☐ If possible, DO NOT make configuration changes or download the operating system and firmware using the "send configuration" function – instead, use the USB memory stick or the firmware download via FTPs. (Doing so could compromise the communication process described as UNIP/UDP or service)
- ☐ Ensure that changes made as part of the project are properly documented.
- ☐ Always store the documents in a safe place.
- ☐ Check the components used in the project cyclically for malware and approval as part of the project.
- ☐ Avoid using of untested components, particularly USB memory sticks.
- ☐ Using Syslog, ensure to check the indications periodically, if no automatic alarming is guaranteed.

Recommendations and specifications

- Use of safe and/or **closed networks**
  - Operating an information technology (IT) system in a public or inadequately closed network potentially allows attackers to access the network and enables spying, manipulation and sabotage.
- Using technology in **closed, non-accessible areas**
  - A local open access to rooms or cabinets during installation provides possibilities of manipulation
- **Do not use switched telephone lines**
  - According to the BDEW whitepaper, switched telephone lines represent an open access point and must be avoided.
- Use services only if the security concept allows this, e.g.
  - Bluetooth®, where available, set to "can be enabled" as standard
  - Web server use of https and user management is recommended
  - USB Ethernet DHCP service enabled – assignment of an IP address on service laptop
- **Enabling FTPs/https secure services** for firmware update and web server
  - the secure services encrypt the information that is sent and make access much more difficult.
- **Only allow firmware update on 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 newest **technology** as far as possible
  - On the series5 platform, not all the security features can be provided without affecting the overall concept, and with it the basic function of the system.
  - series5+ units are well equipped but newer series grant more efficient protection s. Security related issues of the series page 151.
- Use **the latest update** if possible.
  - From version setIT V4.008, essential components were upgraded to a higher security level according to the BDEW whitepaper security concept.
  - In Version setIT V5.000 additional characteristics have been added.
  - The role concept has been refined.
  - The system password is disabled by editable super admin.
  - New patches have been introduced and certificates renewed.
  - Starting with setIT V5.002 IPsec is supported with IKEv2.
  - From setIT V5.003 Syslog, database encryption and signed firmware are supported.
  - In setIT V5.004.09 and V6.003.06b27 a set of leaks have been closed. Please refer to the current releasenotes..
    We highly recommend to update to setIT from V7.000.

- **Enable user management** and set roles as personally 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
- Set users with **secure passwords**
  - Secure passwords consist of a minimum of 10 characters.
  - The longer and more cryptic the password, the safer its classification.
  - - Avoid family or company names, sequences such as 123, abc and known words possibly listed in dictionaries or rainbow password lists. Special characters and upper/lower case add complexity.
- **Set a super admin** in the 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.
- **Set a database password** in user administration
  - With a database password and *.sdbx files, the projects settings will be stored encrypted in the database file. Any access to the information will only be available with the valid database password.
- **Set the system password** in the 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.
- **Activate sign firmware** in user administration
  - An update to the station will only be valid with a signed firmware file. No other source will be accepted.
- **Disable potentially unsecure services** and approaches such as FTP (firmware update), http (web server) by activating https/FTPs
  - FTP and HTTP allow eavesdropping, and information providing access and manipulation options can be disclosed in 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. Select TCP(TLS secured) to avoid external access. Default as of setITV6.003
- **Change the SNMP Default Community Name**
  - The default community name 'public' is well known. With link to this service, an attacker may read out settings and perform modifications which may lead to unsecure conditions.

- **Create securely-related system messages** 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 error detection
  - Card error detection
  - Expansion slot error detection
  - Time server error detection
  - SD card malfunction
  - Archive errors and overflows
  - Command output interlock indications
  - Change control group indication
  - PLC software status
- **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, since they contain essential access information.
- **Set up a multi-level backup**
  - A potential malfunction or incorrect operation may require a roll-back to an older version in order to maintain operations.

Specifications for series5 components

- **Lock the console**
  - When the console is enabled, a user can access the core system.
- If possible, limit the bandwidth of data connections via networks with public access to 1 MBit/s
  - This limitation will ensure that DOS attacks no longer have any significant sabotaging effect. Any load over this rate can lead to a system restart in extreme cases.

Additional specifications for series5+ /series5e

- **Enable the firewall**
  - The firewall detects attack situations outside normal operation and can filter/disconnect ports on individual paths.
- **Setting the firewall**
  - Limiting services to accesses that are actually being used reduces the potential attack target
- Setting up an **end-to-end encryption** VPN client from setIT V5.0
  - When public or insufficiently protected paths are used, information transfers could be read and manipulated
- While using series5+ devices and if possible, limit 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 a system restart in extreme cases.

Recommendation for active web servers

- **Setting the session timeout** for enabled web servers
  - If the selected timeout session is too large or is disconnected, an open web session may be taken over by another service PC user without renewed authentication.
- **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
- **Only enable the webserver via system command when needed**
  - A disabled webserver simply offers no target area.

Recommendation on active Bluetooth® interface

- **Activate the Bluetooth interface during the session only**
  - The "activatable" setting, which allows temporary Bluetooth activation, is set by default
  - In the setting"active", the Bluetooth interface cannot be disabled due to customer demand.

Recommendation on enabled PLC programming

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

Delivery status

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) chasing light of the "run/com/IO/data" status LED or "run/com/sys/VPN" at series5e devices.

Default values in delivery status

No configuration operation does not yet have any telecontrol communication relationship and is therefore not accessible via the protocols; it has no valid function, and represents 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
3. Ethernet-Controller X101	192.168.179.1/24 if available
4. Ethernet-Controller X103	192.168.180.1/24 if available
5. Ethernet-Controller X105	192.168.181.1/24 if available
6. Ethernet-Controller X107	192.168.182.1/24 if available
USB-device	192.168.59.81/29

Ports after 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 security 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 default output state of commands and setpoints is 0 = off. A current target state "refresh" must be set via the communication.

Passwords after cold start

In the cold-started state, default passwords are enabled, thus allowing 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. Starting with series5+ it is possible to enable your own system password in the project.

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	Remarks
23	telnet	Console with password request (series5 only)
20/21	FTP	Access with password request
67	DHCP	only at USB-Ethernet from series5+
80	http	Port only provides FTP download

The Telnet console via ports 23 and 992 is not accessible from series5+ systems. The root password is overwritten after loading a project with activated FTPS or System password with an unknown, random 19-byte password.

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	Remark
102	IEC 61850	Access control for client IP possible
123	NTP	Client time synchronisation
161/162	SNMP/v3 UDP/Traps	SNMP status interrogations
389/1812	LDAPTCP/Radius UDP	User management from series5e V6.0
443	https	Port only provides FTP/FTPs download
500/4500	IPsec IKEv2	series5+ from V5.2
502	Modbus-TCP	Access control for client IP possible
514/1470	Syslog UDP/TCP	series5+ from V5.3
1194	OpenVPN	VPN-Tunnel ab series5e V6.0
1200	3S	Proprietary (3S) for connection to codeIT
1293	IPsec IKEv1	series5+ from V5.0
1883/8883	MQTT/MQTTS	Data server broker+ ab V7.0
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
16725/17725	http/https	visIT Datenkommunikation
20000	DNP3	TCP Port
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 series5+ technology.

The IP messages routing function is disabled. **Direct TCP access from one network card to another within a station is blocked with an active firewall**. This also applies to network segments that are set up via PPP communication via serial interfaces, for example. A gateway function is only enabled via implementation of the protocols from one interface to another according to the configuration in ISO/OSI application level 7.

Decommissioning

The stations described here are loaded with security features that represent secrets in various forms. Some of these secrets have a considerable protection potential. If such a station - for whatever reason - is taken out of service, appropriate protective measures must be taken in order not to reveal these secrets or to leave them unprotected.
Decommissioning only means the return of a product to a safe stock, not disposal according to WEEE Directive 2002/96/EC.

Deleting the project by cold start

A project created with a security level described here carries secrets that must be deleted when it is taken out of service. This information must be removed by a cold start.
The execution of the cold start is described in the respective manuals; it is usually associated with a restart of the station or is triggered by a command to the station via the parameterisation tool.

The cold start removes the project and its settings and resets the system memory. If the flash memory also needs to be cleaned, this can be done by a basic system update. This also resets the entire flash memory.
If the station can no longer be started and repaired, the CPU module or the SoC system on chip can be removed and destroyed accordingly. The SoC is usually located as a plug-in module on the CPU board. It carries all relevant memories of the basic system.

SD card

If an SD card was inserted, it must be removed and safely deleted. This is particularly necessary if system backups were also saved on the card.
Secure deletion is not achieved by formatting, as only administrative areas are overwritten. Similarly, the standard erase function only marks the files as deleted but does not remove the information stored in the sectors. Use an appropriate tool that actually overwrites the storage area with any content to bring it to a state that is considered securely erased.

Appendix

Comparison of series5 systems

System comparison FW-5

Function	FW-5	FW-5-BT	FW-5 -230	FW-5-BT-230	FW-5 +	FW-5-BT +	FW-5 -230 +	FW-5 -BT-230 +	FW-5 series5e*4	FW-5-4 series5X*7	FW-5 -GATE-3	FW-5 -GATE-4G-3
series5+	-	-	-	-	+	+	+	+	-	-	-	-
series5e	-	-	-	-	-	-	-	-	e	-	-	-
series5X	-	-	-	-	-	-	-	-	-	X*7	X*7	X*7
secure-boot	-	-	-	-	-	-	-	-	-	•	•	•
Breite /mm	68	68	86	86	68	68	86	86	68	68	45	68
DI internal	8	8	8	8	8	8	8	8	8	8	-	-
DO internal	4	4	4	4	4	4	4	4	4	4	-	-
AI internal	2	2	2	2	2	2	2	2	2	2	-	-
EM max.	10	10	10	10	12	12	12	12	12	12	12	12
Temp.sensor	-	-	-	-	-	-	-	-	•	•	•	•
LAN	1	1	1	1	1	1	1	1	1	1	2	2
IP-links	64	64	64	64	64	64	64	64	64	64	64	64
IED IEC61850	-	-	-	-	16	16	16	16	40	40	40	40
RS-232/V.24	1	1	1	1	1	1	1	1	1	1	1	1
RS-485	1	1	1	1	1	1	1	1	1	1	2	2
CL/S0	-	-	-	-	-	-	-	-	-	-	-	-
Mobile radio	-	-	-	-	-	-	-	-	-	-	-	•
USB device/host	•/•	•/•	•/•	•/•	•/•	•/•	•/•	•/•	•/•	-	-	-
USB OTG	-	-	-	-	-	-	-	-	-	•	•	•
Bluetooth®	-	•	-	•	-	•	-	-	-	-	-	-
SD card	O	O	O	O	O	O	O	O	O	O	-	-
microSD card	-	-	-	-	-	-	-	-	-	-	O	O
20..72 V DC	•	•	-	-	•	•	-	-	•	•	•	•
230 V AC	-	-	•	•	-	-	•	•	-	-	-	-
U_{Batt} / U_{Mod}	-	-	•	•	-	-	•	•	-	-	-	-

• = contained in standard, O = Expansion/Option/Licence, - = not available

Technical details are available in the respective descriptions.

Comparison FW-5-GATE

Function	FW-5 series5+	FW-5 series5e *4	FW-5 series5X *4	FW-5 -GATE	FW-5 -GATE CL	FW-5 -GATE-230	FW-5 -GATE-230 CL	FW-5 -GATE e	FW-5 -GATE CL e	FW-5 -GATE-4G	FW-5 -GATE -4G CL	FW-5 -GATE-450 *6	FW-5 -GATE -3 *7	FW-5 -GATE -4G-3 *7
series5+	+	-	-	+	+	+	+	-	-	-	-	-	-	-
series5e	-	e*4	-	-	-	-	-	e*4	e*4	e*4	e*4	e*6	-	-
series5X*7	-	-	X*7	-	-	-	-	-	-	-	-	-	X*7	X*7
secure-boot*7	-	-	•	-	-	-	-	-	-	-	-	-	•	•
Breite /mm	68	68	68	45	45	68	68	45	45	68	68	68	45	68
DI internal	8	8	8	-	-	-	-	-	-	-	-	-	-	-
DO internal	4	4	4	-	-	-	-	-	-	-	-	-	-	-
AI internal	2	2	2	-	-	-	-	-	-	-	-	-	-	-
EM max.	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Temp.sensor	-	•	•	•	•	•	•	•	•	•	•	•	•	•
Mobile radio	-	-	-	-	-	-	-	-	-	4G	4G	450-	-	4G
LAN	1	1	1	2	2	2	2	2	2	2	2	2	2	2
IP-links	64	64	64	64	64	64	64	64	64	64	64	64	64	64
IED IEC61850	16	40	40	16	16	16	16	40	40	40	40	40	40	40
RS-232/V.24	1	1	1	1	1	1	1	1	1	1	1	1	1	1
RS-485	1	1	1	2	1	2	1	2	1	2	1	2	2	2
CL/S0	-	-	-	-	1	-	1	-	1	-	1	-	-	-
USB device/host	•/•	•/•	-	•/•	•/•	•/•	•/•	•/•	•/•	•/•	•/•	•/•	-	-
USB OTG	-	-	•	-	-	-	-	-	-	-	-	-	•	•
Bluetooth®	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SD card	O	O	O	-	-	-	-	-	-	-	-	-	-	-
microSD card	-	-	-	O	O	O	O	O	O	O	O	O	O	O
24 V DC	•	•	•	•	•	-	-	•	•	•	•	•	•	•
20..72 V DC	•	•	•	•	•	-	-	-	-	-	-	-	-	-
230 V AC	-	-	-	-	-	•	•	-	-	-	-	-	-	-
U_{Batt} / U_{Mod}	-	-	-	-	-	•	•	-	-	-	-	-	-	-

+ = series5+, e = series5e, X = series5X

• = contained in standard, O = Expansion/Option/Licence, - = not available

*0 from setIT V5.0, *1 from setIT V5.1, *3 from setIT V5.3, *3.5 from setIT V5.3.05, *3.7 from setIT V5.3.07, *4 from setIT V5.004, *6 from setIT V6, *7 from setIT V7.002

Technical details are available in the respective descriptions.

Use of the Extension Modules

Extensions EM	FW-5 alle	FW-5 + alle	FW-5 rev3 5e	FW-5-4 5X	FW-5-GATE alle	FW-5-GATE 5e	FW-5-GATE-4G/-2	FW-5-GATE-450	FW-5-GATE-3 5X	FW-5-GATE-4G-3 5X	FW-5-GATE.NB-IoT
series5		+	e	X*7	+	e	e	e	X*7	X*7	X*7
4DI4DO*3.5	-	O	O	O	O	O	O	O	O	O	O
VPP-1*4.7	-	-	O	O	-	O	O	O	O	O	O
8DI	O	O	O	O	O	O	O	O	O	O	O
8DI-220*3.7	-	O	O	O	O	O	O	O	O	O	O
8DO	O	O	O	O	O	O	O	O	O	O	O
8DO-220*3.7	-	O	O	O	O	O	O	O	O	O	O
8DI2AI	O	O	O	O	O	O	O	O	O	O	O
4AI	O	O	O	O	O	O	O	O	O	O	O
4AO	O	O	O	O	O	O	O	O	O	O	O
2AO*1	-	O	O	O	O	O	O	O	O	O	O
DSO-1	O	O	O	O	O	O	O	O	O	O	O
DSO-2	O	O	O	O	O	O	O	O	O	O	O
RES-1	O	O	O	O	O	O	O	O	O	O	O
PM-1*1	-	O	O	O	O	O	O	O	O	O	O
PM-1-R/-S*3.5	-	O	O	O	O	O	O	O	O	O	O
PM-2*6	-	-	O	O	-	O	O	O	O	O	O
ISO-1*6*i	-	-	O	O	-	O	O	O	O	O	O
PIT-1*6	-	-	O	O	-	O	O	O	O	O	O
PDPS-1*1	-	O	O	O	O	O	O	O	O	O	O
M2G-1*0	-	O	O	-	O	O	-	-	-	-	-
GPRS-1	-	O	O	-	O	O	-	-	-	-	-
TETRA-1	O	O	O	-	O	O	-	-	-	-	-
PWR-1	-	O	O	O	O	O	O	O	O	O	O
TBUS-T/-R	-	O	O	O	O	O	O	O	O	O	O
TEST-1/8DI2AI	O	O	O	O	O	O	O	O	O	O	O

+ = series5+, e = series5e, X = series5X
• = contained in standard, O = Expansion/Option/Licence, - = not available
*0 from setIT V5.0, *1 from setIT V5.1, *3 from setIT V5.3, *3.5 from setIT V5.3.05, *3.7 from setIT V5.3.07,
*4 from setIT V5.004, *4.7 from setIT V5.004.07, *6 from setIT V6, *7 from setIT V7.002, *i ISO-1-1 from V6.003

Technical details are available in the respective descriptions.

System comparison

Function	series5	series5+	series5e	series5X
CPU	ARM9 ARM920T	ARM9 SAM9G45	Cortex A8 TI3552	Cortex®-A7 i.MX6
MHz	180	400	800	800
MIPS	200	400	1200	~1000
RAM /MB	32	128/256	512	512
ROM /MB	64	128/256	512	512
SD card max.	1 GB	1 GB	1 GB	1 GB/8 GB*7.2
eMMC max..	-	-	-	1.8 GB *7.2
secure-boot *7.2	-	-	-	•
Real-time clock days	5 SuperCap	30 Li-Ion	60 Li-Ion	60 Li-Ion
codeIT IEC61131-3	O	O	O	O
straton workbench #7	-	-	O	O
visIT *3.5	-	O	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	O
IEC 61850 server *4	-	-	O	O
IEC 62056-21	-	O	O	O
SYM²/SML	-	O	O	O
DNP3 outstation*3	-	O	O	O
DNP3 master*7	-	-	O	O
DSfG *0	-	O	O	O
LACBUS *7	-	-	O	O
MQTT *7	-	-	O	O
Modbus RTU/TCP	•1	•1	•	•
3964R/RK512	•1	•1	•	•-m5
Profibus-DP	O	O	O	O-m5
NTP/DCF	•	•	•	•
Firewall	-	•	•	•
DDOS Firewall *4	-	-	•	•
http/FTP	•	•	•	•
https/FTPs/IPsec	-	•	•	•
SNMP *1	-	•	•	•
SNMPv3 *3.5	-	•	•	•
SNMP-agent *7	-	-	•	•

VPN IKEv1/ IKEv2 *3	-	•	•	•
SYSLOG *3	-	•	•	•
openVPN *6	-	-	•	•
RADIUS/LDAP *6	-	-	•	•
CMS/update-server*7.2	-	-	-	O

+ = series5+, e = series5e

• = 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, *7 setIT V7, *7.2 setIT V7.002, -m5 not with m5

Information on using relays

Assemblies with relay outputs have been declared 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 for automation applications with good powers under resistive and weakly-inductive loads for average and higher switch operations (typically 2 A @24 V DC, 2 A @250 V AC).
AgSiO2	Silver tin oxide is a good choice for high switch loads, especially in network voltage applications under high 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 is the special contact for very low load 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 essentially determined by the relay contact, number, mechanics and the material of the relays. The entire switching capacity can be limited by the terminals and layer design 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 greater DC 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 reverse voltages are often limited by protective circuits. However, these prolong the breaking process.
Max. switching voltage	As well as the max. switching voltage of the relay, the maximum switchable voltage is specified by the protective circuit of the module. These sensitive 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 type, protection circuits can delay the breaking procedure.
Life	The lifetime of a relay is often only specified as a mechanical lifetime in switching cycles without load. Since the lifetime 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, 8DO-220, 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 resistive
Steady-state current *	6.0 A AC
Breaking capability	1500 VA, resistive: 6.0 A @24 V DC/ 0.4 A @60 V DC / 0.2 A@110 V DC/ 0.17 A @220 V DC inductive: 2 A @ 24 V DC, 3 A @ 250 V AC
Switching times ON/OFF	8 ms / 4 ms
switching cycles	> 5*10^6 mechanical EN 60947-5-1: 6000 @ 24 V DC, 2 A, 25° C
Switching frequency	72000 h^{-1} without load /360 h^{-1} with load
Isolation	6000 V surge contact/coil, 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 significant

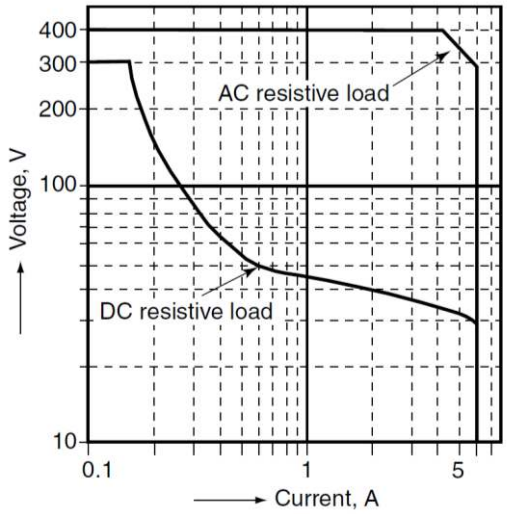
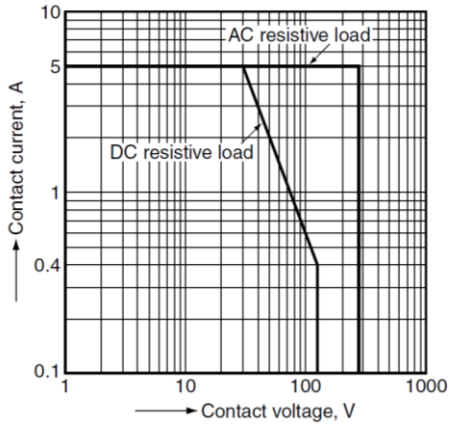


Figure 40: Switching capacity APF 30224
Source: Panasonic APF

APAN	monostable NO contact used on **8DO rev3, VPP-1**
Contacts *	AgNi + Au
Switching voltage *	max. 250 V AC, max. 110 V DC
Making capacity	5.0 A resistive, min. 1 mA 5 V DC 110 mW
Steady-state current *	5.0 A
Breaking capability	1250 VA, 150 W 5.0 A @30 V DC/ 1 A @60 V DC / 0.4 A @110 V DC
Switching times ON/OFF	10 ms / 5 ms
Switching cycles	> $2*10^7$ mechanical > $5*10^4$ mechanical: 5A 250 V AC, 30 V DC, resistive, 25° C
Switching frequency	1200 h^{-1} nominal load
Isolation	6000 V surge contact/coil, 3000 V rms 1 min
Safety *	EN 43149: 5 A 250 VAC ($\cos\varphi$ = 1) 40° / 3 A 250 V AC 90° C / 5 A 30 V DC 90°C, general use / B300, R300 (Pilot duty) EN 479891: Class I, Division 2, Groups A, B, C, D Hazardous Location
Environment *	- 40° + 90°C

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



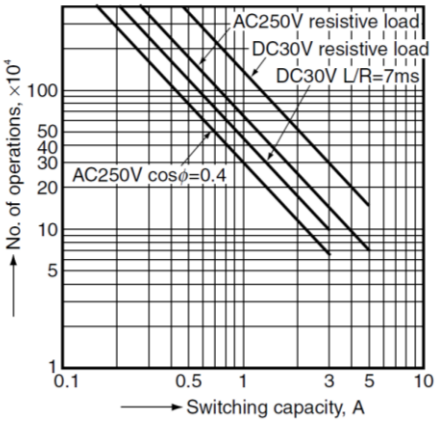


Figure 41: Switching capacity APAN310x
Source: Panasonic PA-N

RT2	monostable changeover contact used on **4DI4DO-1-x**
Contacts *	2 contacts AgNi 90/10
Switching voltage *	250 V AC, max. 300 V DC, max. 400 V AC
Making capacity *	8.0 A / UL: 10 A / 15 A max. 4 s
Steady-state current *	8.0 A / UL: 10 A
Breaking capability	2000 VA 8.0 A @24 V DC/ 1.0 A @60 V DC / 0.35 A @110 V DC/ 0.25 A @220 V DC
Switching times ON/OFF	8 ms / 6 ms
Bounce time	typical 4 ms
switching cycles	> $10*10^6$ mechanical EN 60947-5-1: 6050 2 A @24 V DC / 0.2 A @250 V DC / 3 A @250 V AC
Switching frequency	72000 h^{-1} without load/ 360 h^{-1} with load
Isolation	5000 Vrms contact/coil, > 10 mm 2500 Vrms contact/contact, >3 mm
Safety *	EN IEC 61810-1: operative range 2 UL: coil insulation system class F
Environment	- 40° + 85°C

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

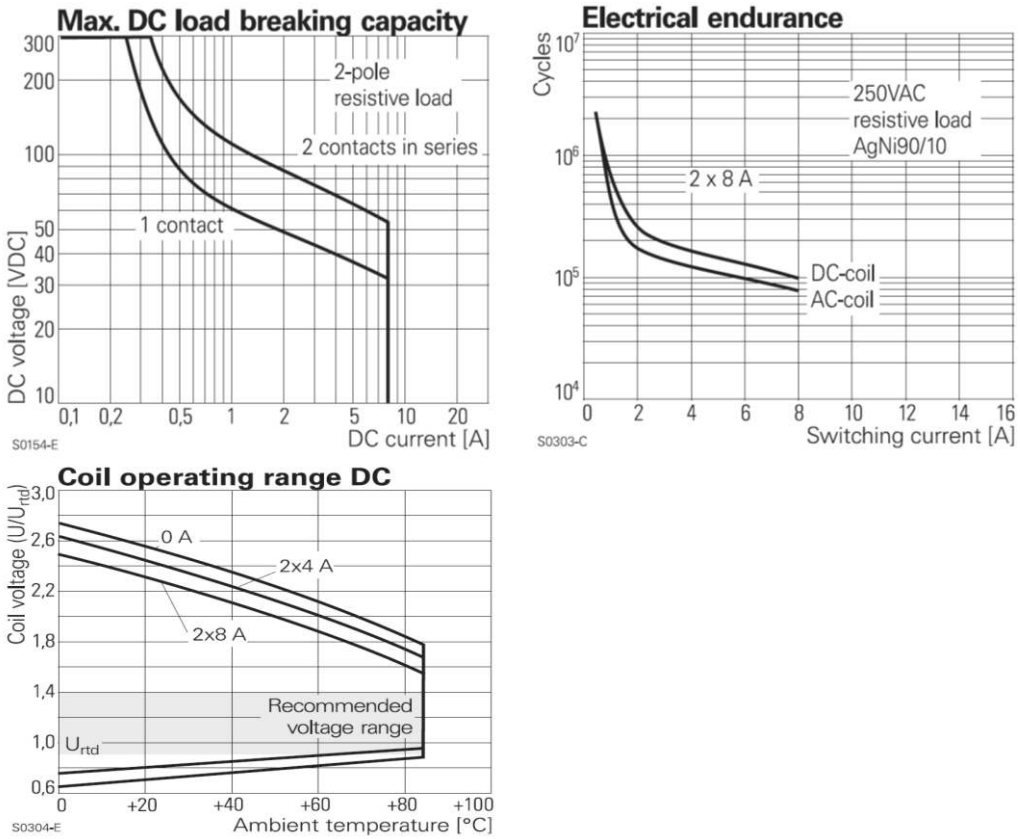


Figure 42: Switching capacity, life and working area RT2
Source: Tyco Electronics/Schrack

RT2 bistable	bistable changeover contact used on **4DI4DO-2-x**
Contacts *	2 contacts AgNi 90/10
Switching voltage *	250 V AC, max. 300 V DC, max. 400 V AC
Making capacity	8.0 A / UL: 10 A / 15 A max. 4 s
Steady-state current *	8.0 A / UL: 10 A
Breaking capability	2000 VA, 8.0 A @24 V DC/ 1.0 A @60 V DC / 0.35 A @110 V DC/ 0.25 A @220 V DC
Switching times ON/OFF	typical 10 ms / 5 ms
Bounce time	typical 4 ms
switching cycles	> $2*10^6$ mechanical EN 61810: $30*10^3$ 8 A @250 V AC 85° C UL508: $20*10^3$ 10 A @250 VAC general purpose 85°C, $6*10^3$ Pilot duty B300, R300 85° C
Switching frequency	72000 h^{-1} without load/ 900 h^{-1} with load
Isolation	5000 Vrms contact/coil, > 10 mm 2500 Vrms contact/contact, >3 mm
Safety *	EN IEC 61810-1: operative range 2 UL: coil insulation system class F
Environment	- 40° + 85°C

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

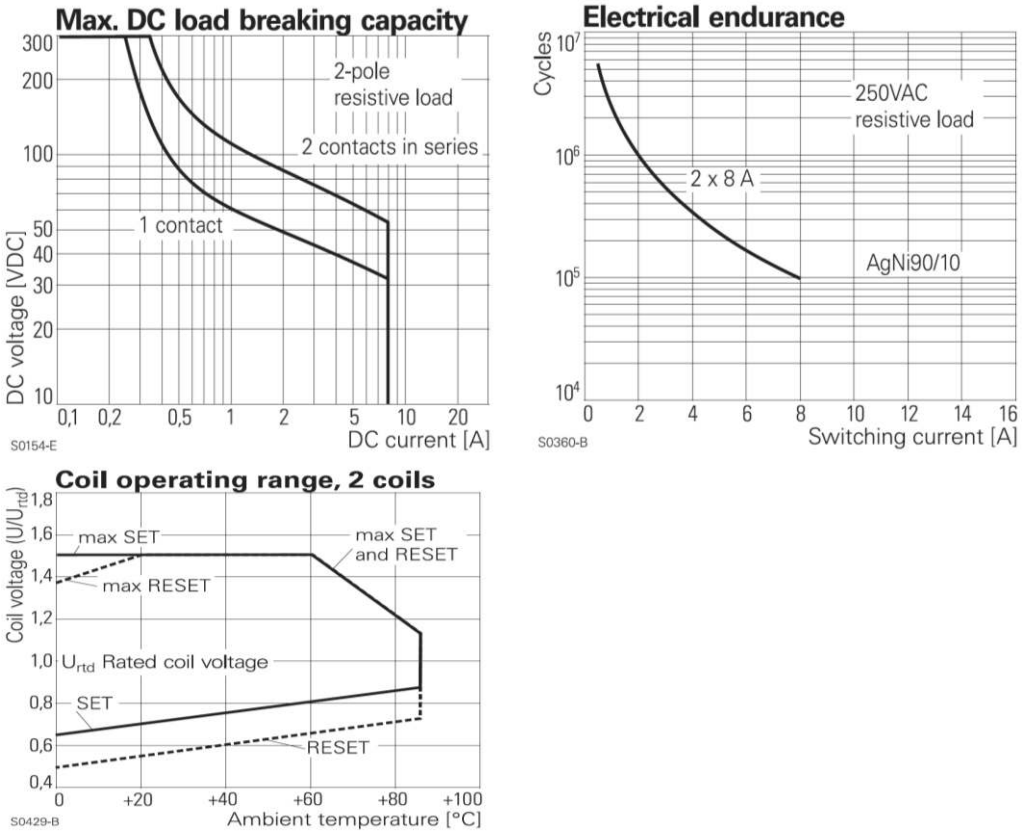


Figure 43: Switching capacity, life and working area RT2 bipolar
Source: Tyco Electronics/Schrack

AZ6991	monostable NO contact used alternatively on **FW-5, 8DO** bis rev2**, RES-1, PIT-1**
Contacts *	AgNi
Switching voltage *	250 V AC, max. 125 V DC, max. 400 V AC
Making capacity	6,0 A
Steady-state current *	6,0 A AC
Breaking capability	2216 VA or 180 W, resistive: 6,0 A @30 V DC /6 A @ 277 V AC
Switching times ON/OFF	8 ms / 4 ms
Switching cycles	> $10*10^6$ mechanical, $3*10^5$ at 5 A @ 50 V AC UL: 6000 at 6 A @30 V DC, 85° C
Isolation	4000 V surge contact/coil, 4000 V rms 1 min Air and creepage distance > 8 mm
Safety *	EN 60730-1, EN 60335-1 VDE: 6 A 250 V AC 85°C 50.000 / 6 A 30 V DC 85°C 60.000 cycles UL/ CUR: C300/R300 pilot duty 85 °C 6 A @ 30 V DC 6000 cycles
	- 40° + 85°C

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

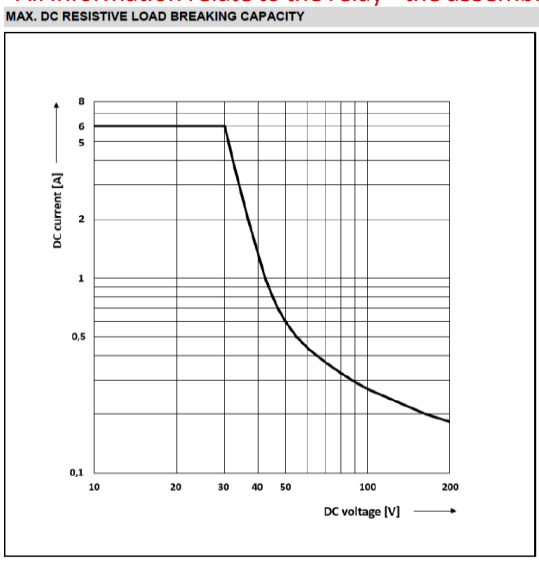


Figure 44: Switching capacity Z6991
Source: ZETTLER electronics GmbH

Mobile radio

Antennae 2G/3G/4G

Many different types of antennae with different characteristics are available in the field of mobile radio technology. The list displayed here constitutes suggestions and has no aspirations to completeness or universal functionality.
Please follow the instructions in Installation of antennae on Page 49.

Omnidirectional

Rod antenna, omnidirectional LTE/UMTS/GPRS	
Frequency	698-960, 1710-2700 MHz LTE700/GSM850/GSM900/GSM1800,PCS 1900/3G/UMTS/WiFi2400/LTE2600
Gain:	+4 dBi, omnidirectional, vertical
Cable:	RG58, 5 m, 50 Ω
Connector:	SMA m
Dimensions:	48 x 82 (Ø x H)
Installation:	on masts and walls
Weight:	0.4 kg including bracket
Environment:	indoor/outdoor, -40° to +80°C
Item	310004053311

Rod antenna, magnetic, omnidirectional LTE/UMTS/GPRS	
Frequency	690-960/1710-2170/2500-2700 MHz
Gain:	3-5 dBi, omnidirectional, vertical
Power:	30 W max.
Cable:	RG174, 3 m, 50 Ω
Connector:	SMA m
Dimensions:	70 x 306 mm (Ø x H)
Installation:	magnetic base, hinged joint 'Antenna ground' is required
Weight:	0.3 kg including bracket
Environment:	indoor/outdoor, -30° to +90°C
Item	

Installation antenna	**Disguised/underfloor/shaft installation**
Frequency	dual-band 900/1800 MHz
Gain:	0 dBi, omnidirectional
Power:	max. 25 W
Cable:	2 m, RG174
Connector:	SMA on request
Dimensions:	104 x 15.5 x 40 mm (W x H x D)
Weight:	0.3 kg
Environment:	outdoor, -40° to +80°C
Item	310004050450

MiMo Antenna

Hybrid antenna MIMO LTE/UMTS/GPRS	
Frequency	698-960/1710-2700 MHz
Gain:	+2 dBi 698-960, +5 dBi 1710-2710 MHz +4 dBi 2.2 - 2.7 GHz, hybrid polarisation
Power:	20 W max.
Cable:	2*CS29, 5 m, 50 Ω
Connector:	2* SMA m
Housing:	150 x 180 x 60 mm (W x H x D), IP66
Installation:	on wall/mast, adjustable
Weight:	1.1 kg
Environment:	indoor/outdoor, -30° to +80°C
Item	312406007710

Directional antenna MIMO LTE/UMTS/GPRS	
Frequency	698-960/1710-2700 MHz
Gain:	+6 dBi 698-960, +9 dBi 1710-2700 MHz +6 dBi 2.39-2.7 GHz, polarisation vertical
Power:	20 W max.
Cable:	2*CS29, 5 m, 50 Ω
Connector:	2* SMA m
Housing:	180 x 230 x 94 mm (W x H x D), IP66
Installation:	on wall/mast, adjustable
Weight:	1.1 kg
Environment:	indoor/outdoor, -30° to +70°C
Item	312406007720

Cabinet/roof antenna MIMO LTE/UMTS/GPRS	
Frequency	698-960/1710-3800 MHz
Gain:	+1.5dBi 698-960, +4.5dBi 1710-700 MHz +5dBi 2.5 - 3.8 GHz, omnidirectional antenna
Power:	20 W max.
Cable:	RG174, 3 m, 50 Ω
Connector:	2* SMA m, angular connector
Housing:	45 x 49 x 150 mm (W x H x D), IP66
Installation:	on wall, adjustable
Weight:	0.37 kg
Environment:	indoor/outdoor, -30° to +70°C
Item	312406007730

MIMO with GPS

Panel antenna MIMO LTE/UMTS/GPRS+GPS/GNSS passive	
Frequency	698-960/1710-3800 MHz
Gain: +5dBi 2.5-3.8 GHz, +26 dB LNA omnidirectional antenna	+1.5dBi 698-960, +4.5dBi 1710-700 MHz
Power:	20 W max.
Cable:	RG174, 3 m, 50 Ω /GPS: RG174, 3 m
Connector:	3* SMA m, angular connector
Housing:	45 x 49 x 150 mm (W x H x D), IP66
Installation:	on wall, adjustable
Weight:	0.37 kg
Environment:	indoor/outdoor, -30° to +70°C
Item	312406007740

Panel antenna MIMO LTE/UMTS/GPRS+GPS/GNSS active	
Frequency	698-960/1710-2700 MHz
Gain: +4dBi 2.2-2.7 GHz, +26 dB LNA directional, vertical polarisation	+2dBi 698-960, +5dBi 1710-2700 MHz
Power:	20 W max.
Cable:	RG58, 5 m, 50 Ω /GPS: RG174, 6 m
Connector:	3* SMA m
Housing:	150 x 230 x 94 mm (W x H x D), IP66
Installation:	on wall, adjustable
Weight:	1.1 kg
Environment:	indoor/outdoor, -30° to +80°C
Item	312406007720

Accessories

Accessories	
310051003200	FME-f/SMA-m adapter
310004053300	Antenna extension, 5 m, SMA-m /SMA-f
310004053400	Antenna extension, 10 m, SMA-m /SMA-f
310004053500	Antenna extension, 20 m, SMA-m /SMA-f

Frequency bands

Band		Tx /MHz	Rx /Mhz	Typ
1	**2100**	**1920–1980**	**2110–2170**	**FDD**
2	1900	1850–1910	1930–1990	FDD
3	**1800**	**1710–1785**	**1805–1880**	**FDD**
4	1700	1710–1755	2110–2155	FDD
5	850	824–849	869–894	FDD
6	850	830–840	875–885	FDD
7	**2600**	**2500–2570**	**2620–2690**	**FDD**
8	**900**	**880–915**	**925–960**	**FDD**
9	1800	1749.9–1784.9	1844.9–1879.9	FDD
10	1700	1710–1770	2110–2170	FDD
11	1500	1427.9–1447.9	1475.9–1495.9	FDD
12	700	699–716	729–746	FDD
13	700	777–787	746–756	FDD
14	700	788–798	758–768	FDD
15		Reserved	Reserved	FDD
16		Reserved	Reserved	FDD
17	700	704–716	734–746	FDD
18	850	815–830	860–875	FDD
19	850	830–845	875–890	FDD
20	**800**	**832–862**	**791–821**	**FDD**
21	1500	1447.9–1462.9	1495.9–1510.9	FDD
22	3500	3410-3490 res.	3510-3590 res.	FDD
23	2000	2000–2020	2180–2200	FDD
24	1600	1626.5–1660.5	1525–1559	FDD
25	1900	1850–1915	1930–1995	FDD
26	850	814-849	859-894	FDD
28	**700**	**758-803**	**703-748**	**FDD**
28A	700	758 – 788	703 – 733	FDD
28B	700	778 – 803		FDD
31	**450**	**452,5-457,5**	**462,5-468,5**	**FDD**
33	2100	1900–1920	1900–1920	FDD
34	1900	2010–2025	2010–2025	FDD
35	1900	1850–1910	1850–1910	FDD
36	1900	1930–1990	1930–1990	FDD
37	1900	1910–1930	1910–1930	FDD
38	2600	2570–2620	2570–2620	FDD

39	1900	1880–1920	1880–1920	FDD
40	2500	2300–2400	2300–2400	FDD
41	2500	2496–2690	2496–2690	FDD
42	3500	3400–3600	3400–3600	FDD
43	3700	3600–3800	3600–3800	FDD
44	700	703-803	703-803	FDD
46	5200	5150 – 5925	0	TDD
47	5900	5855 – 5925	0	TDD
48	3500	3550 – 3700	0	TDD
50	1500	1432 – 1517	0	TDD
51	1500	1427 – 1432	0	TDD
53	2400	2483.5 – 2495	0	TDD
65	2100	1920 – 2010	2110 – 2200	FDD
66	1700	1710 – 1780	2110 – 2200[B 3]	FDD
70	1700	1695 – 1710	1995 – 2020	FDD
71	600	663 – 698	617 – 652	FDD
72	**450**	**451 – 456**	**461 – 466**	**FDD**
73	450	450 – 455	460 – 465	FDD
74	1500	1427 – 1470	1475 – 1518	FDD
85	700	698 – 716	728 – 746	FDD
87	410	410 – 415	420 – 425	FDD
88	410	412 – 417	422 – 427	FDD
103	700	787 – 788	757 – 758	FDD

Source: https://en.wikipedia.org/wiki/LTE_frequency_bands

International APN

If the APN is not specified explicitly in the project, network and country ID MCC/MNC are read from the SIM, and an APN is set automatically on the basis of this list. Information in this list for countries outside the EU does not enable any conclusions to be drawn on any permits in these countries. Approvals for countries outside the EU are dependent on the module and its respective permit.

Land	MCC	MNC	Netz	APN (Standard)	User	Password	Auth
BE	206	20	Base	gprs.base.be	base	base	PAP
BE	206	10	Mobistar	mworld.be			
BE	206	01	Proximus	internet.proximus.be			
BE	206	05	Telenet	telenetwap.be			
DE	262	03/05	E-Plus	internet.eplus.de	eplus	internet	PAP
DE	262	07/08/11	O²	internet			
DE	262	01/06	Telekom	internet.telekom	t-mobil	tm	PAP
DE	262	02/04/09	Vodafone	web.vodafone.de			
FI	244	14	Ålcom	internet			
FI	244	03/04/12	DNA Oyj	internet			
FI	244	05	ELISA	internet			
FI	244	36/91	Sonera	internet			
FR	208	20/21	Bouygues	a2bouygtel.com			
FR	208	15/16	Free	free			
FR	208	01/02	Orange	orange.fr	orange	orange	PAP
FR	208	09/10/11/13	SFR	websfr			
IR	432	35	Irancell	mtnirancell			
IR	432	11	MCI	mcinet			
IR	432	20	Rightel	rightel			
LT	246	02	Bite GSM	wap.biteplius.lt			
LT	246	01	Omnitel	omnitel	omni	omni	PAP
LT	246	03	Tele2 LT	internet.tele2.lt			
LU	270	99	Orange LU	orange.lu			
LU	270	01	Post	web.pt.lu			
LU	270	77	Tango	internet	tango	tango	PAP
MY	502	13/19	Celcom	celcom4g			
MY	502	16	DiGi	diginet			
MY	502	12/17	Maxis	unet			
MY	502	18	U Mobile	my3g			

Land	MCC	MNC	Netz	APN (Standard)	User	Password	Auth
NL	204	08/10	KPN B.V	portalmmm.nl			
NL	204	02	Tele2	internet.tele2.nl			
NL	204	12	Telfort	internet			
NL	204	16/20	T-mobile	internet			
NL	204	04	Vodafone	office.vodafone.nl	vodafone	vodafone	PAP
NL	204	15	Ziggo	ziggo.dataxs.mobi			
NO	242	02	Netcom	internet.netcom.no			
NO	242	05	Network Norway	internet			
NO	242	01	Telenor	telenor			
NO	242	03	Teletopia	www.teletopia.no			
AT	232	10	3	drei.at			
AT	232	01/02/09	A1 Telekom Austria	a1.net	ppp@a1plus.de	ppp	PAP
AT	232	11	bob	bob.at	data@bob.at	ppp	PAP
AT	232	05	Orange	orange.web	web	web	PAP
AT	232	07	Tele.ring	web	web@telering.at	web	PAP
AT	232	03	T-Mobile	gprsinternet	t-mobil	tm	PAP
AT	232	12	Yess	web.yess.at			
PL	260	03	Orange PL	internet	internet	internet	PAP
PL	260	06	Play	internet			
PL	260	01	Plus	internet			
PL	260	02	T-Mobile Polska	erainternet	erainternet	erainternet	PAP
RO	266	03/06	Cosmote	broadband			
RO	266	10	Orange RO	internet	internet	orange	PAP
RO	266	05	RCS&RDS	internet			
RO	266	01	Vodafone	internet.vodafone.ro	internet.vodafone.ro	vodafone	PAP
CH	228	03	Salt	internet			
CH	228	02	Sunrise	internet			
CH	228	01	Swisscom	gprs.swisscom.ch			
TR	286	03	Avea	internet			
TR	286	04	Aycell	aycell			
TR	286	01	Turkcell	internet			
TR	286	02	Vodafone	vodafone			
AE	424	03	DU	du	du	du	PAP
AE	424	02	Etisalat	mnet	Mnet	Mnet	PAP

Glossary

Term	Description
3GPP	3rd Generation Partnership Project
2G	2. Generation Mobile radio (GSM/GPRS)
3G	3. Generation Mobile radio (CDMA, HSPA)
4G	4. Generation Mobile radio (LTE™)
5G	5. Generation Mobile radio (NR: uRLLC, eMBB, mMTC)
APAC	Regions in Asien, Australia and Ozeania
APN	Access Point Name
CA	Carrier Aggregation (LTE™-Advanced ab rel 10)
CCC	China Compulsory Certification
CDMA	Code Division Multiple Access
CE	Conformité Europeenne, European Conformity
CSD	Circuit Switched Data
DC-HSPA+	Dual-Carrier HSPA+ 3GPP rel9
DFOTA	Delta Firmware Upgrade Over the Air
DSDA	Dual SIM Dual Active dual receiver, dual transceivers
DSDS	Dual SIM Dual Standby dual receiver, single transceiver
DSSS	Dual SIM Single Standby single receiver, single transceiver
EDGE	Enhanced Data Rate of GSM Evolution
EMEA	Europe Middle East Afrika
eMBB	Enhanced Mobile Broadband (5G NR: high data rates)
eSIM	embedded SIM (legacy naming)
eUICC	embedded SIM (new naming)
FCC	Federal Communications Commission
FDD-LTE	Frequency Division Duplexing
FDMA	single carrier modulation and orthogonal frequency multiplexing
FOTA	Firmware upgrade over the air
GCF	Global Certification Forum (3GPP)
GLONASS	Globales Satelite navigation system
GNSS	Global Navigation Satelite System
GPRS	General Packet Radio Service (2G)
GPS	Global Positioning System
GSM	Global System for Mobile Communication
HSDPA	High-Speed Downlink Packet Access
HSPA	High Speed Packet Access (3G+WCDMA)
HSPA+	High Speed Packet Access 3GPP rel7
HSUPA	High Speed Uplink Packet Access (3G+WCDMA)
LDO	Low Drop Out
LPW	Low power wireles
LTE™	Long Term Evolution
MCC	Mobile Country Code
MIMO	Multiple Input Multiple Output
MISO	Multiple Input Single Output
mMTC	Massive Machine Type Communications (5G NR: high numbers)
MNC	Mobile Network Code
MRD	Mobile Receiver Diversity
NR	New Radio (5G NR: uRLLC, eMBB, mMTC)
OFDMA	Orthogonal Frequency Division Multiple Access

OTA	Over the air
PIN	Personal Identification Number
PUK	Personal Unblocking Key
R-UIM	Removable User Identity Module (SIM)
RSRP	Reference Signal Received Power
RSRQ	Reference Signal Received Quality
RSSI	Received Signal Strength Indicator
SIM	Subscriber Identity Module
SISO	Single Input Single Output
TDD-LTE	Time Division Duplexing
UICC	Universal Integrated Circuit Card /SIM
uRLLC	Ultra Reliable Low Latency Communication (5G NR: short latency)
UIM	User Identity Module (SIM)
UMTS	Universal Mobile Telecommunications System (3G)
USIM	Universal Subscriber Identity Module (application software for UICC)
USSD	Unstructured Supplementary Service Data (GSM)
VSWR	Voltage Standing Wave Radio
WCDMA	Wide Code Division Multiple Access

Figures

Literature

[1] **Online Help /Manual setIT**, SAE IT-systems GmbH & Co. KG, 2022
[2] **Interoperability list IEC 60870-5-101**; SAE IT-systems GmbH & Co. KG; 2016
[3] **Interoperability list IEC 60870-5-104**; SAE IT-systems GmbH & Co. KG; 2017
[4] **IEC61850 Conformance Statements ACSI-PIXIT-PICS-TICS**;
SAE IT-systems GmbH & Co. KG; 2022
[5] **setIT Configuration**; SAE IT-systems GmbH & Co. KG; 2018
[6] **Manual codeIT** 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] **Checklist IT-Security**; SAE IT-systems GmbH & Co. KG; 2022

Change log

10.06.22	First translation from German manual FW-5-GATE-4G-3

Outstanding additions

- Setting up the mobile radio unit is described in setIT Help <F1>
- Add IFX-485

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nameplates

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Nameplate on FW-5-GATE-4G-3

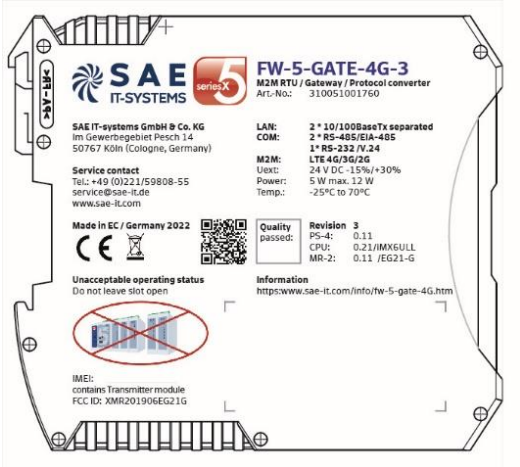

Figure 45: Example new nameplates on FW-5-GATE-4G-3 series5X

Nameplate on PS-60

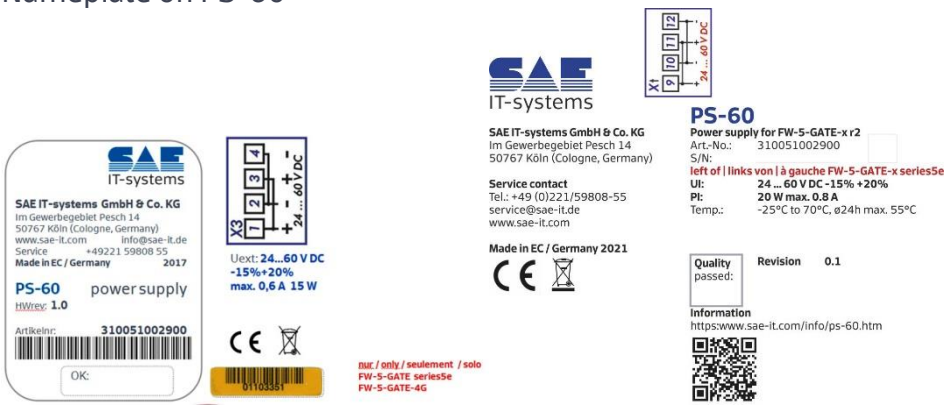

Figure 46: Example Nameplates on PS-60

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Sicherheit Health&Safety Art 3(1)(a)	IEC 62368-1 2014 + Corr.1 2015 / EN 62368-1 2014 + AC 2015, EN 62311: 2008
EMV/EMC Art 3(1)(b)	ETSI EN 301 489-1 [V2.2.1] ETSI EN 301 489-52 [V1.1.0] (draft) EN 55032: 2016 Class B EN 61000-6-2: 2019
Funk Spektrum Radio Spectrum Art 3(2)	ETSI EN 301 511 [V12.5.1] ETSI 301 908-1 [V13.1.1] ETSI 301 908-2 [V13.1.1] ETSI TS 151 010-1 v12.8.0
andere others	DIN EN IEC 63000:2019 : RoHS2

Zur ordnungsgemäßen Inbetriebnahme der Anlage ist folgendes Zubehör erforderlich: setIT V7.002, LTE Antenne
For a regular set-up of the device additional accessories are required: setIT V7.002, LTE Antenne
Une mise en place regulaire exige les accessoires suivantes: setIT V7.002, LTE Antenne

Köln, 11.04.2022
Ort und Datum
Place and date
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Im Gewerbegebiet Pesch 14 · 50767 Köln
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i.V. Dipl.-Ing. Jürgen Venhaus
Product Manager
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Bis/ 19.04.2016		ab/ 20.04.2016	IEC 61000-6-2:2005-01 IEC 61000-6-4:2011-02 Device class A
2004/108/EG 2004/108/EC *2004/108/CE*	EMV Richtlinie EMC Directive *Directive CEM*	2014/30/EU 2014/30/EU *2014/30/UE*	
2011/65/EU 2011/65/EU *2011/65/UE*	RoHS RoHS *RoHS*		DIN EN 50581:2012

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i.V. Ulrich Werner
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Bis/ *until/jusqu'a* 19.04.2016		ab/ *from/ de* 20.04.2016	IEC/EN 61326-1:2013-07 DIN EN 55011:2011 Klasse A: Industriebereich
2004/108/EG 2004/108/EC *2004/108/CE*	EMV Richtlinie EMC Directive *Directive CEM*	2014/30/EU 2014/30/EU *2014/30/UE*	
2014/35/EG 2014/35/EC *2014/35/CE*	Niederspannungsrichtlinie Directive Low Voltage *Directive Basse Tension*		IEC/EN 61010-1:2011 IEC/EN 61010-2-030:2011
2011/65/EU 2011/65/EU *2011/65/UE*	RoHS RoHS *RoHS*		DIN EN 50581:2012

Die aufgeführten Normen gelten als Grundlage für eine Risikoanalyse nach 2014/30/EU, die gesondert angefordert werden kann.
The standards listed shall be the basis for a risk analysis after 2014/30 / EU, which can be requested separately.
Les normes citées sont la base d'une analyse des risques après 2014/30 / UE, qui peut être demandé séparément.

SAE IT-systems
SAE IT-systems GmbH & Co. KG
Im Gewerbegebiet Pesch 14 • 50767 Köln
Tel: +49221 59 808-0 • info@sae-it.de

Köln, 19.4.2016
Ort und Datum
Place and date
lieu et date

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

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

Erklärung der EG/EU - Konformität
Declaration of EC/EU- Conformity • *Déclaration CE/UE de Conformité*

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

Wir erklären in alleiniger Verantwortung, dass unser benanntes Produkt, mit der /den folgenden Normen oder normativen Dokumenten übereinstimmt: • We declare under our sole responsibility that the named product is in conformity with the following standards or normative documents: • *Nous attestons sous notre responsabilité que le produit désigner est conforme aux normes ou aux documents normatifs suivants:*

PM-2

- Anwendungsbereich Fernwirktechnik
- Area Telecontrol
- *Champ d'application Télégestion*

Richtlinie • Directive • *Directive*		Norm • Standards • *Normes*
2014/30/EU 2014/30/EU *2014/30/UE*	EMV Richtlinie EMC Directive *Directive CEM*	IEC/EN 61326-1:2013-07 DIN EN 55011:2018 Klasse A: Industriebereich
2014/35/EG 2014/35/EC *2014/35/CE*	Niederspannungsrichtlinie Directive Low Voltage *Directive Basse Tension*	IEC/EN 61010-1:2011 IEC/EN 61010-2-030:2011
2011/65/EU 2011/65/EU *2011/65/UE*	RoHS RoHS *RoHS*	DIN EN IEC 63000:2019

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Köln, 22.05.19
Ort und Datum
Place and date
lieu et date

IT-systems
SAE IT-systems GmbH & Co. KG
Im Gewerbegebiet Pesch 14 • 50767 Köln
Tel: +49221 59 808-0 • info@sae-it.de

i.V. Dipl.-Ing. Jürgen Venhaus
Product Manager
SAE IT-systems GmbH & Co. KG

SAE IT-SYSTEMS

SAE IT-systems

Erklärung der EG/EU - Konformität

Declaration of EC/EU- Conformity • *Déclaration CE/UE de Conformité*

SAE IT-systems GmbH & Co. KG
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PDPS-1

- Anwendungsbereich Fernwirktechnik
- Area Telecontrol
- *Champ d'application Télé-conduite*

Richtlinie • Directive • *Directive*			**Norm** • Standards • *Normes*
Bis/ 19.04.2016		ab/ 20.04.2016	
2004/108/EG 2004/108/EC *2004/108/CE*	EMV Richtlinie EMC Directive *Directive CEM*	2014/30/EU 2014/30/EU *2014/30/UE*	DIN EN 61000-6-2:2006-03 DIN EN 61000-6-4:2011
2011/65/EU 2011/65/EU *2011/65/UE*	RoHS RoHS *RoHS*		DIN EN 50581:2012

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Köln, 19.4.2016
Ort und Datum
Place and date
lieu et date

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

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

SAE IT-systems

Erklärung der EG/EU - Konformität

Declaration of EC/EU- Conformity • *Déclaration CE/UE de Conformité*

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TBUS-R & TBUS-T

- Anwendungsbereich Fernwirktechnik
- Area Telecontrol
- *Champ d'application Télé-conduite*

Richtlinie • Directive • *Directive*			**Norm** • Standards • *Normes*
Bis/ *jusqu'à* 19.04.2016		ab/ *à partir de* 20.04.2016	DIN EN 61000-6-2:2006-03 DIN EN 61000-6-4:2011
2004/108/EG 2004/108/EC *2004/108/CE*	EMV Richtlinie EMC Directive *Directive CEM*	2014/30/EU 2014/30/EU *2014/30/UE*	
2011/65/EU 2011/65/EU *2011/65/UE*	RoHS RoHS *RoHS*		DIN EN 50581:2012

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Les normes citées sont la base d'une analyse des risques après 2014/30 / UE, qui peut être demandé séparément.

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Tel: +49221 59 808-0 • info@sae-it.de

Köln, 19.4.2016
Ort und Datum
Place and date
lieu et date

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

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

Sitz Köln
Amtsgericht Köln
HRA 15207

Ust-IDnr DE812996839
Steuernr 223/5818/2459

Geschäftsführer
Dipl.-Ing. Joachim Schuster
Dipl.-Ing. Oliver Callegari

Pers. haft. Gesellschafterin
SAE IT-Verwaltungs GmbH
Sitz Köln AG Köln HRB 33731

Erklärung der EG/EU - Konformität
Declaration of EC/EU- Conformity • *Déclaration CE/UE de Conformité*

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

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ISO-1

- Anwendungsbereich Fernwirktechnik
- Area Telecontrol
- *Champ d'application Télégestion*

Richtlinie • Directive • *Directive*		Norm • Standards • *Normes*
2014/30/EU 2014/30/EU *2014/30/UE*	EMV Richtlinie EMC Directive *Directive CEM*	IEC/EN 61326-1:2013 DIN EN 55032:2016 Klasse B: Gewerbemischbereich
2014/35/EG 2014/35/EC *2014/35/CE*	Niederspannungsrichtlinie Directive Low Voltage *Directive Basse Tension*	
2011/65/EU 2011/65/EU *2011/65/UE*	RoHS RoHS *RoHS*	DIN EN 50581:2012

Die aufgeführten Normen gelten als Grundlage für eine Risikoanalyse nach 2014/30/EU, die gesondert angefordert werden kann.
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Les normes citées sont issues d'une analyse des risques selon 2014/30/UE, qui peut être demandée séparément.

Köln, 30.11.18
Ort und Datum
Place and date
lieu et date

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Tel: +49221 59 808-0 • info@sae-it.de

i.V. Dipl.-Ing. Jürgen Venhaus
Product Manager
SAE IT-systems GmbH & Co. KG

Sitz Köln
Amtsgericht Köln
HRA 15207

Ust-IDnr DE812996839
Steuernr 223/5818/2459

Geschäftsführer
Dipl.-Ing. Joachim Schuster
Dipl.-Ing. Oliver Callegari

Pers. haft. Gesellschafterin
SAE IT-Verwaltungs GmbH
Sitz Köln AG Köln HRB 33731

IEC 615850 ed2

Das hier gezeigte Zertifikat wird in Kürze auch für die FW-5 Reihe ausgestellt.

No. 10331039-DSO 22-2796rev1

IEC 61850 Certificate Level A[1]

Issued to:
SAE IT-systems GmbH & Co. KG
Im Gewerbegebiet Pesch 14
50767 Köln
Germany

For the client system:
BCU-50-M
RTU
Software version: 07.002.00B
Hardware version: 3

The client system has not been shown to be non-conforming to:

IEC 61850 Edition 2 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 Edition 2, the UCA International Users Group Edition 2 Client Conformance Test Procedures version 1.2 with client system's protocol, model and technical issue implementation conformance statements and product's extra information for testing: "IEC 61850 Interoperability Telecontrol Substation Automation starting with setIT V7.0 from series5e devices, revision 1.00".

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 (18/24)	9	GOOSE Control Block (1/2)
2	Data Sets (6/10)	12a	Direct Control (5/9)
2+	Data Set Definition (8/8)	12b	SBO Control (7/11)
4	Setting Group Selection (3/3)	12c	Enhanced Direct Control (5/9)
5	Unbuffered Reporting (23/24)	12d	Enhanced SBO Control (7/11)
6	Buffered Reporting (26/28)	13	Time Synchronization (4/4)
		14	File Transfer (3/8)

This certificate includes a summary of the test results as carried out at DNV in The Netherlands with UniCA 61850 IED Simulator version 6.1.31 and UniCA 61850 Analyzer 6.40.1. This document has been issued for information purposes only, and the archived DNV verification report No. 10331039-DSO 22-2795 rev2 will prevail.

The test has been carried out on one single specimen of the product as referred above and submitted to DNV by SAE IT-systems GmbH & Co. KG. The manufacturer's production process has not been assessed. This certificate does not imply that DNV has approved any product other than the specimen tested.

Arnhem, April 12, 2022

G. Akse
Business Development Manager
Interoperability of Smart Power Systems

Issued by:

R. Schimmel
Verification Manager

[1] Level A - Independent test lab with certified ISO 9001 Quality System

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www.dnv.com
contact@dnv.com

No. 10331039-DSO 22-2796rev1

IEC 61850 Certificate Level A

Applicable Test Procedures from the UCA International Users Group Edition 2 Client Conformance Test Procedures version 1.2

Conformance Block	Mandatory	Conditional
1: Basic Exchange	cAss1, cAss2, cAss3, cAssN1, cAssN4, cAssN5, cAssN6	cAssN7, cSrv1, cSrv2, cSrv4, cSrv5, cSrv7, cSrv10, cSrvN1, cSrvN3, cSrvN5, cSrvN6
2: Data Sets		cDs1, cDs2, cDs5, cDs6, cDsN1a, cDsN1b
2+: Data Set Definition		cDs10, cDs11, cDs12, cDs13, cDs14, cDsN10a, cDsN10b, cDsN11
4: Setting Group Selection	cSg2, cSgN1	cSg1
5: Unbuffered Reporting	cRp3, cRp4, cRp5, cRp8, cRp9, cRp10, cRp11, cRp13a, cRp14, cRp15, cRp19, cRpN2, cRpN5, cRpN6	cRp1, cRp2, cRp6, cRp7, cRp12, cRp13b, cRp16, cRp18, cRpN1
6: Buffered Reporting	cBr3, cBr4, cBr5, cBr8, cBr9, cBr10, cBr11, cBr13a, cBr14, cBr15, cBr19, cBr30, cBr31, cBrN2, cBrN5, cBrN6	cBr1, cBr2, cBr6, cBr7, cBr12, cBr13b, cBr16, cBr18, cBr33, cBrN1
9: GOOSE control block		cGcb1
12a: Direct Control	cCtl4, cCtl5, cDOns1, cDOns2	cCtl2
12b: SBO Control	cCtl4, cCtl5, cSBOns1, cSBOns2, cSBOns3	cCtl2, cSBOns4
12c: Enhanced Direct Control	cCtl4, cCtl5, cDOes1, cDOes2	cCtl2
12d: Enhanced SBO Control	cCtl4, cCtl5, cSBOes1, cSBOes2, cSBOes3	cCtl2, cSBOes4
13: Time sync	cTm1, cTmN1	cTm2, cTmN2
14: File transfer	cFt1, cFt3, cFtN1	

Page

DNV Netherlands B.V.
Utrechtseweg 310-B50, 6812 AR ARNHEM, The Netherlands
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As the product is based on the same software, the certificate shown will soon also be available for FW-5 products.

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