SmartWire-DT® Gateway
EU5C-SWD-CAN

E:T•N

Powering Business Worldwide

Original operating manual
The German-language edition of this document is the original operating manual.

Translation of the original operating manual
All editions of this document other than those in German language are translations of the original operating manual.

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2. Edition 2009, publication date 06/09
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7. Edition 2013, publication date 01/13

See list of revisions in chapter "About this manual"

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Editor: Bettina Ewoti

⚠ Danger!
Dangerous electrical voltage!

Before commencing the installation

- Disconnect the power supply of the device.

- Ensure that devices cannot be accidentally retriggered

- Verify isolation from the supply

- Earth and short-circuit

- Cover or enclose neighbouring units that are live.

- Follow the engineering instructions (AWA/IL) of the device concerned.

- Only suitably qualified personnel in accordance with EN 50 110-1/-2 (VDE 0105 Part 100) may work on this device/system.

- Before installation and before touching the device ensure that you are free of electrostatic charge.

- The functional earth (FE) must be connected to the protective earth (PE) or to the potential equalizing. The system installer is responsible for implementing this connection.

- Connecting cables and signal lines should be installed so that inductive or capacitive interference do not impair the automation functions.

- Install automation devices and related operating elements in such a way that they are well protected against unintentional actuation.

- Suitable safety hardware and software measures should be implemented for the I/O interface so that a line or wire breakage on the signal side does not result in undefined states in the automation device.

- Ensure a reliable electrical isolation of the low voltage for the 24 V supply. Only use power supply units complying with IEC 60 364-4-41 (VDE 0100 Part 410) or HD 384.4.41 S2.

- Deviations of the mains voltage from the nominal value must not exceed the tolerance limits given in the technical data, otherwise this may cause malfunction and dangerous operation.

- Emergency switching off devices complying with IEC/EN 60 204-1 must be effective in all operating modes of the automation devices. Unlatching the emergency switching off devices must not cause restart.

- Built-in devices for enclosures or cabinets must only be run and operated in an installed state, desk-top devices or portable devices only when the housing is closed.

- Measures should be taken to ensure the proper restart of programs interrupted after a voltage dip or failure. This should not cause dangerous operating states even for a short time. If necessary, emergency switching off devices should be implemented.

- Wherever faults in the automation system may cause damage to persons or property, external measures must be implemented to ensure a safe operating state in the event of a fault or malfunction (for example, by means of separate limit switches, mechanical interlocks, etc.).

Contents

0 About this Manual

This manual describes the installation, commissioning and programming of the following SmartWire-DT gateway

- EU5C-SWD-CAN

The SmartWire-DT (SWD) communication system provides electromechanical switchgear and pilot devices with communication capabilities.

Support Center

The latest version of this manual can be found in other languages on the Internet by visiting our Support Center at:

http://www.moeller.net/en/support

By entering the search keyword "Gateway" or "SWD" into the quick search or by entering the document designation, e.g. MN05002002Z-DE.
Basic information concerning the SmartWire-DT topic can be found in:

- "SmartWire-DT The System", MN05006002Z-EN
- "SmartWire-DT Modules", MN05006001Z-EN

You can find further information on the topics SmartWire-DT and the Smart-Wire-DT modules in the following documents:

- Instructional leaflet „EU5C-SWD…", IL05006001Z-DE

The standard EDS files can also be found in our Support Center by entering "SWD" as a search term.

Download Center

The XSoft-CoDeSys-2 software described in this manual, as well as the SWD-Assist engineering tool, can be downloaded by visiting the Eaton Download Center at:

http://www.eaton-automation.com

0.1 List of revisions

This is a fully revised version. and replaces version
09/11 of MN05013002Z. In contrast to previous versions, which described SmartWire-DT gateways for various field buses, this version only covers one single SmartWire-DT gateway. The following table show the most important changes that have been made in terms of content:

Publication date	Page(s)	Subject	New	Modi-fied	Omit-ted
01/13	65	„"Online replacement" device parameter"	✓		

0.2 Target group

This manual is intended for automation technicians and engineers.

Extensive knowledge of how to work with the field bus being used, as well as familiarity with the SmartWire-DT system, will make it easier to understand the contents of this manual.

A specialist knowledge of electrical engineering is needed for commissioning and programming.

0.3 Exclusion of liability

All information in this operator manual was provided by us to the best of our knowledge and belief and in accordance with the current state-of-the-art. However, this does not exclude the possibility of inaccuracies so that we cannot accept any liability for the accuracy and completeness of the information. In particular, this information does not guarantee any particular properties.

The devices described here must only be set up and operated as specified in this manual and in the installation instructions provided with the device. The devices must be installed, commissioned, operated, maintained, and retrofitted by qualified people only. The devices must only be used in the recommended areas and only in conjunction with third-party devices and components that have been approved by us. Only use is technically faultless condition is permitted. Fault-free and safe operation of the system requires proper transport, storage, installation and commissioning as well as careful operation and maintenance.If the following safety instructions are not observed, particularly with regard to commissioning and maintenance of the devices by insufficiently qualified personnel and/or in the event of improper use of the devices, any hazards caused by the devices cannot be excluded. We assume no liability for any injury or damages incurred.

0.4 Device designations and abbreviations

- EDS - Electronic Data Sheet
- PDO - Process Data Objects
- SDO - Service Data Objects

Following designations XSoft-CoDeSys-2 are used:

- Module - SWD module
- Station - Coordinator
- Station address - Address of the field bus module

0.5 Reading conventions

Symbols used in this manual have the following meanings:

> **DANGER**
> Warns of hazardous situations that result in serious injury or death.

> **CAUTION**
> Warns of the possibility of hazardous situations that could result in slight injury or even death.

> *NOTICE*
> Warns about the possibility of material damage.

→ Indicates useful tips.

▶ Indicates instructions to be followed.

For greater clarity, the name of the current chapter and the name of the current section are shown at the top of each page.

0 About this Manual
0.5 Reading conventions

1 SmartWire-DT Gateway® EU5C-SWD-CAN

1.1 Proper use

EU5C-SWD-CAN SmartWire-DT gateways are used to establish a connection between a SmartWire-DT line, together with its SmartWire-DT modules, and a higher-level controller.

SmartWire-DT is not designed for transmitting safety-relevant signals and must not be used as a replacement for controllers such as burner, crane, and two-hand safety controllers.

Despite the above, SmartWire-DT can be used in applications with safety categories of up to 3, PL d as per EN ISO 13849-1 and SIL Cl2 as per EN 62061 if specific add-ons are incorporated. For more information, please consult manual "SmartWire-DT Modules", MN05006001Z-EN.

1.2 Overview of functions

EU5C-SWD-CAN gateways are used to connect a SmartWire-DT line with CANopen and make it possible to access the data of up to99 SmartWire-DT modules . These gateways can be integrated as modular field bus modules into control systems that use this type of communications. This makes it possible to access the data of every individual module from the controller.
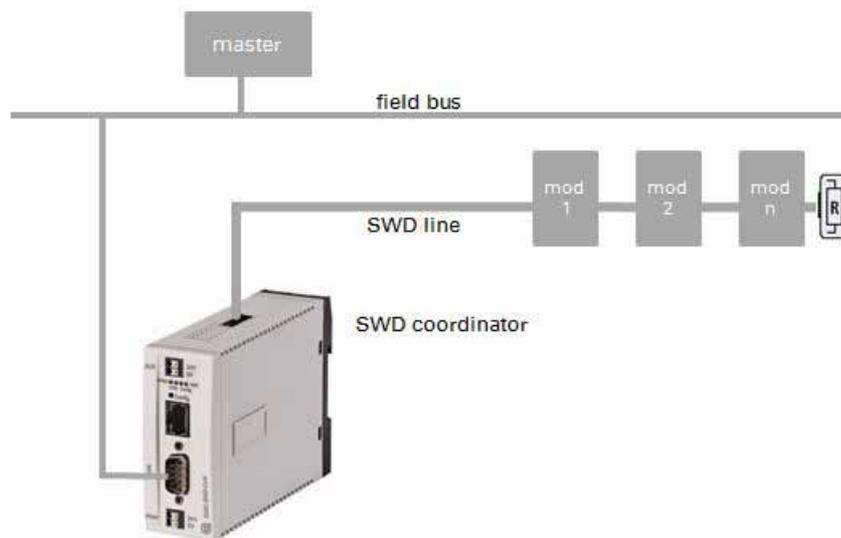
Figure 1:   Connecting the field bus and SmartWire-DT with a gateway

The integrated Ethernet switch on the device is used to connect Standard 9-pin D-sub plug . The SmartWire-DT line, along with its modules, is connected to the gateway. The ribbon cable, with the SWD modules and all connection components - such as blade terminals and external device plugs - is referred to as the "SWD line."

Terminals for two 24-V power supplies are available: POW for the gateway and the SmartWire-DT modules and AUX for powering the contactor coils if these are also operated via SmartWire-DT modules.

The 8-pin ribbon cable is used to run data communications, as well as the power for the SmartWire-DT modules and the contactor coils, from the gateway to the modules.

The diagnostic port is used to connect to a computer in order to run the SWD assist planning and commissioning program.

When working with an EU5C-SWD-CAN gateway, this interface can also be used to update the operating system.

1.3 Versions
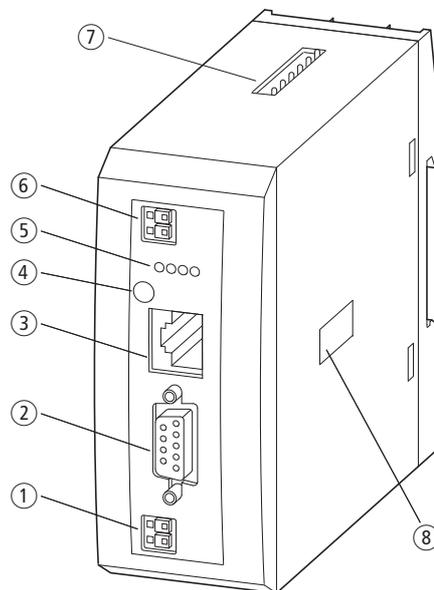
Figure 2:   Front view
              EU5C-SWD-CAN

① Power supply, 24 V DC POW
② Fieldbus interface
③ Diagnostics interface
④ Configuration buttons
⑤ LED indicators: POW, CAN, Config, SWD
⑥ Power supply, 24 V DC AUX
⑦ SmartWire-DT connection
⑧ Dip switch for address setting

1.4 Important data for engineering

In connection with the SmartWire-DT modules, the gateway appears as a modular module on the relevant field bus. The following gateway can be run on the field buses specified below:

Gateway	Fieldbus
EU5C-SWD-CAN	CANopen, according to DS301.4 profile

Each SmartWire-DT module is presented as a separate module, with its data, to the field bus master.

The following number of SmartWire-DT modules is the maximum number that can be run on the gateway:

Gateway	Maximum number of modules at the SWD line
EU5C-SWD-CAN	99

Make sure to take the maximum volume of data that can be transmitted on the field bus into account. The corresponding limit will be defined by the field bus.

The following applies when using CANopen: 4 TX and 4 RX PDOs with 8 bytes of data each are provided to each field bus module, i.e., 32 bytes in each direction. Together with the reserved PDOs corresponding to other modules (node ID offsets 32/64/96), this means that there are a total of 4*32 = 128 bytes of payload data available in each direction.

Field bus-slave	Max. input data [Byte]	Max. output data [Byte]
CANopen	128	128

→ Information about the volume of input and output data of an SWD module is provided in the Appendix of the manual "Smart-Wire-DT Modules", MN05006001Z-EN.

The SmartWire-DT line may be extended up to 600 m.

1.4.1 Field bus connection

The connection to the gateway uses a plug. A 9-pin D-sub plug is used in order to connect to the field bus.

CANopen	SUB-D plug	Signal
	1	–
	2	CAN_L
	3	GND
	4	–
	5	–
	6	GND
	7	CAN_H
	8	–
	9	–
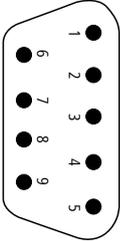
Figure 3:   Assignment of the connection plug for CANopen at gateway

1.4.2 Baud rate

The gateway supports operation with the relevant field bus masters up to the following Baud rate:

Fieldbus	Maximum data baud rate in MBit/s
CANopen	1

The unit will adapt to the field bus master's Baud rate automatically.

EU5C-SWD-CAN gateways feature an automatic baud rate detection function that scans the baud rate being used on the field bus and then sets the unit to this fixed baud rate. This function is only run when the gateway is powered on, i.e., it is not used cyclically to synchronize the baud rate afterwards.

1.4.3 Valid device field bus addresses

Data bus	Address	Address setting with dip switch	Valid address range
CANopen	Node ID	3 - 8	1 - 32

2 Installation

SWD gateways must only be installed and wired up by qualified electricians or other persons familiar with electrical engineering.

The SWD gateway is installed in the following order:

- Adjust the field bus adresse at the device.
- If the SWD gateway is the first or last module on the CANopen field bus, activate the bus termination resistor in the device.
- Mount the device.
- Connect the power supply.
- Connect the SmartWire-DT line.
- Connect the field bus.

2.1 Setting the gateway's field bus address

Before mounting the device, set the field bus address by using the DIP switches (DIP = Dual Inline Package). The DIP switches are located under a cover on the right side of the gateway.

> *NOTICE*
>
> Changes made to the dip switches' settings will take effect only after the power supply is turned off and back on again.

,

Follow the example below in order to configure an address on the gateway - 18 (decimal) is used as an example in this case:

$18_{dec}= 16 +2 = 1\cdot 2^4 + 1 \cdot 2^1$

The address is to be set at the dip switches.

for EU5C-SWD-CAN the following applies:

▶ Use DIP switches 3-8 to set the CANopen address. For a list of valid addresses, refer to ➡ Section "1.4.3 Valid device field bus addresses", page 10.

DIP Switch						Description
1	2	3	4	5	6	
2^5	2^4	2^3	2^2	2^1	2^0	
OFF	ON	OFF	OFF	ON	OFF	Setting the gateway's field bus address to a value of 18_{dec}

EU5C-SWD-CAN

Figure 4:   Setting the field bus address on an EU5C-SWD-CAN gateway

2.2 Activating the bus termination resistor for CANopen

If the EU5C-SWD-CAN gateway is the first or last module, the integrated bus termination resistor can be activated by using DIP switch 1.

▶ Set DIP switch 1 to the "ON" position.
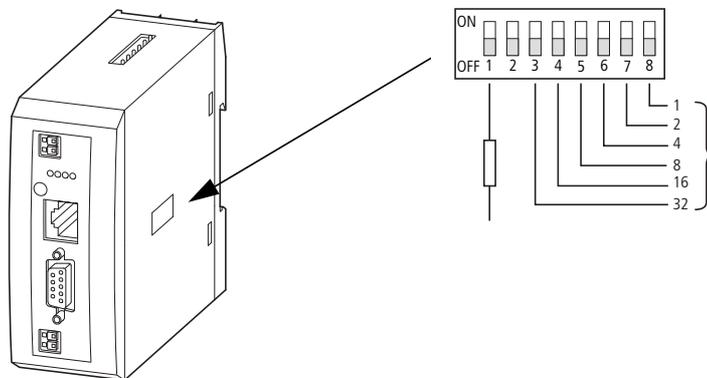
Figure 5:   Activate the EU5C-SWD-CAN bus termination resistor

2.3 Mounting Considerations

Install the EU5C-SWD-CAN gateway in a control cabinet, a panelboard, or an enclosure in such a way that the power supply and terminal connections cannot be touched accidentally during operation. Snap the device onto an IEC/EN 60715 top-hat rail or fix it in place using fixing brackets. EU5C-SWD-CAN gateways can be mounted either vertically or horizontally.

For ease of wiring, leave a clearance of at least 3 cm between the device terminals and the wall or adjacent devices.
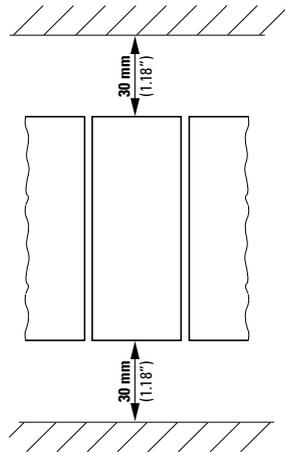
Figure 6:   Vertical mounting   Figure 7:   Horizontal mounting
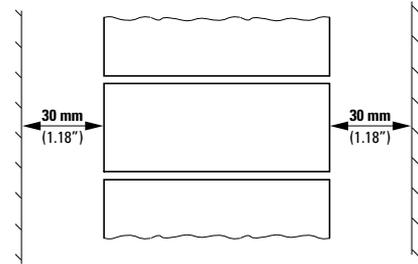
2.3.1 Mounting the EU5C-SWD-CAN gateway on a top-hat rail

Before mounting the device, make sure that you have set the device's field bus address and, if necessary, that the bus termination resistor (if any) has been activated with the corresponding DIP switch.
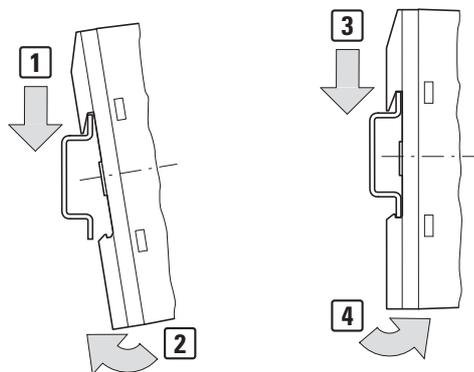
Figure 8:   Mounting on top-hat rail

▶   Place the EU5C-SWD-CAN gateway on the top-hat rail's upper edge in an inclined position. Lightly push the device down and against the top-hat rail until it snaps into place over the top-hat rail's lower edge.

The spring mechanism will make the EU5C-SWD-CAN gateway automatically lock into place.

▶   Check that the gateway is seated firmly.

The device is mounted vertically on a top-hat rail in the same way.

2.3.2 Screwing the EU5C-SWD-CAN gateway into place

For screw fixing, you will need two fixing brackets that can be used on the back of the EU5C-SWD-CAN gateway. Fixing brackets ZB4-101-GF1 are available as accessories.
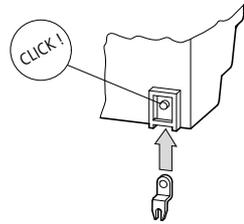
Figure 9:   Inserting a fastening bracket

Figure 10:   EU5C-SWD-CAN screw fixing

2.4 Potential Relationship between the Components

The entire SmartWire-DT system operates on a common supply voltage. Provide a common star point for the earth wiring. In this way the various modules in the SmartWire-DT system will not be electrically isolated from one another. The field bus and the SmartWire-DT system are electrically isolated from one another.

2.5 Connecting the power supply

> **⚠ DANGER**
>
> In safety-relevant applications the power supply providing power to the SmartWire-DT system must feature a PELV power supply unit (protective extra low voltage).

> **⚠ DANGER**
>
> The gateway has protection against polarity reversal for the 24-V-DC-POW supply. If, however, the gateway is connected to a grounded device, e.g., a computer, via the diagnostic interface, the gateway may be destroyed if the polarity of the power supply is reversed!

The gateway and the SmartWire-DT modules are powered via the POW terminals. The Gateway uses the voltage at POW to generate the 15-V supply voltage for the SmartWire-DT modules with a maximum output current of 0.7 A.

If loads or contactor modules are also connected via the SWD line, the 24-VDC control voltage for the loads must be supplied in addition to the device supply voltage. The AUX terminals are used for this purpose.

Take into account the total power consumption and the voltage drop in your SWD line and, if necessary, include additional supply units, such as power feeder modules, in your design. The SWD assist software program will provide support when you are carrying out the corresponding calculations. In addition, it will automatically let you know if additional power supply modules are required for your design.
The manual "SmartWire-DT The System", MN05006002Z-EN, contains detailed calculation examples.
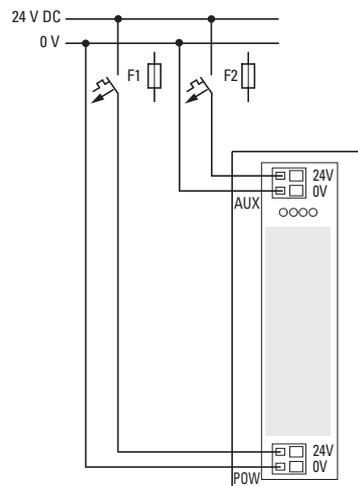
Figure 11:   Connection of power supply

▶ Connect the 24 V DC voltage to the connection terminals POW on the front side of the gateway.

▶ If necessary, connect the 24 VDC voltage for the contactor coils to the AUX terminals.

▶ Connect the POW and AUX supply voltages via separate miniature circuit-breakers or fuses.

Miniature circuit-breaker F1 for POW

- Cable protection in accordance with DIN VDE 0641 Part 11, IEC/EN 60898:
    - Miniature circuit-breaker 24 V DC rated operational current 3 A; trip type C or
    - Fuse 3 A, utilization class gL/gG

- Cable protection for cable AWG 24 in accordance with UL 508 and CSA-22.2 no. 14:
    - Miniature circuit-breaker 24 V DC rated operational current 3 A; trip type C or
    - Fuse 3 A

Miniature circuit-breaker F2 for AUX

- Cable protection in accordance with DIN VDE 0641 Part 11, IEC/EN 60898:
    - Miniature circuit-breaker 24 V DC rated operational current 3 A; trip type Z or
    - Fuse 3 A, utilization class gL/gG
- Cable protection for cable AWG 24 in accordance with UL 508 and CSA-22.2 no. 14:
    - Miniature circuit-breaker 24 V DC rated operational current 2 A; trip type B or
    - Fuse 2 A

2.6 Connect SmartWire-DT®

▶ Grab the end of the SWD line that has an arrow pointing away from the blade terminal.

▶ Plug this blade terminal into the gateway's SmartWire-DT connection.

To do so use the SmartWire-DT cable SWD-4-100LF8-24 and the SWD-4-8MF2 relevant blade terminal or prefabricated cables of type SWD-4-(3/5/10)F8-24-2S.

→ Detailed instructions explaining how to assemble a SmartWire-DT external device plug (SWD4-8SF2-5) onto an 8-pin Smart-Wire-DT cable can be found in "SmartWire-DT The System", MN05006002Z-EN, in the "Assembling external device plug SWD4-8SF2-5" section.

SWD4-...LF...

SWD4-8MF
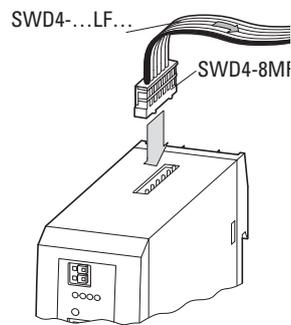
Figure 12: Connection SmartWire-DT

2.7 Connect field bus
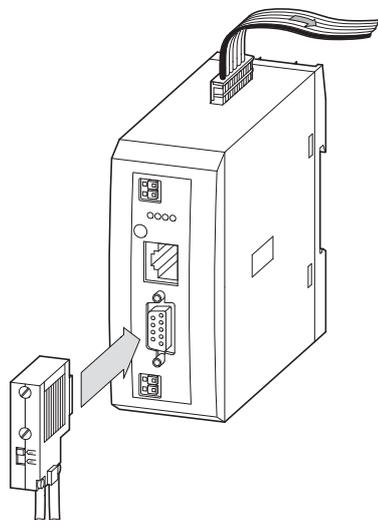
Figure 13:   EtherNet/IP or Modbus-TCP
                CANopen

CANopen

For connection to the CANopen cable you require a 9-pole D-SUB socket.
(e.g. PS416-ZBS-411)

▶   Connect the CANopen cable with the CANopen plug to the gateway's
    field bus interface.

2.8 Connecting the diagnostics interface

The EU5C-SWD-CAN SmartWire-DT gateway features a serial interface on the front. By using a programming cable, you can connect it to a computer and do the following with the corresponding software:

- Online SmartWire-DT line diagnostics using the SWD assist program
- Generate and export a project-specific INI file.
- Updating the operating system.

You can use any of the following programming cables:

Table 1: Programming cable for the connection to a PC

Device	Programming cable	Baud rate
EU5C-SWD-CAN	EU4A-RJ45-CAB1	–
	EU4A-RJ45-USB-CAB1	38.4 kBaud

	Pin	RS232
8	8	RxD
7	7	–
6	6	–
5	5	TxD
4	4	GND
3	3	–
2	2	–
1	1	–
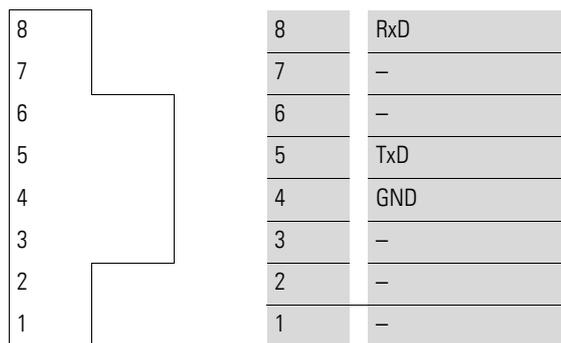
Figure 14: Configuration of the serial interface.

2.9 Wiring in accordance with EMC requirements

Undesired faults can occur on the field bus due to electromagnetic interference. This can be minimized beforehand by the implementation of suitable EMC measures. These include:

- EMC-conformant system configuration,
- EMC compliant cable routing,
- Measures designed to reduce potential differences
- the correct installation of the field bus system
  (cable, connection of the bus connectors, etc.),
- Using shielding
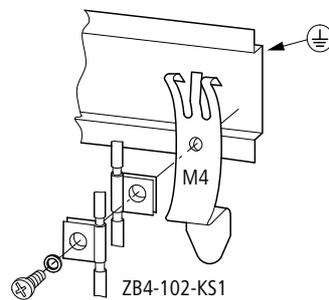
for top-hat rail   **for mounting plate**
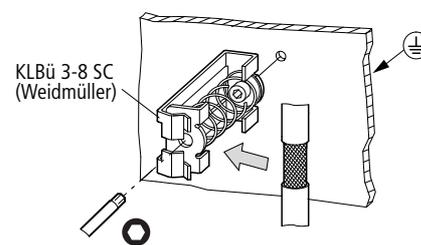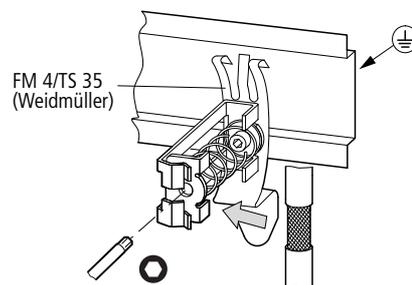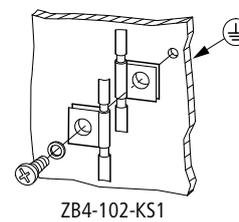
Figure 15:   Field bus shielded by using a shield

3 Commissioning

Before switching on, check whether the power supply for the gateway is connected correctly. The configuration and installation of the SmartWire-DT line must also have been carried out correctly with all modules connected.

> ⚠ **DANGER**
>
> If you already have integrated devices and equipment in a system, block off any parts of the system that are connected to the working area in order to prevent access. This will ensure that no one will be injured if the system behaves unexpectedly, e.g., motors start up unexpectedly.

Commissioning takes place in several steps:

1 Commissioning the SmartWire-DT line
2 Take the field bus into operation.
3 Load and start the PLC program.

Rules for successfully commissioning an EU5C-CAN

Make sure to follow the rules below in order to successfully commission the gateway:

To operate the device, the target configuration must be stored. The device will only startup up error-free if the actual configuration at the start matches the target configuration.

3.1 Putting the SmartWire-DT® into operation

➡ Chapter 7 "What you need to know about SmartWire-DT®", page 55 goes over the terms and basic knowledge related to SmartWire-DT.

> ⚠ **DANGER**
>
> Switch off the power supply whenever you are reconnecting modules in the SmartWire-DT system. The SmartWire-DT modules may be permanently ruined otherwise!

Before the gateway can exchange data with the PLC, the target configuration needs to be imported and stored in the gateway. The target configuration will be compared with the current actual configuration every time the gateway is started. During this process, the gateway will determine whether there are any SWD modules that cannot be reached or whether a wrong type of module is plugged into the SWD line. SmartWire-DT's response to any detected discrepancies will depend on how the device parameters for the SWD coordinator and the SWD modules have been configured ➡ Chapter 7 "What you need to know about SmartWire-DT®", page 55.

If a SmartWire-DT module drops out, it will be possible to continue running the SmartWire-DT line with the remaining modules. This applies even after the gateway is restarted or switched on again later. Please note that the application program can always be used to diagnose cases in which a SWD module has dropped out.

➜ The target configuration should only be imported for SWD lines that have all the corresponding SmartWire-DT modules.

NOTICE

If you press the configuration button and a SWD module is missing or has dropped out from the SWD line, only the modules up to the device that dropped out will be assigned an address and stored. It will not be possible to use the remaining modules until the defective module is replaced and the configuration is imported again by pressing the configuration button.

Import the target configuration in the following cases:

• Initial Commissioning
• Replacement of a defective module
• Whenever the SWD module layout on the SWD line is changed

The online functions of the SWD assist software offer a wide range of options for the display and the diagnostics functions of the SmartWire-DT line even without the active PLC ➜ Section "7.8 SWD assist", page 72.

3.1.1 Reading of target configuration

The target configuration needs to be imported the first time the device is commissioned, whenever a module is replaced, and whenever the SWD module layout on the SWD line is changed.

Requirements that must be met in order to import the target configuration:

• All SmartWire-DT modules are connected to the SmartWire-DT line.
• The SmartWire-DT line is connected to the gateway.
• Voltage POW is applied to the gateway and the POW LED lights up.
• Configurated power feeder module are connected.
• The SmartWire-DT status LEDs of the SWD modules are on or are flashing.

▶ Press the configuration button on the gateway for at least two seconds. The SWD-LED on the gateway begins to flash orange. The SWD-LEDs on the SmartWire-DT modules also flash.

All modules are addressed in sequence, the complete configuration is stored retentively in the gateway as target configuration. After this the SWD-LED lights green, continuous light.

→ If the target configuration import process cannot be started and the SWD LED is showing an orange light, disconnect the Smart-Wire-DT gateway's field bus connection and try importing the target configuration again.

→ If the SWD LED shows a solid red light, no addresses have been assigned to any of the SWD modules. If this happens, check the SWD line - especially the SmartWire-DT connection.

3.1.2 Switching on when the target configuration is stored

If a target configuration is already stored in the gateway, the system will check, every time the gateway is switched on, whether the modules that are actually on the SWD line match the target configuration in the gateway. The SWD LED on the gateway will indicate the result of this check → Section "7.7 LEDs on the device", page 71.

3.2 Take the field bus into operation

If you are putting the field bus into operation for the first time, you will first have to set up the PLC programming environment → Chapter 5 "Take XSoft-CoDeSys-2 into operation", page 31

Generally speaking, the following basic initial commissioning steps need to be carried out:

1 Add the standard EDS files to the PLC programming environment.
2 Open or create the project in the PLC programming environment.
3 Search for the field bus master in the PLC programming environment (target system) and Set the baud rate, e.g.,1.5 MBaud.
4 Select the gateway as a field bus module.
5 select the SmartWire-DT
6 Configure the gateway's and the SWD modules' parameters in the PLC programming environment

3.2.1 Creating field bus communication CANopen

The green SWD LED on the gateway is used to indicate that the gateway and the SmartWire-DT line are communicating successfully. This is a prerequisite for communications between the gateway and the PLC via the field bus.

With configuration check

▶ Check, in XSoft-CoDeSys-2, whether "Generate SDOs for module list" is enabled in "PLC Configuration" -> "CAN Module Selection" tab.
▶ Load the program into the PLC.

The CAN field bus' configuration will be transferred to the CAN master when the program is loaded into the PLC. If you are using an Eaton CAN master, the master will transfer the planned SmartWire-DT configuration for the SmartWire-DT line to the gateway and check it against the target configuration. This configuration check is an Eaton service that is not available in standard CAN configurators. Please note that the "Generate SDOs for module list" check box needs to be enabled in order for this service to work.

If the planned SWD configuration matches the target configuration stored on the gateway, the CAN LED will show a solid green light. The CAN LED and the Config LED will be used to indicate any errors that occur ➜ Section "Table 11: LED SWD coordinator", page 71.

Without configuration check

If you are using another manufacturer's CAN master, you will not be able to load the planned SWD configuration into the gateway. Because of this, make sure to disable the configuration comparison in this case.

If you do not want the system to carry out this configuration check, follow the steps below:

▶ In XSoft-CoDeSys-2, the "Generate SDOs for module list" option must be disabled in "PLC Configuration" -> "CAN Module Selection" tab.
▶ Open the "Service Data Objects" tab.
▶ In the "Service Data Objects" tab, find the object with index 0x2003 and sub-index 0 and set the "Disable configuration check" parameter to a value of "1".
▶ Load the program into the PLC.

The configuration check will be disabled. This means that the compatibility list cannot be used accordingly. The user themselves must check whether the target configuration matches the planned SWD configuration.

If the SWD, Config, and CAN LEDs show a solid green light, you have successfully completed the commissioning process.

3.2.2 CAN-LED status display

Table 2: CAN-LED at SWD gateway

Status	CAN-LED	Data exchange Gateway - PLC
CAN interface inactive	off	No
Baud rate detection active on the CAN bus	Red strobe light	No
CAN baud rate detected ,waiting for a valid target configuration	Orange	No
Communication error on the CAN bus (error warning level reached.)	Red flashing	yes
Monitoring error (node guarding/heartbeat)	flickering red flashing light	only SDO
Communication error on the CAN bus (bus Off.)	red	no, but NMT is possible
Pre-operational initialization mode - communication only possible via SDOs	Green flashing	only SDO
Stopped - no data exchange	Green strobe light	No
Operational - data exchange is possible via PDOs and SDOs	Green	yes

3.2.3 POW status display

Description	POW
Device ready for operation	on
If the other three gateway LEDs are permanently red, the operating system or the hardware is faulty. If they show continuous orange light, the gateway is in Firmware Update mode. This mode can be deactivated by switching on the power supply again.	off

4 Description files for CANopen

In order to be able to run the SWD gateway on a CANopen field bus, the SWD gateway's properties must be stored in a description file. This file follows specific standards for the corresponding field bus and can be loaded into the PLC programming environment for the field bus master being used.

The EDS file contains all the properties of a SWD gateway in its role as a field bus module. Since SWD gateways are modular field bus modules, this EDS file will also contain the properties of the potential SWD modules as inputs/outputs.

This is why new developments in SmartWire-DT, as well as the addition of new SWD modules, will result in new and different versions of gateway EDS files.

➡ Please note that not all EDS files support all SmartWire-DT modules.

Make sure that you are working with the latest version of the standard EDS files in your PLC programming environment. Check whether there are available updates for the files at our Support Center ➡ Page 3.

The selected EDS file must be appropriate for the SWD modules that you will be running with SmartWire-DT. In turn, this will also require you to use a specific operating system version, as well as a specific hardware device version.

For CANopen, we recommend loading the operating system version that corresponds to the EDS file's version.

Updating the operating system

For more information on how to update the operating system, please refer to the Online Help function included in SWD-Assist version 1.10 and higher. Enter "Update operating system" under the "Search" tab.

In the case of EU5C-SWD-CAN, the versions are updated via the diagnostic interface by using SWD-Assist.

4.1 Where are the standard EDS files?

There are multiple versions of each EDS file available for the CANopen gateway. The latest version will contain the descriptions for all currently available SWD modules.

The first EDS file for the EU5C-SWD-CAN CANopen gateway is named "EU5C-SWD-CAN.eds", version 1.0. All newer versions are named "EU5C-SWD-CANxxxx.eds", where "xxxx" = "_V110" for version 1.10 and so on.

To download the standard EDS file, please visit our Support Center
➔ Page 3. To find it quickly, simply enter "SWD" or "EDS" as a search term.

▶ Click on "Download" to the left of "EDS file for the CANopen SmartWire-DT gateway....".
▶ Select the latest version, save it, and unzip the .zip file in a project folder of your choice.

4.2 What is a project-specific INI file

In addition to the standard ESD file, you can also use SWD assist to generate a project-specific INI file. Eaton PLC programming environments come with a service that makes it possible to import this INI file. The selection of SWD modules on the SWD line will already be assigned to the EU5C-SWD-CAN modular field bus module.

If you load the project-specific INI file into the PLC programming environment, the SWD modules will be shown directly under "Selected Modules," eliminating the need to tediously select each individual SWD module manually➔ Section "5.3.1 Select the SmartWire-DT modules", page 33. In addition, this will prevent you from selecting the wrong SWD modules by accident.

Follow the steps below in order to generate a project-specific INI file:

▶ Start SWD assist.
▶ Switch to the Communication view by clicking on the "View" -> "Communication View" menu option.
▶ Click the "Online" button.

The program will show the target configuration, but this configuration will not be in the Project view yet.

▶ Click on the button "Device =>PC".

The target configuration will be loaded into the Project view.

▶ Click on the "Offline" button.
▶ Switch to the Project view by clicking on the "View" -> "Communication View" menu option.
▶ Click on the menu option "Project"->"Export Configuration".
▶ Specify the project folder as the storage location and confirm with "Save."

SWD assist stores the GSD file under the name of the current project with the appropriate extension, such as "SWD_Proj.ini". This can be installed in XSoft-CoDeSys-2 in the same way as the standard EDS file.

4.3 Versions of description files

To download an overview table showing which description file has to be used in order to be able to add your SWD modules to your PLC configuration, please visit our Support Center → Section " Support Center", page 3 and enter "SWD" into the Search field.

The "SmartWire-DT Modules" manual defines the applicable device version, operating system version, and description file version requirements for each SWD module in detail.

5 Take XSoft-CoDeSys-2 into operation

An EDS description file (EDS = Electronic Data Sheet) is used for integration of the gateway and operation via the field bus CANopen. The EDS file contains standardized descriptions of the CANopen modules
→ Chapter 4 "Description files for CANopen", page 27.

5.1 Select field bus master

The connection of a SWD line via the EU5C-SWD-CAN gateway to the controller XC200 is described in this chapter. Please check beforehand whether you have a current XSoft-CoDeSys-2 version installed with the necessary EDS file.

Then please proceed as follows:

▶ Start XSoft-CoDeSys-2 and open a project.
▶ Open the "PLC configuration" and tick the destination system, e.g. „XC-CPU201...".
▶ Use the "Insert"-> "Attach subelement" ->"CAN master" menu option to insert the CAN master.
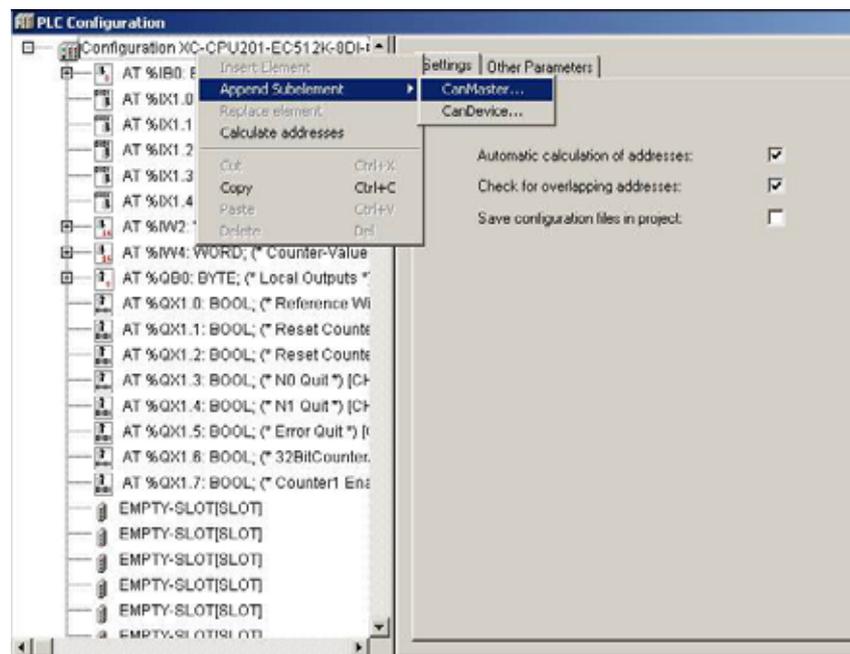
Figure 16: Inserting the CAN master in the
XSoft-CoDeSys-2 PLC Configuration window

5.2 Integrate library

➡️ Use of the CANopen master function presumes integration of the library "3S_CANopenMaster.lib".

The "3S_CANopenMaster.lib" library coordinates data communications for the selected modules in the PLC configuration.

The XSoft-CoDeSys-2 PLC programming environment will automatically add the CANopen libraries as soon as a CAN master or CAN device is added to the PLC configuration.

In order to add the library manually, follow the steps below:

▶ Click on the "Window" -> "Library manager" menu option.
▶ If the file is not found in this window, select a file and open the context menu.
▶ Select the "Additional libraries" context menu option
▶ Select "3S_CANopenMaster.lib" from the directory.

The library will be added under "Resources/Library manager."
"3S_CANopenManager.lib" and "3S_CanDrv.lib" will have been automatically loaded as well.

5.3 Select gateway as field bus module

▶ Select the CAN master, e.g., "XC-CPU201..." and use the "Insert" ->
"Attach sub element" menu option to open the selection list of CANopen
slave modules. Once the list is open, select the "EU5C-SWD-CAN" gate-
way.
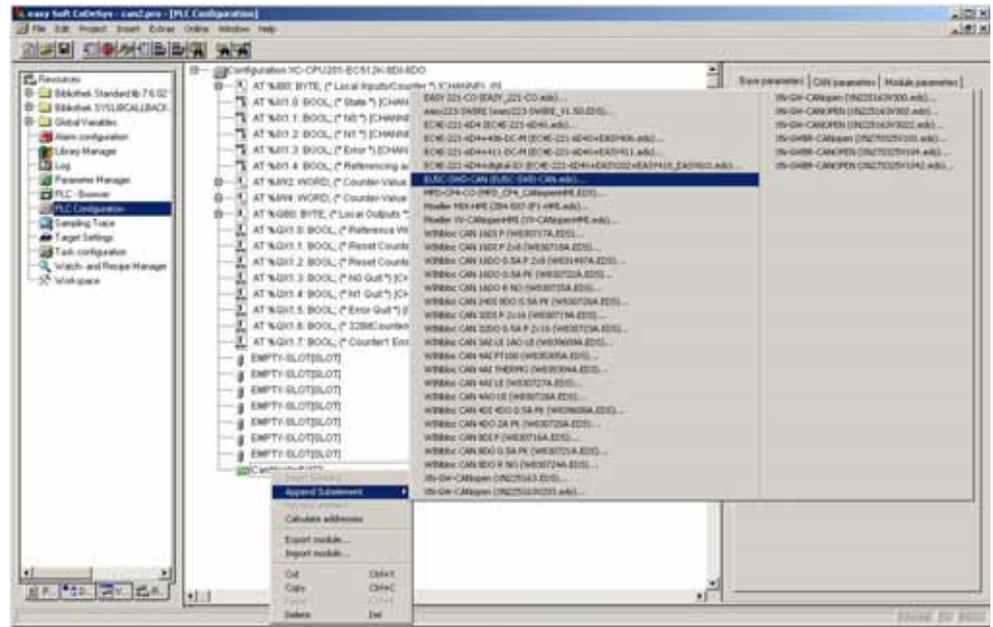
Figure 17:   Select the gateway in XSoft-CoDeSys-2

5.3.1 Select the SmartWire-DT modules

▶ Change over to the register "CAN Module Selection".
▶ Select the SWD modules that you need for the SWD line. Make sure to
select them in the correct order. This order must perfectly match the
physical order of the SWD modules on the SWD line.
▶ To load the planned SWD configuration into the gateway, enable the
"Create SDOs for module list" option.

This way, the target configuration stored on the gateway can be compared
with the planned SWD configuration created on the programming system. If
this check box is not enabled, you will have to open the "Service Data
Objects" tab and set the "Disable Configuration check" parameter to True
(= 1).

➡   Data will only be exchanged if
the "Create SDOs for module list" option is enabled or the "Dis-
able configuration check" parameter = 1.

Figure 18: Selection of SWD modules in XSoft-CoDeSys-2
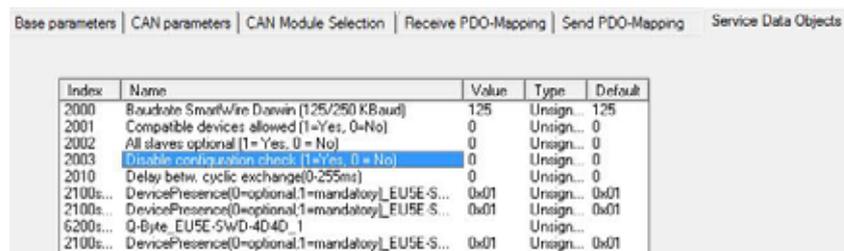
Figure 19: Setting "Disable Configuration check" to "1" in XSoft-CoDeSys-2

"Support universal module M22-SWD-NOP"

It will only be possible to enable this option if the "Create SDOs for module list" option has been enabled previously.

5.3.2 Import of the project specific INI file into XSoft-CoDeSys-2

In addition to the standard ESD file, you can also import a project-specific INI file generated previously with SWD assist. Eaton PLC programming environments come with a service that makes it possible to import this INI file. The selection of SWD modules on the SWD line will already be assigned to the EU5C-SWD-CAN modular field bus module.

Follow the steps below in order to import the INI file:

▶ Change over to the register "CAN Module Selection".
▶ Click on the "Import" button.
▶ Select the INI file in the stored project folder and confirm with "OK."

All of the SWD line's SWD modules will be shown in "Selected modules."

5.3.3 Selecting the profile for a SWD module

Every SWD module has a standard profile. In addition, certain SWD modules have multiple profiles. This makes it possible to receive less or more cyclic data from SWD modules and process it in the application program.

For more information on which SWD modules have which additional profiles available and which one of them is the standard profile in each case, please refer to the "SmartWire-DT module" manual.

We will use the PKE-SWD-32 SWD module with standard profile 2 as an example in order to show how a module with a specific profile can be selected:

Table 3:   Data profile of the SWD module PKE-SWD-32

| Profile | Input byte | | | | |
	4	3	2	1	0
PKE-SWD-32 (Profile 2/default)	–	√	√	√	√

To select the SWD module with profile 3, follow the steps below:

▶ Switch to the "CAN Module Selection" tab in the XSoft-CoDeSys-2 PLC Configuration window.
▶ Select the SWD module with the relevant profile, e.g., PKE-SWD-32(Profil3).
▶ Switch to the "Service Data Objects" tab in the XSoft-CoDeSys-2 PLC Configuration window
▶ In the line for the previously selected SWD module - "PKE-SWD-32 Index2102sub1" -, read the profile code shown in the line. In this particular example, the code is "0x2094."
▶ Enter a 3 into the profile code in the SWD module's "Value" column.

➜ Please note that the profile will not take effect until after the profile code has been entered.

Figure 20:   Entering profile code "0x2094" into the "Value" column

5.3.4 Changing the profile for a SWD module

If you want to change the profile for a SWD module, follow the steps below:

▶ Change over to the CAN module selection register.
▶ In "Selected modules," select the SWD module with the profile that you want to change.
▶ Delete the entry.
▶ In "Available modules," select the SWD module with the profile you want and follow the steps in ➜ Section "5.3.3 Selecting the profile for a SWD module".

➜ Do not change the profile code in the "Value" column without first selecting the corresponding data profile.
The profile code in the "Value" column must always be identical to the profile code shown in the "Name" column.

5.4 Parameter Definition

Parameters for communication of the gateway with the CANopen master and with the SWD line are also defined in the controller configuration.

These are the meanings of the individual registers.

"Basisparameter" register

This tab is used to define the I/O start addresses that are used to map the SWD modules to the controller map's inputs/outputs. By default, the programming system will create a complete connection to the inputs/outputs used up until now. You can, however, change these values to other, unassigned areas.

"CAN-Parameter" register

The parameters that relate to communication with the field bus CANopen are entered under these settings. These include, for example, the module address (node ID) or the monitoring time (Node-Guarding/Heartbeat).

➜ Only the addresses 1 to 32 may be assigned for the gateway ➜ Section "6.1.1 PDO mapping", page 41.

5.5 Guarding mechanisms

Node guarding or heartbeat can be used to monitor communication between the gateway and the CAN master.

Node guarding

In node guarding the CAN master uses cyclical protocols to monitor the CAN modules. The Guard Time is minimum 200 ms. The Life Time Factor is 3.

For this the CAN master sends within the set cycle time a frame for which the CAN modules send an appropriate response. If a module does not respond, the CAN master repeats this operation. The CAN module is considered as non-existent if the number of repeat attempts exceeds the set value. The monitoring interval (Guard Time) and the number of repetition attempts can be set as required. Node guarding is activated by default.

Heartbeat

If the **Activate heartbeat creation** option is checked, the module emits heartbeats at the millisecond interval specified in **Heartbeat producer time**. The heartbeat function is deactivated if the entered value is 0.

Unlike in node guarding mode, the CAN modules and the CAN master each send own messages in a heartbeat mode a frame for monitoring communication. It is also possible to create dependencies in the communication processes between the CAN modules.

➔ The node guarding and heartbeat functions cannot be run for the same module at the same time.

However, you can use node guarding for one module and the heartbeat function for another. The figure below shows the "CAN-Parameter" register.

Figure 21:   Adjusting the CAN parameters inXSoft-CoDeSys-2

5.6 Set device parameter of the gateway

The **Service Data Objects** tab can be used to configure the device parameters for the gateway and, as a result, for the SWD line Table 9, page 66. Any settings that are changed here will be sent to the gateway by means of an SDO transfer when the field bus is initialized.

Figure 22:   Changing settings

▶   Select the field you want and change the value as needed.

5.7 Set the device parameters of the SWD modules

Once you have selected SWD modules new parameters are added to the service data objects. Thus, for example, specification of the transient behavior can be performed individually. If certain SWD modules are mandatory for operation, you can define that the complete SWD line will not go into operation, if one of these essential modules is missing Table 10, page 67.

To find the parameters more easily the name of the module and the position of the SWD module in the SWD line are always appended to the actual settings (0 = first module, 1 = second module etc.).

5.8 Accessing SmartWire-DT data with CANopen
Input/output addresses

The selection of the SWD modules in the controller configurator automatically causes the input/output addresses of the modules to be assigned. Assignment of the addresses to the individual SWD modules can be viewed in the controller configuration.
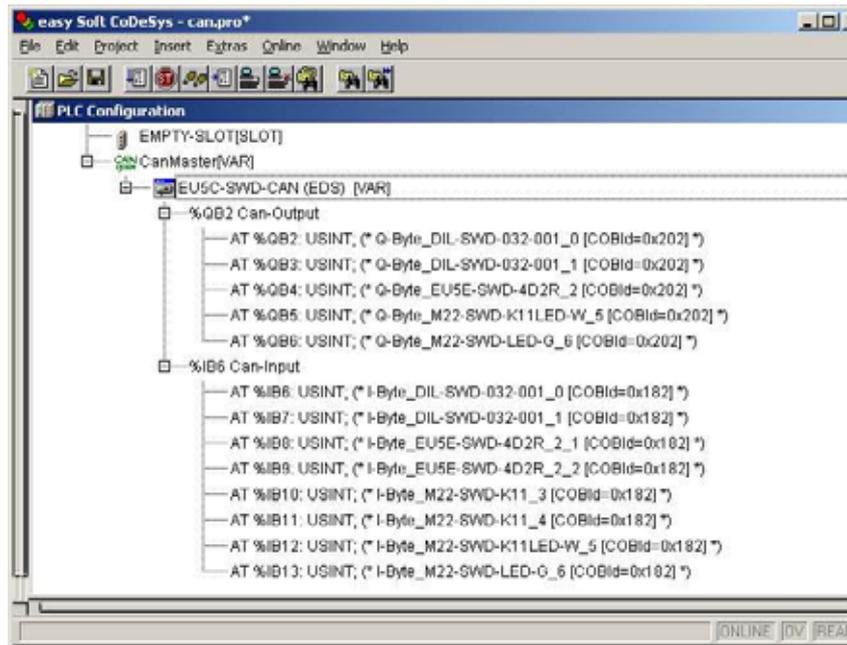
Figure 23:   SWD module addresses in XSoft-CoDeSys-2

These inputs and outputs can be addressed using the PLC's I/O image table.

→ Please refer to the manual "SmartWire-DT Modules", MN05006001Z-EN for the configuration and meaning of the input and output data.

5.9 Diagnostics

SmartWire-DT provides basic diagnostics in the I/O image table, as well as extended diagnostics based on emergency frames ➞ Section "7.4 Cyclical input and output data of the SWD modules", page 62.

An extended diagnosis is reported automatically via emergency telegrams in the event of a diagnosis. It can also be read out for each module via an SDO request. You will find details on this in ➞ Section "6.2 Object Dictionary", page 45 and in ➞ Section " Extended diagnostic services", page 63.

6 Implementing data objects in accordance with the CANopen standard

6.1 CANopen services

6.1.1 PDO mapping

A maximum of 16 reception PDOs and 16 transmission PDOs are supported.A maximum of 128 bytes are therefore available in each communication direction for utility data interchange.

Only the four default RX PDOs and the four default TX PDOs are active in the device's initial state (after the gateway is reset). If additional PDOs are needed for transfer purposes, PDOs 5 to 16 can be activated by the user.

Ensure that the COB-IDs of the activated PDOs do not collide with the other CANopen modules in the same network. The addresses of the individual PDOs are derived as follows:

PDO 1 - PDO 4: address = NodeID + standard offset

PDO 5 - PDO 8: Adresse = NodeID + standard offset + 64

PDO 9 - PDO 12: address = NodeID + standard offset + 96

PDO 13 - PDO 16: adress = NodeID + standard offset + 32

Accordingly only node IDs in the range 1 to 32 should be used for the gateway.

PDO configuration

By default, byte variables are mapped to PDOs 1 to 8 and word variables are mapped to PDOs 9 to 16. Only these PDOs are mapped automatically.

If more than 64 byte or 32 word variables are added, they must be in free PDOs

6.1.2 SDO communication

The simple SDO server connection is supported (expedited SDO server).

Segmented SDO access with a limit of 114 bytes is also supported for acyclic communications to SWD modules.

6.1.3 Network Management

The gateway features NMT services as per specification CiA301.

6.1.4 Emergency telegrams for error messages

The errors that are output are governed by /DS301/. Errors are reported by means of an emergency telegram. The current status of the error register can be read out from the object list entry 0x1001/0. An error history, in which the last six errors are stored, can be read out of the object list entry 0x1003.

Structure of the emergency telegram

Byte 0:	1 Byte	Byte 2	Bytes 3-7
Emcy error code	Emcy error code	Error register	Manufacturer-specific error codes

Emergency error code

Error code (hex)	Meaning
00xx	Error reset (no errors)
01xx	general error
50xx	Devices-hardware
60xx	Devices-software
70xx	attached modules (xx = module address)
FFxx	manufacturer specific

If "Emcy-Error-Code" = 0xFF01 to 0xFF63 are indicated, bytes 3 to 7 will contain manufacturer-specific error codes. An error code has a length of one byte, meaning that up to five error codes will be transmitted in bytes 3 to 7. Unused bytes will be padded with 0x00 (= no error). Byte 1 of the EMCY frame will contain the module address of the SWD line SWD module that is signaling the error. Tabelle 4 shows examples of manufacturer-specific error codes. Manufacturer-specific error codes correspond to extended diagnostic alarms → Section " Extended diagnostic services", page 63.

➔ You will find detailed information on this in the manual "Smart-Wire-DT Modules", MN05006001Z-EN.

Error codes 0xFF01 to 0xFF63 of the SWD modules

Table 4: Manufacturer-specific error codes

Error code	Meaning	used by
0x00	No diagnostic alarm active	All devices that support the extended diagnosis
0x10	Contact in middle position	RMQ
0x11	Contact short-circuit	RMQ
0x13	Output overload	I/O module

Error code 0xFF00 of the SWD gateway

If "Emcy-Error-Code" = 0xFF00 is displayed, a 32-bit variable with error flags as shown on Tabelle 5 will be stored in the EMCY frame's manufacturer-specific area (bytes 4 to 7).

Byte 3 of the EMCY frame has a value of 0x00.

Table 5: Failure code listing for "Emcy error code" = 0xFF00

Byte:	BIT	dwBit	Relevance	Meaning
4	0	0	Info	CANopen: not all reception word variables can be mapped in PDOs.
	1	1	Info	CANopen: not all reception byte variables can be mapped in PDOs.
	2	2	Info	CANopen: not all transmission word variables were able to be mapped in PDOs.
	3	3	Info	CANopen: not all transmission byte variables were able to be mapped in PDOs.
	4	4	Fault	CANopen: no valid CAN baud rate found.
	5	5	Fault	CANopen: no valid CANopen node ID is set (set the value 1 to 32!).
	6	6	-	reserved
	7	7	-	Free
5	0	8	Fault	CANopen: non-correctable CAN stack error.
	1	9	Fault	CANopen: monitoring error (node guarding/heartbeat.)
	2	10	Info	SWD: project configuration check
	3	11	-	Free
	4	12	Info_x	SWD: extended diagnosis of a module is pending.
	5	13	Info_x	SWD: CFG setting of at least one SWD module changed.
	6	14	-	Free
	7	15	-	Free
6	0	16	Fault	SWD: necessary SWD module missing.
	1	17	Warning	SWD: optional SWD module missing.
	2	18	Warning	SWD: actual configuration not equal to target configuration, but compatible
	3	19	Warning	SWD: target configuration not equal to actual configuration, but compatible
	4	20	Fault	SWD: no valid target configuration present
	5	21	Fault	SWD: no valid project configuration present
	6	22	Fault	SWD: differences between target configuration and actual configuration
	7	23	Fault	SWD: differences between project configuration and target configuration
7	0	24	Fault	SWD: short-circuit in the 15 V power supply of the SWD line
	1	25	Fault	SWD: internal error of the SWD coordinator
	2	26	Info_x	SWD: at least one SWD module is transmitting a basic diagnosis.
	3	27	Fault	SWD: no SWD module found.
	4	28	Info	SWD: the use of compatible modules is allowed.
	5	29	Info	SWD: all modules are registered as "optional".
	6	30	Info	SWD: no comparison between target and project configuration
	7	31	-	Free

After reception of the NMT telegram "Start Node" it is indicated by the dispatch of an EMCY-telegram that the gateway is still in the SWD mode "Failsafe". This error message is taken back to the SWD mode "normal" after the change.

Failsafe: no initial data are transferred to the SWD modules. The initial information of the modules is available in the PLC.

Error register

Table 6: Error register format

BIT	M/0	Meaning
0	m	Generic error
0	0	Current
2	0	Voltage
3	0	Temperature
4	0	Communication error (overrun, error state)
5	0	Device profile specific
6	0	reserved
7	0	manufacturer specific

6.2 Object Dictionary

The object list of the SWD CANopen gateway consists of static and dynamic entries.

Static entries are available in any case, dynamic entries being generated depending on the attached modules.

6.2.1 Static entries

CANopen-specific entries (0x1000 - 0x1FFF)

The entries in the CANopen specific area of the object list are created statically and are attainable via an SDO access as soon as the coupling unit participates in CAN communication.

Further information on the type and use of the listed CANopen-specific entries in the object list can be referred to in /CiA301/.

Table 7: CANopen-specific entries

Index	Subindex	Data type	Setpoint value
Description			
0x1000	0	U32	0x
Device type (device profile number + additional information):			
0x1001	0	U8	0x0
Error register			
0x1003	0 - 6	U32	
Error history			
0x100C	0	U16	0x0
Guard time (node guarding)			
0x100D	0	U8	0
Life time factor (node guarding)			
0x1014	0	U32	0x80+NodeID
COB-ID EMCY object			
0x1016	0 - 4	U16	
Consumer heartbeat time			
0x1017	0	U16	0
Producer heartbeat time			
0x1018	0-4		
Identity Object			
0x1027	0-100	U16,(Sub0 = U8)	
Module list (VendorID+DeviceID) (rw)*			
0x1029	0-1	U8	
Error behavior object / communication error (rw)			
0x1200	0-3		
Server SDO Parameter			

Index	Subindex	Data type	Setpoint value
0x1400 – 0x140F	0-2		
RX-PDO communication parameters			
0x1600 – 0x160F	0-8		
RX-PDO mapping parameters			
0x1800 – 0x180F	0-2		
TX-PDO communication parameters			
0x1A00 – 0x1A0F	0-4		
TX-PDO mapping parameters			

User-specific entries (0x2000-0x5FFF)

Index areas	Entries
0x2000 - 0x20FF	Configuration settings of the SWD configurator
0x2100 - 0x21FF	Configuration settings of the SWD modules
0x2200 - 0x22FF	acyclic communication with SWD modules
0x2300 - 0x23FF	extended diagnostic messages from SWD modules

Listing of the object entries

Index	Subindex	Data type	Setpoint value
Configuration settings of the SWD configurator			
Description			
0x2000	0	U8	4(1..7)
Baud rate SmartWire-DT (r/w)			
0x2001	0	U8	0(0..1)
Compatibility rule for exchange (0=compatible devices allowed; 1=compatible devices not allowed) (r/w)			
0x2002	0	U8	0(0..1)
Presence of Slave devices (0=defined by each slave; 1=all slaves are optional.) (r/w)			
0x2003	0	U8	1(0..1)
Disable configuration check			
0x2004	0	U32	--
DiagFlags (Table 14.4) (ro)			
0x2006	0	U8	0
Online replacement allowed (r/w)			
0x2010	0	U8	0(0..255)
Delay between cyclic exchange (ms) (r/w)			
Configuration settings of the SWD modules			
0x2100	0..100	U8	1(0..1)
Presence of device on SWD (0 = device may not be present; 1 = device shall be present. (r/w)			
0x2101	0..100	U16	
Device options (parameter/presence) + slave address			
0x2102	0..100	U32	
CFG of devices			
0x2103	0..100		
Serial number of SWD device			
0x2104	0..100	U8	0
Use of NOP-Modules (r/w)			
0x2110	0..100	U32	
Parameter of devices			
Acyclic communication with SWD modules			
0x2200-0x22FF	0..100	U32	
Acyclic communication with modules (r/w)			
Extended diagnostic messages from SWD modules			
0x2300-0x23FF	0..10	1…5 bytes	
Extended diagnostics of the SWD modules (ro)			

Baud rate SWD-(0x2000)

- Content

SmartWire-DT baud rate

- 4 = 125 kBaud (setpoint value)
- 5 = 250 kBaud

- Read access: Returns the SWD baud rate that is currently configured. (4 stands for 125 kbaud.)
- Write access: valid value range of 0 - 7

Compatibility rule (0x2001)

- Content

General compatibility setting. This defines whether the replacement of a SWD module by a compatible module is allowed.

- 0 = replacement allowed
- 1 = replacement not allowed (setpoint value)

- Read access: returns the current compatibility setting.
- Write access: used to set the desired compatibility behavior (0 or 1)

Presence of module devices (0x2002)

- Content

This global entry defines how the SWD line behaves, if no module is found.

- 0 = it is individually settable for each SWD module whether it will be treated as an "optional" or "necessary" module (default setting).
- 1 = all SWD modules are treated as "optional" modules.

- Read access: returns the setting that is currently configured.
- Write access: used to define the desired behavior.

Disable configuration check (0x2003)

- Content

Via this entry it can be defined whether the SWD gateway is allowed to start without the performance of a comparison between the target configuration and the project configuration.

- 1 = the SWD gateway also starts up without comparison between the planned configuration and the target configuration. This setting is conceived for CANopen configurators that do not support downloading of the planned module list to the gateway.

If a planned configuration is downloaded to the gateway, a comparison of the configurations takes place.

- 0 = the comparison between planned configuration and target configuration is mandatory (default setting).

- Read access: returns the setting that is currently configured.
- Write access: used to define the desired behavior.

DiagFlags (0x2004)

• Content

Via this entry the current status of the diagnostic flags in accordance with table Tabelle 5 Page 43 can be read out.

• Read access: returns the diagnostic flags' current state.
• Write access: not permissible

Online replacement allowed (0x2006)

• Content

This entry can be used to allow or prohibit the block-by-block hot swapping of SWD modules.

  • 0 = (default setting) Hot swapping one or more SWD modules (without SetNew) is not allowed.
  • 1 = Hot swapping one or more SWD modules (without SetNew) is allowed.
• Read access: returns the setting that is currently configured.
• Write access: Used to set the desired behavior.

Delay between cyclic exchange (0x2010)

• Content

Pause time between two SWD cycles in milliseconds
(0 - 255 ms)

• Read access: pause time that is currently configured
• Write access: pause time that should be set

At present this parameter cannot be changed.

6.2.2 Dynamic entries

The following new entries in the object list are generated each time the gateway is started:

Module list 0x1027

Range 0x2100 to 0x22FF: Properties of SWD modules

Range 0x6000 to 0x6FFF: utility data of SWD modules.

Specification of the dynamic object list entries is performed depending on the target configuration.

Input and output data of the individual SWD modules are mapped into the PDOs in the order of the SWD line structure.

"Input byte" entry

All input bytes of the SWD modules are listed.

"Input word" entry

All word input data of the SWD modules are lined up.

"Output byte" entry

All output bytes of the SWD modules are lined up.

"Output word" entry

All word output data of the SWD modules are lined up.

Module list (0x1027)

• Content
Subindex = 0 (U8): the subindex 0 specifies the number of SWD modules registered in the target configuration.

Subindex = 1 (U16): module no: an entry (module ID) is generated with the order in which the SWD modules were recorded in the target configuration. This entry is formed from the stringing together of the vendor ID and device ID.

• Read access: returns data from the stored gateway target configuration.
• Write access: used to write data to the **Planned configuration**. Writing may only be performed when in
"pre-operational" status.

The list of planned modules can be transferred from the CAN master to the gateway via the entry "Module list (0x1027)".

Presence of device (0x2100)

These local entries define how the SWD gateway behaves, if individual modules are not found.

• Subindex = 0:
number of modules recognized on the SWD line
• Subindex = 1 to number of SWD modules: this entry defines whether the corresponding module is allowed to be missing from the SWD line ("optional"); in this case the SWD line continues to run. Or whether the module is regarded as being necessary. If a module is missing, the SWD line is set to failsafe mode.

Preferences:

• 0 = module is allowed to be missing from the line = "optional" module.
• 1 = the module is not allowed to be absent = "necessary" module. (Default setting)

• Read access: returns the setting that is currently configured for the specified module.
• Write access: desired setting for the specified module.

➜ This setting can also be defined for each module in the register **Service data objects** in the CAN-configuration of the gateway.

Module options + slave address (0x2101)

• Content

- Subindex = 0: the subindex 0 represents the number of SWD modules registered in the target configuration.
  - Subindex = 1 to the number of SWD modules
  - Byte 1 = current SWD address of the addressed module
  - Byte 2 = bit 0: module has parameter; bit 1: module is present; bit 2 to bit 7 = fixed on 0.

- Read access: returns data from the stored gateway target configuration.
- Write access: not permissible

Module CFG (0x2102)

- Content
  - Subindex = 0:
    the subindex 0 represents the number of SWD modules registered in the target configuration.
  - Subindex = 1 to the number of SWD modules:
    Number and format of the input and output data made available to these modules

- Read access: returns data from the stored gateway target configuration.
- Write access: used to write data to the planned SWD configuration. The writing may be performed only in "pre-operational" status. The module must support the changed configuration settings.

Module serial number (0x2103)

- Content
  - Subindex = 0:
    the subindex 0 represents the number of SWD modules registered in the target configuration.
  - Subindex = 1 to the number of SWD modules:
    Serial number of the module found in the corresponding place

- Read access: returns data from the target configuration (stored gateway target configuration).
- Write access: not permissible.

Use of NOP modules (0x2104)

- Contents :
  - Subindex = 0(default): the subindex 0 represents the number of SWD modules registered in the target configuration.
  - Subindex = n = 1..100
    - 0 = SWD module n is not allowed to be replaced with an M22-SWD-NOP universal module on the line.
    - ModulNr: 1= SWD module n can be replaced with an M22-SWD-NOP universal module on the line
- Read access: Returns the current "Use of NOP-Modules" setting for SWD module n.
- Write access: Writes back the current "Use of NOP-Modules" setting for SWD module n.

No. of parameter bytes (0x2109)

- Contents :
  - Subindex = 0: the subindex 0 represents the number of SWD modules registered in the target configuration.
  - Subindex = 1-255 : The number of parameter bytes assigned to this module.
- Read access: data are being returned from the target configuration (confirmed target configuration).
- Write access: used to write data to the planned SWD configuration. The writing may be performed only in "pre-operational" status.

Module parameter (0x2110)

- Content
  - Subindex = 0:
    The subindex 0 returns the number of known parameter entries in the target configuration.
  - Subindex = 1 - 255: parameter data
- Read access: returns data from the target configuration. (stored gateway target configuration)
- Write access: used to write data to the **Planned configuration**. Writing may only be performed when in "pre-operational" status. The module must support the changed parameter values.

➡ At present this property is not supported by SWD modules.

6.2.2.1 Accessing SWD module data acyclically (0x2200-0x22FF)

- Content

An index for the storage of extended diagnostic messages is reserved for each SWD module registered in the target configuration. (Index = 0x2200 + SWD address)

Subindex = 0 - 255: module specific. Acyclic access to the module data. The subindex is interpreted as a module index. Maximum of 120 bytes of utility data per access (subindex)

Access via acyclic data traffic to module data is allowed via SDO utilities in "operational" status only.

- Read access: module-specific
- Write access:module specific

➡ The number and meaning of the available object indexes are described in the relevant documentation (e.g. "SmartWire-DT Modules", MN05006001Z-EN" manual).

6.2.2.2 Fetching the last diagnostic alarm (0x2300-0x2363)

- Content

An index for the storage of extended diagnostic messages is reserved for each SWD module registered in the target configuration. (Index = 0x2300 + SWD module address)

A maximum of five diagnostic alarms are stored for an SWD module; the length of a diagnostic entry is one byte.

- Subindex 0: the number of diagnostic alarms available for this SWD module (values 0 - 5)
- Subindex: 1 - 5: diagnostic alarm

Access via acyclic data traffic to module data is allowed via SDO utilities in "operational" status only.The CAN coupling unit stores a maximum of 256 bytes of extended diagnostic messages.

- Read access: acyclic diagnostic alarms
- Write access: not permissible

6.2.2.3 Utility data area (0x6000 - 0x7FFF)

Process data is stored in this area.

Index	Subindex	Data type
0x6000	0 - 100	U8
I-bytes		
0x6001	0 - 100	U16
I-words		
0x6200	0 - 100	U8
Q-bytes		
0x6201	0 - 100	U16
Q-words		

Input byte (0x6000)

- Content
  - Subindex = 0: the subindex 0 returns the number of input bytes available in the target configuration.
  - Subindex = 1 up to the number of SWD modules:
    Access to the input bytes available in the target configuration.

- Read access: returns the input byte referenced by the subindex.
- Write access: not permissible

Input word (0x6001)

- Content
  - Subindex = 0:
    The subindex 0 returns the number of input words available in the target configuration.

- Subindex = 1 up to the number of SWD modules:
  Access to the input words available in the target configuration.

- Read access: returns the input word referenced by the subindex.
- Write access: not permissible.

Output byte (0x6200)

- Content
  - Subindex = 0:
    The subindex 0 returns the number of output bytes available in the target configuration.
  - Subindex = 1 up to the number of SWD modules: access to the output bytes available in the target configuration.

- Read access: returns the output byte referenced by the subindex.
- Write access: outputs the output byte referenced by the index.

Output word (0x6201)

- Content
  - Subindex = 0:
    The subindex 0 returns the number of output words available in the target configuration.
  - Subindex = 1 up to the number of SWD modules:
    Access to the output words available in the target configuration.

- Read access: returns the output word referenced by the index.
- Write access: outputs the output word referenced by the index.

6.3 Further CANopen specifications

- /CiA301/ CiA 301, CANopen application layer and communication profile, Version 4.02
- /CiA306/ CiA 306, CANopen electronic data sheet specification for CANopen, Version 1.3
- /CiA303-3/ CiA 303, CANopen indicator specification, Version 1.2
- /CiA801/ CiA AN801, CANopen automatic bit-rate detection

7 What you need to know about SmartWire-DT®

This chapter provides a general overview of SmartWire-DT (SWD).
For more detailed descriptions, please refer to the following manuals:

- "SmartWire-DT The System", MN05006002Z-EN
- "SmartWire-DT Modules", MN05006001Z-EN

With SmartWire-DT you can interconnect up to 99 modules very quickly in simple steps. Modules can consist of switchgears as well as I/O components.

The ribbon cable with the SWD modules and all components required for connecting them is called the SWD line. The SWD line starts at the blade terminal as a possible connection to the control relay and then ends at the bus termination.
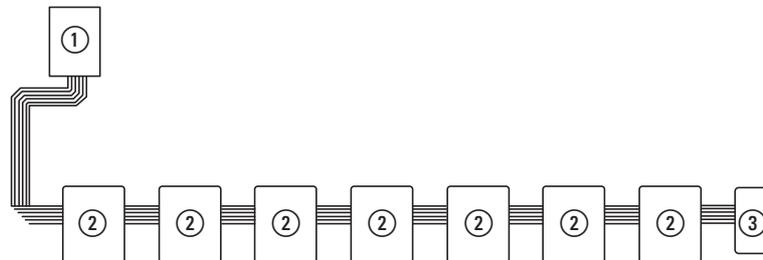
Figure 24:   SWD coordinator with SWD line
① SWD coordinator
② SWD module
③ Bus termination

Wiring assignment

An 8-core connecting cable is used by SWD coordinator to feed the SWD modules with power and exchange data. SmartWire-DT is self-configuring and addresses its modules at the push of a button.

Table 8:   Configuration of the SmartWire-DT ribbon cable

	Meaning	
+24 V DC	U_{AUX}, Contactor control voltage	
Chassis ground	Contactor control voltage	
GND	for device supply voltage and data cable	
Data B	Data cable B	
Data A	Data cable A	
GND	for device supply voltage and data (data A, data B)	
SEL	Select cable for automatic addressing of the SmartWire-DT modules	
+15 V DC	U_{SWD}, Device supply voltage	
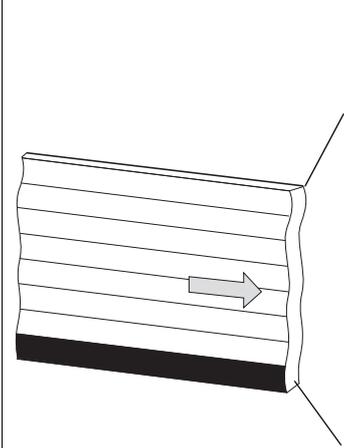
The power supply for SWD coordinator and the SWD modules is connected via the POW terminals. The 15 V power supply of the SWD modules U_{SWD} is generated from POW.

If you wish to use contactors, circuit-breakers or motor starters in the installation with SmartWire-DT, a 24 V DC voltage U_{AUX} must be fed in at AUX.

Definition of terms: components - elements - modules

The SWD components consist of SWD modules and SWD elements.

SWD modules are all those SWD components that respond to a request from the SWD coordinator, i.e. can exchange data. They are assigned an SWD module address.

SWD elements are passive SWD components that do not exchange data but are required for operating the SmartWire-DT network. SWD elements are, for example, the power feeder modules, SWD cables, adapters etc. SWD elements are not given an SWD module address.

SWD universal module

If functions have to be retrofitted on an installation, modifications in the hardware configuration and program extension are normally very labor-intensive. The use of a universal module enables you to initially replace the SWD modules that are required at a later time. If the installation is then extended later, the planned modules are then installed instead of the universal modules. In this way, you will be able to retain all module addresses.A detailed description on connecting the universal modules is provided in the "SmartWire-DT Modules", MN05006001Z-EN.

Power feeder module

The number and the types of SWD modules determine the volume of data to be transferred and the current consumption.

You can use power feed modules if your application has a higher power consumption than the device provides, or if the cable length of the SWD line causes an increased voltage drop. Calculation examples are provided in the "SmartWire-DT The System", MN05006002Z-EN.

Power feeder modules are power supply units that are connected additionally to the SmartWire-DT when there is an increased current consumption or increased voltage drop. Being a passive SWD element, a power feeder module does not have a module address.

The EU5C-SWD-PF1 power feeder module feeds the 24 V DC supply voltage for contactors on the SWD line.

The EU5C-SWD-PF2 power feeder module feeds both the 24 V DC supply voltage for contactors as well as the 15 V DC supply voltage for other SWD modules on the SWD line.

Figure 25:   Schematic layout of an SWD line with the
               EU5C-SWD-PF2 power feeder module
① EU5C-SWD-CAN
② EU5C-SWD-PF2

7.1 Configurations

The following different SWD configurations are possible:

1   Planned SWD configuration
    Before the SWD coordinator can start running, the device must know
    which SWD modules are present and how their parameters have been
    configured. This collected information is found in the planned SWD con-
    figuration.
    Depending on the field bus protocol that you will be using, you will be
    creating the planned SWD configuration in the PLC programming envi-
    ronment or in SWD assist.

    → Please note that the planned SWD configuration and the project
       configuration are not the same thing.

    While the planned SWD configuration describes the parameters
    and the layout of the modules on the SWD line, the project con-
    figuration is the description for the controller as such.

2   Target configuration
    Pressing the "Config" configuration button on the device will make the
    system determine the actual configuration and store it as a target config-
    uration in the SWD coordinator.
3   Actual configuration
    By this is meant the actual physical configuration present on the SWD
    line. Every Every time SWD coordinator is started, the actual configura-
    tion is determined and compared with the stored target configura-
    tion.time SWD coordinator is started, the actual configuration is deter-
    mined and compared with the stored target configuration.

7.2 Changing the planned SWD configuration in SWD assist

To change the configuration of the SWD line, e.g., to add a new module or
replace an existing one, you will have to change the planned SmartWire-DT
configuration and import the target configuration again. Proceed as described
in → Section "3.1.1 Reading of target configuration", page 30.

Example: Changing or replacing a module on the SWD line

Module M22-SWD-K11LED-W has one changeover contact and one white
LED. This module is to be replaced with an M22-SWD-K22LED-W module,
which features two changeover contacts and one white LED. In order to
change the module, you would proceed as follows:

▶   Switch the power supply off at the device.
▶   Pull the M22-SWD-K11LED-W out of the external device plug.
▶   Plug the M22-SWD-K22LED-W into the external device plug.
▶   Switch on the power supply.

The SWD LED will show a red light, indicating that, as expected, the mod-
ules on the SWD line do not match the target configuration stored on the
device.

▶ Press the "Config" configuration button on the front of the device.

The device will detect all the modules currently on the SWD line and store them in the device as a target configuration.

The SWD LED will show a green light, as the modules on the SWD line will match the target configuration.

The Config LED will show a red light, as the modified target configuration will no longer match the planned SWD configuration. You will now have to make them match again by using SWD assist or the PLC programming environment.

In order to modify the planned SWD configuration in SWD assist, you would proceed as follows:

▶ Start SWD assist.
▶ Open the "*.swd" application file with File -> Open
▶ Switch to the Project view or turn off the Communication view by clicking on the "View" -> "Communication view" button.
▶ Replace the M22-SWD-K11LED-W module in the Project view. To do so, go to the device catalog and drag M22-SWD-K22LED-W to drop it where M22-SWD-K11LED-W is located on your workspace.

The SWD line will show the symbol for M22-SWD-K11LED-W instead of the original module.

▶ Save the changed project file „*.swd" in the PC.
▶ In order to establish a connection to the device, first switch to the Communication view by clicking on the "View" > "Communication view" buttons.
▶ Click on the "Connection setup" button and then on the "Online" button.

Device ⁞
Project. ≠ Target config.

The device information in SWD assist will show that the planned SWD configuration and the target configuration in the device still do not match. Because of this, the planned SWD configuration in SWD assist will have to be transferred to the device.

▶ Store the modified planned SWD configuration on the device. To do this, click the "Configurations
in the device" button and then the "PC=>device" button.

The device information will show the STOP device status.

SWD status ⁞
STOP

The Config LED will show a green light. This indicates that the target configuration and the planned SmartWire-DT configuration match. The device can now run.

7.3 SWD cycle time

The SWD cycle time is the time required for the cyclic exchange of data between the coordinator and all modules using a common data frame on the SWD line.

The SWD gateway is the coordinator.

The SWD cycle time does not depend on the number of modules on the SWD line as much as it does on the amount of payload data that the summation frame needs to transmit. Within this context, "payload data bytes" refers to the number of input and output bytes of a module.

There are commonplace modules, such as switches, that transmit little payload data. However, there are also modules with multiple settings and read-out values, such as motor-protective circuit-breakers.

To calculate the SWD cycle time, each byte is counted as 10 bits, since a start bit and a stop bit are required for each byte for synchronization purposes. The SWD cycle time can be calculated using the following formula:

$$\text{SWD cycle time } t_p \text{ [ms]} = \frac{1}{C} \left[n \cdot 10 \text{ bit} + 2 \text{ bit} \cdot n_{TN} + 30 \text{ bit} \cdot 10 \right]$$

n = Number of user data bytes.
C = Baud rate [kBit/s]
n_{TN} = number of modules

Example:

The following values are given:

Input bytes = 13 bytes

Output bytes = 8 bytes

Modules: 9

Baud rate = 125kBit/s

n = Number of user data bytes = 21

$$\text{SWD cycle time } t_p \text{ [ms]} = \frac{1}{125 \text{ kBit/s}} \left[21 \cdot 10 \text{ bit} + 2 \text{ bit} \cdot 9 + 30 \text{ bit} \cdot 10 \right] = 4.224 \text{ ms}$$
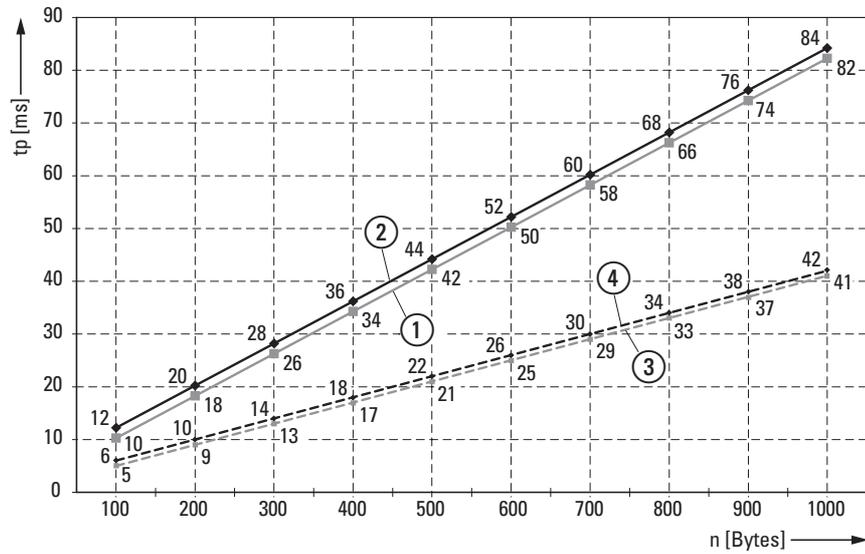
Figure 26: SWD cycle time based on the amount of transmitted payload data bytes
① 125 kBit/s: 1 SmartWire-DT module with n user data bytes
② 125 kBit/s: 99 SmartWire-DT module with n user data bytes
③ 250 kBit/s: 1 SmartWire-DT module with n user data bytes
④ 250 kBit/s: 99 SmartWire-DT module with n user data bytes

When the baud rate doubles, the SWD cycle time is cut in half. In the example above, the SWD cycle time goes from 4,224 ms at 125 kbit/s to 2.112 ms at 250 kbit/s.

7.4 Cyclical input and output data of the SWD modules

All the inputs and outputs of the SWD modules that are present are stored in a data storage area inside the SWD coordinator. This data storage area is referred to as the "process image. " The input data can have a maximum size of 800 bytes, while the output data can have a maximum size of 642 bytes. In total, the data area must not exceed 1000 bytes. The cyclic exchange of data between the SWD coordinator and the SWD modules takes place in a common data frame.The input data can consist of several bytes, depending on the module. This input data contains information such as switch positions and diagnostic information.

The modules' input and output data is available to the PLC programming environment. To find out more about how it can be accessed, please refer to → Chapter 5 "Take XSoft-CoDeSys-2 into operation", page 31.

Diagnostics possibilities

The SWD coordinator can provide the following diagnostic information:

- Cyclic diagnostic information
- Extended diagnostics information

Cyclic diagnostics information

SmartWire-DT provides you with cyclical diagnostic information. This information can be evaluated in the program and used for further control tasks.

This basic diagnostic information is coded in the normal process image of each SWD module. The information about whether the SWD module is exchanging data normally or whether diagnostic alarms are currently present is provided on all SWD modules in the first input byte (byte 0) at bit positions 4 and 6.

> ⚠️ **DANGER**
>
> Persons, systems and machines may be put at risk if an N/C contact is misinterpreted. When using N/C contacts always evaluate the PRSNT and DIAG diagnostic bits of this module.

Example of input and diagnostic data

The M22-SWD-K11-LED-R function element has a red LED for illuminated pushbuttons and the two switch states 0 and 1. With cyclical input data of one byte, it contains information on switch position and diagnostic information.

Byte 0:

7	6	5	4	3	2	1	0
Diagnostic data				Input data			
SUBST	PRSNT	–	DIAG	–	–	NO1	NC1

BIT	designation	Meaning
0	NC1 = Normally Closed	0: contact actuated 1: contact not actuated
1	NO1 = Normally Open	0: contact not actuated 1: contact actuated
2	Not used	-
3	Not used	-
4	DIAG	0: no diagnostic alarm 1: Diagnostic alarm present
5	Not used	-
6	PRSNT	0: module not present 1: module present
7	SUBST	0: planned module is present 1: M22-SWD-NOP(C) universal module present

The diagnostic bits of the individual SWD modules can be looked up in the "SmartWire-DT Modules", MN05006001Z-EN.

Example for output data:

The M22-SWD-K11-LED-R function element has a red LED for illuminated pushbuttons and the two switch states 0 and 1. With cyclical output data of one byte, it contains information on switch position and diagnostic information.

Byte 0:

7	6	5	4	3	2	1	0
–	–	–	–	–	–	–	Q0

BIT	designation	Meaning
0	Q0	Control section LED
1	Not used	–
2	Not used	–
3	Not used	–
4	Not used	–
5	Not used	–
6	Not used	–
7	Not used	–

Extended diagnostic services

If a SWD module is signaling "Diagnose," i.e., if bit 4 of input byte 0 is set to 1, the corresponding details can be obtained by evaluating the extended diagnostic services.

If you were to determine the detailed states for an M22-SWD-K11-LED-R function element as an example of a SWD module, you would be able to get information on the following:

&Value	Meaning
0x10	The contact is longer than four seconds in the middle position.
0x11	There is a short-circuit in the contact.

If there is a diagnostic alarm present for an SWD module, this means that there is a fault on this module. Using the SWD assist software you can display the extended diagnostic alarms to identify the faults more closely.

Proceed as follows for SWD assist to display the extended diagnostic alarms:

▶ In SWD-Assist, switch to the Communication View by clicking on the "View" -> "Communication View" menu option.
▶ Connect to the SWD coordinator by clicking on the "Connection establishment" button -> "Online."
▶ In the workspace, click on the module that you want to diagnose.
▶ In the Properties field choose the "Diagnostics buffer" tab.

The table in the Properties field shows you the extended diagnostic alarms. The alarms are logged and displayed with a time stamp. The time stamp is based on the system time of your PC. The code is displayed in decimal notation. Diagnostic alarms can be categorized as follows:

• Code < 1000:
  Alarm comes directly from the module; the code is the same as a fault on field bus systems. These fault messages are described in the "Smart-Wire-DT module" manual. The error codes stated there are in hexadecimal notation.
• Code ≧ 1000:
  Alarm was generated by SWD coordinator as the SWD module can no longer send.

The extended diagnostic alarms are not retentive in the SWD assist.
If SWD coordinator is switched off, the diagnostics buffer is cleared.

Further information on extended diagnostics is provided in the Online Help of SWD assist.

For more information on how to evaluate the extended diagnostic messages in the PLC programming environment, please refer to ➔ Chapter 5 "XSoft-CoDeSys in Betrieb nehmen", page 31.

7.5 SWD device parameters

In the case of EU5C-SWD-CAN, the device parameters can be configured in the PLC programming environment.

A "required module" is a module for which the „DevicePresence" = "1" so that it is enabled.

The „All slaves optional" and „DevicePresence" device parameters define whether there is a SmartWire-DT error when the actual configuration is different from the target configuration.

The "Compatible devices allowed" and "AcceptUniversalModul" device parameters define whether there is a SmartWire-DT error when the target configuration is different from the planned configuration.

"Online replacement" device parameter

The „Online replacement" device parameter makes it possible to hot swap SWD modules block by block. In addition, the„All slaves optional" parameter must be set to "1". Otherwise, the entire line will be disabled if communications with one or more SmartWire-DT modules are lost.

> *NOTICE*
>
> Hot swapping modules on the SWD line is only allowed in conjunction with the SWD4-FFR-PF1-1 power supply module and SWD4-FFR-ST1-1 cable adapter SmartWire-DT components.

When „Online replacement" is enabled, the SmartWire-DT coordinator will perform an automatic addressing routine if it detects any differences between the target configuration and the actual configuration when comparing them. The comparison between the planned SmartWire-DT configuration and the target configuration will continue to be performed.

Examples

Remember that if „All slaves optional" is set to "1"and is enabled, the SWD line will continue to run even if a module on the line drops out - regardless of whether „Online replacement" is enabled or disabled.

When „Online replacement"="0", this means that the device parameter is not enabled. If the module is replaced with an identical module while the power is off, the target configuration will have to be imported again after the power is turned back on. The SWD line will not start running. In other words, the user is required to intervene.

When „Online replacement"="1", this means that the device parameter is enabled. If the module is replaced with an identical module while the power is off, a new target configuration will be automatically imported. If this imported target configuration matches the planned SmartWire-DT configuration, the SWD line will start running. The SWD line will also start running if the new modules are compatible with the planned SmartWire-DT configuration and the "Compatible devices permissible"="1"is enabled.

7.5.1 Device paramters of the SWD gateway

Table 9:   Device parameter SWD coordinator

Device parameter adjustable on SWD coordinator	VALUE	Reaction SWD line
Baud rate SmartWire-DT	125 KBaud 250 KBaud	125 KBaud =setpoint value Baud rate on SWD line Setting options: • 125 KBaud (setpoint value) • 250 kBaud (operating system V1.10 and higher)
All slaves optional (0 = No; 1 = Yes)	0	0=Default setting The device parameter on each SWD module is used to define whether the module is optional ➝ Section " DevicePresence", page 67.
	1	All SWD modules are optional. The SWD line can be run with any number of failed SWD modules. Data will be transferred to the field bus master. The ➝ Section " DevicePresence", page 67 setting in the SWD modules will have no effect.
Compatible devices allowed (0 = No; 1 = Yes)	0	0=Default setting The planned SWD modules in the SWD configuration must comply with the SWD modules of the stored gateway target configuration. If they do not, no data will be transferred to the field bus master.
	1	Data will be exchanged if the SmartWire-DT modules connected to the SWD line are identical to or compatible with the SmartWire-DT modules in the planned SmartWire-DT configuration. If they do not, no data will be transferred to the field bus master This is displayed via the status LED on the device. You will find the list of devices that are compatible with one another in ➝ Table 30, page 106.
Disable configuration check (0 = No; 1 = Yes)	0	The planned SWD configuration and the target configuration will be compared. If they are not identical, no data will be exchanged.
	1	The planned SWD configuration and the target configuration will not be compared. This setting must be used for all configurators except XSoft-CoDeSys-2, since only XSoft-CoDeSys-2 supports downloading a CAN configuration onto the CANopen gateway.
Delay between cyclic data exchange (0 - 255ms)		At present the value cannot be changed.
Online replacement (0 = No; 1 = Yes)	0	0=Default setting; New SWD modules on the SWD line must always be assigned an address by importing the target configuration.
	1	This setting enables block-by-block hot swapping for SWD modules without having to explicitly reconfigure them via the device by pressing the configuration button. In addition, the "All slaves optional" toparameter must be set to "1". Otherwise, the entire line will be disabled if communications with one or more SmartWire-DT modules are lost.

7.5.2 Device parameters of SWD modules

Table 10:   Device parameters of SWD modules

Device parameter adjustable on SWD module	Value	Reaction SmartWire-DT
DevicePresence (0 = optional; 1 = mandatory)	1	Required SWD module 1=Setpoint value The SWD module must be present when the system starts and during operation. A missing SWD module causes following: • PRSNT diagnostic bit to be set to "0" • DIAG diagnostic bit to be set to "1" • The SWD line will not start running or will be stopped, as the case may be. **Note:** This device parameter will only take effect if the coordinator's " „All slaves optional" device parameter is disabled, i.e., if it has a value of "0".
	0	The SWD line will keep running even if the SWD module is missing or defective.
AcceptUniversalModule (0 = No; 1 = Yes)	0	0=Setpoint value The SWD module can not be replaced by a universal module M22-SWD-NOP(C).
	1	The SWD module can be replaced by a universal module M22-SWD-NOP(C).
Q_byte…	0 - 255	0=Setpoint value The actual value of the outputs that is output when the master starts, before the first data are sent by the PLC to the module.

7.5.3 Application cases for the effective use of the device parameters

Compatible devices allowed enabled

The system is already running and both the target configuration and the planned SWD configuration are stored on the SWD coordinator. The SWD coordinator is switched off in order to replace a defective module. As you don't have a replacement of the same type, you use a compatible type according to the table.

When you switch the SWD coordinator back on, the actual configuration will be determined.The automatic configuration comparison will detect the new module and signal this discrepancy by showing a solid red light on the Config LED. You will then have to press the "Config" configuration button. After this, the SWD coordinator will import the new target configuration. The Smart-Wire-DT coordinator will compare the target configuration with the planned SmartWire-DT configuration and detect a difference between both. The system will then check whether the "Compatible devices permissible" option has been enabled.If it has, the SWD coordinator will check whether the module in the target configuration is really compatible with the module in the planned SWD configuration. If it is, there is no SmartWire-DT error and the SWD line will start running.

"AcceptUniversalModul" enabled

You've designed a system and you want to first use a universal module for a specific module, as the actual specific module will be installed as part of a later upgrade. To do this, you enable the „AcceptUniversalModul"=„1" device parameter.

This makes it possible for the module in the planned SmartWire-DT configuration to be replaced by a universal module in the target configuration.Once you install the universal module on the de-energized SWD line, you switch on the SWD coordinator and press the "Config" configuration button to import the target configuration. The check against the planned SWD configuration then shows that the configurations do not match. After this, the SWD coordinator checks whether the „AcceptUniversalModul"=„1" device parameter is enabled for this module. If it is, the SWD line will start running.

7.6 Faults on the SWD line

Different events can occur in conjunction with the SWD line, which require rectification.

Missing or faulty module

If the SWD coordinator determines that the actual configuration is missing a SWD module from the target configuration, the PRSNT diagnostic bit will be set to 0.

If the „All slaves optional" = „1" , missing modules will not trigger a SmartWire-DT error. The „DevicePresence" device parameter, which can be set individually for each SmartWire-DT module, will not be checked in this case. The Config LED and the SWD LED will show a solid green light.

If the „All slaves optional"= „0" , the „DevicePresence" device parameter on the individual SmartWire-DT module will be checked.

If the missing SmartWire-DT module is not a required SmartWire-DT module, the SWD line will keep running and will continue to work with the remaining SmartWire-DT modules. The Config LED and the SWD LED will show a solid green light.

If, however, the SWD module is a mandatory module, the SWD LED will show a flashing red light and the SWD line will not start running. The Config LED will show a solid green light, while the SWD LED will show a flashing red light.
If this error occurs during ongoing operation, e.g., because a module responds too late or is faulty, the SWD line will resume operation as soon as the error is fixed. A restart is not necessary.

"Wrong" or faulty module

An "incorrect" module is one that SWD coordinator finds which, when determining the actual configuration, is not expected in the target configuration.

→ Bear in mind that the serial number of the module is also examined for matching as well as the module type.

This means that if you replace a pushbutton actuator with one of the same type when the SWD line is switched off, it will be identified as an "incorrect" module by the SWD coordinator.

An "incorrect" SWD module on the SWD line can only be found on startup since the replacement of an SWD module is not permitted when the device is switched on. The following therefore distinguishes which cases an "incorrect" module can occur on an SWD line after startup.

If the SWD coordinator determines that an SWD module of the actual configuration does not match the target configuration, it defines it as an "wrong" module. The DIAG diagnostic bit stays at 0.

The same response also takes place if SWD coordinator finds more modules on the SWD line than is stored in the target configuration.

With a "wrong" module the SWD line does not go into operation. The Config LED is green, the continuous light; the SWD-LED is not flashing red.

You may wish to permit the "incorrect" module, because, for example, you wish to replace a faulty SWD module with a new one. Perhaps you wish to replace an SWD module with a compatible SWD module or with a universal module. In that case read further in → Section " Compatible devices allowed enabled", page 68 and → Section " "AcceptUniversalModul" enabled", page 68.

In any case, you will have to press the "Config" configuration button.

7.7 LEDs on the device

The SWD-LED indicates whether the actual configuration of the SWD line matches the target configuration.

The Config LED is used to indicate the result of the configuration comparison between the stored target configuration and the planned configuration. This comparison takes into account all relevant device and module parameters.

Table 11:   LED SWD coordinator

LED		Status	Data exchange coupling unit PLC
SmartWire-DT	off	no supply voltage at POW no target configuration present	No
	Green continuous light	Actual configuration = Target configuration	yes
	green flashing	The SWD modules are being addressed and the actual configuration is being determined, e.g., after switching the system on or downloading a planned SWD configuration with s	No
	red flashing	actual configuration ≠ target configuration e.g., a required module is missing or one module too many	No
	Red continuous light	No SWD line present No 15 V DC device voltage present	No
Config	off	No planned SWD configuration is available, because e.g. • Initial Commissioning or • Program in SWD coordinator was deleted	No
	Green continuous light	target configuration = defined planned SWD configuration	yes
	Green flashing	A module from the planned SWD configuration has been replaced with a compatible module in the target and actual configurations	yes
	Red continuous light	Target configuration ≠ defined planned SWD configuration	No
	Changes from permanent orange to red	The gateway is in firmware update mode when the POW LED is off. The firmware update mode can be left by switching on the supply voltage again.	No

LEDs on the module

Table 12:   LEDs on the relevant module

LED		Status
Module-LED	off	no 15 V supply voltage
	green flashing	Waiting for addressing
	green fast flashing	Error on module and diagnostic alarm is "1"
	Green continuous light	Module matches the target configuration.

Further information is provided in the manual "SmartWire-DT The System", MN05006002Z-EN.

7.8 SWD assist

The SWD assist planning, ordering and commissioning program can be used to perform the following functions, among others:

- Selecting modules, as well as a gateway
- Entering device parameters for the SWD gateway and the SWD modules
- Entering SWD network parameters
- Status indication of the inputs/outputs
- Wiring test
- Reading of the stored actual configuration
- Importing the planned SWD configuration stored on the gateway
- Comparison of the target and actual configuration
- Display of cyclical and acyclical diagnostics messages

The Online Help function provides a detailed description of how to use SWD-Assist. In order to open it, click on the "?" icon on the SWD-Assist menu bar or press the F1 key.

8 Appendix

8.1 Dimensions

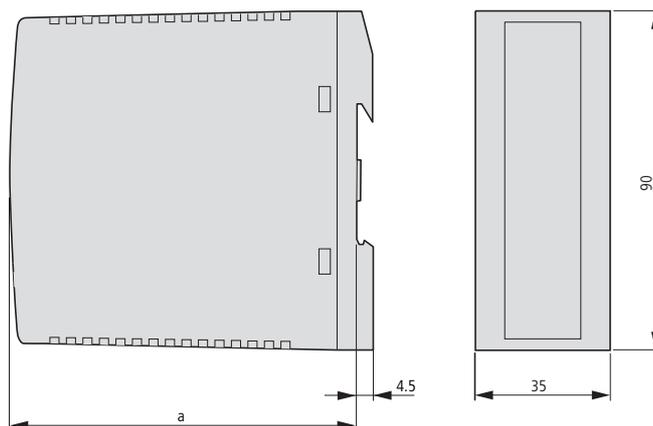|		**EU5C-SWD- CAN**
Dimensions W × H × D	mm	35 × 90 × 126.5
	inch	1.38 × 3.54 × 4.98
Dimensions a	mm	122
	inch	4.8
Space units (SU) width		2
Weight	kg	0.16
	lb	0.35
Mounting Considerations		Top-hat rail IEC/EN 60715, 35 mm or screw fixing usingfixing brackets ZB4-101-GF1 (accessories).
Mounting position		Horizontal or vertical

Figure 27:   Dimensions EU5C-SWD- CAN

8.2 Technical data

8.2.1 Standards

	EU5C-SWD- CAN
Standards	EN 55011, EN 50178, EN 61131-2, IEC EN 61000-4, IEC60068-2-6, IEC60068-2-27

8.2.2 General ambient conditions

		EU5C-SWD- CAN
Ambient mechanical conditions		
Degree of protection (IEC/EN 60529, EN50178, VBG 4)		IP20
Vibrations (IEC/EN 61131-2:2008)		
constant amplitude 0.15 mm	Hz	5 – 8.4
constant acceleration 1 g	Hz	8.4 – 150
Mechanical shock resistance (IEC/EN 60068-2-27) semi-sinusoidal 15 g/11 ms	Impact resis-tances	9
Drop to IEC/EN 60068-2-31 Drop height	mm	50
Free fall, packaged (IEC/EN 60068-2-32)	m	0.3
Ambient climatic conditions		
Operating ambient temperature (IEC 60068-2)	°C	-25 to +55
Condensation		prevent with suitable measures
Storage	°C	−40 to +70
Relative humidity, non-condensing (IEC/EN 60068-2-30)	%	5 – 95
Electromagnetic compatibility (EMC)		
Overvoltage category		II
Pollution degree		2
Electrostatic discharge (IEC/EN 61131-2:2008)		
Air discharge (Level 3)	kV	8
Contact discharge (Level 2)	kV	4
Electromagnetic fields (IEC/EN 61131-2:2008)		
80 - 1000 MHz	V/m	10
1.4 - 2 GHz	V/m	3
2 - 2.7 GHz	V/m	1
Radio interference suppression (SmartWire-DT)		EN 55011 Class A
Burst (IEC/EN 61131-2:2008, Level 3)		
Supply cables	kV	2
Fieldbus cable	kV	1
SmartWire-DT cables	kV	1
Surge (IEC/EN 61131-2:2008, Level 1)		
Supply cables/Fieldbus cable	kV	supply cable: 0.5, bus cable: 1
Radiated RFI (IEC/EN 61131-2:2008, Level 3)	V	10

8.2.3 Power supply

			EU5C-SWD- CAN
DC power supply AUX			
Rated operational voltage		V	24 DC -15 % +20 %
Residual ripple of input voltage		%	$\leqq$ 5
Protection against polarity reversal			Yes
Maximum current	I_{max}	A_x	CE:3[1] UL: 2[1]
Short-circuit strength			no, external fuse CE: FAZ 3 UL: FAZ 2
Heat dissipation		W	Normally 1
Potential isolation			
from power supply POW			Yes
from serial interface			No
from SmartWire-DT			No
from fieldbus interface			Yes
Rated operating voltage of 24-V-DC modules		V	typical U_{AUX} - 0.2
DC power supply POW			
Supply voltage		V	24 DC -15 % + 20 %
		%	$\leqq$ 5
			Yes
Rated operational current	I_e	A_x	0.7
Overload proof			yes
Inrush current and length			12.5 A/6 ms
Heat dissipation at 24 V DC		W	3.8
Potential isolation between U_{POW} and 15 V SmartWire-DT supply voltage			No
Potential isolation			
from power supply POW			Yes
from serial interface			No
from SmartWire-DT			No
from fieldbus interface			Yes
Bridging voltage dips		ms	10
Repeat rate		s	1
Status display			POW-LED plain color: orange

1) When the total power consumption > I_{max} ,
   an EU5C-SWD-PF1 or EU5C-SWD-PF2 power feeder module has to be used.

8.2.4 SmartWire-DT®

			EU5C-SWD- CAN
SmartWire-DT power supply U$_{SWD}$ **(generated from the POW supply voltage)**			
Rated operational voltage	U$_e$	V	14.5 ± 3 %
max. current	I$_{max}$	A	0,7[1]
Short-circuit strength			Yes
Potential isolation			
from power supply POW			No
from power supply AUX			Yes
from serial interface			No
from fieldbus interface			Yes
Connection supply voltages			
Connection type			Push in terminals
solid		mm^2	0.2 – 1.5 (AWG 24 – 16)
flexible with ferrule		mm^2	0.25 – 1.5
SmartWire-DT line			
Module type			SWD configurator
Max. number of SmartWire-DT modules			99
Baud rate		kBd	125/250
Interface standard of data cable			RS485
Address setting			automatically via configuration button
Status display			Multi-color SWD-LED: orange/green/red Dual colored Config LED: green/red
Connections			Plug, 8-pole
Plug connectors			Blade terminal SWD4-8MF2
Bus termination resistor SWD line			integrated in the device: the end of the SWD line must be terminated with SWD-RC8-10

1) When the total power consumption > I$_{max}$,
an EU5C-SWD-PF2 power feeder module has to be used.

8.2.5 Field bus interface CANopen

		EU5C-SWD-CAN
Fieldbus interface		
Function		CANopen slave
Default port		None
Protocol		CANopen
Input data, maximum	Byte:	128
Output data, maximum	Byte:	128
Baud rate	MBit	to 1 MB
Baud rate detection		automatic
Address setting		automatic
Module address		2 – 32
Address setting with		DIP Switch
Status display interface		CAN-LED two-colored: red/green
Bus termination resistor		switched via dip switch at the gateway
Terminal types		1 × SUB-D plug, 9-pole
Potential isolation		
from power supply POW / AUX		yes
from serial interface		yes
from SmartWire-DT		yes

8.2.6 Diagnostics interface

	EU5C-SWD- CAN
Diagnostics interface	
Part no.	RS232
Terminal types	RJ45
Potential isolation	
from power supply POW / AUX	No
from SmartWire-DT	No
from fieldbus interface	Yes

8.3 Compatible SWD module types

You can find permissible SWD modules and their permissible replacement
types:

Table 13:   List of types that are compatible with one another

Part no.	Description	permissible replacement type 1	permissible replacement type 2
RMQ function elements (front mount)			
M22-SWD-K11	Function element, 2 pos. front	M22-SWD-K22	
M22-SWD-K22	Function element, 3 pos. front		
M22-SWD-LED-W	Function element, LED W front	M22-SWD-K11LED-W	M22-SWD-K22LED-W
M22-SWD-K11LED-W	Function element, 2 pos., LED W, front	M22-SWD-K22LED-W	
M22-SWD-K22LED-W	Function element, 3 pos., LED W, front		
M22-SWD-LED-R	Function element, LED R front	M22-SWD-K11LED-R	M22-SWD-K22LED-R
M22-SWD-K11LED-R	Function element, 2 pos., LED R, front	M22-SWD-K22LED-R	
M22-SWD-K22LED-R	Function element, 3 pos., LED R, front		
M22-SWD-LED-G	Function element, LED G front	M22-SWD-K11LED-G	M22-SWD-K22LED-G
M22-SWD-K11LED-G	Function element, 2 pos., LED G, front	M22-SWD-K22LED-G	
M22-SWD-K22LED-G	Function element, 3 pos., LED G, front		
M22-SWD-LED-B	Function element, LED B front	M22-SWD-K11LED-B	M22-SWD-K22LED-B
M22-SWD-K11LED-B	Function element, 2 pos., LED B, front	M22-SWD-K22LED-B	
M22-SWD-K22LED-B	Function element, 3 pos., LED B, front		

Part no.	Description	permissible replacement type 1	permissible replacement type 2
RMQ function elements (base fixing)			
M22-SWD-KC11	Function element, 2 pos., base	M22-SWD-KC22	
M22-SWD-KC22	Function element, 3 pos., base		
M22-SWD-LEDC-W	Function element, LED-W, base	M22-SWD-K11LEDC-W	M22-SWD-K22LEDC-W
M22-SWD-K11LEDC-W	Function element, 2 pos., LED-W, base	M22-SWD-K22LEDC-W	
M22-SWD-K22LEDC-W	Function element, 3 pos., LED-W, base		
M22-SWD-LEDC-R	Function element, LED-R, base	M22-SWD-K11LEDC-R	M22-SWD-K22LEDC-R
M22-SWD-K11LEDC-R	Function element, 2 pos., LED-R, base	M22-SWD-K22LEDC-R	
M22-SWD-K22LEDC-R	Function element, 3 pos., LED-R,, base		
M22-SWD-LEDC-G	Function element, LED-G, base	M22-SWD-K11LEDC-G	M22-SWD-K22LEDC-G
M22-SWD-K11LEDC-G	Function element, 2 pos., LED-G, base	M22-SWD-K22LEDC-G	
M22-SWD-K22LEDC-G	Function element, 3 pos., LED-G, base		
M22-SWD-LEDC-B	Function element, LED-B, base	M22-SWD-K11LEDC-B	M22-SWD-K22LEDC-B
M22-SWD-K11LEDC-B	Function element, 2 pos., LED-B, base	M22-SWD-K22LEDC-B	
M22-SWD-K22LEDC-B	Function element, 3 pos., LED-B, base		
DILM/MSC function elements			
DIL-SWD-32-001	DIL/MSC	DIL-SWD-32-002	
DIL-SWD-32-002	DIL/MSC, Manual/Auto		
PKE-SWD-32			
I/O function elements			
EU5E-SWD-4DX	Digital module, 4 inputs		
EU5E-SWD-8DX	Digital module, 8 inputs		
EU5E-SWD-4D4D	Digital module, 4 inputs, 4 outputs		
EU5E-SWD-4D2R	Digital module, 4 inputs, 2 outputs		
EU5E-SWD-X8D	Digital module, 8 outputs		
EU5E-SWD-4AX	Analog module, 4 inputs		
EU5E-SWD-2A2A	Analog module 2 inputs, 2 outputs		
EU5E-SWD-4PT	Analog module, 4 temperature inputs		
EU5E-SWD-4PT-2	Analog module, 4 temperature inputs		

8 Appendix
8.3 Compatible SWD module types

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