SIEMENS

Industrial Controls

Motor management and control devices
Parameterizing SIMOCODE pro

Operating Manual

02/2023
A5E40507630002A/RS-AG/007

Legal information

Warning notice system

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

⚠ DANGER

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

⚠ WARNING

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

⚠ CAUTION

indicates that minor personal injury can result if proper precautions are not taken.

NOTICE

indicates that property damage can result if proper precautions are not taken.

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

Qualified Personnel

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

Proper use of Siemens products

Note the following:

⚠ WARNING

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

Trademarks

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

Disclaimer of Liability

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

Siemens AG
Smart Infrastructure
Electrical Products
Postfach 10 09 53
93009 Regensburg
GERMANY

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Table of contents

Introduction

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1.1 Important notes

Scope of application

This manual is applicable to the listed SIMOCODE pro system components. It contains a description of the components applicable at the time of printing the manual. SIEMENS reserves the right to include updated information about new components or new versions of components in a Product Information.

Manual Collection

A Manual Collection (https://support.industry.siemens.com/cs/ww/en/view/109743951), a collection of the following five SIMOCODE pro manuals is at your disposal in Industry Online Support:

- SIMOCODE pro - 1 Getting Started
- SIMOCODE pro - 2 System Manual
- SIMOCODE pro - 3 Parameterization
- SIMOCODE pro - 4 Applications
- SIMOCODE pro - 5 Communication

SIMOCODE pro response tables

Specific responses (deactivated, signaling, warning, tripping) can be parameterized for various SIMOCODE pro functions, such as overload. These are always displayed in tabular form:

- "X" = Applicable
- "—" = Not applicable
- Default values are marked "d" for "default" in parentheses.

Response	Function 1	Function 2	Function 3
Tripping	—	X (d)	X
Warning	X (d)	X	—
Signaling	X	X	—
Deactivated	X	X	X (d)
Delay	0 ... 25.5 s (default: 0)	—	—

Brief description of the responses:

- Tripping: The contactor controls QE* are tripped. A fault message is generated which is available as a diagnosis via PROFIBUS DP. The fault message and the device-internal signal remain on until the appropriate length of time has elapsed or the cause of the fault has been eliminated and acknowledged.
- Warning: In addition to the device-internal signal, a warning signal is generated that is available as diagnostics via the communication bus.
- Signaling: Only a device-internal signal is generated, which can be further processed as required.
- Deactivated: The appropriate function is switched off, no signals are generated.

A delay time can also be set for specific responses.

Further information

Please read the operating instructions of the respective components. You can find the operating instructions for SIMOCODE pro at Operating instructions (https://support.industry.siemens.com/cs/ww/en/ps/16027/man).

You can find further information on the Internet:

- SIMOCODE pro (https://www.siemens.com/simocode)
- Information and Download Center (https://support.industry.siemens.com/cs/ww/en/ps/16027/catl)
- Siemens Industry Online Support (SIOS) (https://support.industry.siemens.com/cs/ww/en/ps)
- Certificates (https://support.industry.siemens.com/cs/ww/en/ps/16027/cert)

Disclaimer of liability

The products described here have been developed to carry out safety-related functions as part of a complete plant or machine. In general, a complete safety system consists of sensors, evaluation units, signaling devices and methods for safe tripping. The manufacturer is responsible for ensuring safe functioning of the complete plant or machine. Siemens AG, its subsidiaries, and associated companies (hereinafter referred to as "Siemens") are not in a position to guarantee every characteristic of a complete plant or machine not designed by Siemens.

Siemens also denies all responsibility for any recommendations that are made or implied in the following description. No new guarantee, warranty, or liability claims above those beyond the scope of the Siemens general terms of delivery can be derived from the following description.

1.2 Siemens Industry Online Support

Information and service

At Siemens Industry Online Support you can obtain up-to-date information from our global support database:

- Product support
- Application examples
- Forum
- mySupport

Link: Siemens Industry Online Support (https://support.industry.siemens.com/cs/de/en)

Product support

You can find information and comprehensive know-how covering all aspects of your product here:

- **FAQs**
  Answers to frequently asked questions
- **Manuals/operating instructions**
  Read online or download, available as PDF or individually configurable.
- **Certificates**
  Clearly sorted according to approving authority, type and country.
- **Characteristics**
  For support in planning and configuring your system.
- **Product announcements**
  The latest information and news concerning our products.
- **Downloads**
  Here you will find updates, service packs, HSPs and much more for your product.
- **Application examples**
  Function blocks, background and system descriptions, performance statements, demonstration systems, and application examples, clearly explained and represented.
- **Technical data**
  Technical product data for support in planning and implementing your project

Link: Product support (https://support.industry.siemens.com/cs/ww/en/ps)

mySupport

The following functions are available in your personal work area "mySupport":

- **Support Request**
  Search for request number, product or subject
- **My filters**
  With filters, you limit the content of the online support to different focal points.

- **My favorites**
  With favorites you bookmark articles and products that you need frequently.
- **My notifications**
  Your personal mailbox for exchanging information and managing your contacts. You can compile your own individual newsletter in the "Notifications" section.
- **My products**
  With product lists you can virtually map your control cabinet, your system or your entire automation project.
- **My documentation**
  Configure your individual documentation from different manuals.
- **CAx data**
  Easy access to CAx data, e.g. 3D models, 2D dimension drawings, EPLAN macros, device circuit diagrams
- **My IBase registrations**
  Register your Siemens products, systems and software.

1.3 Siemens Industry Online Support app

Siemens Industry Online Support app

The Siemens Industry Online Support app provides you access to all the device-specific information available on the Siemens Industry Online Support portal for a particular article number, such as operating instructions, manuals, data sheets, FAQs etc.

The Siemens Industry Online Support app is available for Android and iOS:

Android

iOS

1.4 Support Request

After you have registered, you can use the Support Request form in the online support to send your question directly to Technical Support:

Support Request:	Internet (https://siemens.com/support-request)

1.5 Security information

Siemens provides products and solutions with industrial security functions that support the secure operation of plants, systems, machines and networks.

In order to protect plants, systems, machines and networks against cyber threats, it is necessary to implement – and continuously maintain – a holistic, state-of-the-art industrial security concept. Siemens' products and solutions constitute one element of such a concept.

Customers are responsible for preventing unauthorized access to their plants, systems, machines and networks. Such systems, machines and components should only be connected to an enterprise network or the internet if and to the extent such a connection is necessary and only when appropriate security measures (e.g. firewalls and/or network segmentation) are in place.

For additional information on industrial security measures that may be implemented, please visit
https://www.siemens.com/industrialsecurity.

Siemens' products and solutions undergo continuous development to make them more secure. Siemens strongly recommends that product updates are applied as soon as they are available and that the latest product versions are used. Use of product versions that are no longer supported, and failure to apply the latest updates may increase customer's exposure to cyber threats.

To stay informed about product updates, subscribe to the Siemens Industrial Security RSS Feed under
https://www.siemens.com/cert.

1.6 Current information about operational safety

Important note for maintaining operational safety of your system

DANGER

Hazardous Voltage

Can Cause Death, Serious Injury or Risk of Property Damage

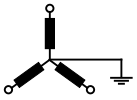
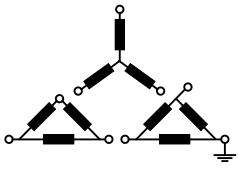
Please take note of our latest information!

Systems with safety-related characteristics are subject to special operational safety requirements on the part of the operator. The supplier is also obliged to comply with special product monitoring measures. We therefore also provide information in the newsletters Industrial controls (https://new.siemens.com/global/en/products/automation/industrial-controls/forms/newsletter.html) and Safety Integrated (https://new.siemens.com/global/en/products/automation/topic-areas/safety-integrated/factory-automation/newsletter.html) about new products, further technical developments as well as standards and guidelines.

1.7 Notes for SIMOCODE pro regarding IEC60947-4-1:2018

1.7.1 Line system configurations

The voltage information regarding the SIMOCODE pro current and current/voltage measuring modules is valid for the following line system configurations according to IEC 60947-4-1:

Three-phase four-wire systems	**Three-phase three-wire systems**
	
[V]	[V]
--	230
230 / 400	400
260 / 440	440
--	500
400 / 690	600

The nameplates of the current/voltage measuring modules state a maximum line voltage of 400/690 V.

1.7.2 Protection of inputs and outputs

The specifications for short-circuit protection (fuses or miniature circuit breakers) are available for the device connections of the main circuit and the auxiliary circuit.

In order to ensure a holistic view for the protection of the device connections, the manufacturer is obliged to provide all relevant information for short-circuit protection and overcurrent protection.

If, for example, device connections for the control supply voltage, the supply voltage, or digital inputs/digital outputs are not connected to self-limiting current sources or energy sources, you can find the relevant information in the section "Mounting, wiring, connecting" of the System Manual and the technical data sheets in Siemens Industry Online Support (https://support.industry.siemens.com/cs/ww/en/ps/16337/td).

1.7.3 Touch current

A protective impedance is present in each of the 3UF711x-1xA01-0 / 3UF712x-1xA01-0 current/voltage measuring modules. This protective impedance is 7.2 MΩ per phase (product version E04 and higher).

⚠ DANGER

Hazardous touch current

When connecting multiple SIMOCODE systems in parallel, make sure that no hazardous touch current occurs.

The SIMOCODE basic units in the 110-240 V AC/DC version include galvanic isolation. This avoids the effect of parallel connection via a central supply voltage for multiple systems when these basic units are used.

The SIMOCODE basic units in the 24 V DC version do not include galvanic isolation.

NOTICE

PELV power supply required

When using numerous current/voltage measuring modules with these basic devices, deploy a PELV power supply, for example, to prevent a potential touch current.

NOTICE

Ground leakage current

Pay attention to any resulting ground leakage current that may occur.

1.8 Recycling and disposal

For environmentally-friendly recycling and disposal of your old device, contact a company certified for the disposal of used electrical and electronic equipment, and dispose of the device as specified in the regulations for your particular country.

Function blocks

2

2.1 Function blocks - input and output types, structure

See also Chapter Function blocks - overview (Page 22).

Properties

Function blocks are stored internally in the SIMOCODE pro system, e.g. for the administration of various control stations, for the set control function, or for motor protection. Every function block has a name and can be equipped with inputs and outputs. The inputs and outputs are used for the internal connection of the various function blocks and, thus, the setup of a device-internal logic instead of an externally wired logic in the control circuit.

The following table shows the possible input types of the internal function blocks of SIMOCODE pro:

Table 2-1 Input types of the internal function blocks of SIMOCODE pro

Input	Example
Plugs (binary)	Function blocks in the basic unit may have binary plugs. These are connected to binary sockets via software. They are relevant for parameterization, e.g. with SIMOCODE ES (TIA Portal).
Plugs (analog)	Function blocks in the basic unit may have analog plugs. These are connected via software to analog sockets. They are relevant for parameterization, e.g. with SIMOCODE ES (TIA Portal). Example: 2-byte word for cyclic send data.
Screw terminals	Screw terminals are outside, e.g. "BU Inputs" function block. Control devices and auxiliary switches are normally connected there.
Control data from the communication bus	e. g. from the DP master to SIMOCODE pro

The following table shows the possible output types of the internal function blocks of SIMOCODE pro:

Table 2-2 Output types of the internal function blocks of SIMOCODE pro

Output	Example
Sockets (binary)	Function blocks in the basic units may have binary sockets. These sockets are assigned to binary plugs in the software. They are relevant for parameterization, e.g. with SIMOCODE ES (TIA Portal).
Sockets (analog)	Function blocks in the basic units may have analog sockets. These sockets are assigned to analog plugs in the software. They are relevant for parameterization, e.g. with SIMOCODE ES (TIA Portal). Example: 2-byte word, max. current I_max.
Screw terminals	Screw terminals are outside, e.g. "BU Output" function block. The contactors, for example, are connected here.

Message data to the communication bus	e. g from SIMOCODE pro to the DP master
Binary terminal block	Internal binary signals (binary sockets) that are not assigned to a function block (fault, status, other), e.g. "Status - Device o. k. (in the CFC editor)
Analog terminal block	Internal analog signals (analog sockets) that are not assigned to a function block, e.g. "Phase Unbalance" (in the CFC editor).

Diagram of basic structure

The following function block diagram (example) shows the basic structure of SIMOCODE pro with its external inputs and outputs and internally stored function blocks:

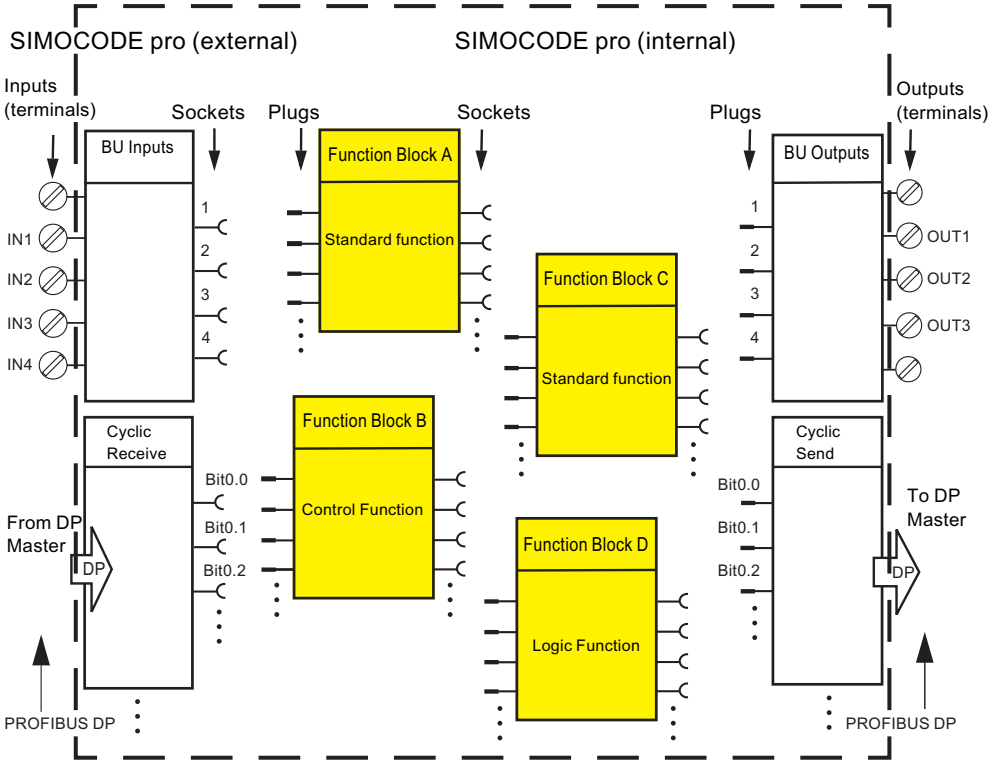


Figure 2-1 Basic structure of SIMOCODE pro

Connecting plugs with sockets

Note

The function block plugs and sockets have **not** already been connected at the factory with the binary inputs and the relay outputs of the basic unit.

The internal wiring (connection between plugs and sockets) is determined by the selected application. [1)]

Note

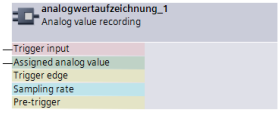
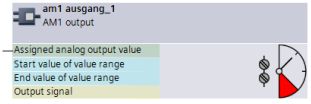
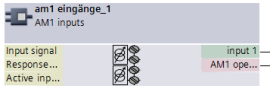
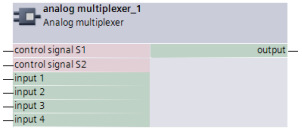
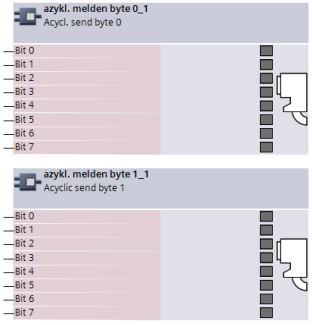
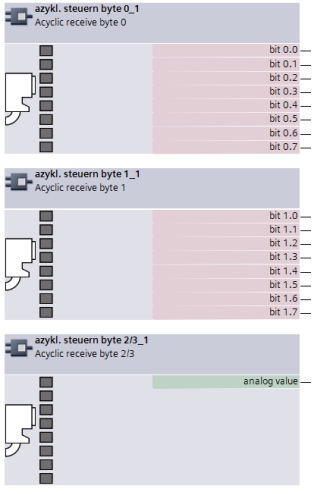
When you have already installed external wiring, but have not yet parameterized SIMOCODE pro:

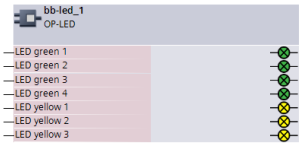
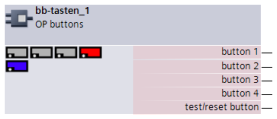
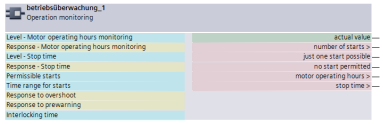
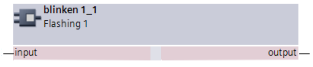
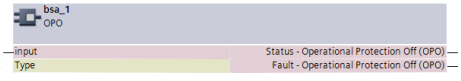
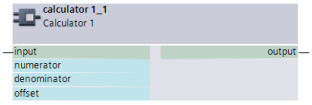
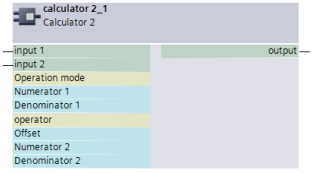
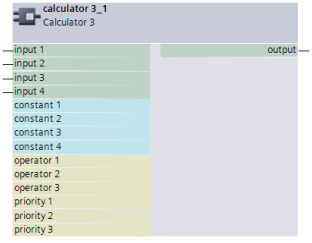
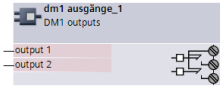
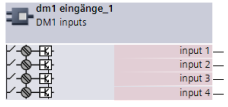
If you press a button now, the contactors will not be energized. [1)]

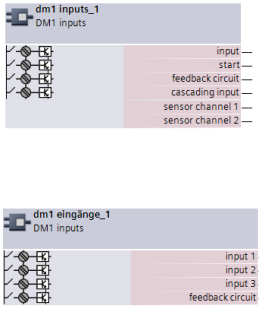
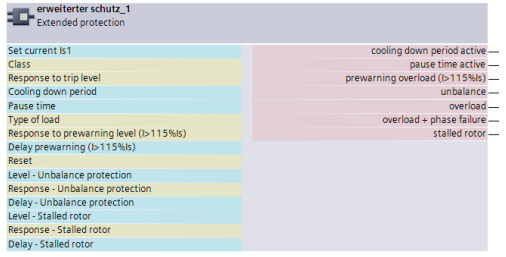
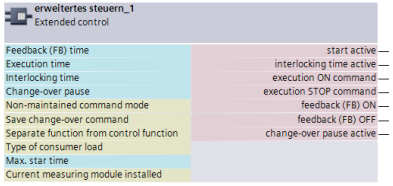
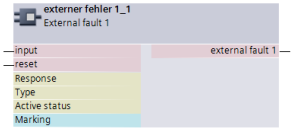
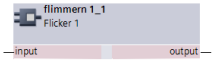
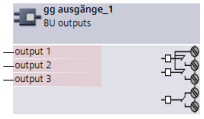
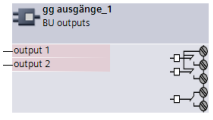
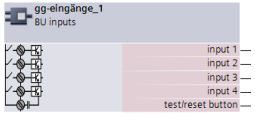
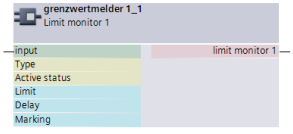
1) If you select and load a preset application (e.g. the reversing starter) in SIMOCODE ES (TIA Portal), all links and interlocks for the reversing starter will be set up in the basic unit.

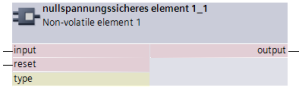
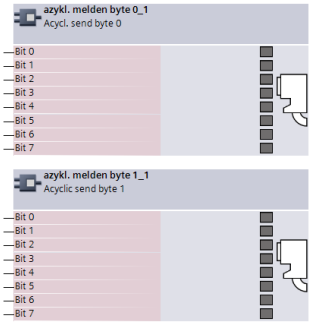
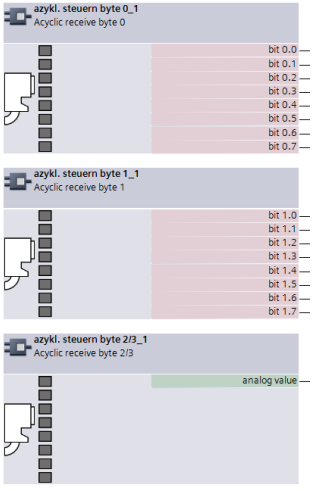
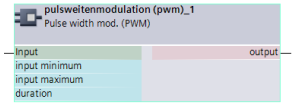
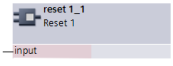
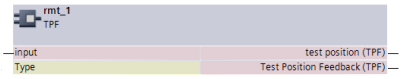
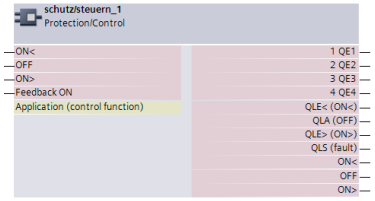
2.2 Function blocks - overview

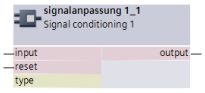
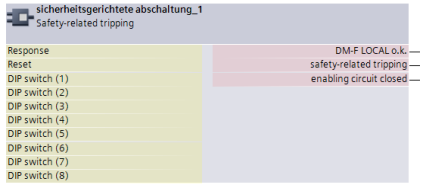
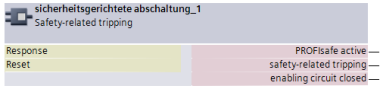
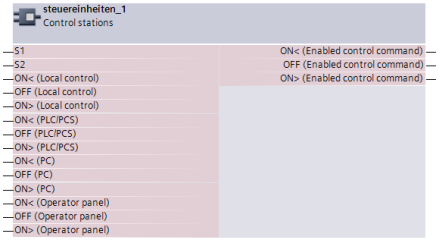
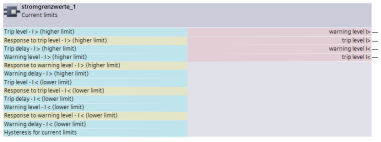
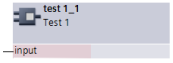
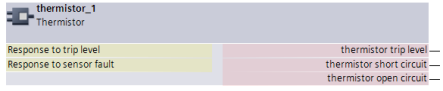
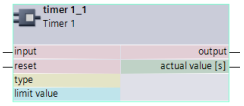
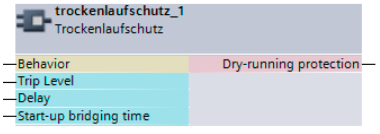
Overview of the function blocks (alphabetical)

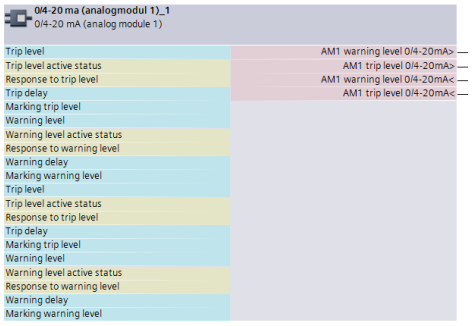
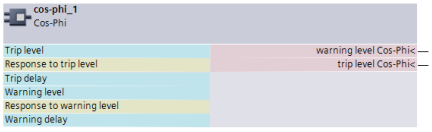
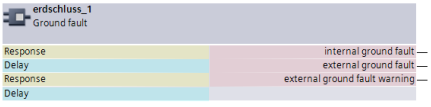
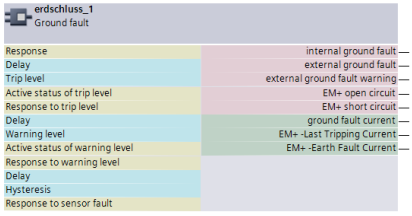
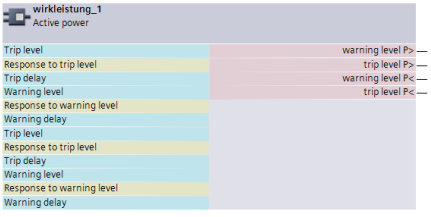
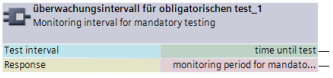
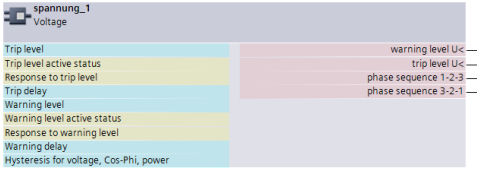
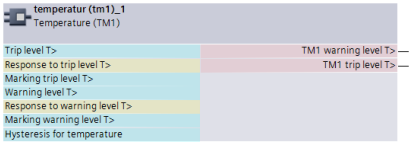
Function block	View in SIMOCODE ES (TIA Portal)	Section
Analog value recording		See Analog value recording (Page 196)
Analog module 1/2 output		See Analog module output (Page 172)
Analog module 1/2 inputs		See Analog module inputs (Page 191)
Analog multiplexer		See Analog multiplexer (Page 255)
Acyclic send byte 0 (1)		See Acyclic Send (Page 178)
Acyclic receive byte 0 (1, 2/3)		See Acyclic Receive (Page 194)

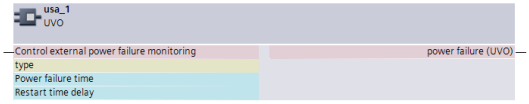
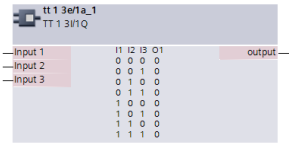
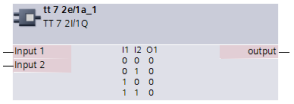
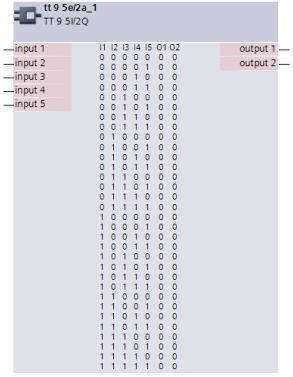
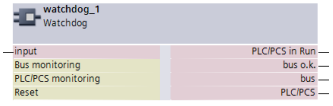
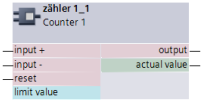
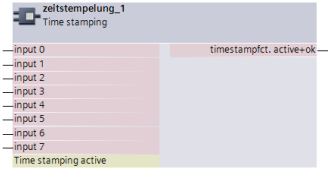
Function block	View in SIMOCODE ES (TIA Portal)	Section
Operator panel LED		See Operator panel LEDs (Page 167)
Operator panel buttons		See Operator panel buttons (Page 184)
Operation monitoring		See Operation monitoring (Page 156)
Flashing 1 (2, 3)		See Flashing (Page 243)
Operational Protection Off (OPO)		See Operational Protection Off (OPO) (Page 209)
Calculator 1		See Calculators (calculation modules) 1, 2 (Page 249)
Calculator 2		See Calculators (calculation modules) 1, 2 (Page 249)
Calculators 3, 4		See Calculators (calculation modules) 3, 4 (Page 253)
Digital module 1 (2) outputs		See Digital module outputs (Page 170)
Digital module 1 (2) inputs		See Digital module inputs (Page 186)

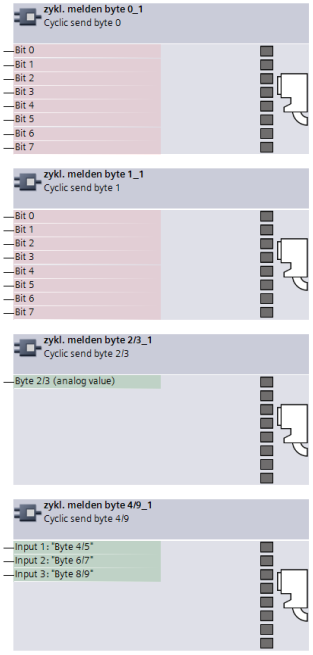
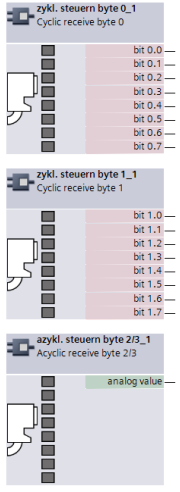
Function block	View in SIMOCODE ES (TIA Portal)	Section
Digital module 1 (2) inputs, DM-F = DM-F Local or DM-F PROFIsafe		See Digital module inputs (Page 186)
Extended protection		See Motor control (Page 73)
Extended control		See Motor control (Page 73)
External fault 1 (2, 3, 4, 5, 6)		See External fault (Page 206)
Flicker 1 (2, 3)		See Flickering (Page 244)
Basic unit outputs, SIMOCODE pro C/V basic units		See Basic unit outputs (Page 165)
Basic unit outputs, SIMOCODE pro S basic unit		See Basic unit outputs (Page 165)
Basic unit inputs		See Basic unit inputs (Page 183)
Limit monitor 1 (2, 3, 4, 5, 6)		See Limit monitor (Page 245)

Function block	View in SIMOCODE ES (TIA Portal)	Section
Emergency start		See Emergency start (Page 213)
Non-volatile element 1 (2, 3, 4)		See Non-volatile elements (Page 240)
OPC UA send data 0 (1)		See OPC-UA send (Page 179)
OPC UA receive data 0 (1, 2/3)		See OPC UA Receive (Page 195)
Pulse width modulator		See Pulse width modulator (Page 257)
Reset 1 (2, 3)		See Test / Reset (Page 200)
TPF (test position feedback)		See Test position feedback (TPF) (Page 204)
Protection/Control		See Motor control (Page 73)

Function block	View in SIMOCODE ES (TIA Portal)	Section
Signal conditioning 1 (2, 3, 4, 5, 6)		See Signal conditioner (Page 237)
Safe tripping, DM-F Local		See Safety-related tripping (Page 214)
Safe tripping, DM-F PROFIsafe		See Safety-related tripping (Page 214)
Control stations		See Control stations (Page 73)
Current limits		See Current limit monitoring (Page 143)
Test 1 (2)		See Test / Reset (Page 200)
Thermistor		See Thermistor protection (Page 53)
Timer 1 (2, 3, 4, 5, 6)		See Timer (Page 233)
Temperature module 1/2 inputs		See Temperature module inputs (Page 189)
Dry-running protection by active-power monitoring		See Dry-running protection of centrifugal pumps by active power monitoring (Page 55)

Function block	View in SIMOCODE ES (TIA Portal)	Section
Monitoring 0/4-20 mA (analog module 1, 2)		See 0/4 - 20 mA monitoring (Page 153)
Cos phi monitoring		See Cos phi monitoring (Page 149)
Ground-fault monitoring with ground-fault module 3UF7500		See External ground-fault monitoring with a 3UF7500 ground-fault module and 3UL22 differential current transformer (Page 140)
Ground-fault monitoring with ground-fault module 3UF7510		See External ground-fault monitoring with a 3UF7510 ground-fault module and 3UL23 residual current transformer (Page 140)
Power monitoring		See Active power monitoring (Page 150)
Monitoring interval for mandatory testing		See Monitoring interval for mandatory testing (Page 162)
Voltage monitoring		See Voltage monitoring (Page 146)
Temperature monitoring 1/2		See Temperature monitoring (analog) (Page 159)

Function block	View in SIMOCODE ES (TIA Portal)	Section
Undervoltage off (UVO)		See Power failure monitoring (UVO) (Page 211)
Truth table 3I/ 1O (1, 2, 3, 4, 5, 6, 10, 11)		See Truth table for 3I / 1O (Page 225)
Truth table 2I/1O (7, 8)		See Truth table for 2I / 1O (Page 229)
Truth table 5I/2O (9)		See Truth table for 5I / 2O (Page 230)
Watchdog		See Watchdog (Bus monitoring, PLC/PCS monitoring) (Page 220)
Counter 1 (2, 3, 4, 5, 6)		See Counter (Page 231)
Time stamp		See Timestamping (Page 221)

Function block	View in SIMOCODE ES (TIA Portal)	Section
Cyclic send byte 0 (1, 2/3, 4/9, 10/10)		See Cyclic Send (Page 176)
Cyclic receive byte 0 (1, 2/3, 4/5)		See Cyclic Receive (Page 193)

Software for parameterization, control, diagnostics and testing

3

3.1 Software packages

Software overview

With the communication-capable switching devices, the user-friendliness of the parameterization software and good system integration (in other words, the ability to integrate optimally and quickly into the most diverse plant configurations and process automation systems) also play an important role alongside the device functionalities and the hardware configuration.

For this reason, the SIMOCODE pro system provides suitable software tools for consistent, time-saving parameter assignment, configuring and diagnostics:

- SIMOCODE ES (TIA Portal) for totally integrated commissioning and service
- SIMOCODE pro PCS 7 function block library for total integration into PCS 7

SIMOCODE ES in the TIA Portal

SIMOCODE ES (TIA Portal) is the central software for configuration, commissioning, operation and diagnostics of SIMOCODE pro with PROFIBUS, PROFINET, EtherNet/IP, and Modbus RTU.

SIMOCODE ES (TIA-Portal) is available as a powerful successor to Version 2007 and is based on the Totally Integrated Automation Portal (TIA Portal) central engineering framework.

SIMOCODE ES (TIA Portal) is integrated seamlessly when further TIA Portal-based software such as STEP 7 or WinCC is available, thus enabling users to achieve a consistent, efficient, and intuitive solution for all automation tasks.

However, use of SIMOCODE ES (TIA Portal) as stand-alone software also provides these advantages.

You can choose between two versions of SIMOCODE ES:

- SIMOCODE ES Basic
- SIMOCODE ES Professional

From V15, the powerful SIMOCODE ES Basic tool for commissioning or maintenance personnel is available for downloading free of charge in the Siemens Industry Online Support.

SIMOCODE ES Professional is a perfect tool for engineers or configuration engineers due to its extended scope of functions and integrated graphic editor. Unlike the Basic version, SIMOCODE ES Professional also permits parameter assignment and diagnostics via PROFIBUS/PROFINET/Ethernet. The display of all operating, service and diagnostic data supplies important information about the current state of the motor and plant at all times – everywhere on PROFIBUS/PROFINET/Ethernet.

More information

- Industry Mall (see Parameter assignment, configuration and visualization for SIRIUS (https://mall.industry.siemens.com/mall/en/de/Catalog/Products/10026777))
- Industry Mall (see Technical specifications (https://support.industry.siemens.com/cs/ww/en/ps/16716/td))
- Software download:
  - SIMOCODE ES (TIA Portal), basic functionality including Professional Trial License (https://support.industry.siemens.com/cs/ww/en/view/109811683)
  - SIMOCODE ES 2007 (https://support.industry.siemens.com/cs/ww/en/view/109750623)

SIMOCODE ES (TIA Portal)	Basic	Professional
Access via the local interface on the device	✓	✓
Parameter assignment in list form	✓	✓
Parameter assignment via expert list	-	✓
Bulk engineering	-	✓
Working with libraries	✓	✓
Printing of parameters in list form	✓	✓
Operator control	✓	✓
Diagnostics	✓	✓
Test	✓	✓
Service data	✓	✓
Analog value recording [1)]	✓	✓
Trend display of measured values	-	✓
Parameter assignment with convenient graphical display	-	✓
Parameter assignment via the integrated graphic editor (CFC-based)	-	✓
Printing of diagrams	-	✓
Parameter comparison	-	✓
Access via PROFIBUS / PROFINET / Ethernet	-	✓
Teleservice via MPI	-	✓
Routing [2)]	-	✓
Firmware update basic units [1)]	✓	✓

1) For SIMOCODE pro V

2) See Requirements for using the routing function with SIMOCODE ES (TIA Portal) (https://support.industry.siemens.com/cs/ww/en/view/109738745)

Working with libraries

Users can create copy templates for SIMOCODE pro device configuration and can manage them in global or project libraries.

This way, individual modules, diagrams and complete device configurations can be saved as reusable elements for frequently occurring tasks.

Integrated graphic editor

The graphic editor is part of SIMOCODE ES Professional. It is based on the Continuous Function Chart (CFC) and adds a powerful tool to the parameterizing interface that enables easy parameterization of devices by drag & drop. Furthermore, all the parameters can also be edited directly in the graphic editor. Extremely compact documentation of all configured parameters is possible, as is the graphic online presentation of the configured device functions including all signal states during operation.

Online functions for commissioning and diagnostics

To this end, SIMOCODE ES provides powerful functions for commissioning and diagnostics of motor feeders. Besides a detailed display of status information and the causes of faults, all available measurement and statistics data can be retrieved online. Access to the fault and event memory and also to analog values recorded on the device, e.g. current or voltage, is also possible.

Trend display of measured values

With this online function, SIMOCODE ES can present the trends of different measured values. It is thus possible, for example, to record and evaluate the startup behavior of a motor or its behavior in different load conditions.

Integration into the central engineering framework

When using other TIA Portal-based software such as STEP 7 or WinCC, for example, the configuration for devices and networks for all components used is created in a standardized environment.

Teleservice via MPI

The Professional version supports the use of MPI Teleservice (comprising the Teleservice software and various Teleservice adapters) for remote diagnostics of the devices. This facilitates diagnostics and maintenance, and it shortens response times for service purposes.

SIMOCODE ES 2007

SIMOCODE ES 2007 is the previous version of the SIMOCODE ES (TIA Portal) software for SIMOCODE pro. It only includes the basic units for PROFIBUS and PROFINET.

SIMOCODE ES 2007 provides the SIMOCODE pro motor management system with a user-friendly and clear user interface with which to configure, operate, monitor and test SIMOCODE pro in the field or from a central location via PROFIBUS. By displaying all operating, service and diagnostic data, SIMOCODE ES supplies important information on whether maintenance work is required or, in the event of a fault, helps prevent faults or localize and rectify them once they have occurred.

Unnecessary plant downtimes can be prevented by changing parameters online (even during operation).

In addition, the graphical editor enables extremely ergonomic and user-friendly parameterization by dragging and dropping: Inputs and outputs of function blocks can be linked graphically and the parameters set. Configured functions can be described in detail and device parameterization can be documented graphically using comments. This speeds up commissioning and simplifies plant documentation. The optimized user interface and integrated graphic editor are used to assign parameters.

Further functions: Operation, diagnostics, testing, S7 routing, teleservice via MPI, STEP 7 object manager.

The following software packages are available:

- SIMOCODE ES 2007 Basic
- SIMOCODE ES 2007 Standard
- SIMOCODE ES 2007 Premium

See also hotspot text (Page 36).

You will find a demo version and the latest updates on the Internet: SIMOCODE ES 2007 (https://support.industry.siemens.com/cs/ww/en/view/109750623)

OM SIMOCODE pro Object Manager

The OM SIMOCODE pro Object Manager is a component of SIMOCODE ES 2007. When SIMOCODE ES and OM SIMOCODE pro are installed on a PC / programming device, SIMOCODE ES can be called directly from STEP 7 V5.x hardware configuration. This enables simple and universal SIMATIC S7 configuration.

SIMOCODE pro PCS 7 library

The SIMOCODE pro PCS 7 function block library is used to simply and conveniently integrate SIMOCODE pro into the SIMATIC PCS 7 process control system. The SIMOCODE pro PCS 7 function block library contains the diagnostic and driver blocks that correspond to the diagnostic and driver concept of SIMATIC PCS 7 and the elements (symbols and faceplates) necessary for operating and monitoring. The application is integrated by graphic interconnection using the CFC Editor.

Signal processing and technological functions of the SIMOCODE pro PCS 7 function block library are based on the SIMATIC PCS 7 standard libraries (Driver Blocks, Technological Blocks) and are optimized for SIMOCODE pro. Users who until now have configured motor feeders in conventional technology via signal blocks and motor or valve blocks can thus easily change to the SIMOCODE pro PCS 7 block library.

The SIMOCODE pro PCS 7 block library allows the user to run the required engineering software on one engineering station (single license) including the runtime software for executing the AS modules in one automation system (single license). If the AS blocks are to be used in additional automation systems, the corresponding number of runtime licenses are required, which are supplied without a data medium.

Note

The PCS 7 libraries are subject to continual updating and improvement.

You can download the current service packs and hotfixes in Siemens Online Support (https://support.industry.siemens.com/cs/ww/en/view/109760422).

Note

Observe the respective system versions!

GSD file

To integrate SIMOCODE pro as a standard slave into SIMATIC S7 or any standard DP master system (automation system). The latest version is on the Internet at GSD file (https://support.industry.siemens.com/cs/ww/en/ps/14280/dl). Further information on integrating DP slaves can be found in the automation system documentation.

Win SIMOCODE-DP converter

Software tool for converting "old" Win SIMOCODE-DP parameter files (3UF5 device series) into SIMOCODE ES parameter files for SIMOCODE pro.

See SIMOCODE ES 2007 (https://support.industry.siemens.com/cs/ww/en/view/109750623).

3.2 Software components

Selection and ordering data: See Catalog IC10 (https://support.industry.siemens.com/cs/ww/en/view/109771990).

Parameters

4

4.1 Motor protection

4.1.1 Motor protection functions

Description

The motor protection functions "Overload Protection", "Unbalance Protection", "Stalled Rotor Protection", and "Thermistor Protection" are described in the following Chapters:

Overload protection (Page 39)

Unbalance protection (Page 52)

Stalled rotor protection (Page 52)

Thermistor protection (Page 53).

Schematic

The following schematic shows the "Extended Protection" function block ("Overload protection," "Unbalance protection," and "Stalled rotor protection") with optional parameter settings and events.

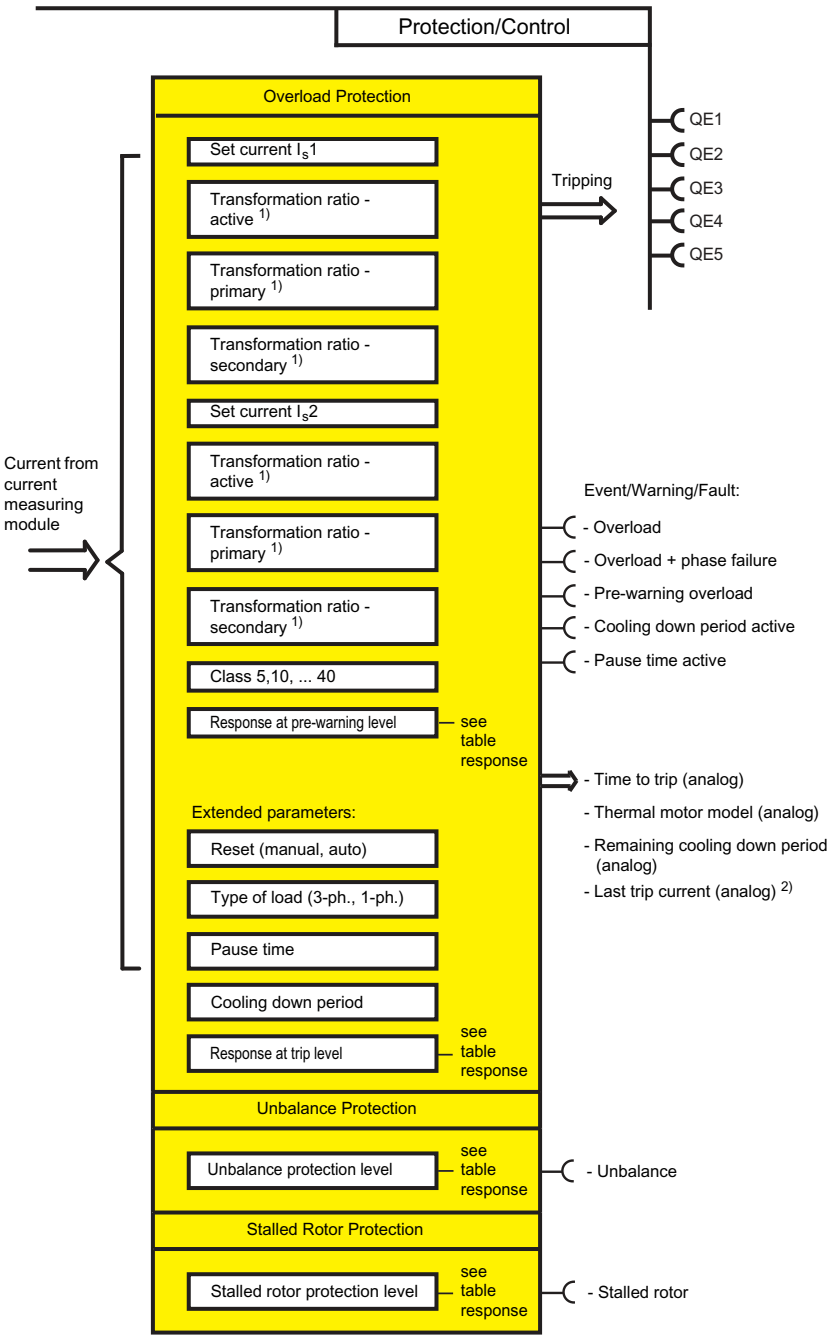


Figure 4-1 "Extended Protection" function block ("Overload Protection," "Unbalance Protection," and "Stalled Rotor Protection")

1) Adjustable transformation ratio when using interposing transformers with SIMOCODE pro V PB, version *E03* and higher

2) If tripped due to overload

Adjustable responses "Overload Protection," "Unbalance Protection," and "Stalled Rotor Protection"

Response	Prewarning level "overload protection"	Trip level "overload protection"	Level "unbalance"	Level "stalled rotor protection"
deactivated	X	X	X	**X**
signal	X	X	X	X
warn	**X**	X	**X**	X
trip	—	**X**	X	X
delay	0 to 25.5 s (**0.5 s**)	—	0 to 25.5 s (**0.5 s**)	0 to 25.5 s (**0.5 s**)

Responses for "Overload Protection", "Unbalance Protection" and "Stalled Rotor Protection"

See also "Tables of responses of SIMOCODE pro" in Chapter Important notes (Page 7).

Note

Deactivate Unbalance Protection in SIMOCODE ES when the load type is set to single-phase!

4.1.2 Overload protection

4.1.2.1 Overload protection function

SIMOCODE pro protects three-phase or AC motors in accordance with IEC 60947-4-1 requirements. The trip class can be set to eight different settings ranging from Class 5E to Class 40E. Thus, the tripping time can be adapted precisely to the power-up behavior of the motor, improving utilization of the motor capacity. Additionally, the "Thermal motor model" and time to overload trip are calculated and made available to the control system. After an overload trip, the remaining cooling down period is displayed (see Class). The motor current is saved in the case of an overload trip.

Depending on the control function, the set current I_s is separately parameterizable for one or two speeds (I_s1 and I_s2).

The rated motor current is usually set with **set current I_s1**. This value can be found on the type plate of the motor. The overload trip characteristic is calculated based on this value.

The **set current I_s2** is only required for motors with two speeds to guarantee the suitable overload protection for the higher speed too. Generally, I_s2 should be set higher than I_s1.

4.1.2.2 Set current Is1

Setting ranges for current setting I_s1

Range: Depends on the selected current measuring module or current / voltage measuring module.

Current setting I_s1 when using a current measuring module or a 1st generation current / voltage measuring:

- 0.3 to 3 A (default: 0.3)
- 2.4 to 25 A
- 10 to 100 A
- 20 to 200 A
- 63 to 630 A

Current setting I_s1 when using a 2nd generation current / voltage measuring module:

- 0.3 to 4 A (default: 0.3)
- 3 to 40 A
- 10 to 115 A
- 20 to 200 A
- 63 to 630 A

Transformation ratio - active

When using an interposing transformer, or if the main supply cable is looped several times through the current measuring module or the current / voltage measuring module, you can enter the transformation ratio of the interposing transformer. Activate the checkbox if you wish to use this option. The parameterized current setting continues to correspond here to the actual rated motor current and does not have to be converted.

The transformation ratio is calculated from the ratio between the rated motor current [A] and the measured current [A] or any multiple of the ratio.

Note

This parameter is only available when using SIMOCODE pro V PB basic unit above version *E03*.

Transformation ratio - primary

Enter the primary current here, with the "Transformation ratio - active" checkbox activated. Range: 0 to 8191.875 (default: 0).

Transformation ratio - secondary

Enter the secondary current here, with the "Transformation ratio - active" checkbox activated. Range: 0 to 15 (default: 0).

4.1.2.3 Set current Is2

Setting ranges for current setting I_s2

Range: Depends on the selected current measuring module or current / voltage measuring module.

Current setting I_s2 when using a current measuring module or a 1st generation current / voltage measuring module:

- 0.3 to 3 A (default: 0.3)
- 2.4 to 25 A
- 10 to 100 A
- 20 to 200 A
- 63 to 630 A

Current setting I_s1 when using a 2nd generation current / voltage measuring module:

- 0.3 to 4 A (default: 0.3)
- 3 to 40 A
- 10 to 115 A
- 20 to 200 A
- 63 to 630 A

Transformation ratio - active

When using an interposing transformer, or if the main supply cable is looped several times through the current measuring module or the current / voltage measuring module, you can enter the transformation ratio.

Activate the checkbox if you wish to use this option. The parameterized current setting continues to correspond here to the actual rated motor current and does not have to be converted.

The transformation ratio is calculated from the ratio between the rated motor current [A] and the measured current [A] or any multiple of the ratio.

Note

This parameter is only available when using SIMOCODE pro V PB above version *E03*.

Transformation ratio - primary

Enter the primary current here, with the "Transformation ratio - active" checkbox activated. Range: 0 to 8191.875 (default: 0).

Transformation ratio - secondary

Enter the secondary current here, with the "Transformation ratio - active" checkbox activated. Range: 0 to 15 (default: 0).

Note

In the case of motors with two speeds, the same or different transformation ratios can be set for each speed, depending upon whether the same or two different interposing transformers is/are used for each speed.

4.1.2.4 Application example

Example 1:

Rated motor current: 700 A.
A 3UF18 68-3G current transformer (205 to 820 A) is used as interposing transformer (transformation ratio 820 : 1), the secondary side is looped once through a current measuring module (0.3 A to 3 A):
Transformation ratio for I_s = 820 : 1; I_s = 700 A

Settings (primary and secondary)

- Set current I_s1: 700 A
- I_s1 Transformation ratio primary: 820
- I_s1 Transformation ratio secondary: 1

Example 2:

Rated motor current: 225 A.
A 3UF1868-3G current transformer (205 to 820 A) is used as interposing transformer (transformation ratio 820 : 1), the secondary side is looped twice through a current measuring module (0.3 A to 3 A):
Transformation ratio for I_s = 820 : 2; I_s = 225 A

Settings (primary and secondary)

- Set current I_s1: 225 A
- I_s1 Transformation ratio primary: 820
- I_s1 Transformation ratio secondary: 2

Example 3:

The motor cable is looped twice through a current measuring module (0.3 to 3 A, for a motor with a rated current of 0.25 A):
Transformation ratio for I_s = 1 : 2; I_s = 0.25 A

Settings (primary and secondary)

- Set current I_s1: 0.25 A
- I_s1 Transformation ratio primary: 1
- I_s1 Transformation ratio secondary: 2

4.1.2.5 Further overload protection parameters

Class

The Class (trip class) defines the maximum time within which SIMOCODE pro must trip from cold at 7.2 times the current setting I_s (motor protection to IEC 60947). SIMOCODE pro meets the requirements of tolerance band E according to IEC / EN 60947-4-1 in respect of the accuracy of the tripping times. Please note that with startups > "Class 10E", the permissible AC3 current of the contactor may have to be reduced (derated), i.e. you must select a larger contactor.

Overload characteristics for 2nd generation current / voltage measuring modules (e.g. 3UF7110-1AA01-0) and dry-running protection (e.g. 3UF712.-1.A01-0)

The following graph shows the trip classes 5E, 7E, 10E (d), 15E, 20E, 25E, 30E, 35E and 40E for 3-pole balanced loads:

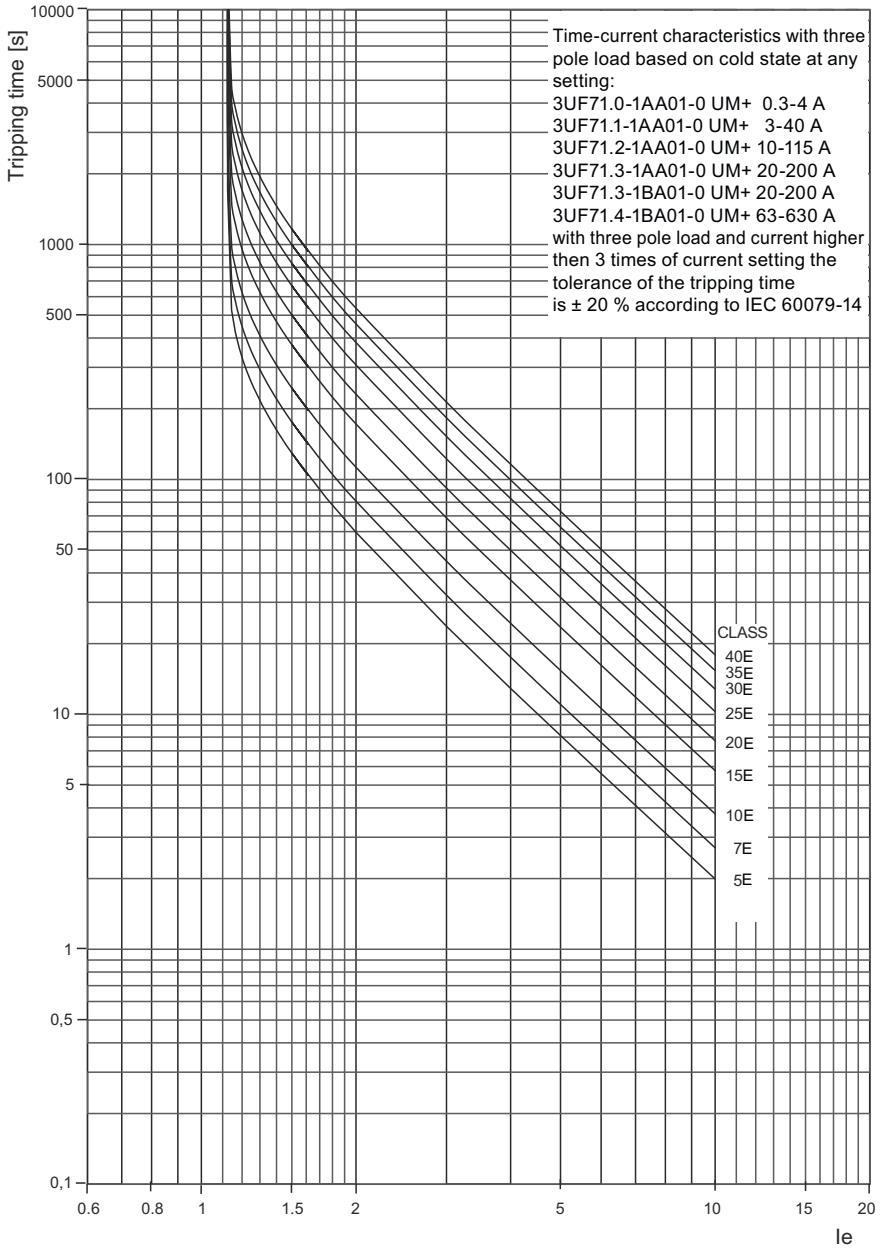


Figure 4-2 Trip classes for 3-pole loads, 2nd generation current / voltage measuring modules

The following graph shows the trip classes 5E, 7E, 10E (d), 15E, 20E, 25E, 30E, 35E, and 40E for 2-pole loads:

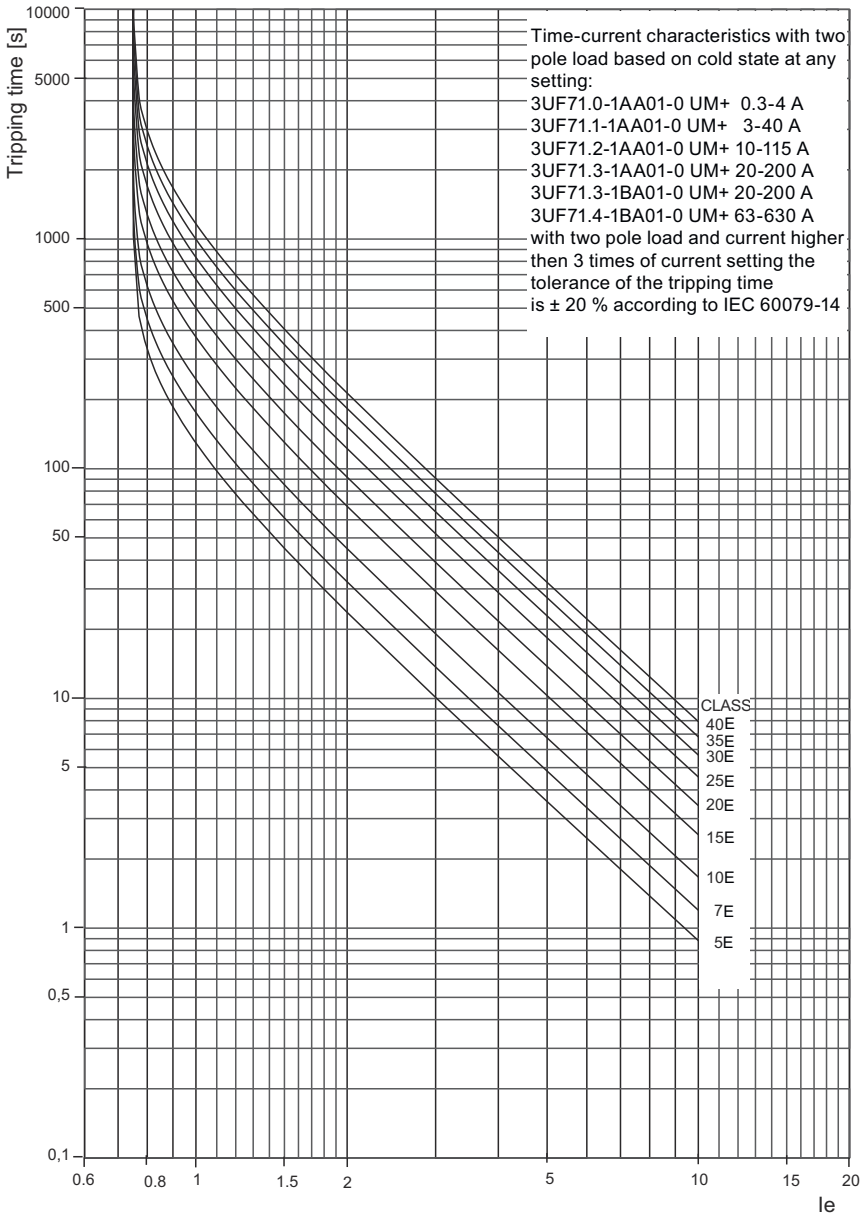


Figure 4-3 Trip classes for 2-pole loads, 2nd generation current / voltage measuring modules

Overload characteristics for current measuring modules, 1st generation current / voltage measuring modules (e.g. 3UF7110-1AA00-0) and 2nd generation current / voltage measuring modules in compatibility mode (e.g. 3UF7110-1AA01-0)

The following graph shows the trip classes 5E, 10E (d), 15E, 20E, 25E, 30E, 35E and 40E for 3-pole balanced loads:

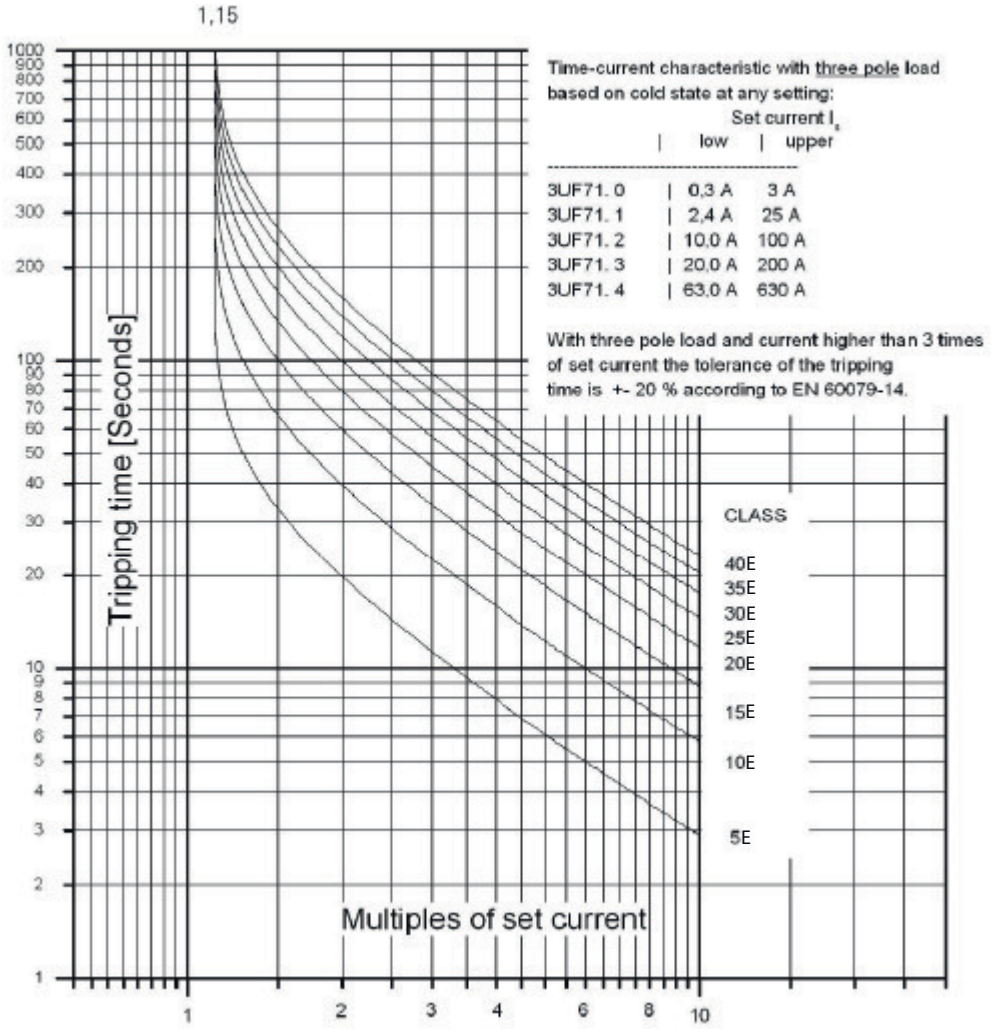


Figure 4-4 Trip classes for 3-pole balanced loads, current measuring modules and 1st generation current / voltage measuring modules

The following graph shows the trip classes 5E, 10E (d), 15E, 20E, 25E, 30E, 35E, and 40E for 2-pole loads:

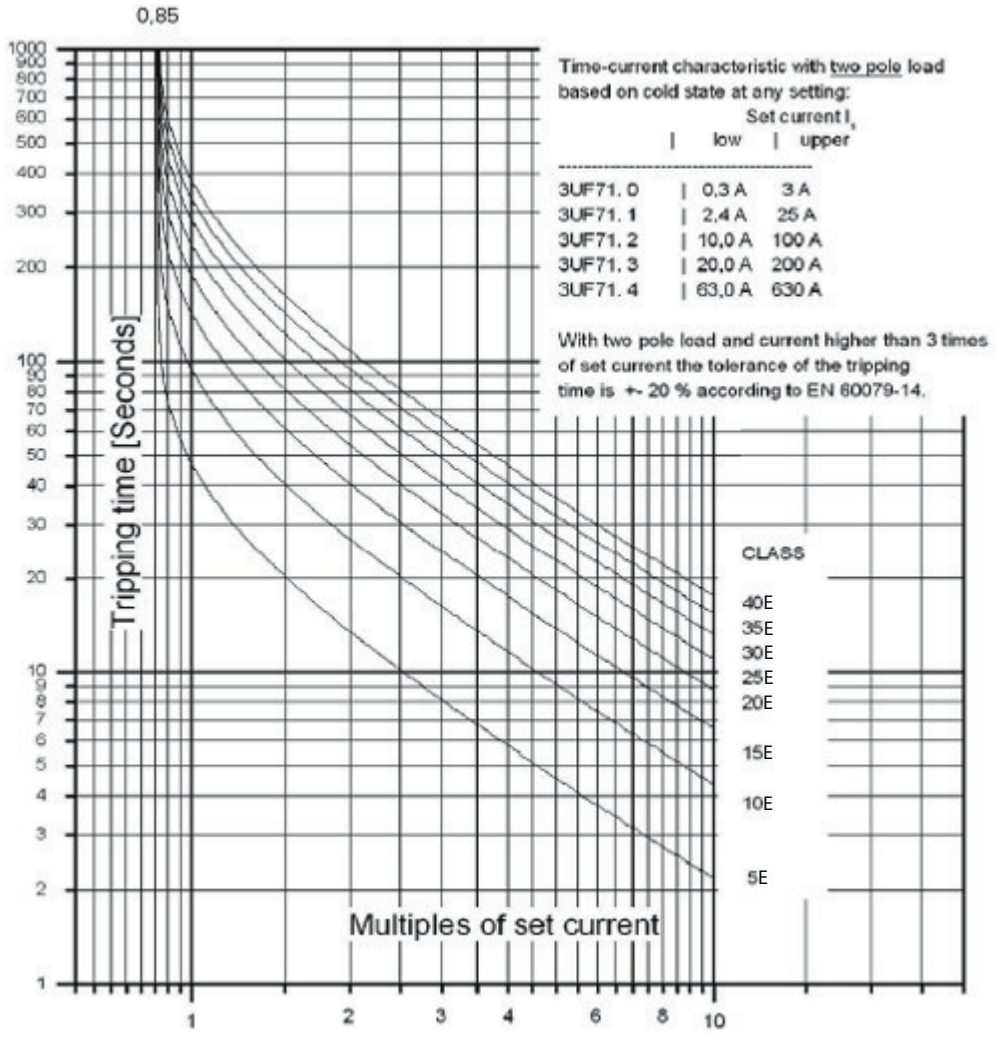


Figure 4-5 Trip classes for 2-pole loads, current measuring modules and 1st generation current / voltage measuring modules

Note

Type of tripping characteristic

If a 1st generation 3UF711*-1AA00-0 current / voltage measuring module is configured in a parameterization, but a 2nd generation 3UF711*-1AA01-0 current / voltage measuring module is used, the tripping characteristic remains that of the 1st generation current / voltage measuring module.

Merely replacing the measuring module hardware does not change the tripping behavior.

Note

Tripping characteristics

The latest tripping characteristics for SIMOCODE pro can be found in Siemens Industry Online Support (SIOS) (https://support.industry.siemens.com/cs/ww/en/ps). Enter the search term "3UF7" and filter for "characteristic" in the search area.

Response to overload

The SIMOCODE pro response to overload can be additionally adjusted here.

Further information: See also "Tables of responses of SIMOCODE pro" in Chapter Important notes (Page 7) and Table "Responses" in Chapter Motor protection functions (Page 37).

Note

With motors for Ex e applications, the response must remain set to "trip"!

Cooling down period

The cooling down period is the amount of time that must elapse before an overload trip can be reset. This is usually 5 minutes. The thermal memory (motor model – see below) is deleted after the cooling down period elapses. Supply voltage failures of SIMOCODE pro during this time extend the specified time correspondingly.

Range: 60 to 6553.5 s (default: 300 s).

Thermal motor model (thermal memory)

"At operating temperature" state

In the "at operating temperature" state, the tripping times are reduced by the factors listed in the table. These factors apply to 3-pole balanced loads, Class 5E to Class 40E.

Table 4-1 Factors for trip times at operating temperature for 2nd generation current/voltage measuring modules

x I_s	Preload as a percentage of the current setting I_s				
	20	**40**	**60**	**80**	**100**
2	0.97	0.89	0.75	0.54	0.24
3	0.97	0.88	0.73	0.51	0.22
4	0.97	0.88	0.72	0.51	0.22
5	0.97	0.88	0.72	0.51	0.21
6	0.96	0.87	0.72	0.50	0.21
7.2	0.96	0.88	0.72	0.50	0.22
8	0.97	0.87	0.72	0.50	0.22
9	0.98	0.87	0.72	0.51	0.21

x I_s	Preload as a percentage of the current setting I_s				
10	0.97	0.87	0.74	0.50	0.21

When the rated motor current (Ie) is at 100%, the value "thermal motor model" is 79% in a steady state, and 100% at the moment of an overload trip.

Table 4-2 Factors for trip times at operating temperature for current measuring modules and 1st generation current/ voltage measuring modules and 2nd generation current/voltage measuring modules in compatibility mode.

x I_s	Preload as a percentage of the current setting I_s					
	0	**20**	**40**	**60**	**80**	**100**
2	1	0.88	0.74	0.58	0.40	0.19
4	1	0.85	0.69	0.52	0.35	0.16
6	1	0.84	0.68	0.51	0.34	0.15
7.2	1	0.84	0.68	0.51	0.33	0.15
8	1	0.84	0.67	0.51	0.33	0.15

For the 1st generation, the following applies:

When the rated motor current (I_s) is at 100%, the value "thermal motor model" is 87% in a steady state and 100% at the moment of an overload trip.

Example of 1st generation devices:

You have operated and switched off a motor with current setting 100 % I_s.

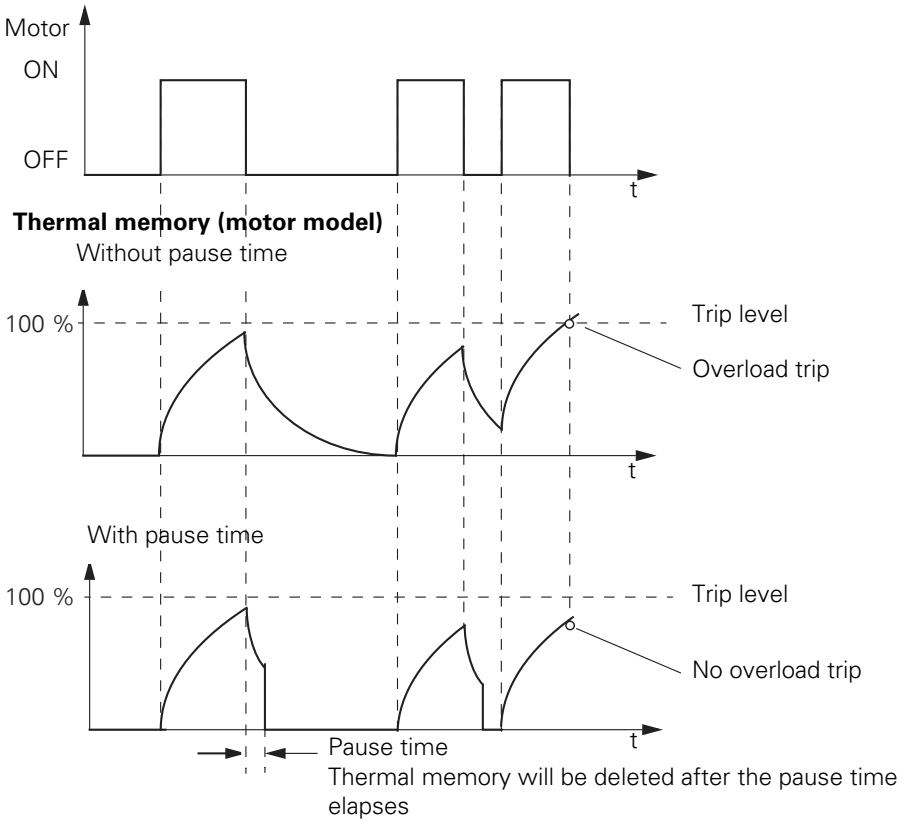
You immediately switch the motor back on. This causes an overload trip with 2 x I_s, Class 10E.

- Tripping time in cold state: approximately 40 s (acc. to tripping characteristic)
- Factor for tripping time with preload 100 % I_s: 0.19 (see Table)
- Reduced tripping time: 0.19 x 40 s = 7.6 s.

Pause time

The pause time is the specified time for the cooling down response of the motor when tripped under normal operating conditions (not in the case of an overload trip). After this interval, the thermal memory in SIMOCODE pro is erased and a new cold restart is possible. This means that many startups can be performed in a short space of time.

The following schematic shows the cooling down response with and without pause time:



Note

Both the motor and the switching devices must be dimensioned specifically for this load!

Pause time: 0 to 6553.5 s (default: 0)

Load type

You can select whether SIMOCODE pro is to protect a 1-phase or a 3-phase load. For a 1-phase type of load, the internal ground-fault monitoring and the unbalance protection must be deactivated. Phase failure monitoring is deactivated automatically.

Load type 1-phase, 3-phase (default)

Note

Decoupling module

When using a 1st generation current / voltage measuring module a decoupling module may be necessary.

See table "Decoupling module requirements for star networks" in Chapter 8.6 "Decoupling module (DCM) for 1st generation current/voltage measuring modules (e.g. 3UF711.1AA000)" in SIMOCODE pro – System Manual (https://support.industry.siemens.com/cs/ww/en/view/109743957).

Delay prewarning

The "Delay" parameter (default: 0.5 s) defines the length of time for which the prewarning level (1.15 x I_s) must be permanently exceeded before SIMOCODE pro will execute the desired response. If no setting is made, there will be no response. In the event of a loss of phase or an unbalance > 50%, the prewarning level will be reached earlier, at approximately 0.85 x I_s.

Reset

If the "Reset" parameter is set to "Auto," the "Overload," "Overload + Unbalance," and "Thermistor" faults will be acknowledged automatically:

- If the cooling time has expired
- If the thermistor value has dropped back down to the specified resetting value

If the "Reset" parameter is set to "Manual", the faults must be acknowledged by a reset signal:

- "TEST/RESET" button on the basic unit
- "TEST/RESET" button on operator panel
- Standard functions "Reset"

For this, the "Reset - Input" (plugs) must be connected to the corresponding sockets, e.g. using reset via bus.

Reset: Manual, Auto (default: manual).

⚠ WARNING

Unexpected restart of the motor

The "Auto-Reset" mode must not be used for applications where an unexpected motor restart may cause personal injury or damage to property.

4.1.3 Unbalance protection

Description

The extent of the phase unbalance can be monitored and transmitted to the control system. A definable and delayable response can be triggered when an adjustable limit has been overshot. If the phase unbalance is more than 50 %, the tripping time is also automatically reduced in accordance with the overload characteristic since the heat generation of the motors increases in asymmetrical conditions.

Phase balance formula

The phase unbalance is calculated using the following equation:

$$\text{Phase unbalance} = \frac{\max([I_{max} - I_{avg}] ; [I_{min} - I_{avg}])}{I_{avg}} \quad I_{avg} = \frac{I1+I2+I3}{3}$$

Level

The level of unbalance to which SIMOCODE pro should react is set here.

Level: 0 to 100 % (default: 40 %)

Response

Here you can choose the response of SIMOCODE pro in case of phase unbalance:
See also "Tables of responses of SIMOCODE pro" in Chapter Important notes (Page 7) and Table "Responses" in Chapter Motor protection functions (Page 37).

Delay

The unbalance level must be exceeded for the period of the set delay time before SIMOCODE pro executes the desired response. If no setting is made, there will be no response.

Setting range: 0 to 25.5 s (default: 0.5 s).

4.1.4 Stalled rotor protection

Description

If the motor current rises above an adjustable stalled rotor protection level (current threshold), a defined and delayable response can be configured for SIMOCODE pro. In this case, for example, the motor can be shut down independently of the overload protection. The stalled rotor protection is only active after the parameterized class time has elapsed, e.g. for Class 10E after 10 seconds, and prevents unnecessarily high thermal and mechanical loads as well as premature aging of the motor.

Level

When the stalled rotor level is exceeded, SIMOCODE pro reacts according to the selected response.

Level: 0 to 1020 % of I_s (default: 0).

Note

Rounding

Intermediate values are automatically rounded.

Response

You can define the response to overshoot of the stalled rotor level here: See also "Tables of responses of SIMOCODE pro" in Chapter Important notes (Page 7) and Table "Responses" in Chapter Motor protection functions (Page 37).

Delay

The "Delay" parameter determines the length of time that the stalled rotor level must be permanently exceeded before SIMOCODE pro executes the desired response. If no setting is made, there will be no response. Setting range: 0 to 25.5 s (default: 0.5 s).

4.1.5 Thermistor protection

Description

Thermistor protection is based on a direct temperature measurement in the motor via binary PTC thermistors which can be connected to the SIMOCODE pro basic unit.

Thermistor protection is used in the case of:

- Motors with high switching frequencies
- Converter operation
- Motors with heavy starting
- Intermittent duty and/or braking operation
- Restricted air supply
- Speeds below the rated speed.

In this case, the sensors are mounted in the winding slot or bearing of the motor.

Schematic and characteristic curve

The resistance of the thermistors increases rapidly (abruptly) when the temperature limit is reached.

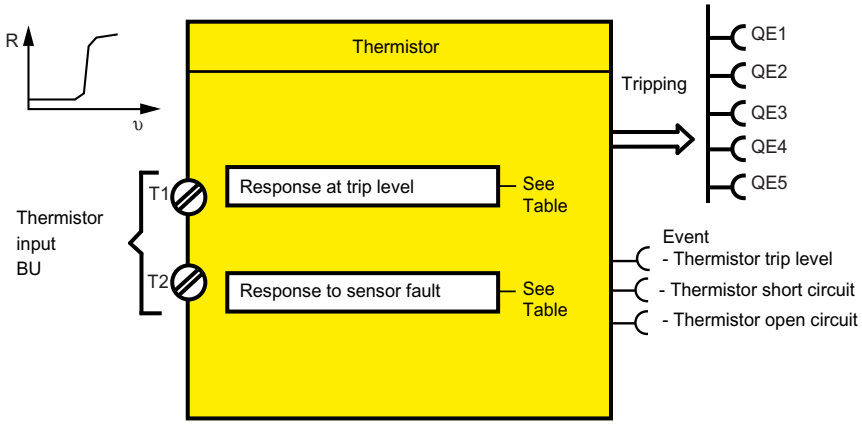


Figure 4-6 Thermistor function block (thermistor protection)

Response

- Overtemperature:
  Here you can select the SIMOCODE pro response to violation of the trip level for overtemperature.

  Note

  With motors for Ex e applications, the response must be set to "trip"!

- Sensor fault (sensor circuit fault): Here you can select the SIMOCODE pro response in the case of a short circuit or open circuit in the thermistor sensor cable.

Table 4-3 "Thermistor protection, binary" response

Response	Trip level	Sensor fault
deactivated	—	X
signal	X	X
warn	X	X (d)
trip	X (d)	X

See also "Tables of responses of SIMOCODE pro" in Chapter Important notes (Page 7).

4.2 Dry-running protection of centrifugal pumps by active power monitoring

Description

With the function shown here, you can implement dry-running protection for centrifugal pumps with a radial-flow impeller, even in hazardous areas, by active-power monitoring. You can use this protection function either alone or in addition to the general "active-power monitoring" described in Chapter Active power monitoring (Page 150). The general function "active-power monitoring" is not approved for use in hazardous areas. SIMOCODE pro can indirectly monitor the state of a device or system via the active power. By monitoring the active power of a pump motor, conclusions can be drawn about the flow rate from the active power level. As the flow rate (delivery rate) decreases, the active power decreases in centrifugal pumps with a radial-flow impeller (progressive delivery characteristic). For dry-running protection, the motor and therefore the pump is disconnected when the active power falls below a minimum value. In addition to avoiding damage to the pump, SIMOCODE pro can contribute, in particular, to explosion protection of centrifugal pumps that handle flammable media or are installed in hazardous areas. In this case, the explosion protection conforms with type of protection b by "control of ignition sources", ignition protection system b1, e.g. acc. to DIN EN 80079-37. The response of SIMOCODE pro on reaching the freely selectable trip level can be delayed. A startup bridging time can also be parameterized.

The protective function "dry-running protection of centrifugal pumps by active-power monitoring" requires the use of a basic unit combined with a current/voltage measuring module and is implemented in the following device types:

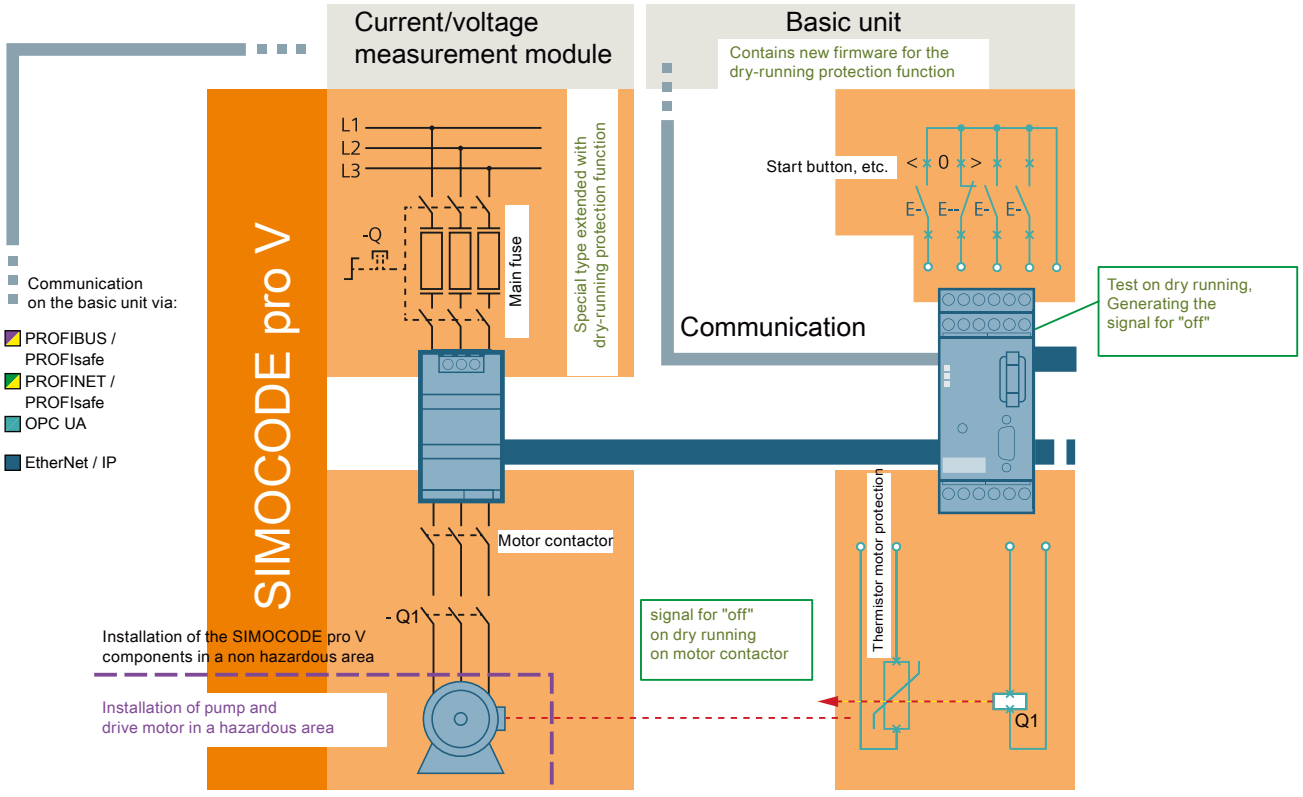
Basic units with PTB 18 ATEX 5003 X / ITS 21 UKEX 0455 X:

- 3UF7010-1A.00-0 (from product version *E16*)
- 3UF7011-1A.00-0 (from product version *E13*)
- 3UF7013-1A.00-0 (from product version *E04*)
- Current/voltage measuring modules: 3UF712.-1.A01-0.

Note

Use exclusively with the control function "direct starter" (direct-on-line starter)

The function "dry-running protection of centrifugal pumps by active-power monitoring" can be used exclusively with the control function "direct starter" (direct-on-line starter).



When the motor contactor is closed, the function "dry-running protection of centrifugal pumps by active-power monitoring" is activated. In the current/voltage measuring module, the measured values for the active power are calculated from the rms values of the measured currents and voltages of the 3 phases and transferred to the basic unit. There, the measured values are compared with the stored trip level. If the system is not in the start-up bridging phase, the delay time starts on undershooting. If the undershooting is pending for the entire delay time, after the delay time expires a signal for "motor off" is generated and sent to the motor contactor. This disconnects the motor from the line power supply. At the same time, the error message "dry-run pump" appears.

NOTICE
Interposing transformers are not permissible Use of interposing transformers in conjunction with the function dry-running protection is not permissible.

Note

Measuring range of the current / voltage measuring module

The measuring range of the current/voltage measuring module selected for the "dry-running protection of centrifugal pumps by active-power monitoring" function must include the currents both at the minimum delivery flow rate Q_{MIN} / P_{MIN} / I_{MIN} and at the operating point Q_{OPT} / P_{OPT} / I_{OPT} (as well as the rated motor current I_N).

If necessary, you can modify the use range of a module by mounting multiple primary windings (see Chapter "Measuring current with an external current transformer (interposing transformer)") in the SIMOCODE pro – System Manual (https://support.industry.siemens.com/cs/ww/en/view/109743957)).

Note

An additional warning threshold can be set

You can optionally configure an additional warning threshold for undershooting the active power using the function "active-power monitoring" (see Active power monitoring (Page 150)) which will give an alarm before the trip level P_{TRIP} is undershot.

However, this warning threshold is not part of the approval for use in hazardous areas.

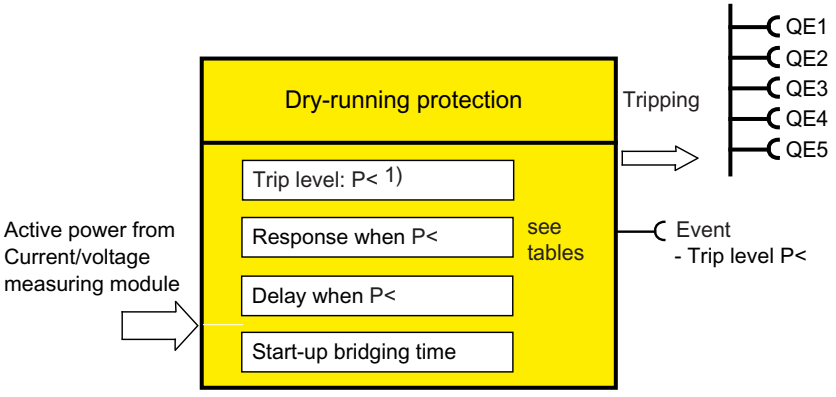


Fig. 4-37 Function block "dry-running protection"

Trip level P_{TRIP}

For dry-running protection of centrifugal pumps by active power monitoring, a trip level can be parameterized for the lower limit:

Trip level:

- P_{TRIP} < (lower limit): 0 - 750000 W (default setting: 0)

Trip level active status

The trip level is active only if the motor is running (the criterion being contactor control), the start-up procedure has been completed, and there is no test position feedback (TPF) (run+).

Response to trip level P_{TRIP} < (lower limit):

Here, you can set how SIMOCODE pro will respond if the set trip level is undershot:

See also "Tables of responses of SIMOCODE pro" in Chapter "Important information" in SIMOCODE pro – System Manual (https://support.industry.siemens.com/cs/ww/en/view/109743957).

Table 4-4 "Trip level" response for dry-running protection by active-power monitoring

Response	Trip level
Deactivated	X (d)
Signal	-
Warn	-
Trip	X
Delay (ongoing operation, including regular switch-off)	0 to 10 s (default: 0.5 s, in steps of: 0.1 s)
Start-up bridging (starting operation)	0 to 60 s (default: 0 s, in steps of: 0.5 s)

Note

Delay time

The delay time (ongoing operation, including regular switch-off) is used to increase reliability by avoiding false tripping (e.g. due to measured-value noise or transient voltage dips) or on undershooting P_{TRIP} on regular switch-off of the pump and prior closure of the shut-off valve on the discharge side.

Specify a startup bridging time if the trip level P_{TRIP} is undershot while the pump is starting (depending on the procedure for opening the shut-off valve on the discharge side).

Reset

You must acknowledge the faults with a reset signal, after checking and remedying the fault where applicable.

- "TEST/RESET" button on the basic unit
- "TEST/RESET" button on operator panel
- Standard function "Reset"

For this purpose, you must connect the inputs "reset input" (connector) to the corresponding sockets, e.g. on reset via the bus.

Application areas

SIMOCODE pro can be used for dry-running protection of centrifugal pumps with a sufficiently progressive pump characteristic curve (sufficiently steep). This chapter provides some example pump characteristic curves for various types of impeller. A characteristic curve is progressive when the active power P increases continuously as the flow rate Q increases (see radial-flow impeller; in practice, most centrifugal pumps have a radial-flow impeller).

A pump characteristic curve is progressive when the ratio of the active power P_{MIN} with the minimum flow rate Q_{MIN} to the active power P_{OPT} at the optimum flow rate (operating point) Q_{OPT} meets the following condition:

$P_{MIN} / P_{OPT} < 0.80$

This condition is met on nearly all centrifugal pumps with an radial-flow impeller.

NOTICE
Test before installation of SIMOCODE pro for dry-running protection of centrifugal pumps
Before installing SIMOCODE pro for dry-running protection of centrifugal pumps, check whether the condition for a sufficiently progressive pump characteristic curve is met based on the medium-specific pump characteristics of the pump manufacturer. For approximation, you can assume that the ratio of the pump shaft outputs ($P_{P,MIN} / P_{P,OPT}$) is similar in magnitude to the ratio of the active powers (P_{MIN} / P_{OPT}).

NOTICE
Coordination of the "pump + motor" combination is required
Coordinate the "pump + motor" combination in a suitable way.
In particular, you must not overdimension the motor too much.
In the partial load range, the efficiency of the motor decreases disproportionately. The characteristic of the pump + motor combination is therefore less steep.

Example types of impeller, example pump characteristic curve

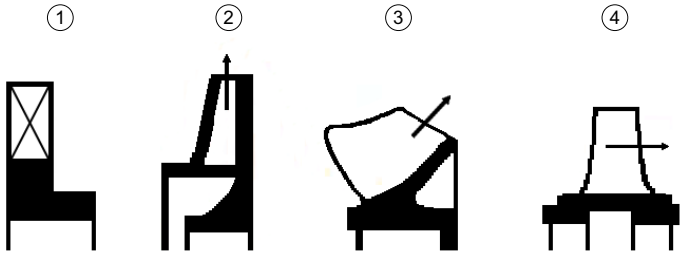


Figure 4-7 Example types of impeller of centrifugal pumps (source: SIHI Group)

① Vane-type impeller

② Radial-flow impeller

③ Mixed-flow impeller

④ Axial-flow impeller (propeller)

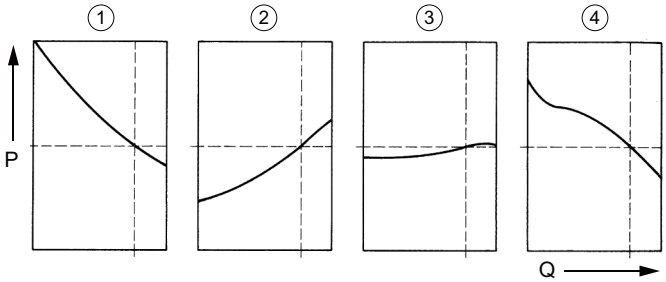


Figure 4-8 Example pump characteristic curve for different types of impeller of centrifugal pumps (source: SIHI Group)

① Vane-type impeller

② Radial-flow impeller

③ Mixed-flow impeller

④ Axial-flow impeller

SIMOCODE pro can be used, in particular, also for dry-running protection of centrifugal pumps that handle flammable media or are installed in a hazardous area.

WARNING

Ex applications

Before using SIMOCODE pro for Ex applications check whether the Ex approvals of SIMOCODE pro cover the relevant use case (see SIMOCODE pro – System Manual (https://support.industry.siemens.com/cs/ww/en/view/109743957), Chapter "Safety and commissioning information for Ex areas" and the labeling on the device).

NOTICE

Example evaluation of ignition hazard assessment

You will find information on the possible contribution of SIMOCODE pro to the Ex protection concept for centrifugal pumps in the example ignition hazard assessment at the end of this chapter.

Note

Sealing system

For centrifugal pumps that are monitored for dry running with SIMOCODE pro, there are no restrictions with respect to the sealing system. For example, simple and double-acting mechanical seals, magnetic drive pumps, and canned motor pumps are conceivable.

Parameter input

The parameters used for the "dry-running protection of centrifugal pumps by active power monitoring" function

- P_{TRIP}: Trip value for the active power on undershooting (trip level)
- $t_{V,TRIP}$: Delay time for tripping during ongoing operation
- t_{BRIDGE}: Start-up bridging time

can be set either by direct input into the device via the engineering software SIMOCODE ES or via the menu-guided input sequence during teach-in with the wizard (see separate description in this chapter). With direct input you additionally have to set the "Behavior" parameter manually to "Trip". With teach-in this is done automatically after leaving the last dialog window.

At the start of the wizard, you open the commissioning editor in the project for the SIMOCODE device in question in the online view. You will find the wizard there under "dry-running protection".

NOTICE

The conditions for sufficient distance from dry running and a sufficiently progressive pump characteristic curve must be met

If you enter the trip level directly via the engineering software, you must take the following measures:

- Check that the conditions for sufficient distance of the trip level from the dry-run state ($P_{Trip} > 1.1 * P_{MIN}$) are met.
- Check by active power monitoring that the conditions for a sufficiently progressive pump characteristic curve ($P_{MIN} / P_{OPT} < 0.80$) are met
- Manually check that the permissible range of current ($I_U < I < I_O$) and voltage (93 V < U < 794 V) have been met using the respective 3UF7 system

External measuring equipment is not approved for determining the operating point parameters.

NOTICE

Access/authorization concept for input or modification of parameter values

When using SIMOCODE pro for Ex applications, ensure a suitable access/authorization concept for input or modification of parameter values.

The method of operation of the parameters is illustrated in the following figure and described in the following sections.

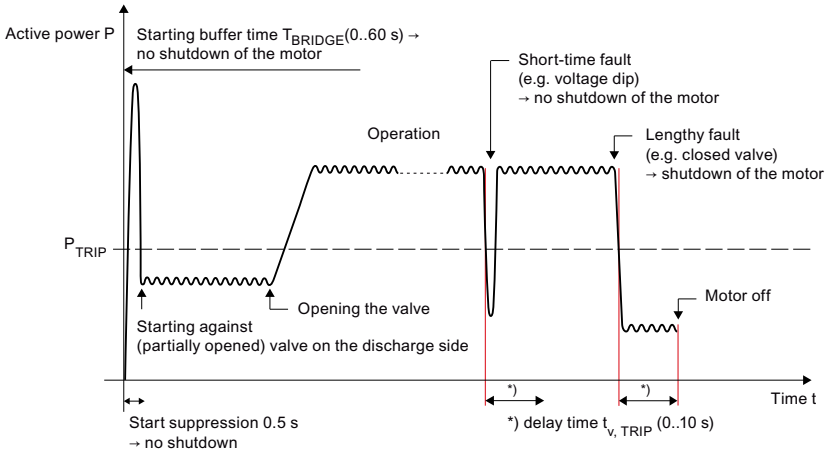


Figure 4-9 Method of operation of the parameters used for dry-running protection of centrifugal pumps by active-power monitoring

Parameter trip value P_{TRIP}

No simple mathematical relation can be stated between the flow rate of a centrifugal pump and the active power on the motor. The influencing factors include material data and installation and operating and ambient conditions.

However, for a certain installed arrangement of the pump, motor, and surrounding plant, a phenomenological, reproducible relationship can be established between the flow rate Q and the active power P. If the operating points are not sufficiently known, the ratios can be determined at the operating point (Q_{OPT}/P_{OPT}) and at the minimum flow rate (Q_{MIN} / P_{MIN}) specified by the pump manufacturer as part of a so-called teach-in (see separate description in this chapter).

Via the menu-guided input sequence (dry-running protection wizard), you can set the trip level for the active power P_{TRIP} (trip value) during the teach-in. It is formed from the measured active power P_{MIN} at minimum flow rate Q_{MIN} multiplied by factor 1.1. This factor is used to establish a sufficient distance between the active power at the trip level and in the dry running state, taking account of the measurement uncertainties.

Alternatively, direct input of the trip value is also possible. Procedure:

- Read off the active power P_{OPT} at the operating point
- Read off the active power P_{MIN} at minimum flow rate, set $P_{TRIP} \geq 1.1\ P_{MIN}$
  - Read off an alternative active power P_a at alternative flow rate Q_a below P_{opt} during ongoing operation and derive the trip value while meeting the condition $P_{opt} > P_{trip} > 1.1 * P_a$ at $Pa \geq P_{min}$.
- Manually check for sufficient scope for progression of the active power characteristic (P_{MIN} / $P_{OPT} < 0.80$)
- Set $P_{TRIP} \geq 1.1 * P_{MIN}$.

NOTICE

Partial load operating states of the pump.

When defining the trip level, consider any potential partial load operating states of the pump.

Parameter delay time $t_{V,TRIP}$

The delay time $t_{V,TRIP}$ during ongoing operation of the centrifugal pump (including switch-off) is used to increase the reliability by avoiding false tripping on transient undershooting of the trip value during ongoing operation (e.g. due to measured-value noise or transient voltage dips).

With parameter $t_{V\,TRIP}$, false tripping is also avoided on regular switch-off of the pump. Depending on the procedure for closing the shutoff valve on the discharge side, the trip level P_{TRIP} may possibly be undershot.

⚠ WARNING

Preventing backflow of the pipe content on the discharge side

Prevent backflow of the content of the pipe on the discharge side with suitable measures.

Reason: Backflow of pumps can result in a generator effect in motors with the danger of sparking on the terminal board.

NOTICE

Signal "motor off" is pending

As soon as the signal "motor off" is pending (the criterion being contactor control), the dry-running protection no longer triggers a fault.

NOTICE

Delay time

Select the delay time $t_{V,TRIP}$ to be sufficiently short so that the dry-running protection function is retained for the specific "pump + motor" system.

Start-up bridging time parameter t_{BRIDGE}

SIMOCODE pro is suitable for the dry-running protection of centrifugal pumps during ongoing operation.

Note

Minimum active power threshold

During start-up, the following effect can occur: Undershooting a minimum active power threshold by starting the pump against a (partially opened) valve on the discharge side.

NOTICE

Start-up bridging time t_{BRIDGE}

Provide a start-up bridging time t_{BRIDGE} against false tripping during which the dry-running protection by active power monitoring is deactivated due to active-power.

If the trip level is still undershot after expiry of t_{BRIDGE}, then the delay time $t_{V,TRIP}$ starts to run from this instant.

As part of a safety assessment, you must decide whether additional measures for dry-running protection are required based on the start-up bridging time t_{BRIDGE} for starting and how they should be handled (e.g. organizationally or by devices).

NOTICE

Manufacturer specifications

Note any data of the manufacturer of the centrifugal pump on the length of the starting operation against a (partially opened) valve on the discharge side.

The following effects may also occur during starting of the pump:

- Transient (< 1 s) undershooting of the active power threshold because starting is performed based on active power = 0 and based on electrical effects (e.g. inertia of the motor contactor). False trips are avoided by a start-up override of 500 ms that is permanently in the device and cannot be modified.
- Transient (< 1 s) starting overcurrent (inrush) during which no dry running can be detected by undershooting a minimum active power threshold. Does not result in false tripping and is therefore non-critical in respect of the Ex protection because of the short duration.

Logging of the set parameter values

After input or modification of parameter values, we recommend recording the defined numeric values, including the time of input, and archiving the log file. This is important, in particular, when using SIMOCODE pro as part of a an Ex protection concept.

To generate a log file, use the print function of SIMOCODE ES. The log file also contains the parameters set for the "dry-running protection" function.

Note

Log reset

If you modify the dry-running parameters without using a wizard, an existing log from a wizard is reset.

Checking and changing the set parameter values

If necessary, check and correct the set parameter values for suitability for the dry running protection function. This applies, in particular, to the trip value P_{TRIP}. Checking may be necessary, for example, in the following cases:

- After changes (e.g. impeller replacement) or repairs on the pump, on the pump motor or on the surrounding plant (pipes, valves, vessels, etc. in the intake path and in the discharge path)
- On changing the medium being pumped
- On changes to the operating conditions
- At regular intervals, in accordance with legal requirements (e.g. test cycle for Ex protection)

NOTICE
Measuring devices Ensure that the measuring devices used are functioning correctly when inspected (e.g. flow meter). Calibrate them, if necessary.

Procedure for teach-in using the dry running protection wizard

Requirements:

Perform the teach-in with the real medium to be pumped under real operating conditions (e.g. temperatures, pressures).

Requirements:

- The starting phase of the pump must have been completed.
- As a prerequisite in the plant, we recommend flow rate measurement on the discharge side.

Note

Automation

To reduce manual interventions, you can store the relevant sequences for a (partially) automated teach-in in your process control system, if required.

Note

Password protection must have been deactivated

If password protection is activated, you must deactivate it.

Note

Setting a temporary trip level

In teach-in, the plant is temporarily operated with minimum flow rate Q_{MIN}, which results in minimum active power P_{MIN}.

To avoid false tripping, but still ensure basic protection against dry running, you should set a temporary trip level before teach-in, the value of which is smaller than the expected minimum active power P_{MIN}.

We recommend the following settings:

- Temporary trip level: At least 30% above the pump shaft power at zero delivery (see pump characteristic curve)
- Delay time $t_{V,TRIP}$ = 0 or as short as possible

As the trip level, enter this value by direct input using the SIMOCODE ES engineering software and transfer the change to the device. You will find the parameters in the project for the SIMOCODE pro device in question in the parameter editor under the respective SIMOCODE parameters "Parameters → Dry-running protection".

⚠ WARNING

Using and resetting the temporary trip level

The temporary trip level only provides basic protection and does not provide dry-running protection for applications in hazardous areas.

Reset this temporary trip level before resuming production if the teach-in sequence is not completed!

⚠ WARNING

Qualified personnel required

The teach-in has to be carried out by qualified responsible specialist personnel.

Failure to follow proper procedures results in **personal injury and damage to property**.

⚠ WARNING

Information provided by the pump manufacturer

The manufacturer's instructions must be observed.

NOTICE

Device parameterization during starting (only affects system in which SIEMENS process controls are used)

If the startup parameter block is deactivated (for PROFINET, "Fieldbus interface→ Startup parameter block" has the default setting "deactivated"), the SIMOCODE pro device parameters are stored in the CPU of the automation system and transferred to SIMOCODE pro via PROFIBUS or PROFINET when the system starts. Parameters that were transferred directly to the device during the teach-in would then be overwritten.

Therefore ensure before teach-in starts that the startup parameter block is activated and effective in the device.

If you want to use the device parameterization during startup nevertheless, proceed as follows:

- Compile the control hardware after completion of the teach-in and load it into the CPU. In this way, the SIMOCODE pro device parameters with the up-to-date settings for the dry-running protection function are loaded into the CPU
- Now deactivate the startup parameter block in the SIMOCODE pro device parameters and transfer this change to the SIMOCODE pro basic unit. This procedure ensures that the device parameters transferred to SIMOCODE pro during system startup contain the up-to-date settings for the dry-running protection function.

NOTICE

Use of a memory module

If a memory module is used, you must ensure that the parameter settings are updated on the memory module after the teach-in process.

Performing the "teach-in" with the dry-running protection wizard

The procedure of a teach-in is illustrated in the example pump characteristic curve (see below). Flow rate measurement on the discharge side is assumed.

At the start of the menu-guided input sequence, open the commissioning editor in the project for the SIMOCODE device in question in the online view. You will find the wizard there under "dry-running protection".

NOTICE

Time monitoring of the teach-in

The teach-in is monitored by a timer in the device's firmware, which becomes active when inactivity is detected.

If the system remains at the same dialogue window for a period of 10 min and if simultaneously the timer is not reset manually SIMOCODE pro goes into the fault condition; an error message to that effect is displayed and the motor is switched off.

You can restart the timer manually at any time during ongoing operation in each dialogue window of the wizard with the "Reset Timer" button.

First start the pump (according to the instructions provided in the documentation of the pump manufacturer) and ensure that the pump has attained operating conditions (especially temperature).

Next, perform the following steps as you are prompted in the input sequence:

1. Starting the dry-running protection wizard: Start the dry-running protection wizard in the online view of the commissioning editor of SIMOCODE ES
2. Check the currently active settings during teach-in: After the wizard has been started, the parameters of the dry-running protection function currently active in the device are displayed:
   - Response
   - Trip level
   - Tripping delay time
   - Start-up bridging time

   Check the settings for use of a temporary trip level (see instruction "Setting a temporary trip level" at the beginning of this chapter)

NOTICE
Changing the currently active setting You can only change the currently active setting by entering the parameters directly in the engineering software. Close the dry-running protection wizard to do this. Remember that the pump is still in operation (limited by the timer that monitors during inactivity).

3. Setting the flow rate to the operating point Q_{opt}: Set the optimum flow rate within your plant configuration and manually enter the numeric value for the operating point Q_{OPT} that you can read off from the flow rate measuring device on the discharge side (SIMOCODE pro records the associated active power P_{OPT}).
4. Setting of the flow rate to Q_{MIN}: Set the minimum flow rate within your plant configuration and manually enter the numeric value for the minimum flow rate Q_{MIN} that you can read off the flow rate measuring device on the discharge side (SIMOCODE pro records the associated active power P_{MIN}).
5. Display of the calculated trip level: The trip value determined by the system $P_{TRIP} = 1,1 * P_{MIN}$ for the active power is displayed.
6. Setting of the delay times:
   - Enter the delay time $t_{V,TRIP}$ for ongoing operation of the centrifugal pump (default value: 0.5 s)
   - Enter the start-up bridging time t_{BRIDGE} (default value: 0 s)
7. Display of the summary, checking and activation of the dry-running protection function: Check the displayed parameter values (P_{TRIP}, $t_{V,TRIP}$, t_{BRIDGE}) for the dry-running protection by active-power monitoring and the set values pairs P_{OPT} / Q_{OPT} and P_{MIN} / Q_{MIN}.

After confirmation, the input sequence is exited and the modified parameter values are activated in the device by the teach-in.

NOTICE

Delivery flow rate must be sufficiently large

Before activation of the parameter values, make sure that the delivery flow rate is sufficient at this instant.

This avoids unwanted tripping.

NOTICE

Tests performed by the device

In SIMOCODE pro, the preconditions for the use of the function "dry-running protection" are checked during the teach-in. A check is made to see whether the following conditions are met:

- Progressive pump characteristic curve (P_{MIN} / P_{OPT} < 0.80)
- Current in the permissible range ($I_U < I < I_o$)
- Voltage in the permissible range (93 V < U < 794 V)

If one of the above conditions is not met, an error message is output. In this case you must

- close the dry-running protection wizard
- eliminate the error and then restart the dry-running protection wizard
- if necessary also restart the pump beforehand.

Check the determined absolute values for P_{OPT} and P_{MIN} for plausibility irrespective of this (where applicable by comparing the pump characteristics). Determine the cause for obvious deviations before activating the dry-running protection function.

NOTICE

Checks in case of manual direct input of the trip level

If you entered the trip level manually with the engineering software, check for the following conditions:

- the conditions for a sufficiently progressive pump characteristic curve
- the conditions for sufficient distance of the trip level from the dry-run state
- the conditions for the permissible range of current and voltage

Note

Log file

For documentation purposes, we recommend generating and printing out a log file after parameter setting by teach-in.

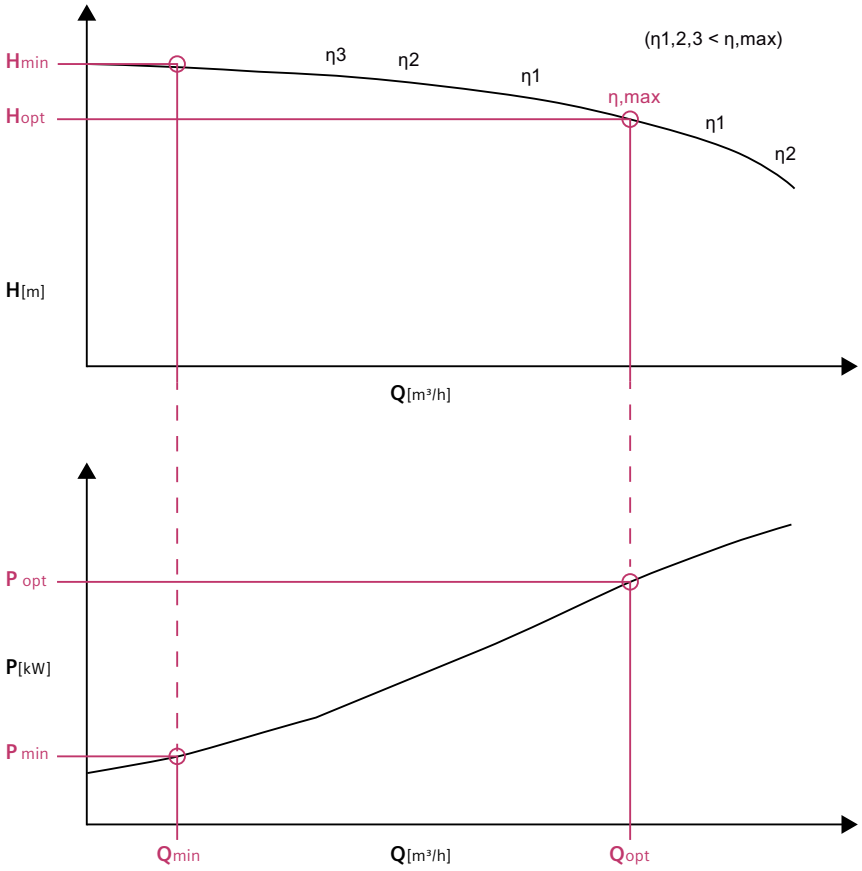


Figure 4-10 Example monitoring parameters for the teach-in illustrated in the characteristic curve of a centrifugal pump with a radial-flow impeller for water at a speed of 1450 rpm (example); source: KSB SE & Co. KGaA

Alternatives when a flow measurement is missing on the discharge side

If no stationary flow rate measurement is provided, we recommend the following alternatives, for example:

- Mobile flow rate measurement by ultrasound in clamp-on technology (calibration required)
- Determine the flow rate via level change in a vessel
- Procedure as for hydraulic acceptance tests for centrifugal pumps acc. to DIN EN ISO 9906

Ignition hazard assessment acc. to ISO 80079-36 for centrifugal pumps in hazardous areas – prevention of an ignition source from becoming active with the help of dry-running protection by active power monitoring with SIMOCODE pro (example illustration)

According to the data in DIN EN ISO 80079-37, Chapter 1 and Chapter 4, for non-electrical devices (centrifugal pumps in this case) for use in explosive atmospheres, an ignition hazard assessment must be performed according to DIN EN ISO 80079-36 (protection by control of ignition sources "b"). For each individual identified ignition hazard, suitable protection measures must be defined depending on the fault conditions to be considered. This ignition hazard assessment must be performed by the manufacturer of centrifugal pumps that are approved for use in hazardous areas.

As the plant operator, you are responsible for use of devices as intended, in particular in hazardous areas, considering the influencing factors of the environment.

The following exemplary ignition hazard assessment according to DIN EN ISO 80079-36 is an example illustration and documentation for centrifugal pumps. It refers exclusively to ignition hazards that can be reduced by the use of SIMOCODE pro for dry-running protection by active-power monitoring and lists the control measures required for this. It does not purport to be complete. As the plant operator, you must adapt, detail, and expand this ignition hazard assessment to the local conditions in any case.

serial no.	1		2					3			4					
	Ignition hazard		Assessment of the frequency of occurrence without application of an additional measure					Measures applied to prevent the ignition source becoming effec-tive			Frequency of occurrence incl. measures applied					
	a	b	a	b	c	d	e	a	b	c	a	b	c	d	e	f
	Potential ignition source	Description / basic cause (Which conditions originate which ignition hazard?)	In normal operation	during foresee-able mal-function	during rare mal-function	Not relevant	Reasons for assessment	Description of the measure applied	Basis (citation of standards, technical rules, experimen-tal results)	Technical documentation (evidence including relevant features listed in column 1)	In normal operation	During foreseeabl e	during rare mal-function	Not relevant	Resulting EPL in respect of this ignition hazard	Necessary restrictions
1.1	Hot surface	power losses dissipated as heat		X			The maximum surface temperature of the pump has been defined by the pump supplier in the course of a type-examination for worst case conditions during normal operation.	Monitoring of minimum flow by Control Products (e.g. SIMOCODE pro) (by monitoring if the active power falls below a minimum value); trip criteria have been defined according to the operating manual for the pump	ch. 6.5.1 of ISO 80079-37	EU-type examination certificate / Certificate of Conformity (CoC) according to IEC Ex; Manual Collection SIMOCODE pro; SIL Verification Report (Dekra Exam) con-cerning functional safety; instructions according to the operating manual for the pump			X		Gb	T...
1.2					X		flow and temperature monitoring, failure of monitoring devices cannot be ex-cluded (rare malfunction)							X	Ga	T...
1.3		temperature of the pumped medium in conjunction with hydraulic losses of the pump as well as power dissipation of the motor		X			The maximum surface temperature was defined in a type test of the manufacturer in the most unfavorable conditions, but in normal operation The permissible temperature of the medium to be pumped is defined in the operating instructions.						X		Gb	T...
1.4					X		Flow rate and temperature monitoring, failure of monitoring equipment cannot be excluded (rare fault)							X	Ga	T...
1.5		pump is operating against a closed valve or a down-stream blockage (continuous opera-tion + shut-down)		X			In normal operation the pump will not operate against closed valve or downstream blockage. This case is only relevant for anticipated malfunctions.						X		Gb	T...
1.6					X		Flow and temperature monitoring, Failure of monitoring devices cannot be ex-cluded (rare malfunction)							X	Ga	T...
1.7	mechanical spark	Impeller hits casing (in case of malfunction without or with only little liquid)			X		Formation of sparks inside pump - only relevant if simultaneously too less liquid is present	Monitoring of permanent liquid filling inside pump during operation by Control Product (e.g. SIMOCODE pro) (by monitoring if the active power falls below a minimum value); avoidance of simultaneous occur-rence of an effective ignition source and an explosive atmosphere						X	Ga	T...
1.8		Loose metal parts in the medium being pumped (in case of a fault without liquid or with just a little liquid)			X									X	Ga	T...
1.9		Impeller rubs against casing (in case of malfunction without or with only little liquid)			X									X	Ga	T...
1.10		Unintended ingress of particles from outside (in case of malfunction without or with only little liquid)			X			Monitoring of permanent liquid filling inside pump during operation by Control Product (e.g. SIMOCODE pro) (by monitoring if the active power falls below a minimum value); avoidance of simultaneous occur-rence of an effective ignition source and an explosive atmos-phere; prevention of ingress of particles from outside, e.g. installation of a strain-er, operator's respon-sibility.						X	Ga	T...
1.11	Electrical sources	Backflow of liquid through the pump caused by "slurping mode" (repeated periods of incomplete conveying of liquid rests) after emptying of a ves-sel			X		Pump is operating as electric generator; electro-magnetic induc-tion of voltage at terminal box of motor; formation of sparks by flashover	Monitoring of minimum flow by Control Products (e.g. SI-MOCODE pro) (by monitoring if the active power falls below a minimum value); trip criteria have been defined according to the operating manual for the pump; application of a motor with adequate type of protection (e.g. Ex d, Ex e)					X		Gb	T...
Resulting EPL including all existing ignition hazards															Gc bis Ga	T...

Figure 4-11 Example ignition hazard assessment for centrifugal pumps in hazardous areas according to EN ISO 80079-36 - Representation of the possible contribution of SIMOCODE pro to prevent an ignition source from becoming active with the help of dry-running protection by active power monitoring

4.3 Motor control

4.3.1 Control stations

4.3.1.1 Description of functions of control stations

Control stations - overview

Control stations are places from which control commands are issued to the motor. The "Control Stations" function block is used for administration, switching and prioritization of these different control stations. SIMOCODE pro allows parallel administration of up to four different control stations. Dependent on the set control function, up to five different control commands can be transmitted from every control station to SIMOCODE pro.

Control stations can be:

- **Local** in the direct vicinity of the motor; control commands via pushbuttons.
- **PLC/PCS or PLC/PCS [PN]**, switching commands are issued by the automation system (remote).
- **PC or PC/OPC UA [HMI]**, control commands are issued via an operator control station or via PROFIBUS DPV, OPC UA or PROFINET with the SIMOCODE ES software.
- **Operator panel**, control commands are issued via the buttons of the operator panel in the control cabinet door.

Examples of control commands:

- **Motor ON (ON >), Motor OFF (OFF)** for a direct starter
- **Motor CCW (ON <), Motor OFF (OFF), Motor CW (ON >)** for a reversing starter
- **Motor SLOW (ON >), Motor FAST (ON >>), Motor OFF (OFF)** for a Dahlander circuit.

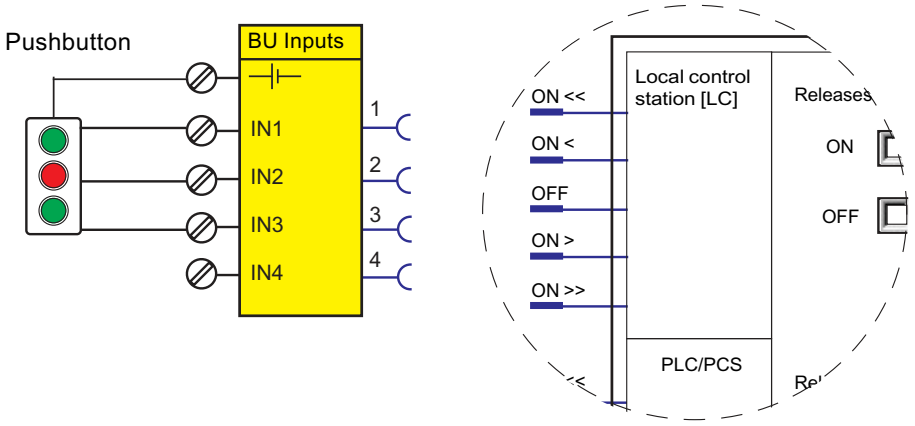
The plugs of the "Control Stations" function block must be connected to any sockets (e.g. binary inputs on the basic unit, control bits from the bus, etc.) for the control commands to take effect. Up to five different control commands can come from each control station. Up to five plugs (plug ON <<, ON <, OFF, ON >, ON >>) are available on the function block for each control station. The number of active plugs depends on the control function selected. With a direct starter, for example, only the plugs "ON >" and "OFF" are active.

Control stations

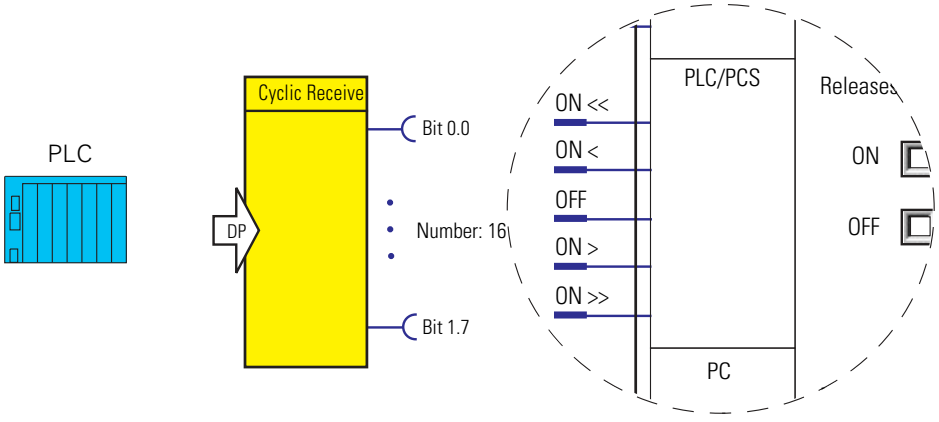
- **Control station - local control:** In this case, the command devices are usually in the immediate vicinity of the motor and are wired to the inputs of SIMOCODE pro. The plugs of the "Control Stations" function block must be connected to any sockets (normally the function blocks for the basic units or the digital module inputs – BU Inputs, DM Inputs) for the control commands to take effect.

Note

The OFF command "LC OFF" is 0-active. This ensures that SIMOCODE pro shuts the motor down safely if an open circuit occurs in the supply cable, for example. The precondition is that the control station is active.



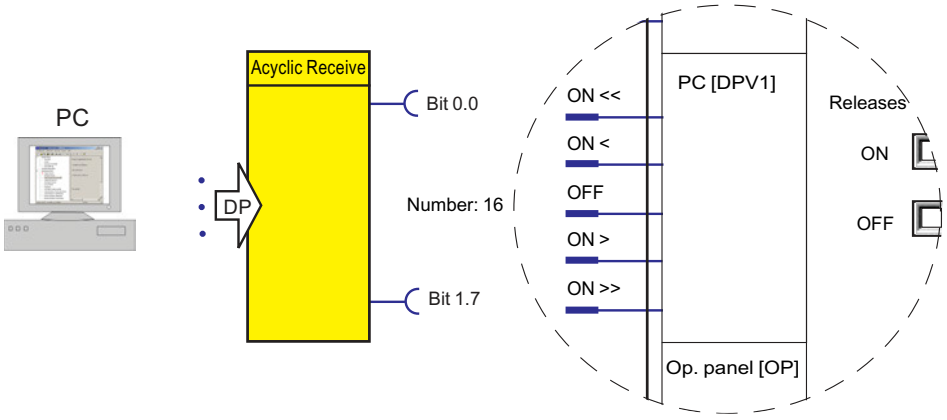
- **PLC/PCS or PLC/PCS [PN] control station:** This control station is primarily intended for control commands from the automation system (PLC / PCS) via the cyclic receive telegram of the bus. The plugs of the "Control Stations" function block must be connected to any sockets, typically with cyclic receive, for the control commands to take effect.



- **PC or PC/OPC UA [HMI] control station:** This control station is primarily intended for switching commands on an arbitrary PC that, along with the automation system, is used as a second master on PROFIBUS DP or that, as a client, accesses the data made available by SIMOCODE pro, as server, via OPC UA. The control commands are sent via the Acyclic receive telegram from PROFIBUS DPV1 or are transferred using a client-server connection via OPC UA.

Note

If the SIMOCODE ES or SIMATIC PDM PC software is connected to SIMOCODE pro via communication bus, its control commands automatically take effect via the PC [DPV1] or "PC PC/OPC UA" control station. At the same time, the enabled commands for this control station also take effect for SIMOCODE ES.



- **Control station - operator panel:** This control station is primarily intended for control commands issued via the buttons on the 3UF72 operator panel, which is mounted in a control cabinet door, for example. The plugs of the "Control Stations" function block must be connected to any sockets (normally to the function block for the buttons of the operator panel - OP buttons) for the control commands to take effect.

Note

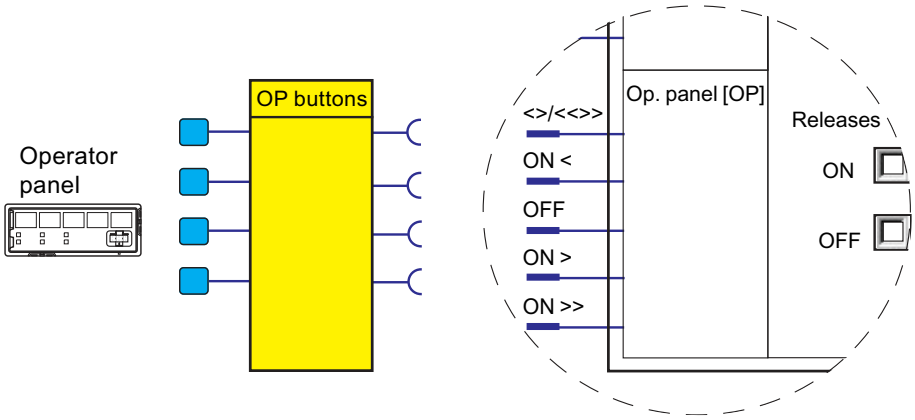
Control functions with two speeds

Since the operator panel only has four buttons for controlling the motor feeder, one button must be used as a speed changeover button for control functions with two speeds and two directions of rotation. For this purpose, this button must be assigned to the internal control command "[OP]<>/<<>>".

Note

"Operator panel [OP]" control station

If the SIMOCODE ES PC software on a programming device is connected to SIMOCODE pro via the system interface, its control commands automatically take effect via the "Operator panel [OP]" control station. At the same time, the enabled commands for this control station also take effect for SIMOCODE ES.



4.3.1.2 Operating modes and mode selectors

Operating modes

You can use the control stations either individually or in combination. There are four different operating modes available for selection:

- Local 1
- Local 2
- Local 3
- Remote / Automatic: In this operating mode, the system must communicate via PLC.

Not all control stations are usually connected. If more than one control station (e.g. local and PLC / PCS) is connected, it makes sense and is also mandatory to operate the control stations selectively. Four operating modes are provided for this purpose which can be selected via two control signals (mode selectors). For each individual control station in every operating mode, it can be stipulated if "ON commands" and / or "OFF commands" are to be accepted. The operating modes are controlled in such a way that only one operating mode is active at any one time.

Example: There are three operating modes in a system:

Table 4-5 Operating modes

Operating mode	Description
Key-operated switch operation, e.g. Local 1	Only local control inputs are permitted! All other control stations are disabled.
Manual operation, e.g. Local 3	Only operator panel control commands and local control commands can be issued.
Remote operation, e.g. remote / automatic	Only PLC/PCS control commands are permitted; only OFF commands are permitted locally.

The key-operated switch must be read in via an input to select these operating modes. The remote switching operation should be controlled via the bus. The key-operated switch operation has priority over all other operating modes.

Mode selector

The S1 / S2 mode selectors are used to switch between the operating modes "Local 1," "Local 2," "Local 3," and "Remote/Automatic." To do this, plugs S1 and S2 must be connected to any sockets (e.g. device inputs, communication bus control bits, etc.).

The table below shows the operating modes depending on the signal states of mode selectors S1 and S2:

Table 4-6 Operating modes depending on S1 and S2

Input	Operating mode			
	Local 1	Local 2	Local 3	Remote / Automatic
S1	0	0	1	1
S2	0	1	0	1

The different operating modes for enabling the control stations can be used to specify the switch authorizations for the individual control stations:

- Local control [LC]
- PLC/PCS [DP] or PLC/PCS [PN]
- PC [DPV1] or PC/OPC-UA [HMI]
- Operator panel (OP)

Only the following are active:

- the operating mode set by plugs S1 and S2 of the "Control Stations" function block and
- the enables selected there.

Example of a dynamic mode selection as a function of time:

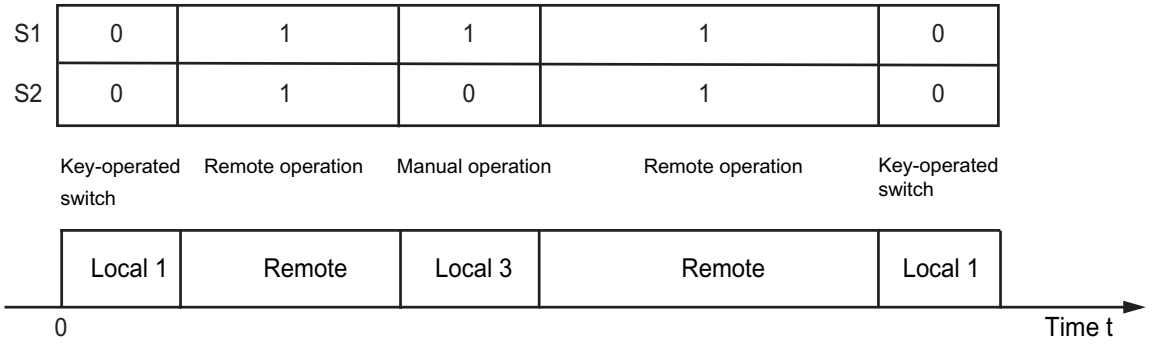


Figure 4-12 Example - mode selection

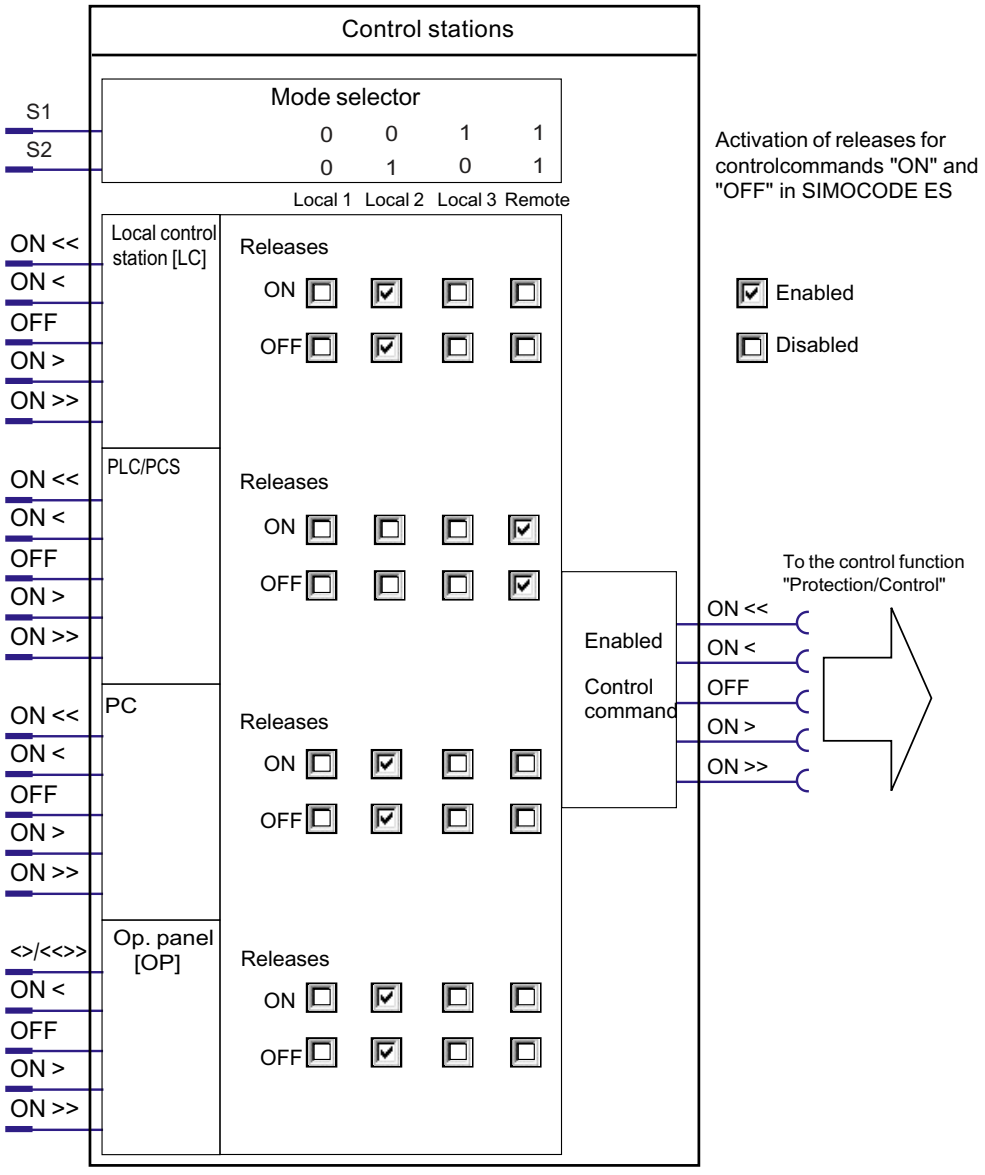
4.3.1.3 Enables and enabled control command

Enables

Enables, which have to be activated, are assigned to the "ON" and "OFF" control commands for each control station in every operating mode. That is, depending on the mode, it is possible to define for each control station whether it is permitted to switch the motor on only, off only, or on and off. The relevant checkbox ☑ is selected in the "Control stations" dialog box in SIMOCODE ES.

Diagram of enables and enabled control command

The following diagram shows the "Control Stations" function block and the operating modes:



Example of enabled commands

The following diagram shows an example of enabled commands for the "Local 2" operating mode, "Dahlander reversing starter" control function:

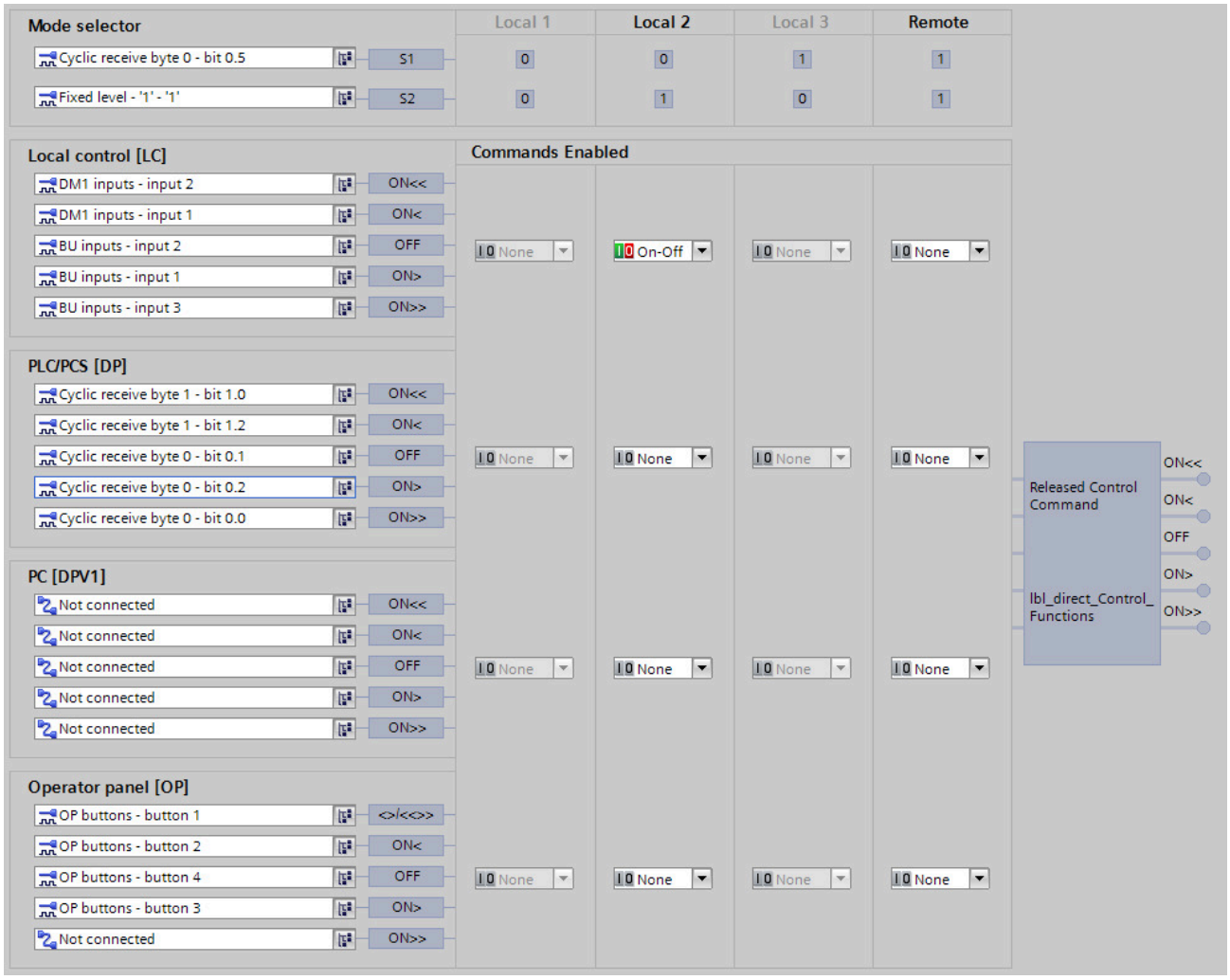


Figure 4-13 Example of enabled commands

In the example, the motor can only be switched on and off in the "Local 2" operating mode via the buttons (local) connected to the inputs of the basic unit and the digital module.

4.3.1.4 Control station settings

Table 4-7 Control station settings

Control stations	Description
LC	Activates the control station via any signal (any sockets, but typically device inputs). The "OFF" plug is 0-active on the control station [LC].
ON <<	
ON <	
OFF	
ON >	
ON >>	
PLC/PCS	Activates the control station via any signal (any sockets, but typically control bits from the bus).
ON <<	
ON <	
OFF	
ON >	
ON >>	
PC	Activates the control stations via any signal (any sockets, but typically control bits from the bus).
ON <<	
ON <	
OFF	
ON >	
ON >>	
Operator panel [OP]	Activates the control stations via any signal (any sockets, but typically buttons on the operator panel)
<>/<<>>	
ON <	
OFF	
ON >	
ON >>	
Mode selector	For switching between the 4 operating modes Local 1, Local 2, Local 3 and remote with any signals (any sockets, e.g. device inputs, control bits from/via the bus.).
S1	
S2	

4.3.2 Control functions

4.3.2.1 Overview and description of control functions

Control functions - overview

Depending on the device series, the system provides the following control functions:

Table 4-8 Control functions

Control function	SIMOCODE pro			
	BP	GP		HP
	C	S	V PN GP	V PB, V MR, V PN, V EIP
Overload relay (Page 92)	✓	✓	✓	✓
Direct starter (direct-on-line starter) (Page 93)	✓	✓	✓	✓
Reversing starter (Page 95)	✓	✓	✓	✓
Circuit breaker (Page 97)	✓	✓	✓	✓
Star-delta starter (Page 99)	—	✓	✓	✓
Star-delta reversing starter (Page 102)	—	—	—	✓
Dahlander starter (Page 106)	—	—	—	✓
Dahlander reversing (Page 108)	—	—	—	✓
Pole-changing starter (Page 111)	—	—	—	✓
Pole-changing reversing starter (Page 114)	—	—	—	✓
Solenoid valve (Page 117)	—	—	—	✓
Positioner 1 to Positioner 5 (Page 120)	—	—	—	✓
Soft starter (Page 124)	—	✓	✓	✓
Soft starter with reversing contactor (Page 127)	—	—	—	✓

Control functions (e.g. direct starters, reversing starters) are used for controlling load feeders. They are characterized by the following important features:

- Monitoring the switch-on / switch-off process
- Monitoring the ON / OFF status
- Tripping if a fault occurs.

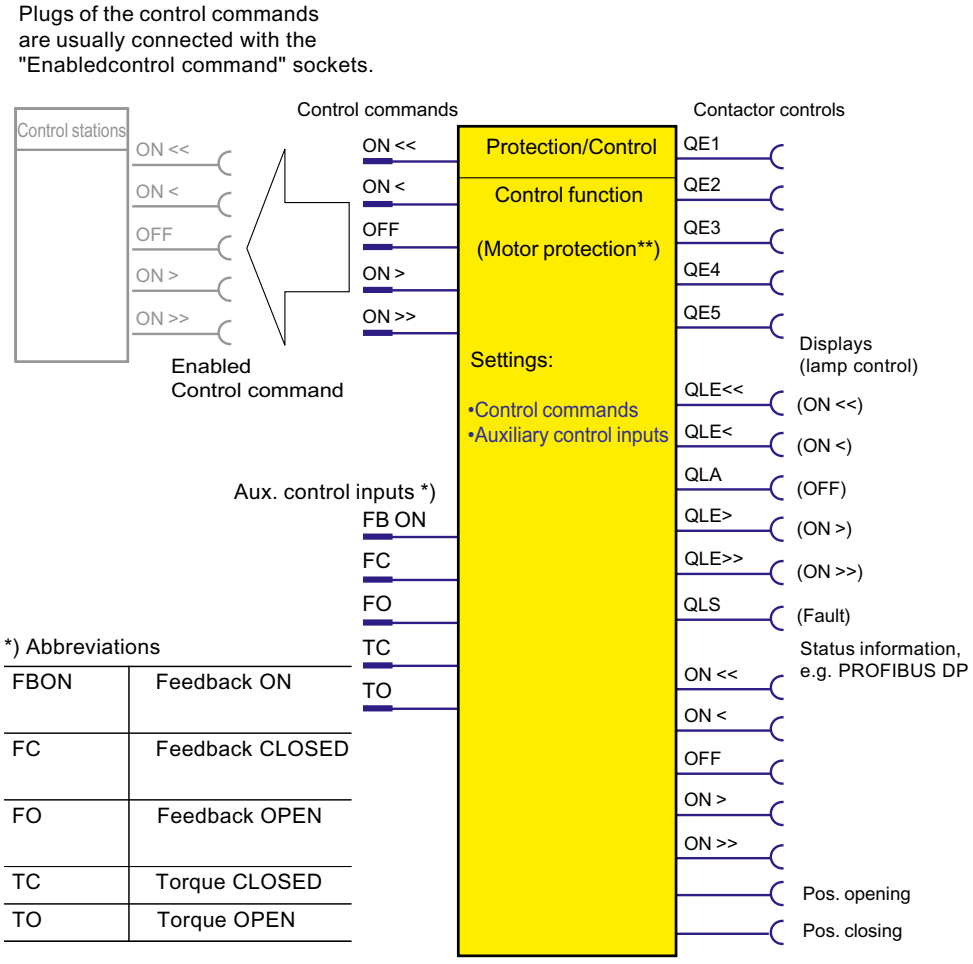
SIMOCODE pro monitors these statuses using the "Feedback ON" auxiliary control input, which is usually derived directly from the current flow in the main circuit, via the current measuring modules.

All the necessary interlocks and logic operations for the respective applications are already implemented in the control functions. Control functions include:

- Plugs for control commands ON <<, ON <, OFF, ON >, ON >> that are usually connected with the "Enabled control command" sockets.
- Auxiliary control inputs (plugs), e.g. Feedback ON
- Sockets for
  - Contactor controls QE1 to QE5.
  - Displays (lamp controls) QL, QLS.
  - Statuses, e.g. "Status - ON <<, Status - ON >>."
  - Faults, e.g. "Fault - feedback (FB) ON," "Fault - antivalence."
- Settings, e.g. interlocking time, non-maintained command mode ON / OFF, etc.
- A logic component with all necessary interlocks and connections for the control function.
- Like control functions, the motor protection with its parameters and signals is active "at a higher level in the background". Motor protection and thermistor protection are independent functions that switch off the motor when activated via the control functions. Detailed description: See Chapter Motor protection (Page 37).

Control function schematic

The following schematic shows a general view of the control function ("Protection/Control" function block):



*) Abbreviations

FBON	Feedback ON
FC	Feedback CLOSED
FO	Feedback OPEN
TC	Torque CLOSED
TO	Torque OPEN

Figure 4-14 "Protection/Control" function block

**) See also Chapter Motor protection (Page 37)

Contactor controls

The QE contactor controls are switched dependent on the incoming control commands and taking the specified control function into consideration including all corresponding interlocks, feedbacks, corresponding parameters and the higher-level motor protection. In general, the QE contactor controls are directly connected to the outputs of the basic unit or the digital modules and switch the connected contactors using relays. The number of usable QE contactor controls is directly dependent on the set control function.

Lamp controls and status information:

The feeder status feedback is signaled via the status information or the QL lamp controls. They are all directly dependent on the status of the auxiliary control input "FB ON". The number of usable lamp controls and status information is directly dependent on the specified control function.

Feeder status feedback:

- Status information, e.g. "Status ON <": These are transmitted, for example, via bus to the automation system and signal the status of the feeder there.
- Displays (lamp control) "Display - QLE <": These can, for example, activate a signal lamp or a pushbutton lamp for status display

  Note

  If the motor is running in test operation, the QLE ... / QLA lamp outputs show a different response (e.g. flashing).

- In addition to the status signals, the "QL..." lamp controls additionally indicate the following:
  - Unacknowledged fault (lamp output general fault QLS is flashing)
  - Saving change-over command (QLE lamp outputs are flickering)
  - Lamp test: All QL outputs are activated for approx. 2 s.

Extended status and fault messages

- Additional status information:
  - Start active: If "Motor" is selected as the load type, this signal is present during the start process of the motor for the duration of the specified class time (e.g. 10 s for Class 10E). Exceptions are the "Overload relay" and "Solenoid valve" control functions.
  - Interlocking time active: For control functions with a change in the direction of rotation, the signal remains present until the specified interlocking time has elapsed.
  - Change-over pause active: For the "Dahlander starter," "Pole-changing starter," and "Star-delta" control functions, the signal is present after changeover until the specified time has elapsed.
- Additional status information for the "Positioner" or "Solenoid valve" control function:
  - Feedback CLOSED (FC)
  - Feedback OPEN (FO)
  - Torque CLOSED (TC)
  - Torque OPEN (TO).
    These feedback signals specify the present status of the corresponding limit switch and/or torque switch. The amount of usable status information is directly dependent on the selected control function.
- Additional fault information for the "Positioner" or "Solenoid valve" control function:
  - Stalled positioner: The torque switch has been activated before the corresponding limit switch. The positioner may have stalled.
  - Double 0: Both torque switches have responded ("positioner" control function only)
  - Double 1: Both limit switches have responded.
  - End position: Positioner or valve has left the end position without receiving a control command
  - Antivalence: The changeover contacts of the limit switches do not issue an antivalent signal ("Positioner 5" control function only).

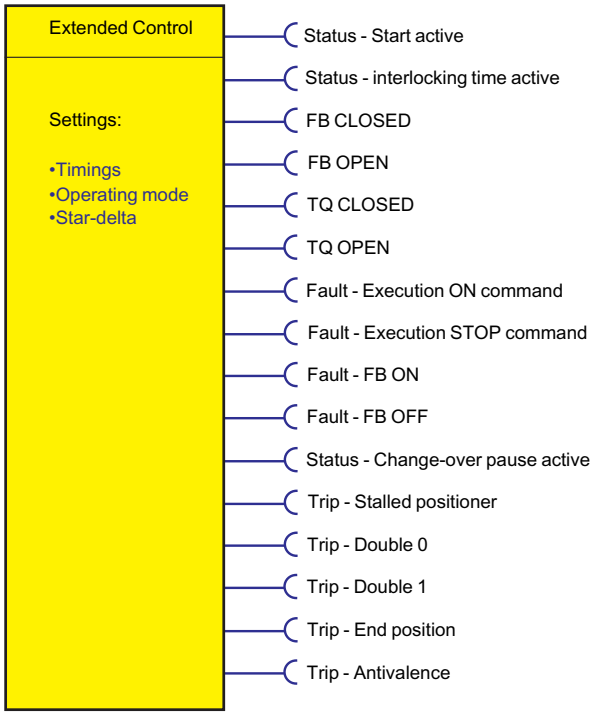


Figure 4-15 "Extended control" function block

4.3.2.2 Application selection, settings and definitions of control functions

Application selection

If you select and load a preset application via the "Add new device" command (e.g. the reversing starter) in SIMOCODE ES, all protective functions, links and interlocks for the reversing starter are set up in the basic unit. These can be flexibly adapted and expanded.

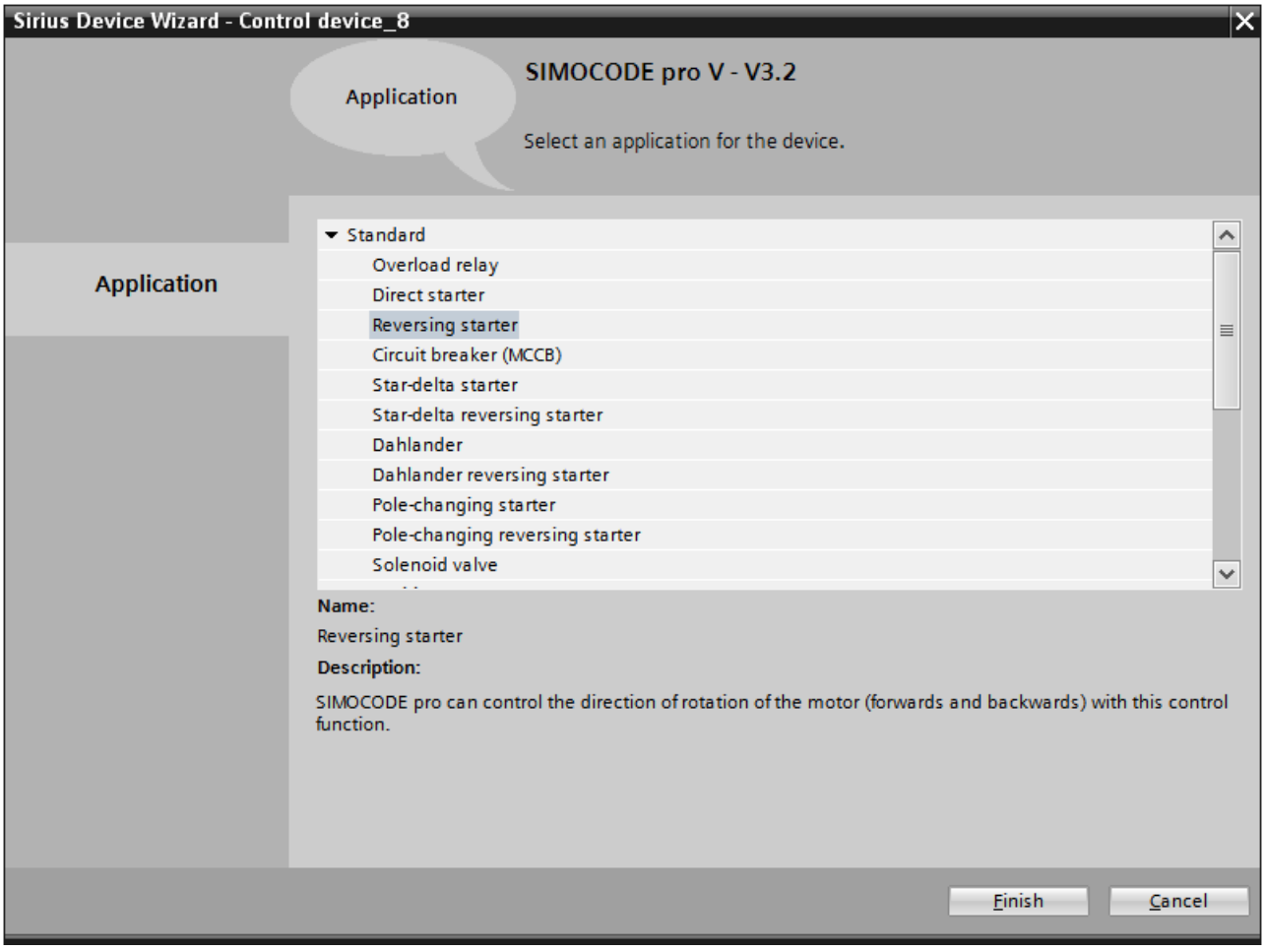


Figure 4-16 Application selection with SIMOCODE ES

Depending on the basic unit used, you can choose from among the following control functions:

Table 4-9 Application selection

Control function	Short Description	Further information
Overload relay	SIMOCODE pro responds like an overload relay.	See "Overload relay" control function (Page 92)
Direct starter (direct-on-line starter)	Switching motor on and off	See "Direct starter" control function (Page 93)

Control function	Short Description	Further information
Reversing starter	Control of direction of rotation of motors (forward, reverse)	See "Reversing starter" control function (Page 95)
Molded-case circuit breaker (MCCB)	Switches a circuit breaker on and off (e.g. 3WL, 3VA)	See "Molded case circuit breaker (MCCB)" control function (Page 97)
Star-delta starter	To limit the starting current, SIMOCODE pro initially starts a motor with a star-connected stator winding and then switches it to delta.	See "Star-delta starter" control function (Page 99)
Star-delta reversing starter	Star-delta starter with both directions of rotation (forward, reverse)	See "Star delta reversing starter" control function (Page 102)
Dahlander starter	Control of motors with only one stator winding in two speed steps (fast, slow)	See Control function "Dahlander starter" (Page 106)
Dahlander reversing starter	Dahlander starter with both directions of rotation (clockwise, counter-clockwise)	See Control function "Dahlander reversing starter" (Page 108)
Pole-changing starter	Control of motors with two stator windings in two speed steps (fast, slow)	See "Pole-changing starter" control function (Page 111)
Pole-changing reversing starter	Pole-changing starter with both directions of rotation (forward, reverse)	See "Pole-changing reversing starter" control function (Page 114)
Solenoid valve	Control of a solenoid valve	See "Solenoid valve" control function (Page 117)
Positioner (1, 2, 3, 4, 5)	Activation of positioners or actuators. Versions 1 to 5	See "Positioner" control function (Page 120)
Soft starter	Control of the 3RW soft starter	See "Soft starter" control function (Page 124)
Soft starter with reversing contactor	Control of the 3RW soft starter, including an additional reversing contactor	See "Soft starter with reversing contactor" control function (Page 127)

Parameters for control functions

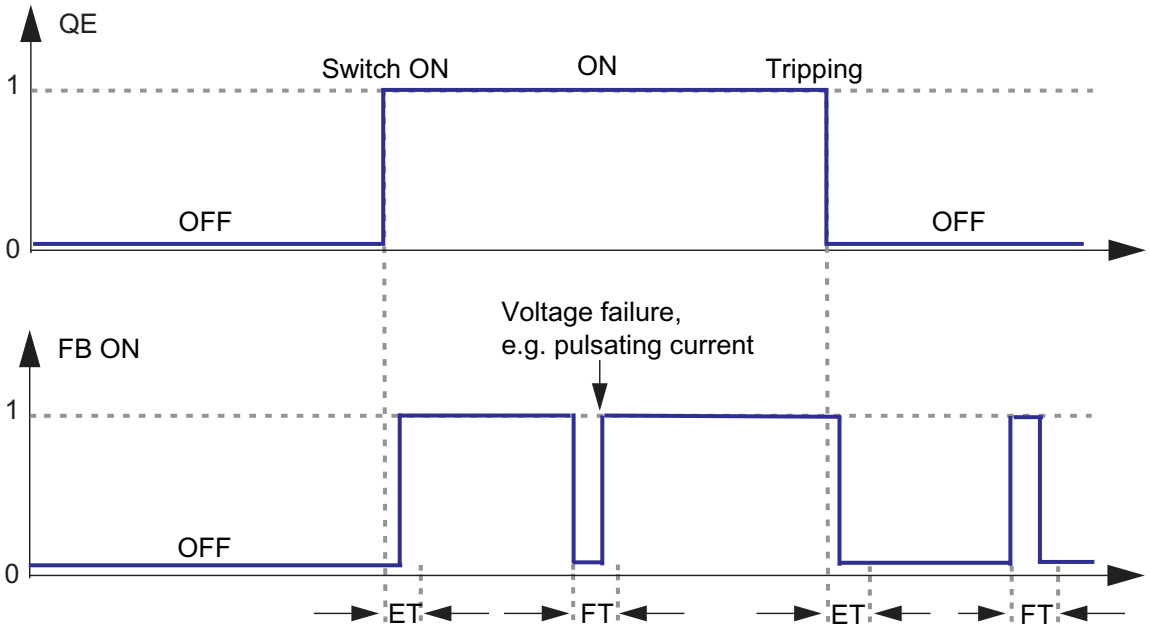
Table 4-10 General settings and definitions

Parameter	Description
ON <<, ON <, OFF, ON >, ON >>	Are usually connected with the "Enabled control command" sockets of the "Control Station" function block. From there, the control commands come from the different control stations. The number of active inputs depends on the control function chosen. With a direct starter, for example, only the inputs "ON >" and "OFF" are active. Default setting: Connected
FB ON [1)]	Auxiliary control input "Feedback ON" (connection with any socket, usually with "Status - Motor current flowing" socket) as factory default. An auxiliary contact from the contactor is not required for signaling. Depending on the control function chosen, this state is signaled by the QLE1 to QLE5 displays and by the "Status - ON <<, - ON <, - ON >, - ON >>" signals. "No motor current flowing" means: the motor is switched off. An auxiliary contact from the contactor is not required for signaling. This state is signaled by the QLA display and the "Status - OFF" signal. Default setting: Status - Motor current flowing
FC, FO, TC, TO	Auxiliary control inputs for the "Positioner" and "Solenoid valve" control functions that are normally connected with the inputs of the basic unit or the digital modules and are used to query the present status of the torque switch and the limit switches that are hard-wired to the inputs.
Non-maintained command mode	• Deactivated (default setting): The control command on the corresponding plug of the control stations "ON <, ON <<, ON >, ON >>" is saved. It can only be revoked by an "OFF" control command from the corresponding control station. An auxiliary contact for locking the contactor is not required. Motor feeders are usually operated in locking mode. Locking is preset. • Activated: Depending on the control function chosen, non-maintained command mode acts on the plugs of all control stations "ON <, ON <<, ON >, ON >>". A control command is only effective as long as there is a "high signal".
Saving change-over command	• Deactivated (default setting): Change-over commands for switching from one direction of rotation / rotational speed to the other are only implemented with a previous "OFF" and after the interlocking time / change-over pause has elapsed. This setting is usually used and is preset. • Activated: Change-over commands for switching from one direction of rotation / rotational speed to the other are implemented without a previous "OFF" once the interlocking time / change-over pause has elapsed. If the selected direction / speed cannot be executed immediately due to a parameterized interlocking time / change-over pause, the selection is signaled by flickering QLE displays. Your selection can be cancelled at any time with "OFF".
Separating DM-FL/FP function from control function	• Deactivated (default setting): Safety-related tripping via the DM-F modules also affects the SIMOCODE pro control function, so that the contactor control is always tripped, too. This setting is selected for applications where safety-related tripping directly affects the motor controlled by SIMOCODE pro. • Activated: Safety-related tripping via the DM-F modules does not affect the SIMOCODE pro control function, so that the contactor control is not tripped. This setting is selected for applications where safety-related tripping does not affect the motor controlled by SIMOCODE pro.

Parameter	Description
Load type	You can select from the following: • Motor (default) • Resistive load (e.g. heater): Since overcurrent generally does not flow during start-up on a resistive load, the "Start active" status is not signaled. In this case, the startup override does not occur for the "signal," "warn," and "tripping" functions.
Feedback time [1)]	SIMOCODE pro monitors the status of the feeder (ON or OFF) via FB ON. If the status of FB ON changes - without a corresponding switching command - "Fault - Feedback (FB)" switches off the feeder. Default setting: 0.5 s The feedback time can be used to suppress such "feedback faults" for a defined period of time, e.g. in the case of network switchover. When the motor is switched off, SIMOCODE pro continuously checks whether FB ON = 0. If the current flows longer than the set feedback time without the "ON" control command being issued, a fault message "Fault - feedback (FB) ON" is issued. The contactor controls can only be connected after the fault has been rectified. When the motor is switched on, SIMOCODE pro continuously checks whether FB ON = 1. If no current flows for longer than the set feedback time without the "OFF" control command being issued, a fault message "Fault - feedback (FB) OFF" is issued. The contactor controls are deactivated.
Execution time [1)]	SIMOCODE pro monitors the switch-on and switch-off process. The switch-on or switch-off process must be completed within this time. Default setting: 1.0 s After the "ON" control command is issued, SIMOCODE pro must be able to detect current in the main circuit within the execution time. Otherwise, the fault message "Fault - Execution ON command" will be issued. SIMOCODE pro deactivates the contactor controls. After the "OFF" control command is issued, SIMOCODE pro must not be able to detect current in the main circuit after expiry of the execution time. Otherwise, the fault message "Fault - Execution OFF command" will be issued. The contactor controls can only be connected after the fault has been rectified.
Interlocking time	SIMOCODE pro prevents, e.g. in the case of reversing starters, both contactors from switching on at the same time. Changing from one direction of rotation to the other can be delayed via the interlocking time. Default setting: 0 s.
Change-over pause	With the control functions "Dahlander starter" and "Pole-changing starter", switching from FAST to SLOW can be delayed by the time configured. In the "Star-delta" control function, the change-over pause extends the time between switching off the star contactor and switching on the delta contactor by the time configured. Default setting: 0.00 s

Parameter	Description
Max. star time	With the "Star-delta starter" and the "Star-delta reversing starter" control functions: Time-dependent switching from star to delta. Max. star time: 0 - 255 s. Default setting: 20 s.
Current measuring module built into the delta circuit or the supply cable	With control function "Star-delta starter" or "Star-delta reversing starter": The current setting and the switching levels for star-to-delta switching depend on the installation location of the current measuring module: • in delta circuit (default): current setting I_s is reduced to I_{rated} x $1/\sqrt{3}$ • In supply cable: current setting

Behavior of "feedback message ON" [1)]



ET: Execution time
FT: Feedback time

Figure 4-17 Execution time (ET) and feedback time (FT) in relation to FB ON

1)

Note

Behavior with a current less than 12 % of I_s

At a current less than 12% of the motor's rated current I_e, the "Current I_max (% of I_e)' and "Current I_Lx (% of I_e)" is indicated as 0 %. Equally, the binary "Status - Motor current flowing" signal remains set to logical zero.

Faults

The contactor controls are deactivated.

The following signals are also output:

- A flashing signal on the QLS lamp control
- A flashing signal on the "GEN. FAULT" LED
- The "Status - General fault" signal
- The corresponding signaling bit of the fault.

4.3.2.3 "Overload relay" control function

Description

With this control function, SIMOCODE pro functions like a solid-state overload relay. Control commands (e.g. ON, OFF) cannot be issued to the load. Control stations and inputs of the control function (e.g. ON >, OFF), do not have any function in the case of overload relays. When the control voltage is applied, SIMOCODE pro automatically closes the QE3 contactor control; it remains active until it is deactivated by the fault message of a protection or monitoring system.

The QE3 contactor control must be connected to any relay output that switches off the contactor coil of the motor contactor in case of overload.

Schematic

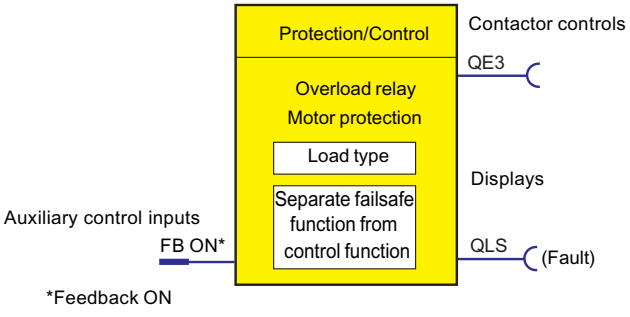


Figure 4-18 Schematic of the "Overload relay" control function, "Protection / Control" function block

Settings

You will find detailed explanations of the settings in Chapter Application selection, settings and definitions of control functions (Page 87).

Table 4-11 Overload relay settings

Overload relay	Description
FB ON	"Feedback ON" auxiliary control input Connection with any socket, usually with "Status - current flowing" socket
Load type	You can choose between: • Motor (default) • Resistive load (see Chapter Application selection, settings and definitions of control functions (Page 87))
Separate fail-safe function from control function	• Deactivated (default setting): A safety-related tripping by the DM-F modules affects the SIMOCODE pro control function, avoiding additional follow-on fault messages. This setting is selected for applications where safety-related tripping directly affects the motor controlled by SIMOCODE pro. • Activated: A safety-related disconnection by the DM-F modules does not affect the SIMOCODE pro control function. This setting is selected for applications where safety-related tripping does not affect the motor controlled by SIMOCODE pro.

Note

In the case of overload, the QE3 output is set (=1) and is only reset after an overload trip (=0).

This output closes when the overload function is parameterized.

Note

Monitoring the number of starts is not possible for this control function.

4.3.2.4 "Direct starter" control function

Description

SIMOCODE pro can switch a motor on and off with this control function.

Control commands

- Start with "ON >" activates the QE1 internal contactor control.
- Stop with "OFF" deactivates the QE1 internal contactor control.

The control commands can be issued to SIMOCODE pro from any control stations (see also Description of functions of control stations (Page 73)). Thus, the inputs (plugs) must be connected to the corresponding sockets, preferably to the "Enabled control command" sockets.

Every fault message causes the QE1 contactor control to be deactivated.

Schematic

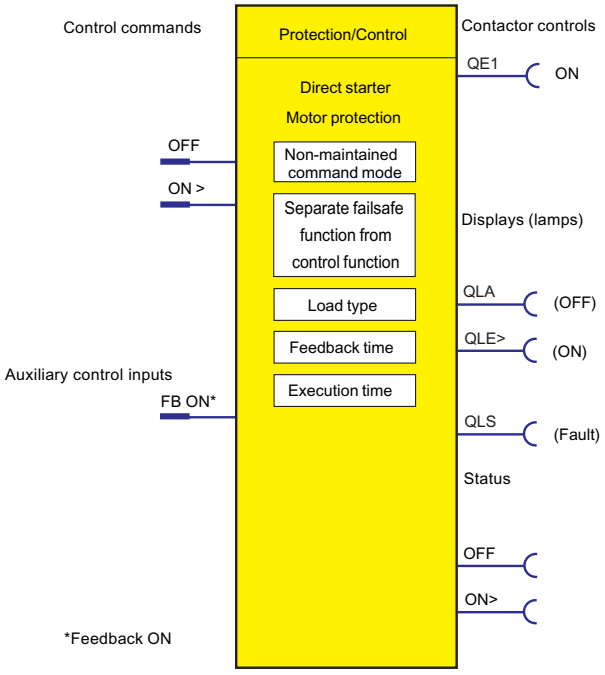


Figure 4-19 Schematic of the "Direct starter" control function, "Protection / Control" function block

Settings

You will find detailed explanations of the settings in Chapter Application selection, settings and definitions of control functions (Page 87).

Table 4-12 Direct starter settings

Direct starter (direct-on-line starter)	Description
OFF	Control command OFF Connection with any socket, usually with "Enabled control command OFF" socket
ON >	Control command ON Connection with any socket, usually with "Enabled control command - ON >" socket
FB ON	"Feedback ON" auxiliary control input Connection with any socket, usually with "Status - current flowing" socket
Non-maintained command mode	• Deactivated (default setting) • Activated

Direct starter (direct-on-line starter)	Description
Separate fail-safe function from control function	• Deactivated (default setting): A safety-related tripping by the DM-F modules also affects the SIMOCODE pro control function, avoiding additional follow-on fault messages. This setting is selected for applications where safety-related tripping directly affects the motor controlled by SIMOCODE pro. • Activated: A safety-related tripping by the DM-F modules does not affect the SIMOCODE pro control function. This setting is selected for applications where safety-related tripping does not affect the motor controlled by SIMOCODE pro.
Load type	You can choose between: • Motor (default) • Resistive load (see Chapter Application selection, settings and definitions of control functions (Page 87))
Feedback time	Range 0 to 25.5 s (default: 0.5 s)
Execution time	Range 0 to 6553.5 s (default: 1.0 s)

4.3.2.5 "Reversing starter" control function

Description

With this control function, SIMOCODE pro can control the direction of rotation of the motor (forwards and backwards).

Control commands

- Start with "ON >" activates the QE1 contactor control (clockwise, i.e. forwards)
- Start with "ON <" activates the QE2 contactor control (counterclockwise, i.e. reverse)
- Stop with "OFF" deactivates internal contactor controls QE1 and QE2.

The control commands can be issued to SIMOCODE pro from any control stations (see also Description of functions of control stations (Page 73)). Thus, the inputs (plugs) must be connected to the corresponding sockets, preferably to the "Enabled control command" sockets.

Every fault message causes contactor controls QE1 and QE2 to be deactivated.

Switching the direction of rotation

The direction of rotation can be switched once the "Status - ON >" or "Status - ON <" signal has expired (motor is switched off) **and** the interlocking time has elapsed:

- Via the "OFF" control command
- Directly when "Saving change-over command" is activated.

SIMOCODE pro prevents both contactors from switching on at the same time. Changing from one direction of rotation to the other can be delayed via the interlocking time.

Schematic

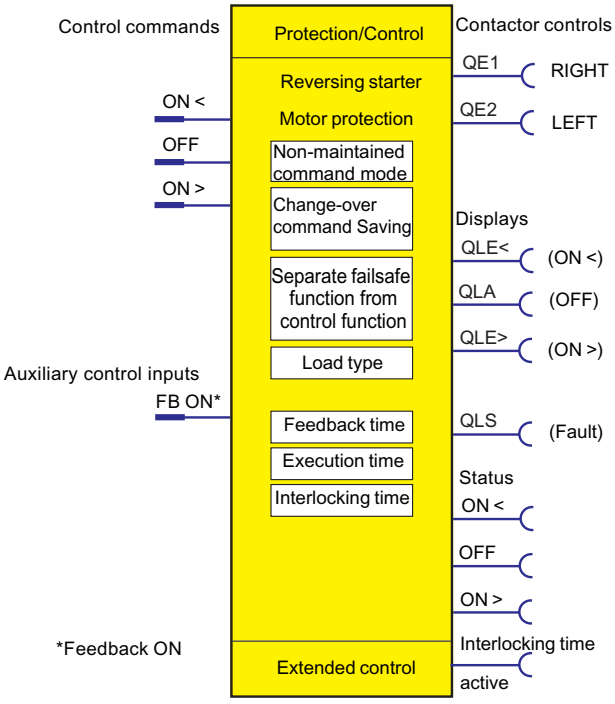


Figure 4-20 Schematic of the "Reversing starter" control function, "Protection/Control" function block

Settings

You will find detailed explanations of the settings in Chapter Application selection, settings and definitions of control functions (Page 87).

Table 4-13 Reversing starter settings

Reversing starter	Description
ON <	Control command ON <, counter-clockwise Connection with any socket, usually with "Enabled control command - ON <" socket
OFF	Control command OFF Connection with any socket, usually with "Enabled control command OFF" socket
ON >	Control command ON >, clockwise Connection with any socket, usually with "Enabled control command - ON >" socket
FB ON	"Feedback ON" auxiliary control input Connection with any socket, usually with "Status - current flowing" socket
Non-maintained command mode	• Deactivated (default setting) • Activated
Saving change-over command	• Deactivated (default setting) • Activated

Reversing starter	Description
Separate fail-safe function from control function	• Deactivated (default setting): A safety-related tripping by the DM-F modules also affects the SIMOCODE pro control function, avoiding additional follow-on fault messages. This setting is selected for applications where safety-related tripping directly affects the motor controlled by SIMOCODE pro. • Activated: A safety-related tripping by the DM-F modules does not affect the SIMOCODE pro control function. This setting is selected for applications where safety-related tripping does not affect the motor controlled by SIMOCODE pro.
Load type	You can choose between: • Motor (default) • Resistive load (see Chapter Application selection, settings and definitions of control functions (Page 87))
Feedback time	Range 0 to 25.5 s (default: 0.5 s)
Execution time	Range 0 to 6553.5 s (default: 1.0 s)
Interlocking time	Range 0 to 255 s (default: 0 s)

4.3.2.6 "Molded case circuit breaker (MCCB)" control function

Description

SIMOCODE pro can mainly switch circuit breakers (e.g. 3WL, 3VA) on and off with this control function. The circuit breakers are then connected to the bus via SIMOCODE pro.

Control commands

- Start with "ON >" activates the QE1 contactor control for a pulse of 400 ms.
- Stop with "OFF" activates contactor control QE3 for a pulse of 400 ms.
- With "Reset", the QE3 contactor control is activated for a pulse of 400 ms when the circuit breaker is tripped (alarm switch = ON).

The pulse of a control command is always fully executed before the "counter pulse" is set.

The control commands can be issued to SIMOCODE pro from any control stations (see also Description of functions of control stations (Page 73)). Thus, the inputs (plugs) must be connected to the corresponding sockets, preferably to the "Enabled control command" sockets.

Making internal assignments

You have to make the following assignments:

1. Assign the QE1 contactor control to the relay output that is connected to the "ON connection" of the motorized operating mechanism of the circuit breaker.
2. Assign the QE3 contactor control to the relay output that is connected to the "OFF connection" of the motorized operating mechanism of the circuit breaker.

3. Assign the SIMOCODE pro input that is connected to the auxiliary switch (AUXS) of the circuit breaker to the auxiliary control input "Feedback ON".
4. Assign the SIMOCODE pro input which is connected to the alarm switch (AS) of the circuit breaker to the input (socket) of the "External fault 1" standard function.

Schematic

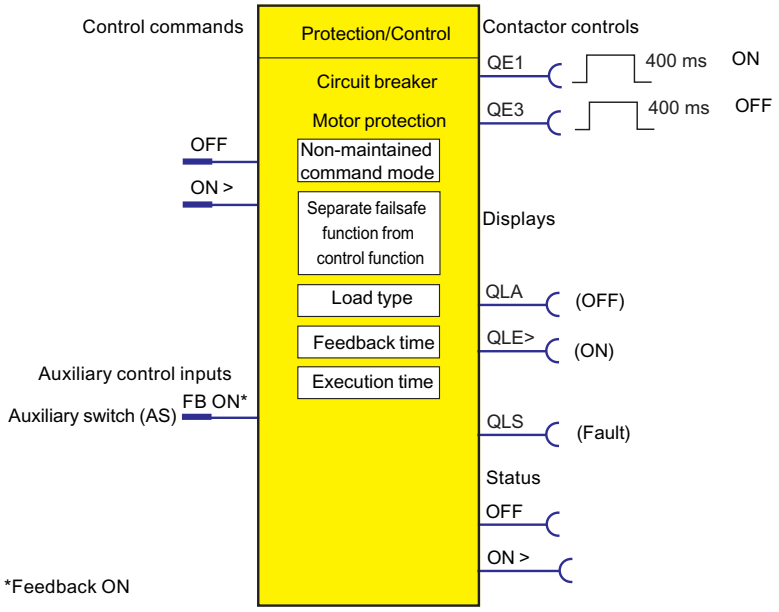


Figure 4-21 Schematic of the "Circuit breaker" control function, "Protection / Control" function block

Settings

You will find detailed explanations of the settings in Chapter Application selection, settings and definitions of control functions (Page 87).

Table 4-14 Circuit breaker settings

Circuit breaker	Description
OFF	Control command OFF (Connection with any socket, usually with "Enabled control command OFF" socket)
ON >	Control command ON (Connection with any socket, usually with "Enabled control command ON >" socket)
FB ON	Auxiliary control input "Feedback ON" (connection always with socket, (input), that the auxiliary switch of the circuit breaker is connected to).
Non-maintained command mode	• Deactivated (default setting) • Activated

Circuit breaker	Description
Separate fail-safe function from control function	• Deactivated (default setting): A safety-related tripping by the DM-F modules also affects the SIMOCODE pro control function, avoiding additional follow-on fault messages. This setting is selected for applications where safety-related tripping directly affects the motor controlled by SIMOCODE pro. • Activated: A safety-related tripping by the DM-F modules does not affect the SIMOCODE pro control function. This setting is selected for applications where safety-related tripping does not affect the motor controlled by SIMOCODE pro.
Load type	You can choose between: • Motor (default) • Resistive load (see Chapter Application selection, settings and definitions of control functions (Page 87))
Feedback time	A repeated ON pulse is only output by the QE1 contactor control once the set feedback time has elapsed. The feedback time should therefore be set higher than the motor off time of the motorized operating mechanism of the circuit breaker. Range 0 to 25.5 s (default: 0.5 s)
Execution time	Range 0 to 6553.5 s (default: 1.0 s)

4.3.2.7 "Star-delta starter" control function

Description

Star-delta starting is used to limit the starting current and to avoid overloading the line supply. In this control function, SIMOCODE pro initially starts the motor with a star-connected stator winding and then switches it to delta.

Control commands

- Start with "ON" first activates the QE1 contactor control (star contactor) and then immediately activates the QE3 contactor control (line contactor)
- Stop with "OFF" deactivates contactor controls QE1, QE2, and QE3.

The control commands can be issued to SIMOCODE pro from any control stations (see also Description of functions of control stations (Page 73)). Thus, the inputs (plugs) must be connected to the corresponding sockets, preferably to the "Enabled control command" sockets. Every fault message causes the QE1, QE2 and QE3 contactor controls to be deactivated.

Switching from star to delta

For this purpose, SIMOCODE pro first deactivates QE1 contactor control again, before connecting QE2 contactor control (delta contactor). SIMOCODE pro switches over from star to delta:

- Current-dependent, for decreasing current below the following thresholds:
  - Transformer installed in delta circuit: $I < 150\ \% I_s$
  - Transformer installed in supply cable: $I < 90\ \% I_s$
- Time-dependent to the time set in the parameter "Max. star time" when the current in star operation does not sink below this threshold.

Safety guidelines

Note

It is recommended that contactor controls QE* are wired to the relay outputs of the basic unit.

Note

if the SIMOCODE pro S basic unit is used, an additional multifunction module is required for this control function.

The typical change-over time from star to delta is between 100 ms and 150 ms.

Note

Spurious tripping can occur if you use the internal ground-fault detection for star-delta connections. During delta operation, the summation current is non-zero due to harmonics.

Note

If the current measuring module is switched to delta (normal case), a current which is $1/\sqrt{3}$ times smaller must be set for the star-delta starter control function.

Example: $I_n = 100$ A

$I_s = I_n \times 1/\sqrt{3}$

$I_s = 100\ A \times 1/\sqrt{3} = 57.7\ A$

Current to be set $I_s = 57.7$ A

Change-over pause

The switching time from star to delta can be extended by the change-over pause. Reason: For motors with a high ratio between starting current and rated current, the line voltage plus motor EMF might result in a very high delta starting current if the change-over pause is too short. The motor EMF decreases if the pause is longer.

Schematic

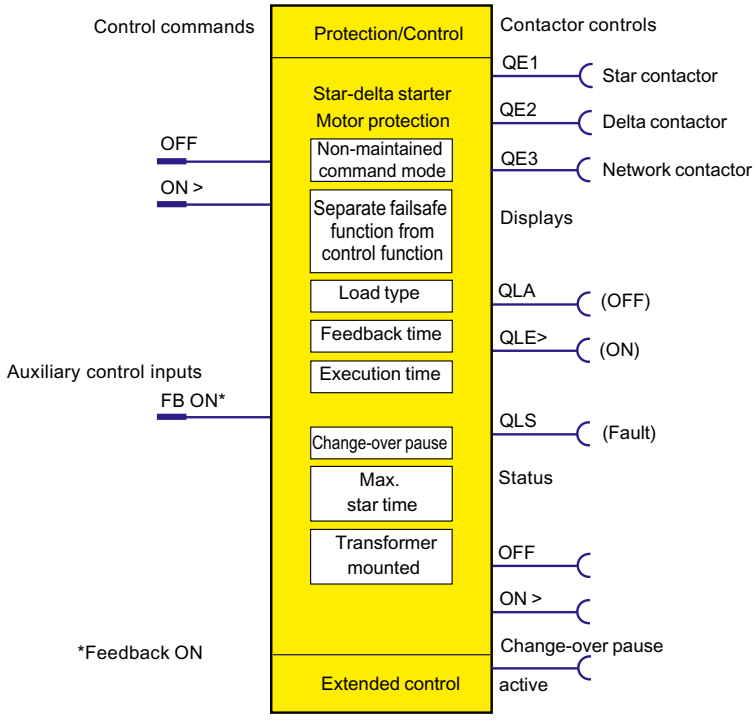


Figure 4-22 Schematic of the "Direct starter" control function, "Protection/Control" function block

Settings

You will find detailed explanations of the settings in Chapter Application selection, settings and definitions of control functions (Page 87).

Table 4-15 Star-delta starter settings

Star-delta starter	Description
OFF	Control command OFF (Connection with any socket, usually with "Enabled control command OFF" socket)
ON >	Control command ON (Connection with any socket, usually with "Enabled control command ON >" socket)
FB ON	Auxiliary control input "Feedback ON" (connection with any socket, usually with "Status - current flowing" socket)
Non-maintained command mode	• Deactivated (default setting) • Activated
Separate fail-safe function from control function	• Deactivated (default setting): A safety-related tripping by the DM-F modules affects the SIMOCODE pro control function, avoiding additional follow-on fault messages. This setting is selected for applications where safety-related tripping directly affects the motor controlled by SIMOCODE pro. • Activated: A safety-related disconnection by the DM-F modules does not affect the SIMOCODE pro control function. This setting is selected for applications where safety-related tripping does not affect the motor controlled by SIMOCODE pro.

Star-delta starter	Description
Load type	You can select from the following: • Motor (default) • Resistive load (see Chapter Application selection, settings and definitions of control functions (Page 87))
Feedback time	Range 0 to 25.5 s (default: 0.5 s)
Execution time	Range 0 to 6553.5 s (default: 1 s)
Change-over pause	Range 0 to 655.3 s (10 ms steps) (default: 0.00 s)
Max. star time	Time-dependent switching from star to delta. Range 0 to 255 s (default: 20 s)
Current measuring module installed [1)]	The current setting and the switching levels for star-to-delta switching depend on the installation location of the current measuring module: • In delta circuit: Current setting I_s is reduced to I_n x 1/√3 (default) • In supply cable: Current setting $I_s = I_n$ (rated current of the motor)

Note

1) If a current / voltage measuring module is in use, the transformer must be connected in the supply cable!

It is also necessary to select "Line-to-line voltage" under "Device configuration → Voltage display".

4.3.2.8 "Star delta reversing starter" control function

Description

With this control function, a motor can be started in both directions of rotation in star-delta operation.

Control commands

- **CW rotation:** Start with "ON >" first activates the QE1 contactor control (star contactor) and then immediately activates the QE3 contactor control (line contactor, clockwise rotation)
- **Counter-clockwise rotation**: Start with "ON <" first activates the QE1 contactor control (star contactor) and then immediately activates the QE4 contactor control (line contactor, counter-clockwise rotation)
- **Stop** with "OFF" deactivates contactor controls QE1, QE2, QE3, and QE4.

The control commands can be issued to SIMOCODE pro from any control stations (see also Description of functions of control stations (Page 73)). Thus, the inputs (plugs) must be connected to the corresponding sockets, preferably to the "Enabled control command" sockets.

Every fault message causes the QE1, QE2, QE3 and QE4 contactor controls to be deactivated.

Switching from star to delta

For this purpose, SIMOCODE pro first deactivates contactor control QE1 before connecting contactor control QE2 (delta contactor).
SIMOCODE pro switches over from star to delta:

- Current-dependent, for decreasing current below the following thresholds:
  - Transformer installed in delta circuit: $I < 150\ \% I_s$
  - Transformer installed in supply cable: $I < 90\ \% I_s$
- Time-dependent to the time set in the parameter "Max. star time" when the current in star operation does not sink below this threshold.

Switching the direction of rotation

The direction of rotation can be switched once the "Status - ON >" or "Status - ON <" signal has expired (motor is switched off) **and** the interlocking time has elapsed:

- Via the OFF control command.
- Directly when "Saving change-over command" is activated.

SIMOCODE pro prevents both contactors from switching on at the same time. Switching from one direction of rotation to the other can be delayed via the "interlocking time."

Startup is always performed in star mode

Safety guidelines

Note

It is recommended that the QE1 and QE2 contactor controls are wired to the relay outputs of the basic unit. You need at least 1 digital module for this control function.

Note

Spurious tripping can occur if you use the internal ground-fault detection for star-delta connections. During delta operation, the summation current is non-zero due to harmonics.

Note

If the current measuring module is switched to delta (normal case), a current which is $1/\sqrt{3}$ times smaller must be set for the star-delta starter control function.

Example: $I_n = 100$ A

$I_s = I_n \times 1/\sqrt{3}$

$I_s = 100\ A \times 1/\sqrt{3} = 57.7\ A$

Current to be set $I_s = 57.7$ A

Change-over pause

The switching time from star to delta can be extended by the change-over pause. Reason: For motors with a high ratio between starting current and rated current, the line voltage plus motor EMF might result in a very high delta starting current if the change-over pause is too short. The motor EMF decreases if the pause is longer.

Schematic

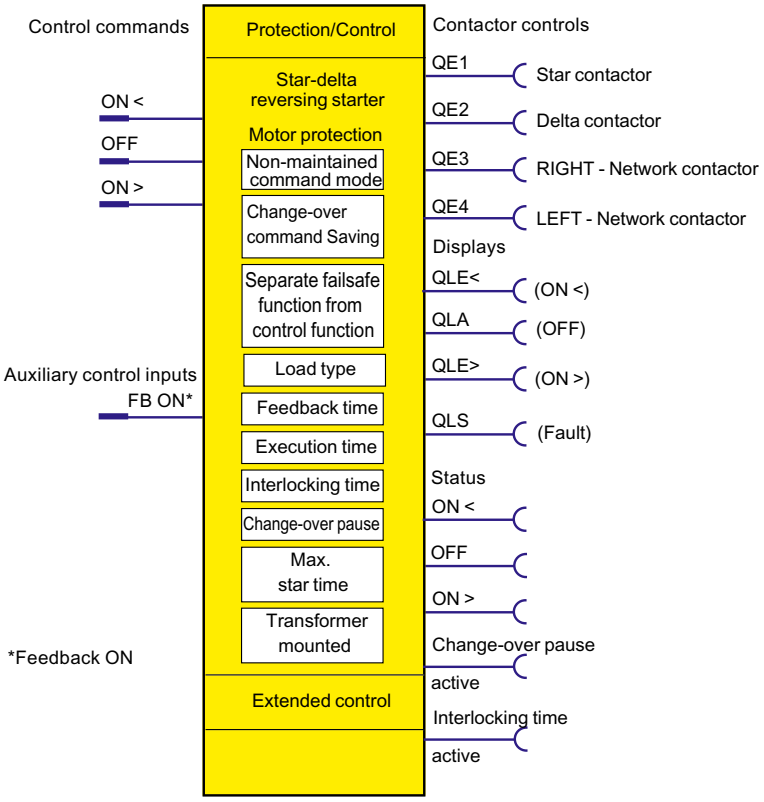


Figure 4-23 Schematic of the "Star-delta reversing starter" control function, "Protection / Control" function block

Settings

You will find detailed explanations of the settings in Chapter Application selection, settings and definitions of control functions (Page 87).

Table 4-16 Star-delta reversing starter settings

Star-delta reversing starter	Description
Voltage display (in the device configuration)	Select "Line-to-line voltage"
Motor control → Control function:	
OFF	Control command OFF Connection with any socket, usually with "Enabled control command OFF" socket

Star-delta reversing starter	Description
ON >	Control command ON > Connection with any socket, usually with "Enabled control command ON >" socket
ON <	Control command ON < Connection with any socket, usually with "Enabled control command ON <" socket
FB ON	"Feedback ON" auxiliary control input Connection with any socket, usually with "Status - current flowing" socket
Non-maintained command mode	• Deactivated (default setting) • Activated
Saving change-over command	• Deactivated (default setting) • Activated
Separate fail-safe function from control function	• Deactivated (default setting): A safety-related tripping by the DM-F modules also affects the SIMOCODE pro control function, avoiding additional follow-on fault messages. This setting is selected for applications where safety-related tripping directly affects the motor controlled by SIMOCODE pro. • Activated: A safety-related tripping by the DM-F modules does not affect the SIMOCODE pro control function. This setting is selected for applications where safety-related tripping does not affect the motor controlled by SIMOCODE pro.
Load type	You can choose between: • Motor (default) • Resistive load (see Chapter Application selection, settings and definitions of control functions (Page 87))
Feedback time	Range 0 to 25.5 s (default: 0.5 s)
Execution time	Range 0 to 6553.5 s (default: 1 s)
Change-over pause	Range 0 to 655.3 s (10 ms steps) (default: 0 s)
Interlocking time	Range 0 to 255 s (default: 0 s)
Max. star time	Time-dependent switching from star to delta. Range 0 to 255 s (default: 20 s)
Current measuring module installed [1)]	The current setting and the switching levels for star-to-delta switching depend on the installation location of the current transformer / current measuring module: • in delta circuit (default): Current setting I_s is reduced to I_n x $1/\sqrt{3}$ • In supply cable: Current setting $I_s = I_n$ (rated current of the motor)

Note

1) If a current / voltage measuring module is in use, the transformer must be connected in the supply cable!

4.3.2.9 Control function "Dahlander starter"

Description

With this function, SIMOCODE pro can control motors with only one stator winding at two speeds (FAST and SLOW). SIMOCODE pro connects the stator winding via the contactors so that there is a high pole number at low speed and a low pole number at high speed.

Control commands

- **SLOW**: Start with "ON >" first activates the QE2 contactor control (SLOW).
- **FAST**: Start with "ON >>" first activates the QE3 contactor control (star contactor, FAST) and then immediately activates the QE1 contactor control (line contactor, FAST).
- **Stop** with "OFF" deactivates contactor controls QE1, QE2, and QE3.

The control commands can be issued to SIMOCODE pro from any control stations (see also Description of functions of control stations (Page 73)). Thus, the inputs (plugs) must be connected to the corresponding sockets, preferably to the "Enabled control command" sockets.

Every fault message causes the QE1, QE2 and QE3 contactor controls to be deactivated.

Switching the speed

The speed can be switched once the "Feedback ON" signal has expired (motor is switched off) **and** on change-over from "FAST" → "SLOW" after the change-over pause has elapsed:

- Via the "OFF" control command
- Directly when "Saving change-over command" is activated.

SIMOCODE pro prevents the contactors for the "FAST" speed from being switched on at the same time as the contactor for the "SLOW" speed.

Change-over pause

The "Change-over pause" parameter can be used to delay switching from "FAST" → "SLOW" to give the motor enough time to run down.

Note

Two current settings must be set for this control function:

- I_s1 for the SLOW speed
- I_s2 for the FAST speed.

Depending on the current range, the current can in many cases be directly measured at both speeds with a single current transformer. Otherwise you will need two external current transformers appropriate for the relevant speed (e.g. 3UF18 with a 1 A secondary transformer rated current), whose secondary cables must lead through the current measuring module within the range 0.3 to 3 A. The current setting I_s1 or I_s2 must be converted according to the secondary currents of the external transformers**.** For more information, see Chapter Overload protection (Page 39).

Schematic

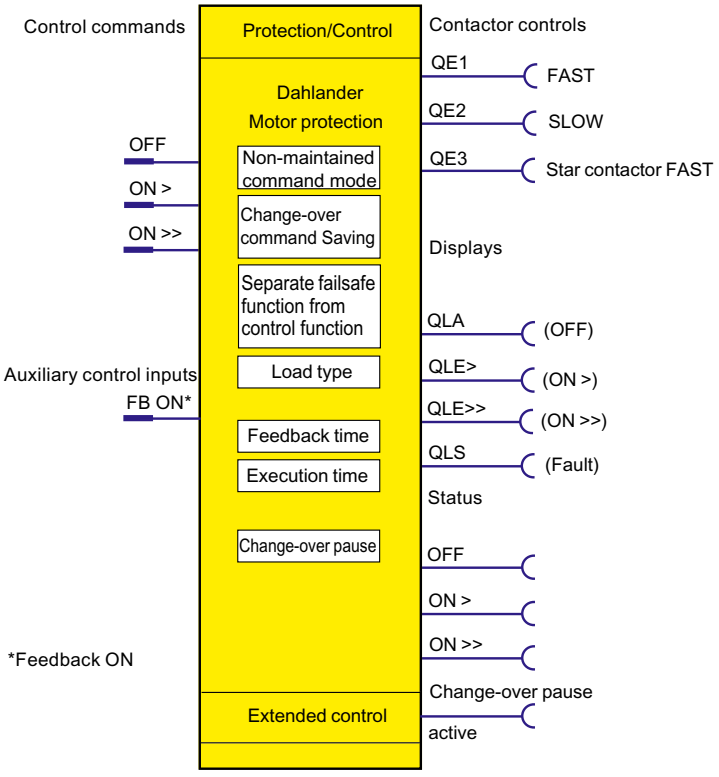


Figure 4-24 Schematic of the "Dahlander starter" control function, "Protection/Control" function block

Settings

You will find detailed explanations of the settings in Chapter Application selection, settings and definitions of control functions (Page 87).

Table 4-17 Settings for Dahlander starters

Dahlander starter	Description
OFF	Control command OFF Connection with any socket, usually with "Enabled control command OFF" socket
ON >	Control command ON > (SLOW) Connection with any socket, usually with "Enabled control command ON >" socket
ON >>	Control command ON >> (FAST) Connection with any socket, usually with "Enabled control command ON >>" socket
FB ON	"Feedback ON" auxiliary control input Connection with any socket, usually with "Status - current flowing" socket
Non-maintained command mode	• Deactivated (default setting) • Activated
Separate fail-safe function from control function	• Deactivated (default setting): • A safety-related tripping by the DM-F modules also affects the SIMOCODE pro control function, avoiding additional follow-on fault messages. This setting is selected for applications where safety-related tripping directly affects the motor controlled by SIMOCODE pro. • Activated: A safety-related tripping by the DM-F modules does not affect the SIMOCODE pro control function. This setting is selected for applications where safety-related tripping does not affect the motor controlled by SIMOCODE pro.
Saving change-over command	• Deactivated (default setting) • Activated
Load type	You can choose between: • Motor (default) • Resistive load (see Chapter Application selection, settings and definitions of control functions (Page 87))
Feedback time	Range 0 to 25.5 s (default: 0.5 s)
Execution time	Range 0 to 6553.5 s (default: 1.0 s)
Change-over pause	Range 0 to 655.3 s (10 ms steps) (default: 0.00 s)

4.3.2.10 Control function "Dahlander reversing starter"

Description

This control function can be used to change the direction of rotation of a motor at both speeds.

Control commands

- **RIGHT-SLOW:** Start with "ON >" activates contactor control QE2 (CW-SLOW)
- **RIGHT-FAST:** Start with "ON >>" first activates contactor control QE3 (star contactor FAST) and then immediately activates contactor control QE1 (CW-FAST)

- **LEFT-SLOW:** Start with "ON <" activates contactor control QE4 (CCW-SLOW)
- **LEFT-FAST:** Start with "ON <<" first activates contactor control QE3 (star contactor FAST) and then immediately activates contactor control QE5 (CCW-FAST)
- **Stop** with "OFF" deactivates the contactor controls.

The control commands can be issued to SIMOCODE pro from any control stations (see also Description of functions of control stations (Page 73)). Thus, the inputs (plugs) must be connected to the corresponding sockets, preferably to the "Enabled control command" sockets. It does not matter in what order the control commands are given. Every fault message causes the contactor control to be deactivated.

Switching the direction of rotation

The direction of rotation can be switched once the "Status - ON >" or "Status - ON <" signal has expired (motor is switched off) **and** the interlocking time has elapsed:

- Via the OFF control command
- Directly when "Saving change-over command" is activated.

SIMOCODE pro prevents both contactors from switching on at the same time. Switching from one direction of rotation to the other can be delayed via the "interlocking time."

Switching the speed

The speed can be switched once the "Feedback ON" signal has expired (motor is switched off) **and** on change-over from "FAST" → "SLOW" after the change-over pause has elapsed:

- Via the OFF control command
- Directly when "Saving change-over command" is activated.

Change-over pause

The "Change-over pause" parameter can be used to delay switching from "FAST"→"SLOW" to give the motor enough time to run down.

Safety guidelines

Note

You need at least one digital module for this control function. This control function cannot be implemented with bistable relay outputs.

Note

Two current settings must be set for this control function:

- I_s1 for the SLOW speed
- I_s2 for the FAST speed.

Depending on the current range, the current can in many cases be directly measured at both speeds with a single current transformer. Otherwise you will need two external current transformers appropriate for the relevant speed (e.g. 3UF18 with a 1 A secondary transformer rated current), whose secondary cables must lead through the current measuring module within the range 0.3 to 3 A. The current setting I_s1 or I_s2 must be converted according to the secondary currents of the external transformers. For more information, see Chapter Overload protection (Page 39).

Schematic

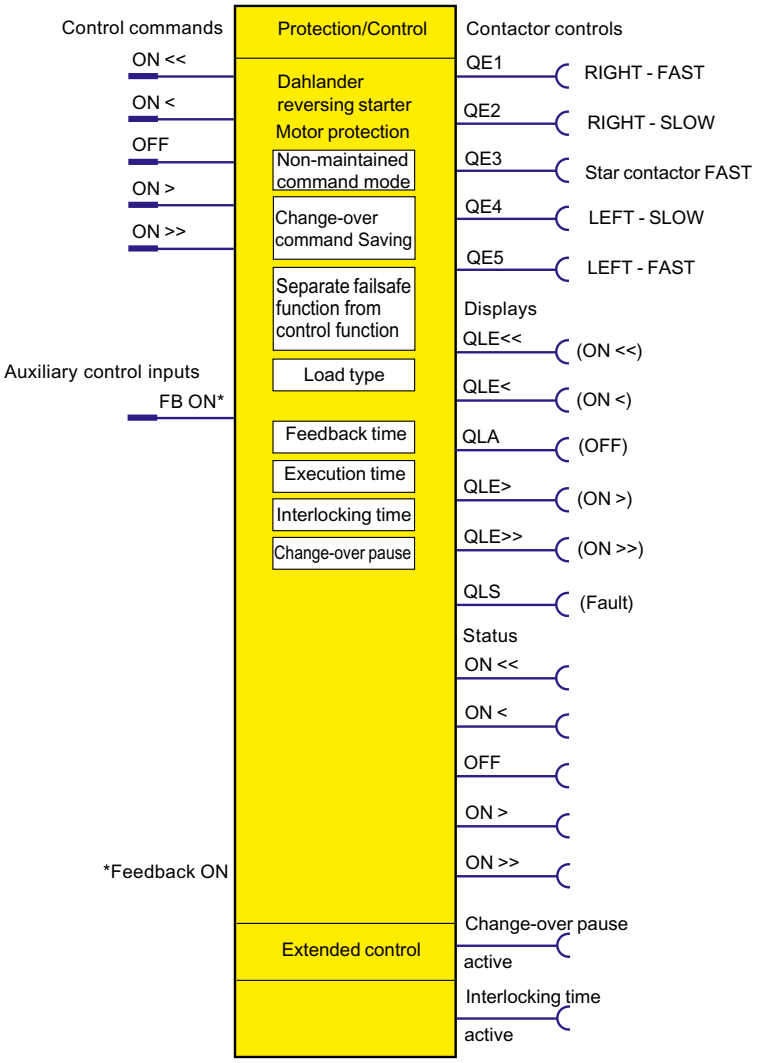


Figure 4-25 Schematic of the "Dahlander starter" control function, "Protection/Control" function block

Settings

You will find detailed explanations of the settings in Chapter Application selection, settings and definitions of control functions (Page 87).

Table 4-18 Control function settings for Dahlander reversing starter

Dahlander reversing starter	Description
OFF	Control command OFF (Connection with any socket, usually with "Enabled control command OFF" socket)
ON	Control command ON > (CW, SLOW) (connection with any socket, usually with "Enabled control command ON >" socket)
ON >>	Control command ON >> (CW, FAST) (connection with any socket, usually with "Enabled control command ON >>" socket)
ON <	Control command ON < (CCW, SLOW) (connection with any socket, usually with "Enabled control command - ON <" socket)
ON <<	Control command ON << (CCW, FAST) (connection with any socket, usually with "Enabled control command ON <<" socket)
FB ON	Auxiliary control input "Feedback ON" (connection with any socket, usually with "Status - current flowing" socket)
Non-maintained command mode	• Deactivated (default setting) • Activated
Saving change-over command	• Deactivated (default setting) • Activated
Separate fail-safe function from control function	• Deactivated (default setting): A safety-related tripping by the DM-F modules also affects the SIMOCODE pro control function, avoiding additional follow-on fault messages. This setting is selected for applications where safety-related tripping directly affects the motor controlled by SIMOCODE pro. • Activated: A safety-related tripping by the DM-F modules does not affect the SIMOCODE pro control function. This setting is selected for applications where safety-related tripping does not affect the motor controlled by SIMOCODE pro.
Load type	You can choose between: • Motor (default) • Resistive load (see Chapter Application selection, settings and definitions of control functions (Page 87))
Feedback time	Range 0 to 25.5 s (default: 0.5 s)
Execution time	Range 0 to 6553.5 s (default: 1.0 s)
Interlocking time	Range 0 to 255 s (default: 0 s)
Change-over pause	Range 0 to 655.3 s (10 ms steps) (default: 0.00 s)

4.3.2.11 "Pole-changing starter" control function

Description

With this control function, SIMOCODE pro can control motors with two stator windings at two speeds (FAST and SLOW).

Control commands

- **SLOW:** Start with "ON >" first activates the QE2 contactor control (SLOW).
- **FAST:** Start with "ON >>" activates QE1 contactor control (FAST)
- **Stop** with "OFF" deactivates the contactor controls.

The control commands can be issued to SIMOCODE pro from any control stations (see also Description of functions of control stations (Page 73)). Thus, the inputs (plugs) must be connected to the corresponding sockets, preferably to the "Enabled control command" sockets.

It does not matter in what order the control commands are given.

Every fault message causes the contactor control to be deactivated.

Switching the speed

The speed can be switched once the "Feedback ON" signal has expired (motor is switched off) **and** on change-over from "FAST"→"SLOW" after the change-over pause has elapsed:

- Via the OFF control command.
- Directly when "Saving change-over command" is activated.

Change-over pause

The "Change-over pause" parameter can be used to delay switching from "FAST"→"SLOW" to give the motor enough time to run down.

Note

Two current settings must be set for this control function:

- I_s1 for the SLOW speed
- I_s2 for the FAST speed.

Depending on the current range, the current can in many cases be directly measured at both speeds with a single current transformer. Otherwise you will need two external current transformers appropriate for the relevant speed (e.g. 3UF18 with a 1 A secondary transformer rated current), whose secondary cables must lead through the current measuring module within the range 0.3 to 3 A. The current setting I_s1 or I_s2 must be converted according to the secondary currents of the external transformers. For more information, see Chapter Overload protection (Page 39).

Schematic

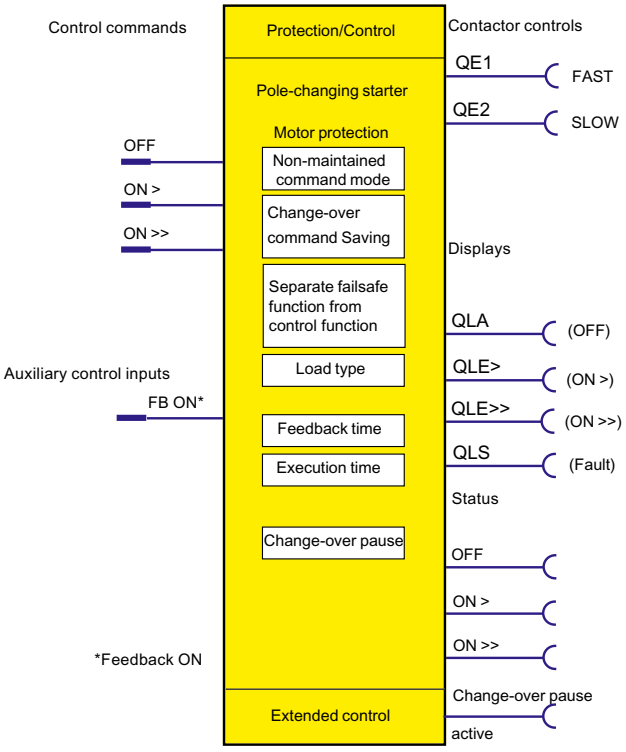


Figure 4-26 Schematic of the "Pole-changing starter" control function, "Protection / Control" function block

Settings

You will find detailed explanations of the settings in Chapter Application selection, settings and definitions of control functions (Page 87).

Table 4-19 Pole-changing starter settings

Pole-changing starter	Description
OFF	Control command OFF (connection with any socket, usually with "Enabled control command - OFF" socket)
ON >	Control command ON > (SLOW) (connection with any socket, usually with "Enabled control command - ON >" socket)
ON >>	Control command ON >> (FAST) (connection with any socket, usually with "Enabled control command - ON >>" socket)
FB ON	Auxiliary control input "Feedback ON" (connection with any socket, usually with "Status - current flowing" socket)
Non-maintained command mode	• Deactivated (default setting) • Activated
Saving change-over command	• Deactivated (default setting) • Activated

Pole-changing starter	Description
Separate fail-safe function from control function	• Deactivated (default setting): A safety-related tripping by the DM-F modules also affects the SIMOCODE pro control function, avoiding additional follow-on fault messages. This setting is selected for applications where safety-related tripping directly affects the motor controlled by SIMOCODE pro. • Activated: A safety-related tripping by the DM-F modules does not affect the SIMOCODE pro control function. This setting is selected for applications where safety-related tripping does not affect the motor controlled by SIMOCODE pro.
Load type	You can choose between: • Motor (default) • Resistive load (see Chapter Application selection, settings and definitions of control functions (Page 87))
Feedback time	Range 0 to 25.5 s (default: 0.5 s)
Execution time	Range 0 to 6553.5 s (default: 1.0 s)
Change-over pause	Range 0 to 655.3 s (10 ms steps) (default: 0.00 s)

4.3.2.12 "Pole-changing reversing starter" control function

Description

This control function can be used to change the direction of rotation of a motor at both speeds.

Control commands

- **RIGHT-SLOW:** Start with "ON >" first activates the QE2 contactor control (RIGHT-SLOW)
- **RIGHT-FAST:** Start with "ON >>" activates contactor control QE1 (CW-FAST)
- **LEFT-SLOW:** Start with "ON <" activates contactor control QE4 (CCW-SLOW)
- **LEFT-FAST:** Start with "ON <<" activates contactor control QE5 (CCW-FAST)
- **Stop** with OFF deactivates the contactor controls.

The control commands can be issued to SIMOCODE pro from any control stations. Thus, the inputs (plugs) must be connected to the corresponding sockets, preferably to the "Enabled control command" sockets.

It does not matter in what order the control commands are given. Every fault message causes the contactor control to be deactivated.

Switching the direction of rotation

The direction of rotation can be switched once the "Status - ON >" or "Status - ON <" signal has expired (motor is switched off) **and** the interlocking time has elapsed:

- Via the "OFF" control command
- Directly when "Saving change-over command" is activated.

SIMOCODE pro prevents both contactors from switching on at the same time. Switching from one direction of rotation to the other can be delayed via the "interlocking time."

Switching the speed

The speed can be switched once the "Feedback ON" signal has expired (motor is switched off) **and** on change-over from "FAST"→"SLOW" after the change-over pause has elapsed:

- Via the "OFF" control command
- Directly when "Saving change-over command" is activated.

Change-over pause

SIMOCODE pro prevents the contactors for "FAST" and "SLOW" from being switched on simultaneously. The "Change-over pause" can be used to delay switching from "FAST"→"SLOW" to give the motor enough time to run down.

Safety guidelines

Note

At least one additional digital module is required for this control function.

Note

Two current settings must be set for the pole-changing starter:

- I_s1 for the SLOW speed
- I_s2 for the FAST speed.

Depending on the current range, the current can in many cases be directly measured at both speeds with a single current transformer. Otherwise you will need two external current transformers appropriate for the relevant speed (e.g. 3UF18 with a 1 A secondary transformer rated current), whose secondary cables must lead through the current measuring module within the range 0.3 to 3 A. The current setting I_s1 or I_s2 must be converted according to the secondary currents of the external transformers. For more information, see Chapter Overload protection (Page 39).

Schematic

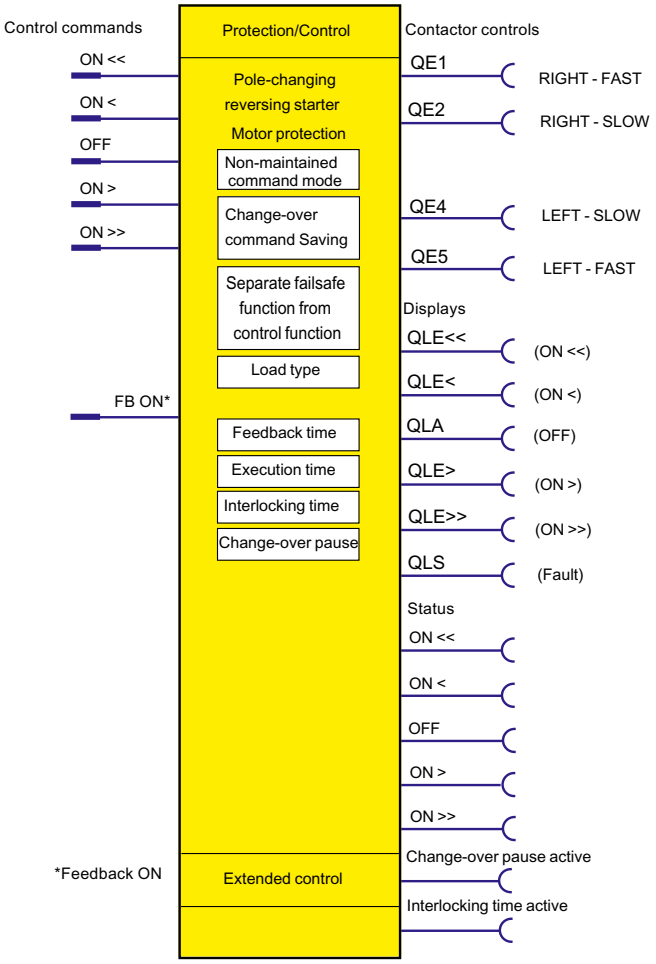


Figure 4-27 Schematic of the "Pole-changing reversing starter" control function, "Protection / Control" function block

Settings

You will find detailed explanations of the settings in Chapter Application selection, settings and definitions of control functions (Page 87).

Table 4-20 Pole-changing reversing starter settings

Pole-changing reversing starter	Description
OFF	Control command OFF (connection with any socket, usually with "Enabled control command - OFF" socket)
ON >	Control command ON > (CW, SLOW) (connection with any socket, usually with "Enabled control command ON >" socket)
ON >>	Control command ON >> (CW, FAST) (connection with any socket, usually with "Enabled control command ON >>" socket)

Pole-changing reversing starter	Description
ON <	Control command ON < (CCW, SLOW) (connection with any socket, usually with "Enabled control command - ON <" socket)
ON <<	Control command ON << (CCW, FAST) (connection with any socket, usually with "Enabled control command ON <<" socket)
FB ON	Auxiliary control input "Feedback ON" (connection with any socket, usually with "Status - current flowing" socket)
Non-maintained command mode	• Deactivated (default setting) • Activated
Saving change-over command	• Deactivated (default setting) • Activated
Separate fail-safe function from control function	• Deactivated (default setting): A safety-related tripping by the DM-F modules also affects the SIMOCODE pro control function, avoiding additional follow-on fault messages. This setting is selected for applications where safety-related tripping directly affects the motor controlled by SIMOCODE pro. • Activated: A safety-related tripping by the DM-F modules does not affect the SIMOCODE pro control function. This setting is selected for applications where safety-related tripping does not affect the motor controlled by SIMOCODE pro.
Load type	You can choose between: • Motor (default) • Resistive load (see Chapter Application selection, settings and definitions of control functions (Page 87))
Feedback time	Range 0 to 25.5 s (default: 0.5 s)
Execution time	Range 0 to 6553.5 s (default: 1.0 s)
Interlocking time	Range 0 to 255 s (default: 0 s)
Change-over pause	Range 0 to 655.3 s (10 ms steps) (default: 0.00 s)

4.3.2.13 "Solenoid valve" control function

Description

SIMOCODE pro can use this function to control a solenoid valve. The solenoid valve is brought into the corresponding end position using the control commands "OPEN" and "CLOSE". SIMOCODE pro must be informed via corresponding limit switches (FC, FO) when the end position has been reached.

Control commands

- **OPEN:** Start with "ON >" activates the QE1 internal contactor control.
- **CLOSE:** Start with "OFF" deactivates the QE1 internal contactor control.

The control commands can be issued to SIMOCODE pro from any control stations (see also Description of functions of control stations (Page 73)). Thus, the inputs (plugs) must be connected to the corresponding sockets, preferably to the "Enabled control command" sockets.

Every fault message causes the QE1 contactor control to be deactivated and puts the solenoid valve into the "CLOSED" position.

Safety guidelines

Note

The motor protection functions are not active. A current measuring module is not necessary.

Note

If both limit switches respond at the same time (FO = 1 and FC = 1), the solenoid valve is immediately switched off via the fault message "Fault - Double 1" (= "CLOSED").

If the end position feedback does not correspond to the control command, the valve is switched off with the fault message "Fault - end position fault" (="CLOSED").

Note

Fault - Execution OFF command is issued if the "OPEN" end position is not reached in the parameterized time.

Fault - Execution ON command is issued if the "CLOSED" end position is not reached in the parameterized time.

Schematic

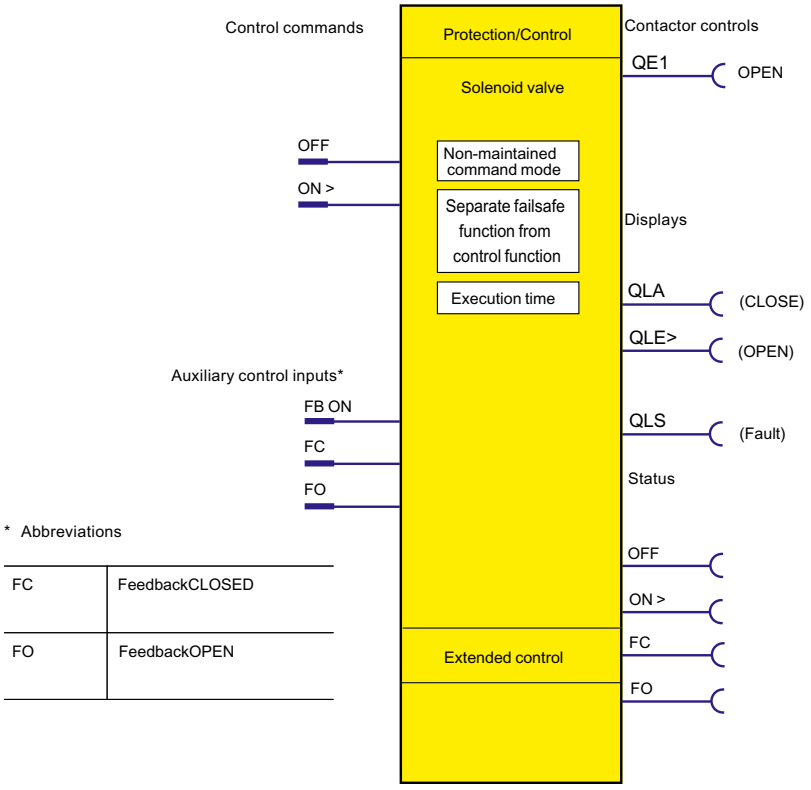


Figure 4-28 Schematic of the "Solenoid valve" control function, "Protection / Control" function block

Settings

You will find detailed explanations of the settings in Chapter Application selection, settings and definitions of control functions (Page 87).

Table 4-21 Solenoid valve control function settings

Solenoid valve	Description
OFF	Control command OFF (CLOSED) (connection with any socket, usually with "Enabled control command OFF" socket)
ON >	Control command ON (OPEN) (connection with any socket, usually with socket "Enabled control command - ON >")
Non-maintained command mode	• Deactivated (default setting) • Activated

Solenoid valve	Description
Separate fail-safe function from control function	• Deactivated (default setting): A safety-related tripping by the DM-F modules is also effected by the SIMOCODE pro control function, avoiding additional follow-on fault messages. This setting is selected for applications where safety-related tripping directly affects the motor controlled by SIMOCODE pro. • Activated: A safety-related tripping by the DM-F modules does not affect the SIMOCODE pro control function. This setting is selected for applications where safety-related tripping does not affect the motor controlled by SIMOCODE pro.
Execution time	Time until the end position is reached. Range 0 to 6553.5 s (default: 1.0 s)

4.3.2.14 "Positioner" control function

Description

SIMOCODE pro can control positioners / actuators with this function. The positioner is moved into the corresponding end position with the "OPEN" and "CLOSED" control commands and is deactivated via its limit switches (1-active) or torque switches (0-active). The response of the limit / torque switches must be passed to SIMOCODE pro via its inputs.

Control commands

- **OPEN:** Start with "ON >" activates contactor control QE1 until "End position OPEN" is reached (Feedback OPEN)
- **CLOSE:** Start with "ON <" activates contactor control QE2 until "End position CLOSED" is reached (Feedback CLOSED)
- **Stop** with "OFF" deactivates the contactor controls. The drive remains in the present position.

The control commands can be issued to SIMOCODE pro from any control stations (see also Description of functions of control stations (Page 73)). Thus, the inputs (plugs) must be connected to the corresponding sockets, preferably to the "Enabled control command" sockets.

Function schematic

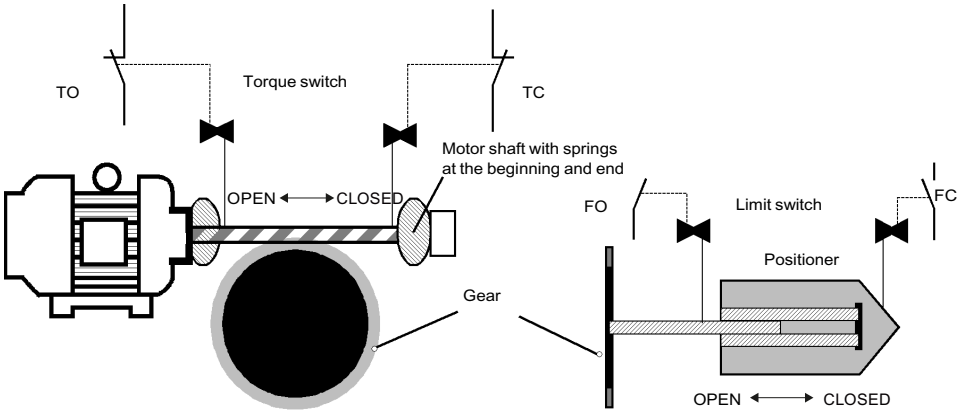


Figure 4-29 Function schematic of the torque and limit switches when controlling positioners

Switching the direction of travel

The direction of travel can be switched once the "Feedback ON" signal has expired (motor is switched off) **and** the interlocking time has elapsed:

- Via the "OFF" control command.

SIMOCODE pro prevents both contactors from switching on at the same time. Switching from one direction of travel to the other can be delayed via the "interlocking time".

Note

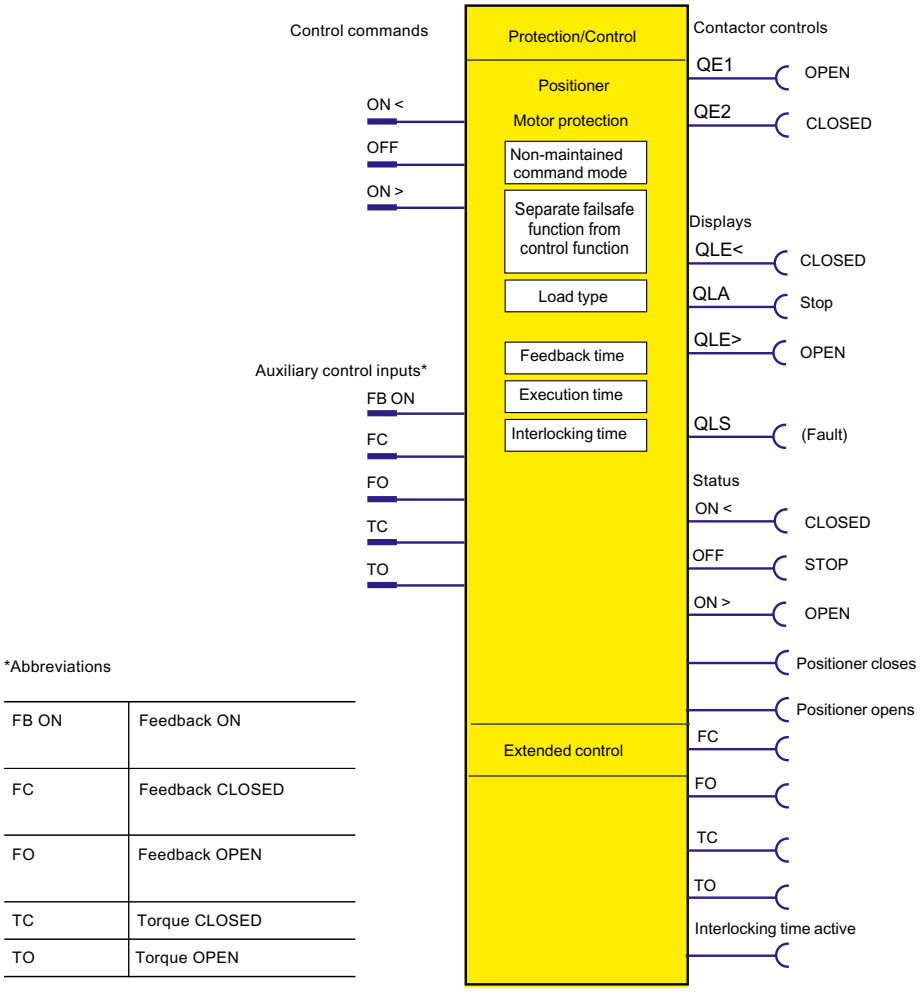
The corresponding torque switch must not respond before the associated limit switch when the torque switch TO (OPEN) and/or TC (CLOSED) is connected! In this case, the positioner is switched off immediately with the fault message "Fault - stalled positioner." If both limit switches respond simultaneously (FO=1 and FC=1), the positioner is switched off immediately with the fault message 'Fault - double 1'. If both torque switches respond at the same time (FO=0 and FC=0), the positioner is immediately switched off with the fault message "Fault - double 0." If the end position feedback does not correspond to the control command, the positioner is switched off with the fault message "Fault - end position fault."

Note

Fault - Execution OFF command is issued if the "OPEN" end position is not reached in the parameterized time.

Fault - Execution ON command is issued if the "CLOSED" end position is not reached in the parameterized time.

Schematic



*Abbreviations

FB ON	Feedback ON
FC	Feedback CLOSED
FO	Feedback OPEN
TC	Torque CLOSED
TO	Torque OPEN

Figure 4-30 Schematic of the "Positioner" control function, "Protection / Control" function block

Types of positioner control

The following table shows the five types of positioner control:

Table 4-22 Types of positioner control

Type **Tripping**	**TC** **Torque closed**	**FC** **Limit closed**	**FO** **Limit open**	**TO** **Torque open**
Positioner 1 After reaching the end position FO (OPEN) or FC (CLOSED).	—	**X**	**X**	—
Positioner 2 After reaching the end position FO (OPEN) or FC (CLOSED) and response of the associated torque switch TO (OPEN) or TC (CLOSED)	**X**	**X**	**X**	**X**
Positioner 3 After reaching the end position FO (OPEN). After reaching end position (CLOSED), the respective torque switch TC must also respond after the limit switch FC has responded.	**X**	**X**	**X**	—
Positioner 4 After reaching the end position FC (CLOSED). After reaching end position FO (OPEN), the respective torque switch FO must also respond after the limit switch TO has responded.	—	**X**	**X**	**X**
Positioner 5 After reaching the end position or the torque. The valve actuator is monitored either just with the limit switches or just with the torque switches. The switches are implemented as change-over contacts and are checked for antivalence. In the case of non-antivalent feedback (e.g. FC=0 and TC=0), SIMOCODE pro detects an open circuit and deactivates the positioner with the fault message "Fault - Antivalence"	**Antivalent active**		**Antivalent active**	

Note

The signals of the torque switches and the limit switches must be wired to the inputs of the basic unit. Torque switches must be 0-active, whereas the limit switches must be 1-active.

Settings

You will find detailed explanations of the settings in Chapter Application selection, settings and definitions of control functions (Page 87).

Table 4-23 Positioner control function settings

Positioner	Description
ON <	Control command ON < (CLOSED) (connection with any socket, usually with "Enabled control command - ON <" socket)
OFF	Control command STOP (connection with any socket, usually with "Enabled control command - OFF" socket)
ON >	Control command ON (OPEN) (connection with any socket, usually with "Enabled control command - ON >" socket)
FB ON	Auxiliary control input "Feedback ON" (connection with any socket, usually with "Status - current flowing" socket)
FC	Auxiliary control input "Feedback CLOSED" (connection with any socket, usually with the socket of an input to which the limit switch is wired.)
FO	Auxiliary control input "Feedback OPEN" (connection with any socket, usually with the socket of an input to which the limit switch is wired.)
TC	Auxiliary control input "Torque CLOSED" (connection with any socket, usually with the socket of an input to which the torque switch is wired.)
TO	Auxiliary control input "Torque OPEN" (connection with any socket, usually with the socket of an input to which the torque switch is wired.)
Non-maintained command mode	• Deactivated (default setting) • Activated
Separate fail-safe function from control function	• Deactivated (default setting): A safety-related tripping by the DM-F modules is also effected by the SIMOCODE pro control function, avoiding additional follow-on fault messages. This setting is selected for applications where safety-related tripping directly affects the motor controlled by SIMOCODE pro. • Activated: A safety-related tripping by the DM-F modules does not affect the SIMOCODE pro control function. This setting is selected for applications where safety-related tripping does not affect the motor controlled by SIMOCODE pro.
Load type	You can choose between: • Motor (default) • Resistive load (see Chapter Application selection, settings and definitions of control functions (Page 87))
Feedback time	Range 0 to 25.5 s (default: 0.5 s)
Execution time	Time until the end position is reached. Range 0 to 6553.5 s (default: 1.0 s)
Interlocking time	Range 0 to 255 s (default: 0 s)

4.3.2.15 "Soft starter" control function

Description

With this control function, SIMOCODE pro can activate the 3RW soft starter. Thus, the 3RW soft starters are connected via SIMOCODE pro to the bus.

Control commands

- Start with "ON >" activates contactor controls QE1 and QE4.
- Stop with "OFF" first deactivates contactor control QE4. When the signal "Feedback ON" has expired, the QE1 contactor control is deactivated 3 s later in order to facilitate a smooth run down via the soft starter.
- With "Reset", the QE3 contactor control is activated for 20 ms and sends the soft starter an acknowledgement signal via a parameterizable relay output.

The control commands can be issued to SIMOCODE pro from any control stations (see also Description of functions of control stations (Page 73)). Thus, the inputs (plugs) must be connected to the corresponding sockets, preferably to the "Enabled control command" sockets.

Every fault message causes the contactor control to be deactivated.

Making internal assignments

You have to make the following assignments:

1. Assign the QE1 contactor control to the relay output which controls the coil of the line contactor.
2. Assign contactor control QE4 to any relay output from which the "ON input" of the soft starter is to be controlled.
3. Assign the QE3 contactor control to the relay output that supplies the 20 ms acknowledgment signal to the soft starter.
4. Assign the "ON >" and "OFF" control commands to the enabled control commands.
5. Assign the SIMOCODE pro input to which the "Fault" signal output of the soft starter is connected to the input (socket) of the standard function "External fault 1."
6. The "startup end" signal of the soft starter can also be wired to one of the inputs and processed by SIMOCODE pro.

Note

In order to avoid disconnections due to faults, the "Execution time" parameter in SIMOCODE pro must be set at least to the soft run-down time of the soft starter.

Note

If the SIMOCODE pro S basic unit is used, an additional multifunction module is required for this control function.

Schematic

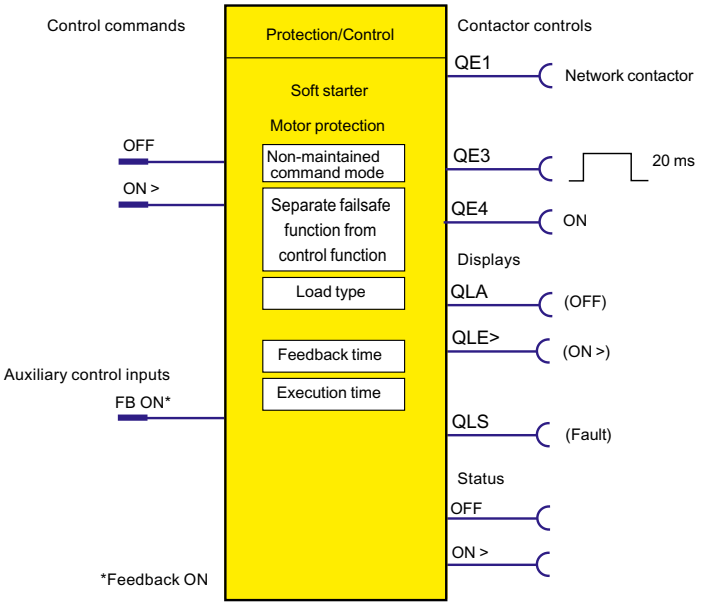


Figure 4-31 Schematic of "Soft starter" control function, "Protection / Control" function block

Settings

You will find detailed explanations of the settings in Application selection, settings and definitions of control functions (Page 87).

Table 4-24 Soft starter settings

Soft starter	Description
OFF	Control command OFF (connection with any socket, usually with "Enabled control command OFF" socket)
ON >	Control command ON (connection with any socket, usually with "Enabled control command ON >" socket)
FB ON	Auxiliary control input "Feedback ON" (connection with any socket —(, usually with socket "Status - current flowing")
Non-maintained command mode	• Deactivated (default setting) • Activated
Separate fail-safe function from control function	• Deactivated (default setting): A safety-related tripping by the DM-F modules also affects the SIMOCODE pro control function, avoiding additional follow-on fault messages. This setting is selected for applications where safety-related tripping directly affects the motor controlled by SIMOCODE pro. • Activated: A safety-related tripping by the DM-F modules does not affect the SIMOCODE pro control function. This setting is selected for applications where safety-related tripping does not affect the motor controlled by SIMOCODE pro.

Soft starter	Description
Load type	You can choose between: • Motor (default) • Resistive load (see Chapter Application selection, settings and definitions of control functions (Page 87))
Feedback time	Range 0 to 25.5 s (default: 0.5 s)
Execution time	At least ≥ soft run-down time Range 0 to 6553.5 s (default: 1.0 s)

4.3.2.16 "Soft starter with reversing contactor" control function

Description

With this control function, SIMOCODE pro can activate the 3RW soft starter including an additional reversing contactor. Thus, the 3RW soft starters are connected via SIMOCODE pro to the bus. SIMOCODE pro can also control the direction of rotation of the motor (forwards and backwards).

Control commands

- Start with "ON >" activates contactor controls QE1 and QE4 (clockwise, i.e. forwards)
- Start with "ON <" activates contactor controls QE2 and QE4 (counterclockwise, i.e. reverse).
- Stop with "OFF" first deactivates contactor control QE4. When the "Feedback ON" signal is no longer issued, contactor control QE1 / QE2 is deactivated 3 s later to leave enough time for a soft run-down via the soft starter.
- With "Reset", the QE3 contactor control is activated for 20 ms and sends the soft starter an acknowledgement signal via a parameterizable relay output.

The control commands can be issued to SIMOCODE pro from any control stations (see also Description of functions of control stations (Page 73)). Thus, the inputs (plugs) must be connected to the corresponding sockets, preferably to the "Enabled control command" sockets.
Every fault message causes the contactor controls to be deactivated.

Switching the direction of rotation

The direction of rotation can be switched once the "Status - ON >" or "Status - ON <" signal has expired (motor is switched off) AND the interlocking time has elapsed:

- Via the "OFF" control command
- Directly when "Saving change-over command" is activated.

SIMOCODE pro prevents both contactors from switching on at the same time. Switching from one direction of rotation to the other can be delayed via the interlocking time.

Making internal assignments

You have to make the following assignments:

1. Assign the QE1 contactor control to the relay output which controls the coil of the line contactor (right).
2. Assign the QE2 contactor control to the relay output which controls the coil of the line contactor (left).
3. Assign the QE4 contactor control to any relay output from which the "ON input" of the soft starter should be controlled.
4. Assign the QE3 contactor control to the relay output that supplies the 20 ms acknowledgment signal to the soft starter.
5. Assign the "ON >", "ON <" and "OFF" control commands to the enabled control commands.
6. Assign the SIMOCODE pro input to which the "Fault" signal output of the soft starter is connected to the input (socket) of the standard function "External fault 1."
7. The "startup end" signal of the soft starter can also be wired to one of the inputs and processed by SIMOCODE pro.

Note

An additional digital module may be necessary for this control function.

Schematic

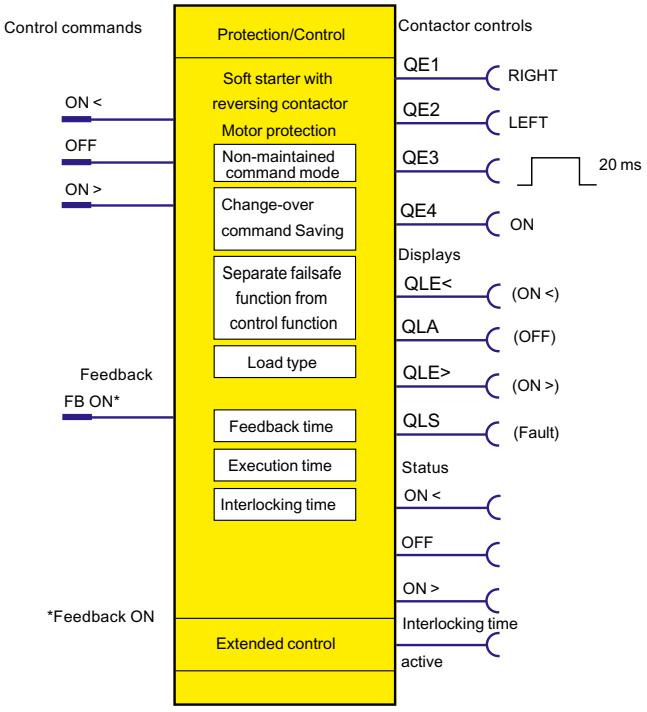


Figure 4-32 Schematic of the "Soft starter with reversing contactor" control function, "Protection / Control" function block

Settings

You will find detailed explanations of the settings in Chapter Application selection, settings and definitions of control functions (Page 87).

Table 4-25 Soft starter with reversing contactor settings

Soft starter with reversing contactor	Description
ON >	Control command ON > (clockwise) (connection with any socket, usually with "Enabled control command - ON >" socket)
OFF	Control command OFF (connection with any socket, usually with "Enabled control command OFF" socket)
ON <	Control command ON < (counterclockwise) (connection with any socket, usually with "Enabled control command - ON <" socket)
FB ON	Auxiliary control input "Feedback ON" (connection with any socket, usually with "Status - current flowing" socket)
Non-maintained command mode	• Deactivated (default setting) • Activated
Saving change-over command	• Deactivated (default setting) • Activated

Soft starter with reversing contactor	Description
Separate fail-safe function from control function	• Deactivated (default setting): A safety-related tripping by the DM-F modules also affects the SIMOCODE pro control function, avoiding additional follow-on fault messages. This setting is selected for applications where safety-related tripping directly affects the motor controlled by SIMOCODE pro. • Activated: A safety-related tripping by the DM-F modules does not affect the SIMOCODE pro control function. This setting is selected for applications where safety-related tripping does not affect the motor controlled by SIMOCODE pro.
Load type	You can choose between: • Motor (default) • Resistive load (see Chapter Application selection, settings and definitions of control functions (Page 87))
Feedback time	Range 0 to 25.5 s (default: 0.5 s)
Execution time	Execution time ≥ Soft run-down time Range 0 to 6553.5s (default: 1.0 s)
Interlocking time	Range 0 to 255 s (default: 0 s)

4.3.3 Active control stations, contactor controls, lamp controls and status information for the control functions

Table 4-26 Active control stations of control functions

Designation / control function	Control station				
	ON <<	**ON <**	**OFF**	**ON >**	**ON >>**
Overload [1) 2) 3)]	-	-	-	-	-
Direct starter [1) 2) 3)]	-	-	OFF	ON	-
Reversing starter [1) 2) 3)]	-	CCW	OFF	CW	-
Circuit breaker [1) 2) 3)]	-	-	OFF	ON	-
Star-delta starter [2) 3)]	-	-	OFF	ON	-
Star-delta reversing starter [2)]	-	CCW	OFF	CW	-
Dahlander starter [2)]	-	-	OFF	SLOW	FAST
Dahlander reversing starter [2)]	CCW-FAST	CCW-SLOW	OFF	CW-SLOW	CW-FAST
Pole-changing starter [2)]	-	-	OFF	SLOW	FAST
Pole-changing reversing starter [2)]	CCW-FAST	CCW-SLOW	OFF	CW-SLOW	CW-FAST
Solenoid valve [2)]	-	-	CLOSED	OPEN	-
Positioner 1 [2)]	-	CLOSED	Stop	OPEN	-
Positioner 2 [2)]	-	CLOSED	Stop	OPEN	-
Positioner 3 [2)]	-	CLOSED	Stop	OPEN	-
Positioner 4 [2)]	-	CLOSED	Stop	OPEN	-
Positioner 5 [2)]	-	CLOSED	Stop	OPEN	-
Soft starter [2) 3)]	-	-	OFF	ON	-
Soft starter with reversing contactor [2)]	-	CCW	OFF	CW	-

Table 4-27 Contactor control with control functions

Designation / control function	**Control station**				
	QE1	QE2	QE3	QE4	QE5
Overload [1) 2) 3)]	-	-	Active	-	-
Direct starter [1) 2) 3)]	ON	-	-	-	-
Reversing starter [1) 2) 3)]	CW	CCW	-	-	-
Circuit breaker [1) 2) 3)]	ON pulse	-	OFF pulse	-	-
Star-delta starter [2) 3)]	Star contactor	Delta contactor	Line contactor	-	-
Star-delta reversing starter [2)]	Star contactor	Delta contactor	RIGHT line contactor	LEFT line contactor	-
Dahlander starter [2)]	FAST	SLOW	Star contactor FAST	-	-
Dahlander reversing starter [2)]	CW-FAST	CW-SLOW	Star contactor FAST	CCW-SLOW	CCW-FAST
Pole-changing starter [2)]	FAST	SLOW	-	-	-
Pole-changing reversing starter [2)]	CW-FAST	CW-SLOW	-	CCW-SLOW	CCW-FAST
Solenoid valve [2)]	OPEN	-	-	-	-
Positioner 1 [2)]	OPEN	CLOSED	-	-	-
Positioner 2 [2)]	OPEN	CLOSED	-	-	-
Positioner 3 [2)]	OPEN	CLOSED	-	-	-
Positioner 4 [2)]	OPEN	CLOSED	-	-	-
Positioner 5 [2)]	OPEN	CLOSED	-	-	-
Soft starter [2) 3)]	ON line contactor	-	Reset	ON command	-
Soft starter with reversing contactor [2)]	RIGHT line contactor	LEFT line contactor	Reset	ON command	-

Table 4-28 Lamp control with control functions

Designation / control function	**Lamp control**				
	QLE << (ON <<)	**QLE < (ON <)**	**QLA (OFF)**	**QLE > (On >)**	**QLE >> (ON >>)**
Overload [1) 2) 3)]	-	-	-	-	-
Direct starter [1) 2) 3)]	-	-	OFF	ON	-
Reversing starter [1) 2) 3)]	-	CCW	OFF	CW	-
Circuit breaker [1) 2) 3)]	-	-	OFF	ON	-
Star-delta starter [2) 3)]	-	-	OFF	ON	-
Star-delta reversing starter [2)]	-	CCW	OFF	CW	-
Dahlander starter [2)]	-	-	OFF	SLOW	FAST
Dahlander reversing starter [2)]	CCW-FAST	CCW-SLOW	OFF	CW-SLOW	CW-FAST
Pole-changing starter [2)]	-	-	OFF	SLOW	FAST
Pole-changing reversing starter [2)]	CCW-FAST	CCW-SLOW	OFF	CW-SLOW	CW-FAST
Solenoid valve [2)]	-	-	CLOSED	OPEN	-

Designation / control function	Lamp control				
Positioner 1 [2]	-	CLOSED	Stop	OPEN	-
Positioner 2 [2]	-	CLOSED	Stop	OPEN	-
Positioner 3 [2]	-	CLOSED	Stop	OPEN	-
Positioner 4 [2]	-	CLOSED	Stop	OPEN	-
Positioner 5 [2]	-	CLOSED	Stop	OPEN	-
Soft starter [2] [3]	-	-	OFF	ON	-
Soft starter with reversing contactor [2]	-	CCW	OFF	CW	-

1) SIMOCODE pro C basic unit

2) SIMOCODE pro V basic units

3) SIMOCODE pro S basic unit

4.4 Monitoring functions

4.4.1 Ground fault monitoring

4.4.1.1 Ground-fault monitoring

Residual current monitoring relays are used in industry to:

- Protect systems from damage caused by residual currents
- Prevent production losses caused by unplanned downtime
- Perform maintenance to meet all demands.

In particular, ground-fault monitoring is used in conjunction with 3UL23 residual current transformers to monitor systems where environmental conditions increase the chance of fault currents.

Internal ground-fault monitoring

SIMOCODE pro acquires and monitors all three phase currents. By evaluating the summation current of the three current values, the motor feeder can be monitored for a possible residual current or ground fault.

Internal ground-fault monitoring via current measuring modules or current / voltage measuring modules is only possible for motors with a 3-phase connection in power systems that are either grounded solidly or with low impedance.

NOTICE
Star-delta connection Spurious tripping can occur if you use internal ground-fault monitoring for star-delta circuits. During delta operation, the summation current is non-zero due to harmonics.

External ground-fault monitoring

The external ground-fault monitoring is normally used in the following cases:

- in cases in which power systems are grounded with high impedance
- in cases, in which precise detection of the ground-fault current is necessary, for example, for condition monitoring.

With ground-fault detection using the residual current transformer 3UL23, it is possible to determine the precise residual current as a measured value to define freely selectable warning and trip levels in a wide range 30 mA to 40 A.

Method of operation:

The main conductors and, if present, the neutral conductor to which the load is connected, are routed through the opening of the residual current transformer 3UL23. Its secondary winding is connected to the ground-fault module.

If an insulation fault occurs, for example, a residual current arises between the incoming and the outgoing currents that is evaluated via the residual-current transformer.

For maximum plant availability, the ground-fault module 3UF7 510-1AA00-0 and the residual current transformer 3UL23 were developed with the following design goals:

- High measuring accuracy: The ground-fault module in conjunction with the residual current transformer 3UL23 achieves a measuring accuracy of ±7.5 %. This enables set limit values to be monitored very precisely. Spurious tripping caused by measuring errors is minimized. The combination of ground-fault module and residual current transformer 3UL23 is designed so that a warning or alarm is triggered at the latest upon exceeding the set limit values. To achieve this, slightly higher residual currents than those actually measured are displayed and compared with the set limit values. The measuring accuracy is -15 % to 0 % of the value displayed. This takes into account the measuring accuracy of monitoring relay and residual current transformer.
- Settable prewarning and trip levels: The threshold levels for the residual current are defined over a very wide range of 30 mA to 40 A. The response of SIMOCODE pro on reaching a prewarning level or trip level can be freely parameterized, including a delay.
- Permanent self-monitoring: The permanent self-monitoring of the ground-fault module 3UF7 510-1AA00-0 and the connected transformer ensures reliable monitoring of the function. The connected 3UL23 residual current transformer is also permanently monitored for open-circuit or short-circuit. This means cyclic manual tests to verify the function are obsolete.
- Settable active status and delay times of the residual current protection. Depending on the application, the monitoring function can be active permanently, only when the motor is running, or only after the motor has started. This permits the suppression of residual currents that are only measured during motor starting due to high starting currents. Short-term residual currents or immitted interference can be easily suppressed by means of the adjustable tripping delay time.

Use of the residual current transformers 3UL22 and 3UL23:

- Use the residual current transformer 3UL23 to detect residual currents with the ground-fault module 3UF7 510-1AA00-0. The residual current transformer 3UL23 is suitable for detecting pure AC residual currents and AC residual currents with a pulsating DC component.

Note

Precondition for using a 3UF7 510-1AA00-0 ground-fault module

Use of this ground-fault module requires a SIMOCODE pro V PB basic unit, with at least product version *E10* (from 09/2013) or a SIMOCODE pro V PN basic unit with at least product version E04*.

- Use the 3UL22 residual current transformer to detect residual currents with the 3UF7 500-1AA00-0 ground-fault module.

Note

Only monitoring of the residual current trip level possible

With this combination, it is only possible to monitor a trip level of the residual current. Measured values are then not available for the residual current.

Note

Precondition for using a 3UF7 500-1AA00-0 ground-fault module

Use of this ground-fault module requires a SIMOCODE pro V PB basic unit, at least version *E02* or later (from 04/2005).

⚠ WARNING

Open-circuit voltage may result in death, serious injury or material damage!

The current transformer output is a constant current power supply. In accordance with U = R * I, the output voltage increases with an increasing resistance. If the connecting terminals of the current transformer are open, the output voltage may become high enough for you to put your life at risk or permanently damage the current transformer.

Avoid operating the unit when open. Operating a network for monitoring safely and without faults requires that the ground fault module and the 3UL23 residual-current transformer have been installed completely. It is absolutely necessary to short-circuit previously installed 3UL23 residual-current transformers when the units are not connected to a ground fault module.

⚠ DANGER

No personal or fire protection!

The ground-fault modules 3UF75* monitor that devices and systems are functioning correctly.

They are not suitable for personal protection or protection from fires.

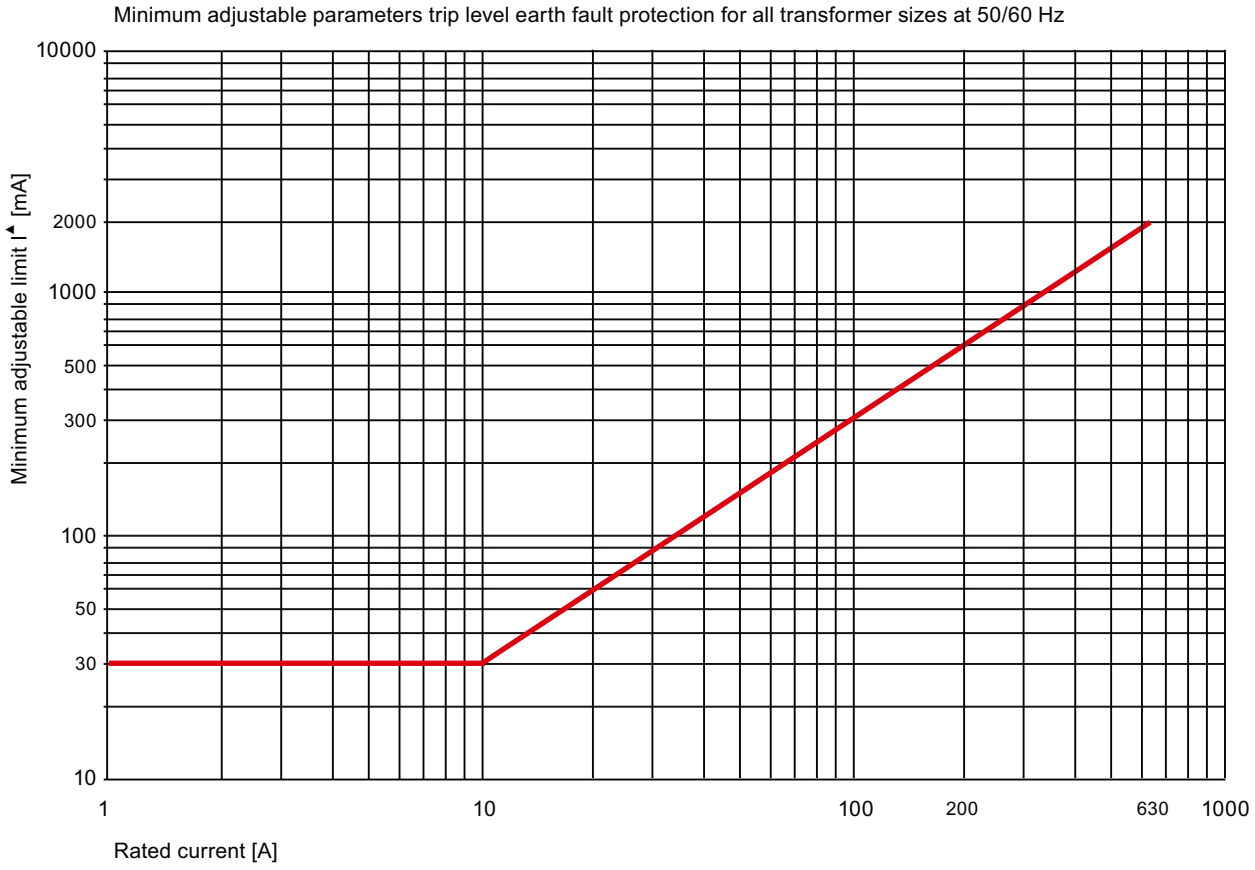
A definable and delayable response can be parameterized in the event a ground fault is detected. A message is output if the ground fault limit is exceeded.

You can define additional trips by parameterization. If the rated fault currents are exceeded, SIMOCODE pro V responds either

- by turning off the contactor controls QE*, or
- by issuing a warning.

4.4.1.2 Limits of fault current measurement

In the event of increasing primary currents, imbalances in the cable routing and current loads in individual cables increasingly cause what appear to be residual currents that are detected by the evaluation units. Spurious tripping may therefore occur if excessively low monitoring limit values have been set at high primary currents. Because of these tolerances in the configuration, the measuring accuracy no longer corresponds to the stated range of ±7.5 %. To avoid spurious tripping, we recommend setting the limit values to the minimum values listed in the following graphic, depending on the applicable primary current.



If monitoring is required within limit values that are lower than those recommended, we recommend the use of delay times, particularly if spurious tripping occurs exclusively during motor startup. If delay times do not lead to the desired result, the use of shield sleeves may considerably lower the minimum possible monitoring limit.

You will find more information in Chapters "2.5.2 Installation specifications" and "2.5.3 Optimization options" in the Manual 3UG4/3RR2 Monitoring Relay (https://support.industry.siemens.com/cs/ww/en/ps/16367/man).

The monitored current waveforms also have a strong influence on the measuring accuracy. In the case of loads with generalized phase control, deviations from the measuring accuracy can occur when monitoring for high residual current limits. The cause of this is the extreme difference between the monitored rms values and the peak values of the residual current.

The more extreme the generalized phase control, the shorter the time during which current flows, and the lower the resulting rms value. To achieve and monitor a high rms value in such a case, an extremely high peak value of the residual current is necessary. In the case of high currents, current transformers tend towards saturation in which a further increase in current on the primary side does not result in an equivalent increase on the secondary side. In the case of extreme peak values of the residual current, the measuring accuracy suffers as a result of this principle. Due to the great difference between the peak value and the rms value, monitoring for lower limits is useful.

4.4.1.3 Internal ground-fault monitoring when using a 2nd generation current / voltage measuring module

Settings

You can parameterize two different response levels (trip level, warning level) for monitoring the ground-fault current.

If the ground-fault current exceeds the response level, the current limit monitoring will respond.

See also "Tables of responses of SIMOCODE pro" in Chapter Important notes (Page 7).

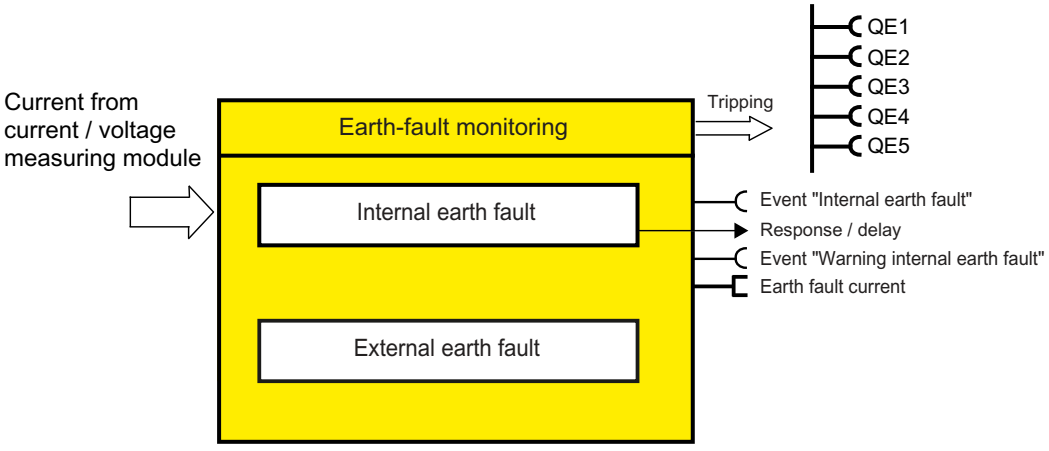


Figure 4-33 "Ground-fault Monitoring" function block

Trip level, warning level

You can parameterize two different response levels (trip level, warning level) for monitoring the ground-fault current.

If the ground-fault current exceeds the response level, the current limit monitoring will respond.

The lowest value for internal ground-fault monitoring that can be set as the warning and trip level is 10% of the set rated motor current I_s.

Trip level	10 to 120 % of I_s in steps of 1% (default: 30)
Warning level	10 to 120 % of I_s in steps of 1% (default: 30)

Two use cases are distinguished depending on the effective motor current through the measuring module:

- Normal stationary use case up to 1.2 x rated motor current I_s: Residual currents greater than the value of the set trip/warning levels are detected. Ground-fault monitoring fulfills the accuracy requirements of IEC 60947-1 Class CI-B.
- Temporary starting or overload operation greater than 1.2 x rated motor current I_s: Responsiveness in the overload range of > 1.2 x rated motor current is reduced to reduce false tripping. Residual currents > I_trip_level + 12.5% x (I_max - 120% x I_s) are detected.

The following levels of accuracy apply to motor currents in the range from 20% x I_u to 120% x I_s:

- I_Fault_Rated in the range 30% to 120% x I_s: Accuracy of the detected residual current with warning or trip level: ±10% according to IEC 60947-1, Annex T, Class CI-A
- I_Fault_Rated in the range 15% to 30% x I_s: Accuracy of the detected residual current with warning or trip level: ±25% according to IEC 60947-1, Annex T, Class CI-B
- I_Fault_Rated in the range 10% to 15% x I_s: No type testing according to IEC 60947-1

Response to trip level

Here you can set how SIMOCODE pro should respond if the trip level is overshot.

See also "Tables of responses of SIMOCODE pro" in Chapter Important notes (Page 7).

Table 4-29 Response to "trip level" in ground-fault monitoring

Response	Trip level
deactivated	X (d)
signal	X
warn	—
trip	X
delay	0 to 25.5 s (default: 0.5 s)

Response to warning level

Here you can set how SIMOCODE pro should respond if the warning level is overshot.

See also "Tables of responses of SIMOCODE pro" in Chapter Important notes (Page 7).

Table 4-30 Response to "warning level" in ground-fault monitoring

Response	Warning level
deactivated	X
signal	X (d)
warn	X
trip	—
delay	0 to 25.5 s (default: 0.1 s)

Hysteresis

Here you can set the hysteresis for the ground-fault current:

Hysteresis	0 to 15% of the level value in steps of 1% Default: 5 %

4.4.1.4 Internal ground-fault monitoring when using a current measuring module or a 1st generation current / voltage measuring module

Response

Here you can set how SIMOCODE pro will respond to an internal ground fault:

See also "Tables of responses of SIMOCODE pro" in Chapter Important notes (Page 7).

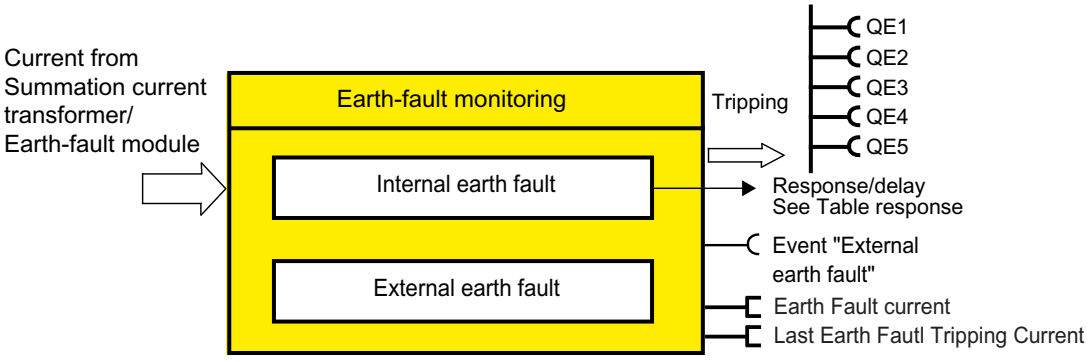


Figure 4-34 "Ground-fault Monitoring" function block

Table 4-31 "Internal ground-fault monitoring" response

Response	Internal ground fault
deactivated	X (d)
signal	X
warn	X
trip	X
delay	0 to 25.5 s (default: 0.5 s)

You can activate internal ground-fault monitoring by parameterization. It covers two different operating conditions:

- Normal operation up to 2 x I_s. The actual operating current must be smaller than twice the current setting I_s. Residual currents of > 30 % of the current setting I_s are detected.
- Start-up or overload operation to 2 x I_s. The actual operating current is greater than 2x the current setting I_s. Residual currents of > 15 % of the effective motor current will be detected.

4.4.1.5 External ground-fault monitoring with a 3UF7500 ground-fault module and 3UL22 differential current transformer

Response

Here you can set how SIMOCODE pro will respond to an external ground fault.

You will find more information in Section "Tables of responses of SIMOCODE pro" in Chapter Important notes (Page 7).

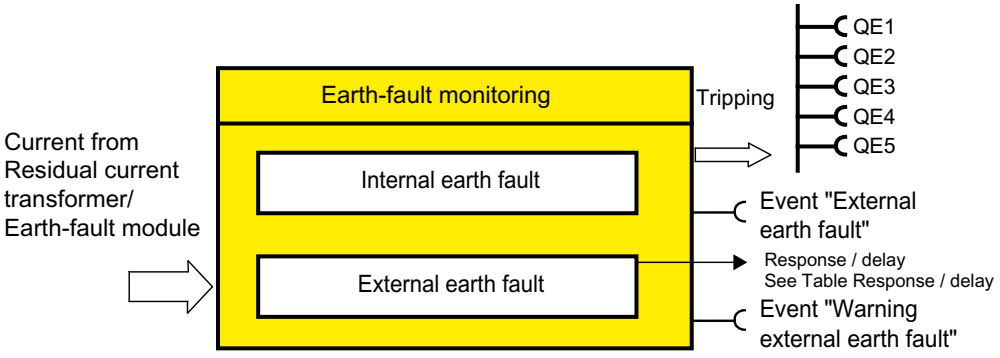


Figure 4-35 "Ground-fault Monitoring" function block

Table 4-32 "External ground-fault monitoring" response

Response	External ground fault
deactivated	-
signal	X (d)
warn	X
trip	X
delay	0 to 25.5 s (default: 0.5 s) 1)
1) Extension of the residual current transformer delay	

If the response is set to "signal", the message "External ground fault" is generated for a ground fault.

If the response is set to "warn", the message "Warning external ground fault" is generated for a ground fault.

4.4.1.6 External ground-fault monitoring with a 3UF7510 ground-fault module and 3UL23 residual current transformer

Settings

You can parameterize two different response levels (trip level, warning level) for monitoring the ground-fault current.

If the ground-fault current exceeds the response level, the current limit monitoring will respond.

See also "Tables of responses of SIMOCODE pro" in Chapter Important notes (Page 7).

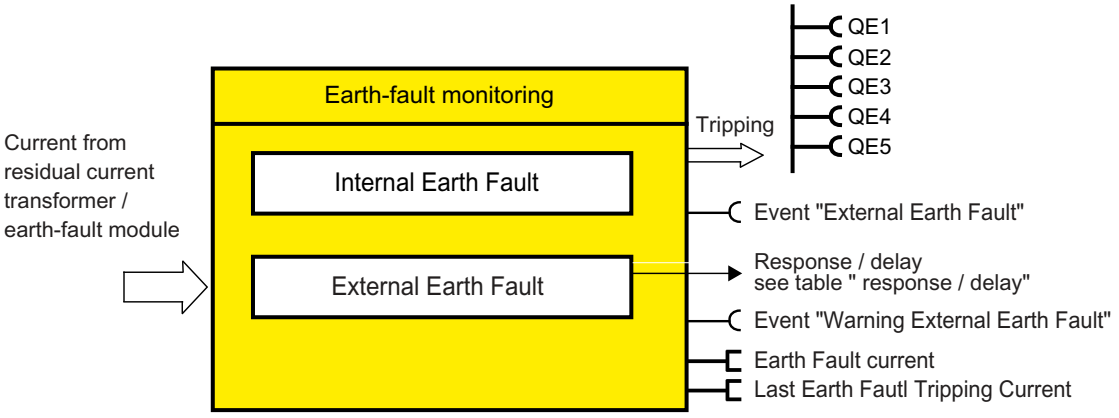


Figure 4-36 "Ground-fault Monitoring" function block

Trip level, warning level

You can parameterize two different response levels (trip level, warning level) for monitoring the ground-fault current.

If the ground-fault current exceeds the response level, the current limit monitoring will respond.

Trip level:	30 mA ... 40 A in 10 mA increments (default: 1000 mA)
Warning level:	30 mA ... 40 A in 10 mA increments (default: 500 mA)

Trip level activity, warning level

Here you can specify in which motor operating states the trip level / warning level will be active:

• Always (on)	Trip level / warning level is always active, regardless of whether the motor is running or at a standstill
• If motor runs, except TPF (run)	Trip level / warning level is only active when the motor is running
• when the motor is on, except TPF, with startup override (run+)	Trip level / warning level is only active when the motor is running and starting has been completed

Response to trip level

Here you can set how SIMOCODE pro should respond if the trip level is overshot.

See also "Tables of responses of SIMOCODE pro" in Chapter Important notes (Page 7).

Table 4-33 Response to "trip level" in ground-fault monitoring

Response	Trip level
signal	X (d)
warn	—
trip	X
delay	0 to 25.5 s (default: 0.5 s) 1)
1) Extension of the residual current transformer delay	

Response to warning level

Here you can set how SIMOCODE pro should respond if the warning level is overshot.

See also "Tables of responses of SIMOCODE pro" in Chapter Important notes (Page 7).

Table 4-34 Response to "warning level" in ground-fault monitoring

Response	Warning level
deactivated	X (d)
signal	X
warn	X
trip	—
delay	0 to 25.5 s (default: 0.1 s) 1)
1) Extension of the residual current transformer delay	

Hysteresis

Here you can set the hysteresis for the ground-fault current:

Hysteresis	0 to 15% of the level value in steps of 1% Default: 5 %

Response to sensor fault

Here you can set how SIMOCODE pro should respond to a sensor fault. Open circuit and short-circuit to 3UL23 residual current transformer are recognized as sensor faults.

Response	Sensor fault
deactivated	X (d)
signal	X
warn	X
trip	X

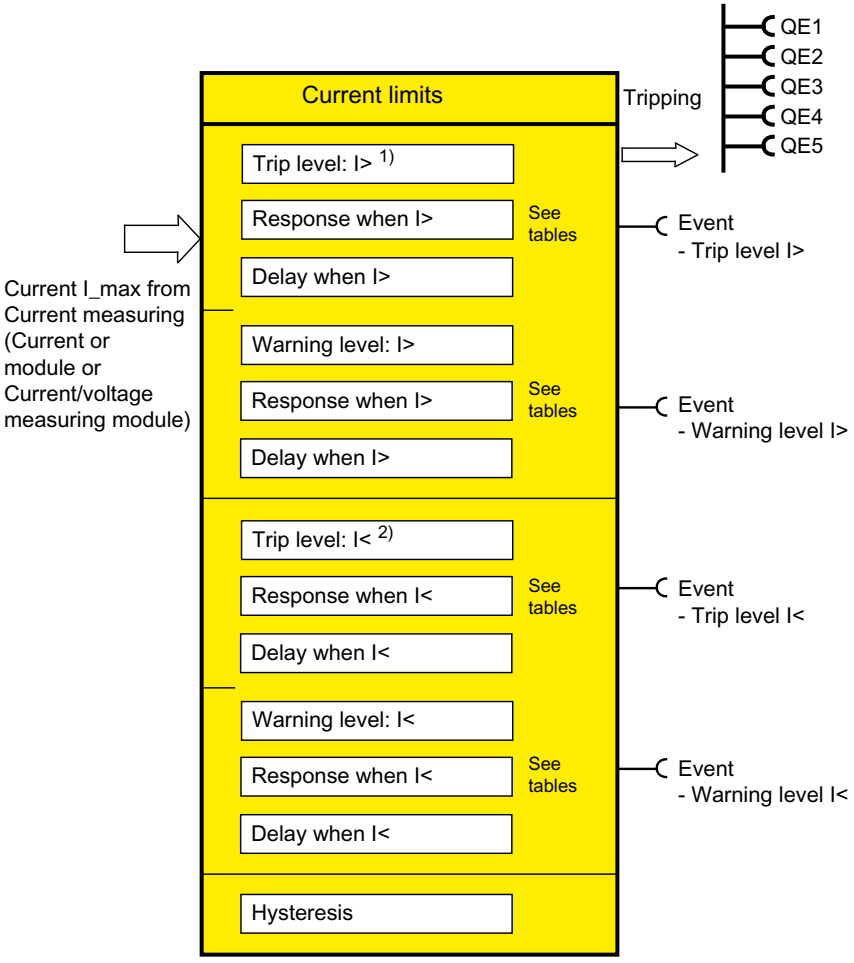
4.4.2 Current limit monitoring

4.4.2.1 Description of functions of current limit monitoring

Monitoring of current limits is used for process monitoring independent of overload protection.

SIMOCODE pro supports two-phase monitoring of the motor current for freely selectable upper and lower current limit values. The response of SIMOCODE pro can be freely configured and delayed if it reaches a prewarning or trip level.

The motor current is measured using current measuring modules or the current / voltage measuring modules.



1) Upper limit
2) Lower limit

Figure 4-37 "Current Limits" function block

4.4.2.2 I> (upper limit)

Trip level, warning level

When monitoring current limits I > (upper limit), two different response levels can be parameterized and monitored: I> (upper limit) trip level, I> (upper limit) warning level

If the current of one or more phases exceeds the response level, current limit monitoring responds.

Trip level	0 to 1020 % of I_s in steps of 4% (default: 0)
Warning level	0 to 1020 % of I_s in steps of 4% (default: 0)

Trip level activity, warning level

The trip level / warning level is active only when the motor is running, the startup procedure has been completed and there is no test position feedback (TPF) (run+).

Response to trip level

Here you can define how SIMOCODE pro will respond if the trip level is undershot.
See also "Tables of responses of SIMOCODE pro" in Chapter Important notes (Page 7).

Table 4-35 "Trip level" response for monitoring current limits I >

Response	Trip level
deactivated	X (d)
signal	X
warn	—
trip	X
delay	0 to 25.5 s (default: 0.5 s)

Response to warning level

Here you can define how SIMOCODE pro will respond if the warning level is overshot.
See also "Tables of responses of SIMOCODE pro" in Chapter Important notes (Page 7).

Table 4-36 "Warning level" response for monitoring current limits I >

Response	Warning level
deactivated	X (d)
signal	X
warn	X
trip	—
delay	0 to 25.5 s (default: 0.5 s)

Hysteresis

Here you can set the hysteresis for the current limits I> (upper limit):

Hysteresis	0 to 15% of the level value in steps of 1% Default: 5 %

4.4.2.3 I< (lower limit)

Trip level / warning level

When monitoring current limits I< (lower limit), two different response levels (trip level / warning level) can be parameterized and monitored:

- I< (lower limit) trip level
- I< (lower limit) warning level

If the current of the phases (I_{max}) drops below the response level, the current limit monitor responds.

Trip level	0 to 1020 % of I_s in steps of 4% (default: 0)
Warning level	0 to 1020 % of I_s in steps of 4% (default: 0)

Trip level activity, warning level

The trip level / warning level is active only when the motor is running, the startup procedure has been completed and there is no test position feedback (TPF) (run+).

Response to trip level

Here you can define how SIMOCODE pro will respond if the trip level is undershot:
See also "Tables of responses of SIMOCODE pro" in Chapter Important notes (Page 7).

Table 4-37 "Trip level" response for monitoring current limits I <

Response	Trip level
deactivated	X (d)
signal	X
warn	—
trip	X
delay	0 to 25.5 s (default: 0.5 s)

Response to warning level

Here you can define how SIMOCODE pro will respond if the warning level is undershot.
See also "Tables of responses of SIMOCODE pro" in Chapter Important notes (Page 7).

Table 4-38 "Warning level" response for monitoring current limits I <

Response	Warning level
deactivated	X (d)
signal	X
warn	X
trip	—
delay	0 to 25.5 s (default: 0.5 s)

Hysteresis

Here you can set the hysteresis for current limits I< (lower limit):

Hysteresis	0 to 15% of the level value in steps of 1% Default: 5 %

4.4.3 Voltage monitoring

Description

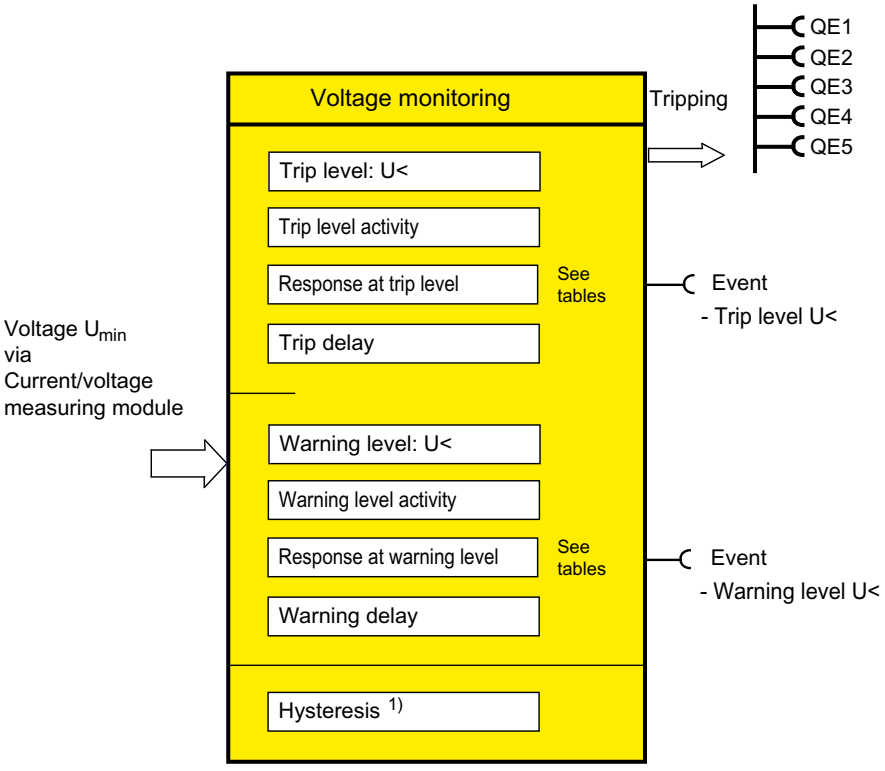
SIMOCODE pro supports two-phase undervoltage monitoring of either a three-phase network or a single-phase network for freely selectable limits. The response of SIMOCODE pro on reaching a prewarning level or trip level can be freely parameterized and delayed.

Voltage measurement is performed using current / voltage measuring modules. This is based on the minimum voltage of all voltages U_{min}.

Note

Please note that only phase voltages are available with SIMOCODE pro V PB basic units up to version *E06*. If required, the line-to-line voltage can be calculated from the phase voltage using the logic module "Calculator 1/2" as follows: Line-to-line voltage = phase voltage * 1.73.

From version *E07* onward, either phase voltage or line-to-line voltage can be used as the basis for monitoring.



1) Hysteresis for voltage, cos phi, power

Figure 4-38 "Voltage Monitoring" function block

Furthermore, even when the motor is switched off, SIMOCODE pro can determine and signal the further availability of the feeder by measuring the voltage directly at the circuit breaker or at the fuses in the main circuit.

Trip level, warning level

You can parameterize two different response levels (trip level/warning level). If the current of one or more phases undershoots the response level or the warning level, voltage monitoring responds.

Trip level:	0 to 2040 V in steps of 8 V (default: 0)
Warning level:	0 to 2040 V in steps of 8 V (default: 0)

Trip level activity, warning level

Here you can specify in which motor operating states the trip level / warning level will be active:

• Always (on)[1)]	Trip level / warning level is always active, regardless of whether the motor is running or at a standstill
• Always, except TPF (on+) (default)	Trip level / warning level always effective, regardless of whether the motor is running or at a standstill; Exception: "TPF", i.e. motor feeder is in test position

- If motor runs, except TPF (run) — Trip level / warning level only active if the motor is ON and not in the test position

1) When using the SIMOCODE pro V PB basic unit (product version *E03* and higher) with a current/voltage measuring module

Response to trip level

Here you can set how SIMOCODE pro should respond if the trip level is undershot. See also "Tables of responses of SIMOCODE pro" in Chapter Important notes (Page 7).

Table 4-39 "Trip level" response for voltage monitoring

Response	Trip level
deactivated	X (d)
signal	X
warn	—
trip	X
delay	0 to 25.5 s (default: 0.5 s)

Response to warning level

Here you can set how SIMOCODE pro should respond if the warning level is undershot. See also "Tables of responses of SIMOCODE pro" in Chapter Important notes (Page 7).

Table 4-40 "Warning level" response for voltage monitoring

Response	Warning level
deactivated	X (d)
signal	X
warn	X
trip	—
delay	0 to 25.5 s (default: 0.5 s)

Hysteresis for voltage, cos phi, power

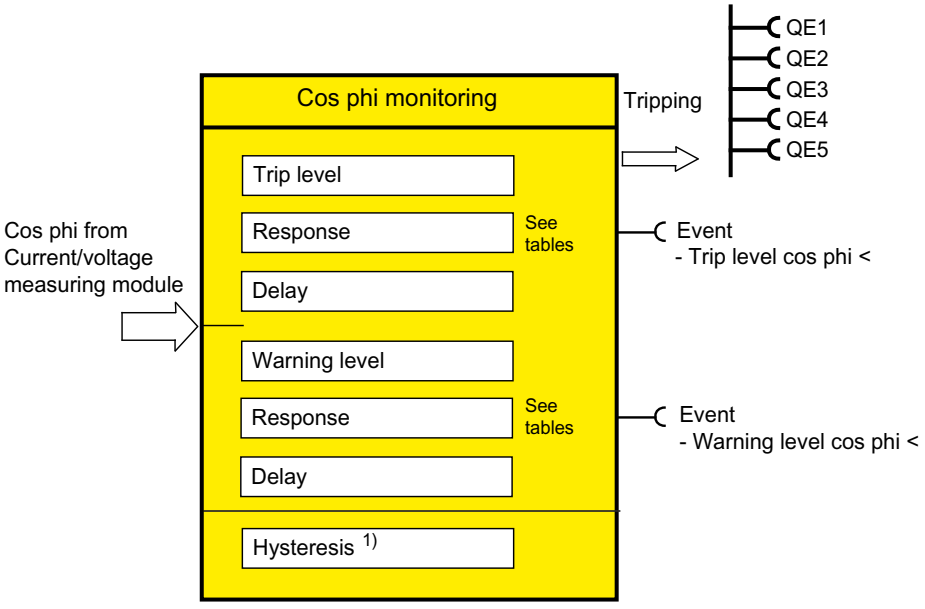
Here you can set the hysteresis for voltage, cos phi and power.

Hysteresis for voltage, cos phi, power — 0 to 15% of the level value in steps of 1% (default: 5 %)

4.4.4 Cos phi monitoring

Description

Cos phi monitoring monitors the load condition of inductive loads. The main field of application is for asynchronous motors in 1-phase or 3-phase networks with loads that fluctuate significantly. The power factor fluctuates more than either the motor current or the active power does, particularly in the low-end performance range of a motor. Therefore, power factor monitoring is particularly suitable for distinguishing between no-load operation and faults, e.g. a broken drive belt or drive shaft. If the set trip level or warning level is undershot, a signal is generated or the motor is switched off, depending upon the setting.



1) Hysteresis for voltage, cos phi, power (see "Voltage Monitoring" function block)

Figure 4-39 "Cos Phi Monitoring" function block

Trip level, warning level

You can parameterize two different response levels (trip level / warning level) for cos phi monitoring.

Trip level	0 to 100 % (default: 0 %)
Warning level	0 to 100 % (default: 0 %)

0 % = cos phi = 0.00

50 % = cos phi = 0.50

100 % = cos phi = 1.00

Trip level activity, warning level

The trip level / warning level is active only when the motor is running, the startup procedure has been completed and there is no test position feedback (TPF) (run+).

Response to trip level

Here you can define how SIMOCODE pro will respond if the set trip level is undershot:
See also "Tables of responses of SIMOCODE pro" in Chapter Important notes (Page 7).

Table 4-41 "Trip level" response for cos phi monitoring

Response	Trip level
deactivated	X (d)
signal	X
warn	—
trip	X
delay	0 to 25.5 s (default: 0.5 s)

Response to warning level

Here you can define how SIMOCODE pro will respond if the set warning level is undershot.
See also "Tables of responses of SIMOCODE pro" in Chapter Important notes (Page 7).

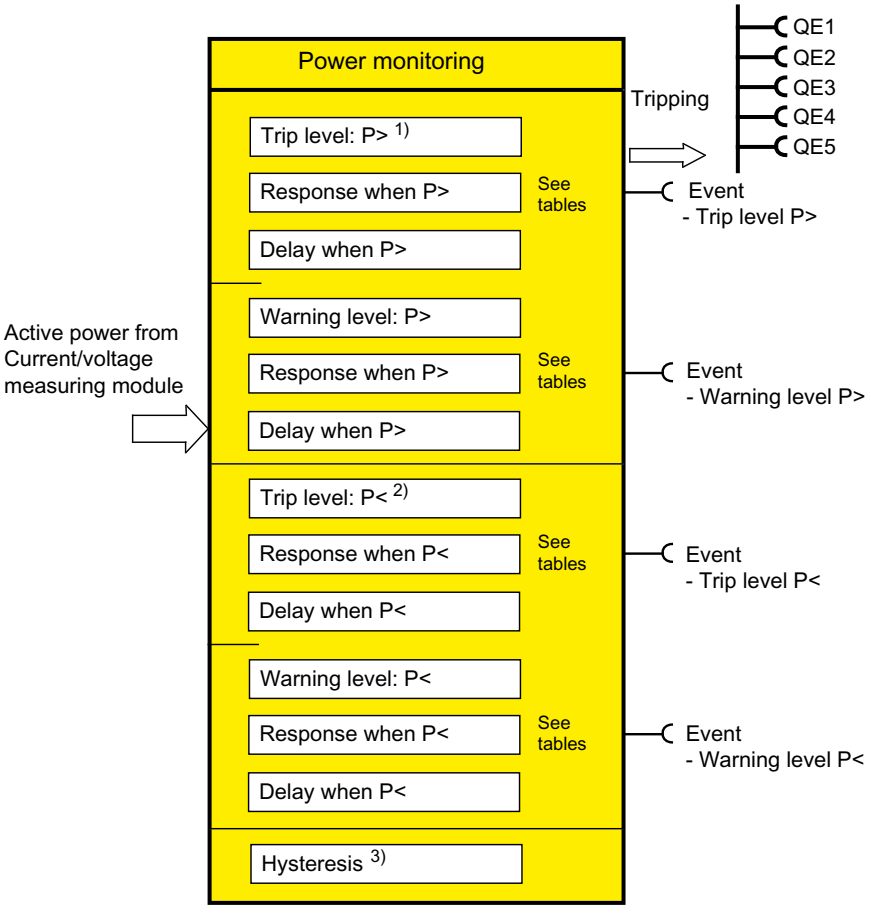
Table 4-42 "Warning level" response for cos phi monitoring

Response	Warning level
deactivated	X (d)
signal	X
warn	X
trip	—
delay	0 to 25.5 s (default: 0.5 s)

4.4.5 Active power monitoring

Description

SIMOCODE pro can indirectly monitor the state of a device or system via the active power. For example, by monitoring the active power of a pump motor, conclusions can be drawn from the active power level about the flow rate or fluid fill levels. The active power curve of a motor is a precise reflection of its actual load across the entire range. Excess load results in increased wear of the motor and, thus, may lead to premature motor failure. Insufficient active power can, for example, be a sign of no-load motor operation.
SIMOCODE pro allows two-phase active power monitoring for freely selectable upper and lower limits. The response of SIMOCODE pro when a prewarning or trip level has been reached can be freely parameterized and delayed.
The active power is measured by means of current / voltage measuring modules.



1) Upper limit
2) Lower limit
3) Hysteresis for voltage, cos phi, power (see "Voltage Monitoring" function block)

Figure 4-40 "Power Monitoring" function block

Trip level, warning level

With active power monitoring, you can parameterize two different response levels (trip level / warning level) for the upper and lower limits.

Trip level

- P> (upper limit) 0.000 to 4294967.295 kW (default: 0.000 kW)
- P < (lower limit)

Warning level

- P> (upper limit) 0.000 to 4294967.295 kW (default: 0.000 kW)
- P < (lower limit)

Trip level activity, warning level

The trip level / warning level is active only when the motor is running, the startup procedure has been completed and there is no test position feedback (TPF) (run+).

Response to trip level P> (upper limit), P< (lower limit)

Here, you can define the response of SIMOCODE pro in the event that the monitored variable overshoots/undershoots the set trip level:
For further information, see also "Tables of responses of SIMOCODE pro" in Chapter Important notes (Page 7).

Table 4-43 "Trip level" response for active power monitoring

Response	Trip level
deactivated	X (d)
signal	X
warn	—
trip	X
delay	0 to 25.5 s (default: 0.5 s)

Response to warning level P> (upper limit), P< (lower limit)

Here, you can define the response of SIMOCODE pro in the event that the monitored variable overshoots/undershoots the set warning level:
For further information, see also "Tables of responses of SIMOCODE pro" in Chapter Important notes (Page 7).

Table 4-44 "Warning level" response for active power monitoring

Response	Warning level
deactivated	X (d)
signal	X
warn	X
trip	—
delay	0 to 25.5 s (default: 0.5 s)

4.4.6 0/4 - 20 mA monitoring

Description

With the aid of an analog module, SIMOCODE pro is capable of measuring and monitoring further process variables as desired. For example, the fill level can be monitored to protect a pump against dry operation, or a differential pressure transducer can be used to monitor the degree of pollution in a filter. If the fill level undershoots a specified level, the pump can be switched off and, if a specific differential pressure value is exceeded, the filter must be cleaned.

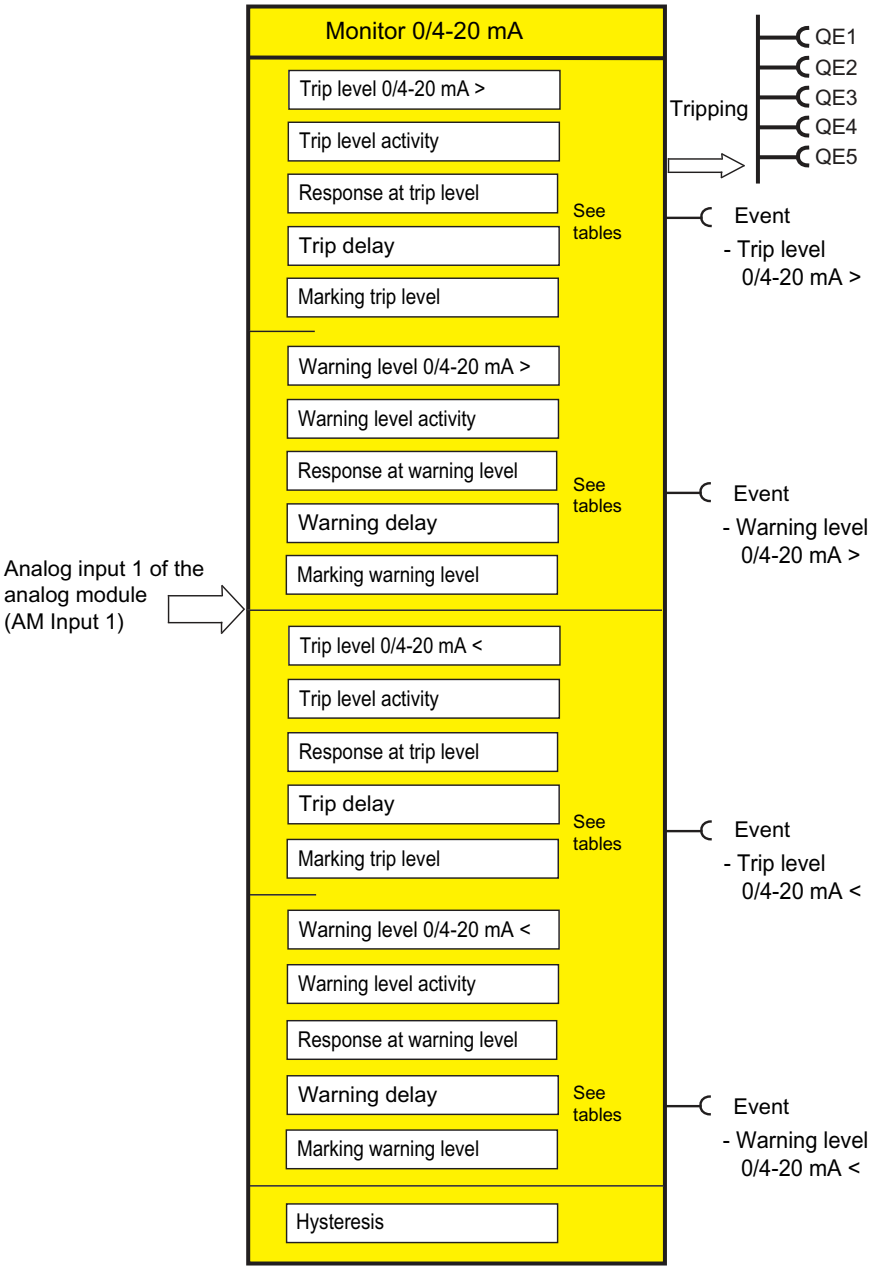


Figure 4-41 "0/4 to 20 mA monitoring" function block

SIMOCODE pro supports two-phase monitoring of the analog signals of a transducer (standardized 0/4-20 mA output signal). The analog signals are routed via the analog module to the 0/4-20 mA (AM1) and 0/4-20 mA (AM2) monitoring function blocks (AM2 only in conjunction with the SIMOCODE pro V PN and pro V EIP basic units).

Trip level, warning level

With 0/4-20 mA monitoring, you can parameterize two different response levels (trip level / warning level) for the upper and lower limits.

Trip level

- 0/4 to 20 > (upper limit)
- 0/4 to 20 < (lower limit)

0.0 ... 23.6 mA / 4.0 ... 22.9 mA (default: 0.0 / 4.0 mA)

Warning level

- 0/4 to 20 > (upper limit)
- 0/4 to 20 < (lower limit)

0.0 ... 23.6 mA / 4.0 ... 22.9 mA (default: 0.0 / 4.0 mA)

Trip level activity, warning level

Here you can specify in which motor operating states the trip level / warning level will be active:

• **Always (on)**	Trip level / warning level is always active, regardless of whether the motor is running or at a standstill
• Always, except TPF (on+)	Trip level / warning level is always active regardless of whether the motor is running or at a standstill, with the exception of "TPF," i.e. motor feeder is in the test position
• If motor is on, except TPF (run)	Trip level / warning level only active if the motor is ON and not in the test position
• If motor is on except TPF, with startup override (run+)	Trip level / warning level is only active when the motor is running, the startup procedure has been completed, and no test position (TPF) is detected

Response to trip level 0/4 to 20 mA > (upper limit), 0/4 to 20 mA < (lower limit)

Here, you can define the response of SIMOCODE pro in the event that the monitored variable overshoots/undershoots the set trip level:
For further information, see also "Tables of responses of SIMOCODE pro" in Chapter Important notes (Page 7).

Table 4-45 "Trip level" response for 0/4 to 20 mA monitoring

Response	Trip level
deactivated	X (d)
signal	X
warn	—

Response	Trip level
trip	X
delay	0 to 25.5 s (default: 0.5 s)

Response to warning level 0/4 to 20 mA > (upper limit), 0/4 to 20 mA < (lower limit)

Here, you can define the response of SIMOCODE pro in the event that the monitored variable overshoots/undershoots the set warning level:
For further information, see also "Tables of responses of SIMOCODE pro" in Chapter Important notes (Page 7).

Table 4-46 "Warning level" response for 0/4 to 20 mA monitoring

Response	Warning level
deactivated	X (d)
signal	X
warn	X
trip	—
delay	0 to 25.5 s (default: 0.5 s)

Marking

The marking is saved in the device and assigned and displayed in the Faults / Warnings online dialog. Optional marking for identifying the message, e.g. "0/4 to 20 >"; range: maximum 10 characters.

Note

Changing the marking of Ethernet and PROFINET connections

Note for firmware versions <V3.0.0 (PROFINET devices) and <V2.0.0 (EtherNet/IP devices)

Each change to the marking requires that the communication interface be restarted when the web server is active. A new start interrupts all Ethernet and PROFINET links and reestablishes them afterward.

Hysteresis for 0/4 to 20 mA

Here you can set the fluctuation range for the analog signal:

Hysteresis for the analog signal 0 to 15 % in steps of 1 % (default: 5 %)

Note

Monitoring of a second process variable via input 2 of the analog module can be done, for example, by free limit monitors.

4.4.7 Operation monitoring

4.4.7.1 Operation monitoring

Motor operation monitoring - use

SIMOCODE pro can monitor the operating hours and stop times of a motor and restrict the number of startups in a defined time frame to avoid plant downtimes due to failed motors caused by running or being stopped for too long.
If an adjustable limit value is exceeded, a signal or warning can be generated that indicates maintenance or replacement of the motor in question is required. After the motor has been replaced, the operating hours and stop times can be reset, for example.

To avoid excessive thermal loads and premature wear of the motor, it is possible to limit the number of motor startups for a specifiable period. The number of still possible starts is available in the SIMOCODE pro for further processing.

The limited number of possible starts can be indicated by prewarnings.

Note

Operating hours, motor stop times and the number of motor starts can be monitored completely in the device and/or transmitted to the automation system via the communication bus.

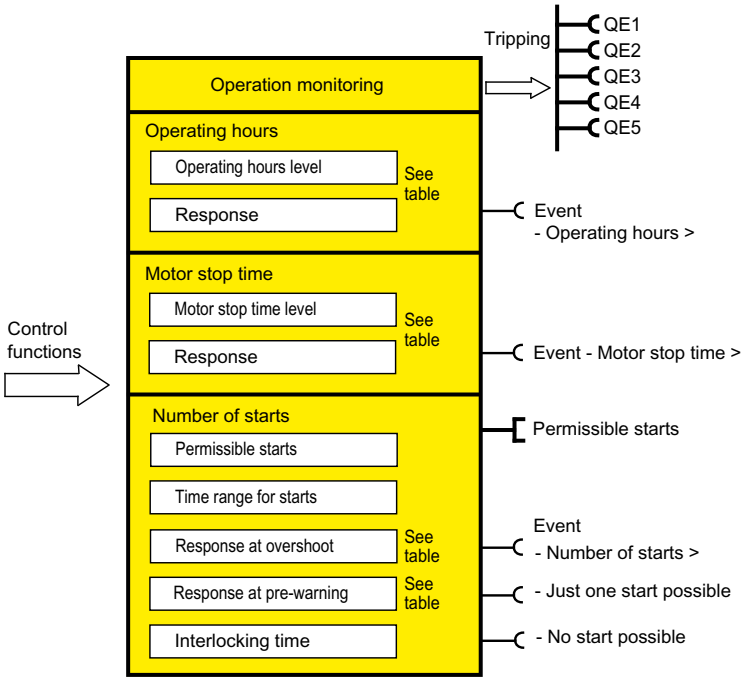


Figure 4-42 "Operation Monitoring" function block

Response

Table 4-47 "Operation monitoring" response

Response	Operating hours monitoring - level	Stop time monitoring - level	Number of starts - overshoot	Number of starts - prewarning
deactivated	X (d)	X (d)	X (d)	X (d)
signal	X	X	X	X
warn	X	X	X	X
trip	—	—	X	—

4.4.7.2 Operating hours monitoring

Motor operating hours monitoring - use

The motor operating hours monitoring function enables the operating hours (service life) of a motor to be recorded so that motor maintenance prompts can be generated in good time as applicable.

Level

If the operating hours exceed the set response level, the monitoring function responds.

Level 0 to 1193046 hours (default: 0 h)

Active status

Unless deactivated, this function is always active, independent of whether the motor is running or not (operating state "ON").

Response

You can define the response to overshoot here.

See also "Tables of responses of SIMOCODE pro" in Chapter Important notes (Page 7) and Table "Responses" in Chapter Operation monitoring (Page 156).

4.4.7.3 Motor stop time monitoring

Motor stop time monitoring - use

System parts for important processes often have dual drives (A and B drives). Ensure that these are always operated alternately. This prevents long motor stop times and reduces the risk of non-availability.

The motor stop time monitoring function can be used, for example, to generate an interrupt, thus initiating connection of the motor.

Level

The length of the permissible motor stop time is stipulated here; if exceeded, the monitoring function responds.

Level 0 to 65535 hours (default: 0 h)

Active status

Unless deactivated, this function is always active, independent of whether the motor is running or not (operating state "ON").

Response

You can define the response to overshoot of the permissible stop time here:

See also "Tables of responses of SIMOCODE pro" in Important notes (Page 7) and Table "Response of operation monitoring" in Operation monitoring (Page 156).

4.4.7.4 Monitoring the number of starts

Number of starts monitoring - use

Monitoring the number of starts can protect system parts (motors and switching devices such as soft starters and converters) from too many start processes within a parameterizable time frame and thus prevent damage. This is also particularly useful for commissioning or manual control.

The schematic below illustrates the principle of monitoring the number of starts:

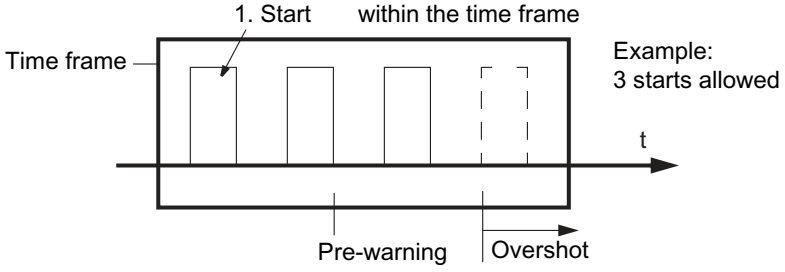


Figure 4-43 Monitoring the number of starts

Permissible starts

The maximum permissible number of starts is set here. The time interval "Time range for starts" commences to run after the first start. After the second to last permissible start has been executed, the "Just one start possible" pre-warning is generated.

Permissible starts: 1 to 255 (default: 1)

Time range for starts

The time range for permissible start processes is set here. The maximum number of starts is only available again after the parameterized time range for starts has elapsed. The number of available starts is shown by the analog value "Permissible starts - Actual value".

Time range for starts: 00:00:00 to 18:12:15 hh:mm:ss (default: 00:00:00)

Active status

Unless deactivated, this function is always active, independent of whether the motor is running or not (operating state "ON").

Response to overshoot

You can define the response to overshoot of the number of starts within the time range for starts here:

See also "Tables of responses of SIMOCODE pro" in Chapter Important notes (Page 7) and Table "Responses" in Chapter Operation monitoring (Page 156).

Response to pre-warning

You can define the response after the penultimate start here.

See also "Tables of responses of SIMOCODE pro" in Chapter Important notes (Page 7) and Table "Responses" in Chapter Operation monitoring (Page 156).

Interlocking time

If a new start command is issued within the time range for starts after the last permissible start, this new start command will no longer be executed if the setting "Response to overshoot - tripping" has been set. "Fault - No. of starts >" will be displayed and the set interlocking time activated.

Interlocking time: 00:00:00 to 18:12:15 hh:mm:ss (default: 00:00:00)

4.4.8 Temperature monitoring (analog)

Schematic and characteristic curve

Temperature monitoring of, for example, motor windings, motor bearings, coolant and gearbox temperature, can be carried out via up to three analog temperature sensors such as NTC, KTY 83/84, PT100, PT1000.

SIMOCODE pro supports two-phase monitoring for overtemperature: Separate levels for warning and tripping temperature can be set.

Temperature monitoring takes into account the highest temperature of all the sensor measuring circuits of the temperature module.

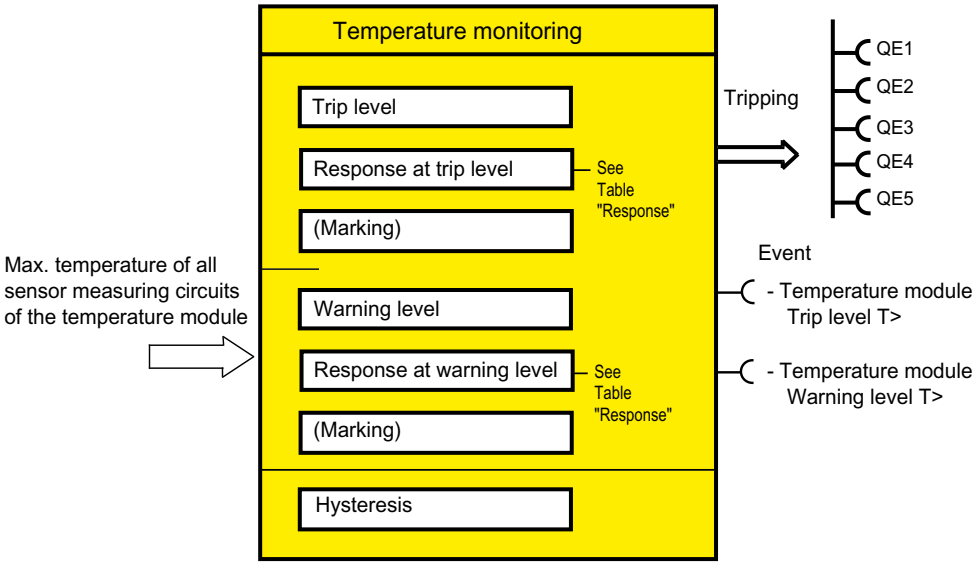


Figure 4-44 "Temperature Monitoring" function block

Settings

Table 4-48 "Temperature monitoring" settings

Temperature	Description
Trip level T >	-273° - 65262°C (default: -273°)
Response to trip level T >	Setting of response when the temperature is overshot (see the following table and Chapter Important notes (Page 7))
Marking for trip level T >	No parameters. Optional marking for identifying the message, e.g. "Temperature>"; range: Maximum 10 characters
Warning level T >	-273° - 65262°C (default: -273°)
Response to warning level T >	Setting of response when the temperature is overshot (see the following table and Chapter Important notes (Page 7))
Marking warning level T >	No parameters. Optional marking for identifying the message, e.g. "Temperature>"; range: maximum 10 characters.
Hysteresis	0° to 255°C in steps of 1°C (default: 5°C)

Trip level activity, warning level

The trip level / warning level is always active, independent of whether the motor is running or not (operating state "ON").

Response

See also "Tables of responses of SIMOCODE pro" in Chapter Important notes (Page 7).

Overtemperature: Here you can select how SIMOCODE pro should respond when the temperature has overshot the warning level / trip level.

Table 4-49 "Overtemperature" response

Response	Warning level T >	Trip level T >
deactivated	X (d)	—
signal	X	X (d)
warn	X	—
trip	—	X

Note

With motors for Ex e applications, the response must be set to "trip"!

Note

The sensor type, the number of measuring circuits in use and the response to a sensor fault must be set in the Temperature module inputs (TM1 / 2 inputs) function block if temperature monitoring is used.

Note

To monitor several sensor measuring circuits individually and independently, a suitable number of free limit monitors can be connected to the temperature module inputs (TM1 / 2 inputs) function block and differing limits set for the individual temperature sensors, instead of the temperature monitoring function block.

4.4.9 Monitoring interval for mandatory testing

Description

Function for monitoring the interval between the connection and the tripping of the enabling circuit (actuator tripping). The monitoring time starts anew every time the enabling circuit closes. This function supports you in complying with test intervals that require verification.
In the enabling circuit of the DM-F Local and the DM-F PROFIsafe, relay contacts perform safety-related tripping. Whether the relay contacts of the enabling circuit actually open or not, can only be established via a change in the switching state of the contacts.
The "Monitoring interval for mandatory testing" function supports the system operator in the monitoring of the time that has elapsed since the last connection of the enabling circuit.
When the adjustable limit has been reached, the set reaction follows (deactivated, signal, warn; see response). This is logged in the event memory.
This monitoring function is an organizational measure that supports the system operator in detecting faults by conducting regular tests, see information in the operating instructions on regularly testing the function of a safety device. The monitoring function itself need not be safety-related.

Note

The function "Time until test" is not a safety-related function

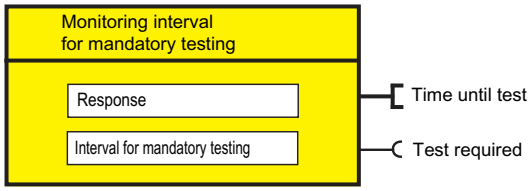


Figure 4-45 "Monitoring interval for mandatory testing" function block

Response

You can set the response here.
See also "Tables of responses of SIMOCODE pro" in Chapter Important notes (Page 7).

Table 4-50 "Safety-related tripping" response

Response	
deactivated	X
signal	X
warn	X
trip	—

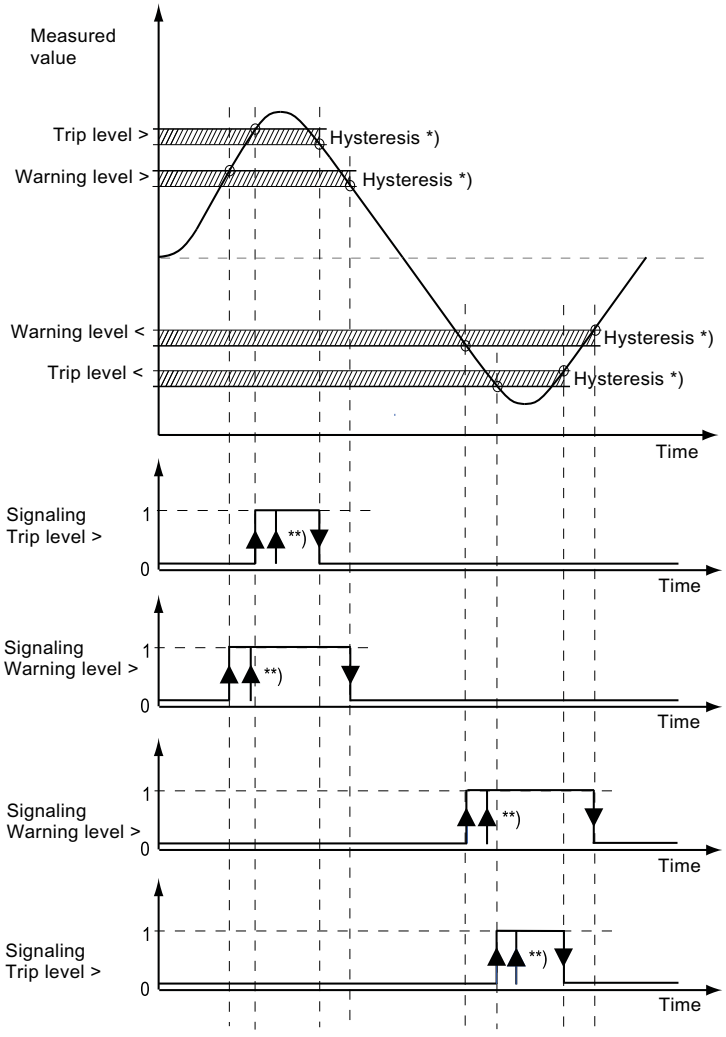
Test interval

Adjustable limit value for the interval for mandatory testing:

Test interval:	0 to 255 weeks (default: 0)

4.4.10 Hysteresis for monitoring functions

The following diagram illustrates the function of the hysteresis for monitoring functions:



*) The hystereses are always based on the respectively set response level (exception: temperature monitoring)

**) The trip and warning level events can also be delayed individually

Figure 4-46 The hysteresis operating principle for monitoring functions

TL = Trip level (trip)
WL = Warning level (warn)

4.5 Outputs

4.5.1 Overview of outputs

Description

SIMOCODE pro has various outputs. These are represented by different function blocks in SIMOCODE pro. They are the external SIMOCODE pro interfaces. Within SIMOCODE pro, the outputs are represented as plugs on the corresponding function blocks and can be assigned to any functions or events via connections.

Outputs include:

- Output terminals ⊘, located on the outside of basic unit, digital modules, and on the analog module
- LEDs on the operator panel for visualizing the operating state or different statuses
- Outputs to PROFIBUS DP (cyclic and acyclic).

Schematic

The following schematic shows a general representation of the various types of output:

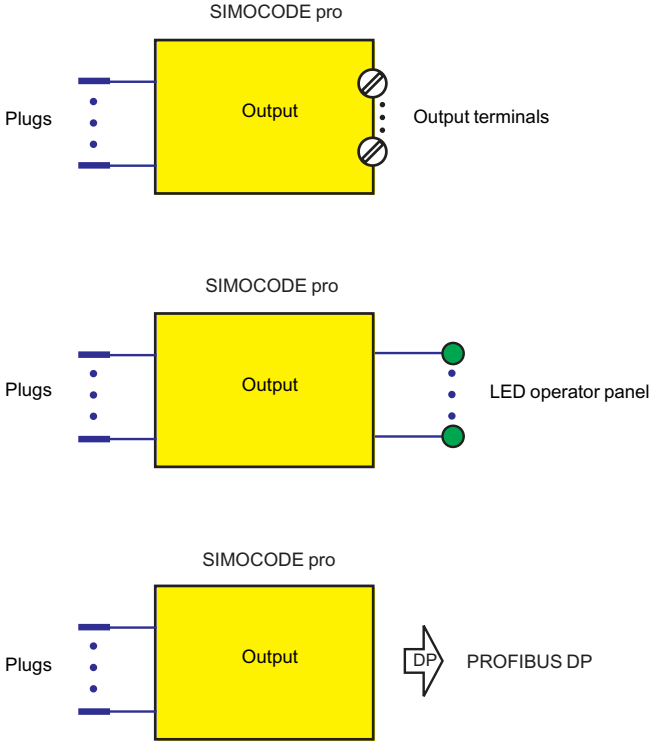


Figure 4-47 General representation of the various output types

Scope and application

Outputs are used, e.g. for controlling motor contactors, displaying states or signaling via the communication bus. The system provides different types of output depending on the device series and the expansion modules in use:

Table 4-51 Outputs

Outputs	SIMOCODE pro						
	BP	GP		HP			
	C	S	V PN GP	V PB	V MR	V PN	V EIP
Basic unit outputs (BU Outputs)	✓	✓	✓	✓	✓	✓	✓
Operator panel LEDs (OP LED)	✓	✓	✓	✓	✓	✓	✓
Digital module 1 outputs (DM1 Outputs)	—	✓ 1)	✓	✓	✓	✓	✓
Digital module 2 outputs (DM2 Outputs)	—	—	—	✓	✓	✓	✓
Analog module output (AM1 output/AM2 output)	—	—	—	✓ 2)	✓ 2)	✓	✓
Acyclic send data (Acyclic send)	✓	✓	—	✓	✓	—	—
OPC-UA send	—	—	✓	—	—	✓	—
Cyclic send data (Cyclic send)	✓	✓	✓	✓	✓	✓	✓

1) for the SIMOCODE pro S basic unit, the DM1 outputs are on the multifunction module.

2) only AM1 output available

4.5.2 Basic unit outputs

Description

SIMOCODE pro has a "BU Outputs" function block with two or three relay outputs. You can, for example, switch contactors or lamps via these relay outputs. For this, the inputs (plugs) of the function block must be connected to the respective sockets (usually the QE contactor controls of the control function). The "BU Outputs" function block consists of:

- Three plugs corresponding to the relay outputs Out1 to Out3
- Three relays
- Output terminals.

In total, one function block "BU outputs" is available on the pro C, pro S, and pro V basic units.

Schematic

The following schematics show the "BU Outputs" function block:

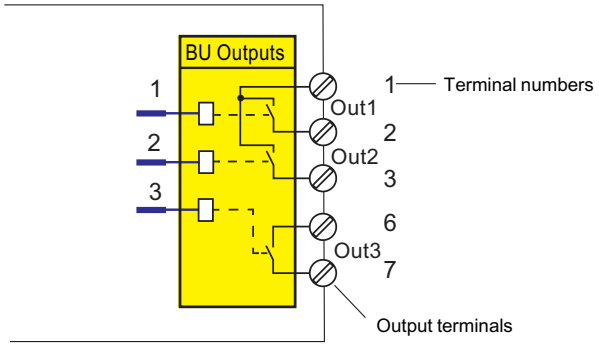


Figure 4-48 "BU Outputs" function block, SIMOCODE pro C, pro V

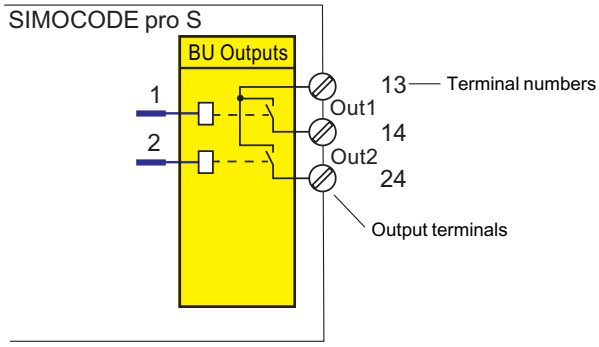


Figure 4-49 Function block "BU outputs," SIMOCODE pro S

Application examples

- Activation of the main contactor in the motor feeder: You can, for example, define which relay output is used for activating the motor contactor in the motor feeder. To do this, connect the desired relay output to the respective "QE..." contactor activation of the control function.
- Activation of lamps for displaying operating states: You can define, for example, which relay outputs are to be used for controlling the lamps / LEDs that display the operating states of the motor (Fault, ON, OFF, FAST, SLOW...). To do this, connect the desired relay output to the respective "QE..." contactor activation of the control function. These are provided specially for activating lamps and LEDs. In addition to the status signals, the "QL..." lamp controls automatically signal the following using a 2-Hz flashing frequency:
  - Test mode (QLE... / QLA lamp outputs are flashing)
  - Unacknowledged fault (lamp output general fault QLS is flashing)
  - Transfer of any other information, status information, warnings, faults, etc. to the relay outputs.
  - Lamp test: All QL outputs are activated for approx. 2 s.

In most cases, the outputs of the basic unit will be connected to the QE or QL outputs.
By referring to Table "Active control stations, contactor controls, lamp controls and status information for the control functions," you can determine which QE outputs are required for which control function.

Settings

Table 4-52 Basic unit output settings

BU outputs	Description
Outputs 1 to 3	Control of the "BU Outputs" function block via any signal (any socket, e.g. device inputs, PROFIBUS DP control bits, etc.), usually from the QE contactor controls.

Defaults depend on the selected application (template): See Application selection, settings and definitions of control functions (Page 87).

4.5.3 Operator panel LEDs

Description

SIMOCODE pro has an "OP LED" function block for controlling the seven freely assignable LEDs. The LEDs are in the operator panel and can be used to display any status. For this, the inputs (plugs) of the "OP LED" function block must be connected to the respective sockets (e.g. to the sockets for the status information of the control function).

Note

The "OP LED" function block can only be used if the operator panel (OP) is connected and configured in the device configuration!

The "OP LED" function block consists of:

- Four plugs, "OP LED green 1" to "OP LED green 4," corresponding to the green LEDs. The green LEDs are optically / mechanically allocated to the buttons on the operator panel. They normally display feedback concerning the motor operating state.
- Three plugs, "OP LED yellow 1" to "OP LED yellow 3," corresponding to the yellow LEDs.
- Four green LEDs.
- Three yellow LEDs (not for the operator panel with display).

One "OP-LED" function block is available for the SIMOCODE pro C, pro S, pro V, pro V MR, pro V PN and pro V EtherNet/IP basic units.

LEDs of the operator panel

The following diagram shows the front view of the operator panel and the LEDs:

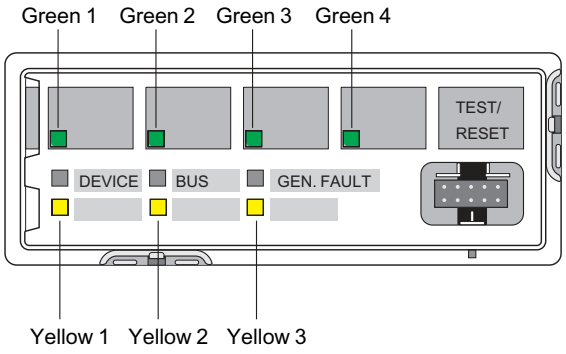


Figure 4-50 LEDs of the operator panel

LEDs of the operator panel with display

The following diagram shows the front view of the operator panel with display and the LEDs:

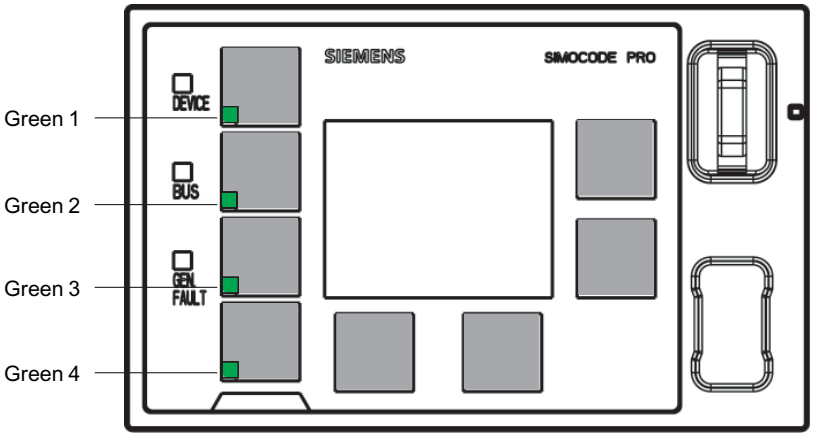


Figure 4-51 LEDs of the operator panel with display

Schematic

The following schematic shows the "OP LED" function block:

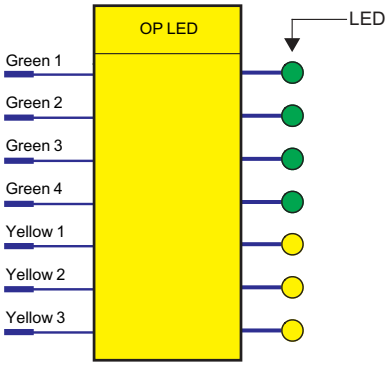


Figure 4-52 Schematic of the "OP LED" function block

Note

The three yellow LEDs mentioned in this section are not available for the operator panel with display. Status information can be read out here directly via the display. While it is still possible to connect the corresponding three plugs via the software, they remain non-functional.

Application examples

- Displaying operating states:
  You can define which LEDs are to be used for displaying the operating states (Fault, ON, OFF, FAST, SLOW...). To do this, connect the desired LED to the respective "QL." lamp control of the control function.
  In many cases, the LEDs are connected with the QL outputs. By referring to Table Active control stations, contactor controls, lamp controls and status information for the control functions (Page 130), you can determine which QL outputs are required for which control functions.
- Transfer of any other information, status information, warnings, faults, etc. to the yellow LEDs.

Settings

Table 4-53 Operator panel LED settings

OP LED	Description
Green 1 to Green 4	The "OP LED" function block can be activated by any signal (any sockets, e.g. "motor" operating state feedback).
Yellow 1 to Yellow 3 [1)]	The "OP LED" function block can be activated by any signal (any sockets, e.g. displays for status, events, faults).
1) No function when using the operator panel with display	

Defaults depend on the selected application (template): See Chapter Application selection, settings and definitions of control functions (Page 87).

4.5.4 Digital module outputs

Description

SIMOCODE pro has two "DM1 Outputs" and "DM2 Outputs" function blocks, which are each equipped with two relay outputs. You can, for example, switch contactors or lamps via these relay outputs. For this, the inputs (plugs of the "DM Outputs" function blocks) must be connected to the respective sockets (e.g. of the control function).

Note

"DM Outputs" function blocks can only be used if the corresponding digital modules (DM) or multifunction modules (MM) are connected and configured in the device configuration!

Each function block has:

- Two plugs, corresponding to relay outputs Out1, Out2
- Two relays
- Output terminals.

The following are available:

- a "DM1 Outputs" function block on the pro S basic unit [1)]
- two function blocks "DM1 outputs" and "DM2 outputs" on the basic units pro V.

Note

1) for the SIMOCODE pro S basic unit, the DM1 outputs are on the multifunction module.

Note

In addition to the two jointly-switched fail-safe enabling circuits, the fail-safe DM-F Local and DM-F PROFIsafe digital modules are equipped with two standard relay outputs, the common potential of which is switched off for safety reasons via an enabling circuit.

From a logical connection point of view, the standard relay outputs are always switched. The state of the fail-safe enabling circuits is not affected by the logical wiring.

Schematic

The following schematic shows the "DM Outputs" function blocks:

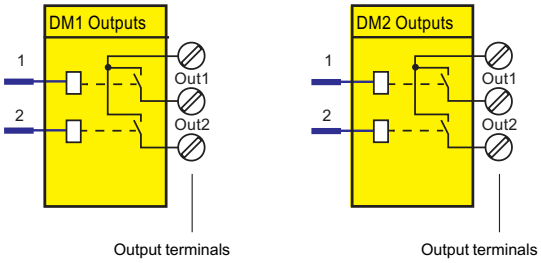


Figure 4-53 Schematic of the "DM1 Outputs" / "DM2 Outputs" function blocks

Application examples

- Activation of the motor contactor in the motor feeder:
  You can, for example, define which relay output is to be used for activating the main contactor in the motor feeder. To do this, connect the desired relay output to the respective "QE" contactor control of the control function.
- Activation of lamps for displaying operating states:
  You can define, for example, which relay outputs are to be used for controlling the lamps/LEDs that display the operating states of the motor (Fault, ON, OFF, FAST, SLOW ...). To do this, connect the desired relay output to the respective "QL..." lamp control of the control function.
- Transfer of any other information, status information, warnings, faults, etc. to the relay outputs.

In many cases, the outputs of the digital module will be connected to the QE outputs.
By referring to Table Active control stations, contactor controls, lamp controls and status information for the control functions (Page 130), you can determine which QE outputs are required for which control functions.

Settings

Table 4-54 "DM1 / DM2 Outputs" settings

"DM1 / DM2 Outputs"	Description
Outputs 1 to 2	Control of the "DM1 Outputs" and "DM2 Outputs" function blocks via any signal (any socket, e.g. device inputs, PROFIBUS DP control bits, etc. usually from the QE contactor controls.)

Defaults depend on the selected application (template): See Chapter Application selection, settings and definitions of control functions (Page 87).

4.5.5 Analog module output

Description

You can use analog modules 1 and 2 to expand the SIMOCODE pro V High Performance Basic Unit with one analog output in each case. The corresponding function blocks "AM1 Output" and "AM2 Output" (AM2 Output only in conjunction with the SIMOCODE pro V PN and pro V EIP basic units) allow every analog value (2 bytes/1 word) in SIMOCODE pro to be output as a 0/4 A - 20 mA signal to a connected pointer instrument, for example. If the function block is activated via the "Assigned analog output value" plug using any integer value between 0 and 65535, an equivalent analog signal of 0 to 20 mA or 4 to 20 mA will be sent to the output terminals of the analog module.

Note

The "AM1 Output" and "AM2 Output" function blocks can only be used if the analog module (AM) is connected and configured in the device configuration.

Schematic

The following schematic shows the "AM1 Output" function block:

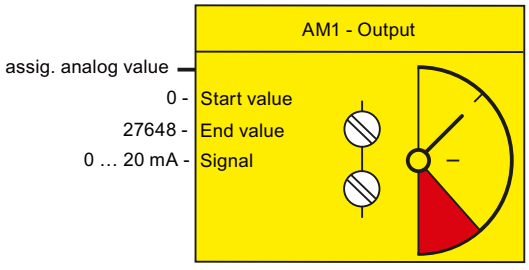


Figure 4-54 Function block "AM1 - output"

Settings

Table 4-55 "Analog module output" settings

Signal/value	Range
Assigned analog output value	Any value (1 word/2 bytes) in SIMOCODE pro
Output signal	0 to 20 mA (default) or 4 ... 20 mA
Start value of value range	0 to 65535 (default: 0)
End value of value range	0 to 65535 (default: 0)

Note

Passive inputs

The inputs of the analog module are passive inputs, i.e. to configure an analog input circuit, each input will require an additional, isolated external current source connected in series. If the output of the analog module is not being used by another application, it can also be used as a current source for an analog module input circuit. The "Start value of value range" and the "End value of value range" of the analog module output have to be set to 65535 for this. Thus, the maximum possible current will always be available via the analog module output.

Application examples

1) Output of the effective motor current - across the entire motor current range

The motor current ranges from 0 to 8 A. The rated current I_N of the motor at nominal load is 2 A.

The set current in SIMOCODE ES I_s corresponds to the rated current I_N (2 A). In SIMOCODE pro, the present phase currents or the maximum current (current IL_1, IL_2, IL_3, max. current I_max) are represented as a percentage of the parameterized current setting I_s in accordance with the selected range:

- 0 A motor current corresponds to 0 % of I_s
- 8 A motor current corresponds to 400 % of I_s
- The smallest unit for the effective motor current in SIMOCODE pro is 1 % (see measured values in data record 94, manual SIMOCODE pro - Communication (https://support.industry.siemens.com/cs/ww/en/view/109743960)).

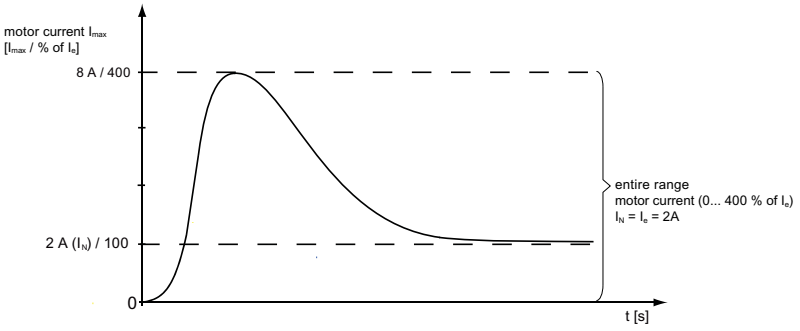


Figure 4-55 Application example: Motor current output - entire range

As a result,

- The "Start value of value range" to be selected is: 0
- The "End value of value range" to be selected is: 400.

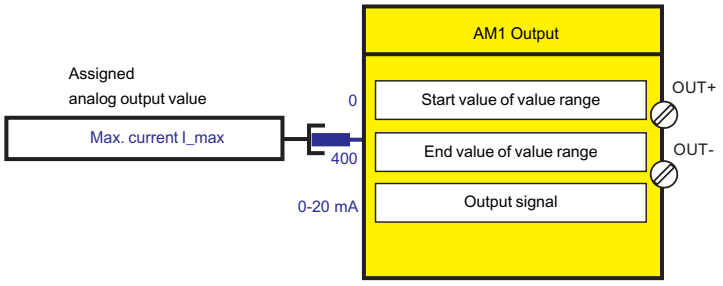


Figure 4-56 Application example: Motor current output - output values to function block AM output

When the parameterized "Output signal" = 0 to 20 mA:

- 0 % motor current: 0 mA at the analog module output
- 400 % motor current: 20 mA at the analog module output.

When the parameterized "Output signal" = 4 to 20 mA:

- 0 % motor current: 4 mA at the analog module output
- 400 % motor current: 20 mA at the analog module output.

2) Output of the effective motor current - only part of the motor current range (overload range)

The motor current ranges from 0 to 8 A. The rated current I_N of the motor at nominal load is 2 A.

The set current in SIMOCODE ES I_s corresponds to the rated current I_N (2 A). However, only the overload range (2 A - 8 A) is to be displayed on an instrument via the analog module output. In SIMOCODE pro, the present phase currents or the maximum current (current IL_1, IL_2, IL_3, max. current I_max) are represented as a percentage of the parameterized current setting I_s in accordance with the selected range:

- 2 A motor current corresponds to 100 % of I_s
- 8 A motor current corresponds to 400 % of I_s
- The smallest unit for the effective motor current in SIMOCODE pro is 1 % (see measured values in data record 94, manual SIMOCODE pro - Communication (https://support.industry.siemens.com/cs/ww/en/view/109743960)).

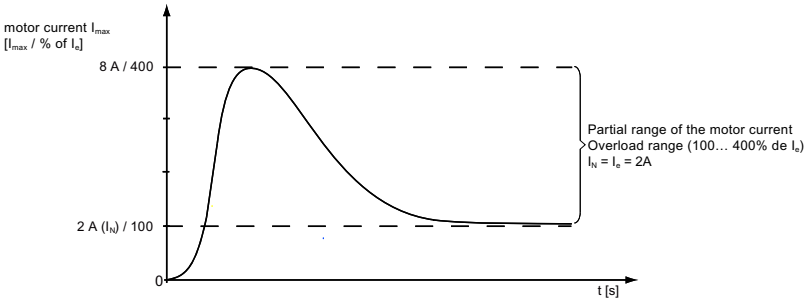


Figure 4-57 Application example: Motor current output - Overload range

As a result,

- The "Start value of value range" to be selected is: 100
- The "End value of value range" to be selected is: 400.

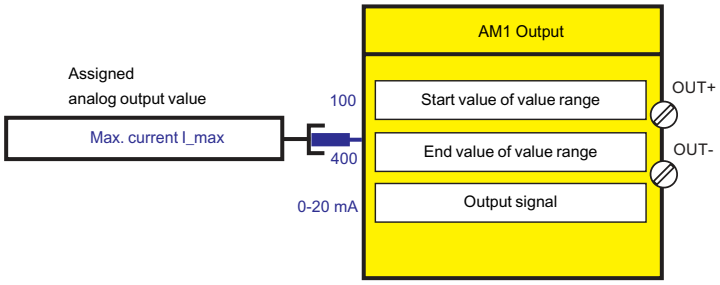


Figure 4-58 Application example: Motor current output - output value to function block AM1 output

When the parameterized "Output signal" = 0 to 20 mA:

- 100 % motor current: 0 mA at the analog module output
- 400 % motor current: 20 mA at the analog module output.

When the parameterized "Output signal" = 4 to 20 mA:

- 100 % motor current: 4 mA at the analog module output
- 400 % motor current: 20 mA at the analog module output.

Note

(relating to examples 1 and 2):

In SIMOCODE pro, phase currents are available as a percentage of the current setting I_s. When using the analog module output to display the present motor current on a connected pointer instrument, the present motor current is always indicated as a percentage of the current setting. If the selected control function is for a motor with only one speed, the pointer instrument can display a percentage (% of I_s) and an absolute value (e.g. in A).

In the case of motors / control functions with two speeds and, thus, two current settings (e.g. pole-changing starters or Dahlander starters), the motor current is only shown on the pointer instrument as a percentage of the present current setting I_s1 or I_s2, depending upon which of the two speeds (slow or fast) currently applies.

3) Output of any analog value from the automation system cyclically via the communication bus

One word (2 bytes) can be transmitted cyclically from the automation system to SIMOCODE pro via PROFIBUS; two words (2 times 2 bytes) can be transmitted via PROFINET. Any value can be output as a 0/4 to 20 mA signal by directly connecting this cyclic control word to the analog module output. If the transmitted value is in S7 Format (0 to 27648), this must be taken into consideration when parameterizing:

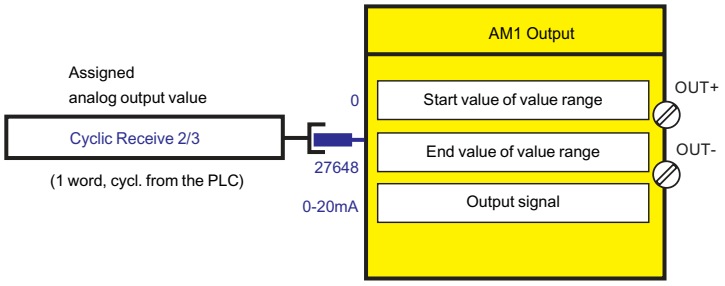


Figure 4-59 Output of an analog value from the automation system

As a result,

- The "Start value of value range" to be selected is: 0
- The "End value of value range" to be selected is: 27648.

When the parameterized "Output signal" = 0 to 20 mA

- 0: 0 mA at the analog module output
- 27648: 20 mA at the analog module output.

When the parameterized "Output signal" = 4 to 20 mA

- 0: 4 mA at the analog module output
- 27648: 20 mA at the analog module output.

4.5.6 Cyclic Send

Description

The "Cyclic Send" function blocks allow you to specify the information to be transferred cyclically to the automation system via the communication bus.

"Cyclic send" function blocks consist of

- 16 bits (two bytes, byte 0 and byte 1 for binary information)
- 9 words (= 18 bytes, for up to 9 analog values, freely parameterizable).

A total of nine "Cyclic Send" function blocks (0, 1, 2/3, 4/9, 10/19, 2-5, 6-9, 10-13, 14-17) are available.

Schematic

The following schematic shows the "Cyclic send" function blocks:

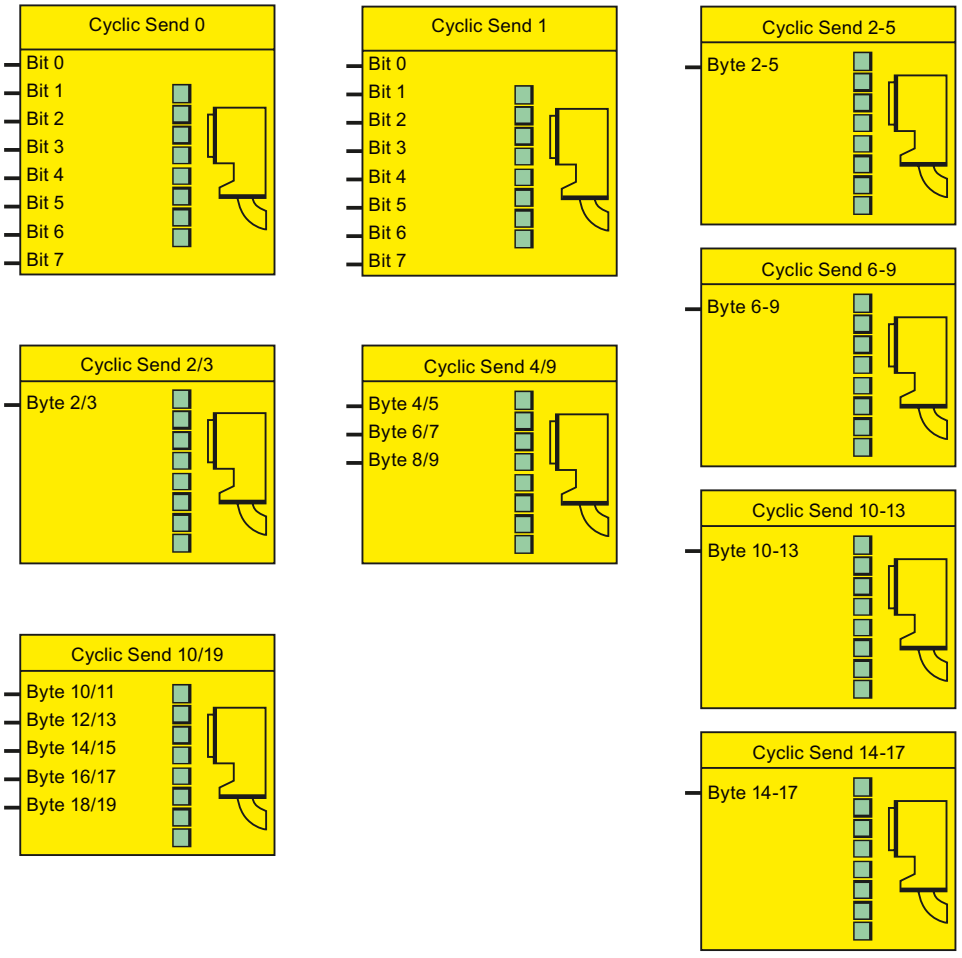


Figure 4-60 Schematic of the "Cyclic send" function blocks

Cyclic PROFIBUS DP services

Cyclic send data is exchanged between the DP master and the DP slave once in every DP cycle. The DP master sends the cyclic receive data to SIMOCODE pro. In response, SIMOCODE pro sends the cyclic send data to the DP master.

Cyclic services for PROFINET / EtherNet/IP

The cyclic send data is exchanged between the IO Device / adapter (SIMOCODE pro) and the IO Controller / scanner (automation system). The IO Controller sends the cyclic receive data to SIMOCODE pro in each case. In response, SIMOCODE pro returns the cyclic send data.

Cyclic send data settings

The cyclic send data is divided up into the following ranges:

- Byte 0/1, bit 0 - bit 7: For assignment of the bits with any signals (e.g. device inputs, events, faults)
- Bytes 2-19: For assignment with any analog values (length: 2 bytes, e.g. maximum current I_max in %, remaining cooling down period, actual value of timers) or floating-point values (length: 4 bytes, only with current/voltage measuring module UM+, e.g. maximum current I_max in A).

The number of available bytes depends on the basic type selected.

The following basic types are available for the following device series:

Basic type	SIMOCODE pro				
	C	S	V PN GP	V PB	V PN
1 (byte 2-9)	—	✓	✓	✓	✓
2 (byte 2/3)	✓	✓	✓	✓	✓
3 (byte 2-19)	—	—	✓	—	✓

Byte 0 of the send data is already pre-assigned; byte 2/3 is pre-assigned with the max. current I_max.

See also "Telegram description and data access" in the manual "SIMOCODE pro - Communication (https://support.industry.siemens.com/cs/ww/en/view/109743960)".

4.5.7 Acyclic Send

Description

In addition to "Cyclic Send" it is also possible to transfer a further 16 bits of binary information to the PLC / PC via acyclic services. The "Acyclic Send" function blocks allow you to specify the information to be transferred acyclically to the automation system via the communication bus. The inputs (plugs) of the function blocks must be connected to the respective sockets.

The Acyclic Send function blocks consist of:

- Eight bits each (= two bytes, byte 0 and byte 1 for binary information)
- One output each to the communication bus

There are two "Acyclic send" function blocks.

Schematic

The following schematic shows the "Acyclic send" function blocks:

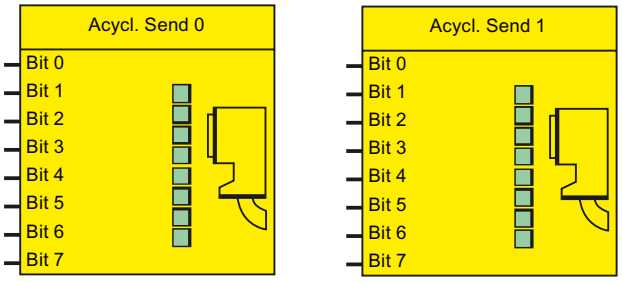


Figure 4-61 Function block "Acyclic send"

Acyclic services

Acyclic send data will only be transferred on request. The information (two bytes) can be found in data record 203. This data record can be read by every master (PLC or PC) that supports the acyclic services of the communication bus.

Settings

Table 4-56 Acyclic send data settings

Acyclic send data	Description
Byte 0 to 1, Bit 0 to bit 7	Setting and resetting of bits by means of any signal (any socket, e.g. device inputs, send data, status information, events, etc.)

4.5.8 OPC-UA send

Description

In addition to "Cyclic Send," it is possible to transfer a further 16 bits of binary information via OPC UA.

With the "OPC UA Send" function block, you can specify which information is to be transferred. The inputs (plugs) of the function blocks must be connected to the respective sockets.

The "OPC-UA send" function blocks each consist of eight bits (= two bytes, byte 0 and byte 1 for binary information).

A total of two "OPC-UA Send" function blocks are available.

Schematic

The following schematic shows the "OPC-UA Send" function blocks:

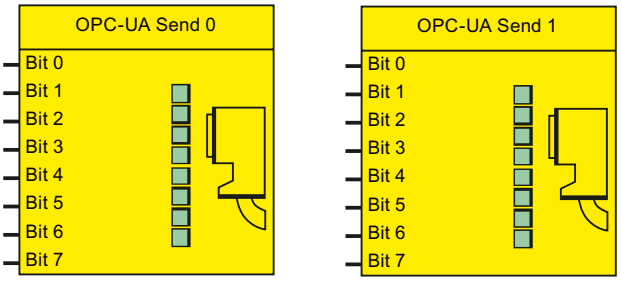


Figure 4-62 "OPC-UA send" function blocks

Settings

Table 4-57 OPC-UA Send Data settings

OPC-UA Send Data	Description
Bytes 0 to 1, bits 0 to 7	Setting and resetting of bits by means of any signal (any socket, e.g. device inputs, send data, status information, events, etc.)

Note

Data record 203 can still be read by every master (PLC or PC) as acyclic send data.

4.6 Inputs

4.6.1 Overview of inputs

Description

SIMOCODE pro has various inputs. These are represented by different function blocks in SIMOCODE pro. These function blocks are the ingoing SIMOCODE pro interfaces. Within SIMOCODE pro, these inputs are represented as sockets on the corresponding function blocks and can be assigned via connections to any functions. Inputs can be:

- Input terminals ⊘, located on the outside of the basic units and digital modules
- Buttons on operator panels (one Test / Reset button, four freely parameterizable buttons), and basic units (one Test / Reset button)
- Temperature module inputs
- Analog module inputs
- Inputs of the communication bus

Schematic

The following schematic shows the general representation of the various input types:

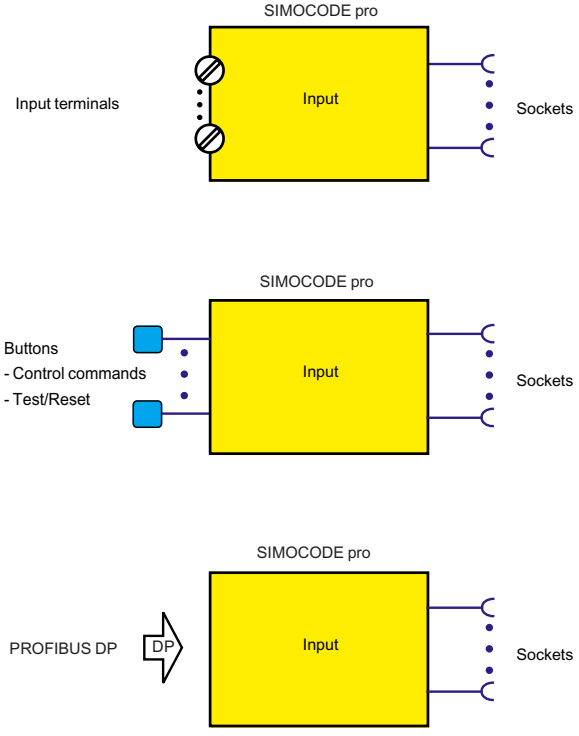


Figure 4-63 General representation of the input types

Scope and application

Inputs are used, for example, to input external signals e.g. via pushbuttons, key-operated switches, etc. These external signals are processed further internally via appropriate connections. The system has different inputs depending upon the device series:

Table 4-58 Inputs

Inputs	SIMOCODE pro						
	BP	GP		HP			
	C	S	V PN GP	V PB	V MR	V PN	V EIP
Basic unit inputs (BU Inputs)	✓	✓	✓	✓	✓	✓	✓
Operator panel buttons (OP Buttons)	✓	✓	✓	✓	✓	✓	✓
Digital module 1 inputs (DM1 Inputs)	—	✓ 1)	✓	✓	✓	✓	✓
Digital module 2 inputs (DM2 Inputs)	—	—	—	✓	✓	✓	✓
Temperature module inputs (TM Inputs)	—	✓	✓	✓	✓	✓	✓
Analog module inputs (AM Inputs)	—	—	—	✓	✓	✓	✓
Acyclic receive (Acycl. receive)	✓	✓	—	✓	✓	—	—
Cyclic receive (Cycl. receive)	✓	✓	✓	✓	✓	✓	✓
Ethernet - OPC-UA Receive	—	—	—	—	—	✓	—

1) for the SIMOCODE pro S basic unit, the inputs and the temperature input are on the multifunction module.

4.6.2 Basic unit inputs

Description

SIMOCODE pro has a "BU Inputs" function block with four binary inputs connected to common potential. You can connect, for example, the buttons for a local control station to the inputs. These signals can be further processed in SIMOCODE pro by internally connecting the sockets of the "BU Inputs" function block.
The "BU Inputs" function block consists of:

- Input terminals⊘ located on the outside of the basic unit, corresponding to the sockets "BU Input 1" to "BU Input 4"
- Sockets in SIMOCODE pro that can be connected to any plugs, e.g. to the "Control Stations" function block
- A socket for the "TEST / RESET" button:
  The function of the "TEST / RESET" button is generally dependent upon the operating state of the device:
  - Reset function for the acknowledgement of pending faults
  - Test function for carrying out device tests

In addition, other functions can be assigned to the "TEST / RESET" button (e.g. operation of the memory module and of the addressing plug).
See also Chapter Test / Reset (Page 200).

There is 1 "BU Inputs" function block.

Schematic

The following schematic shows the "BU Inputs" function block:

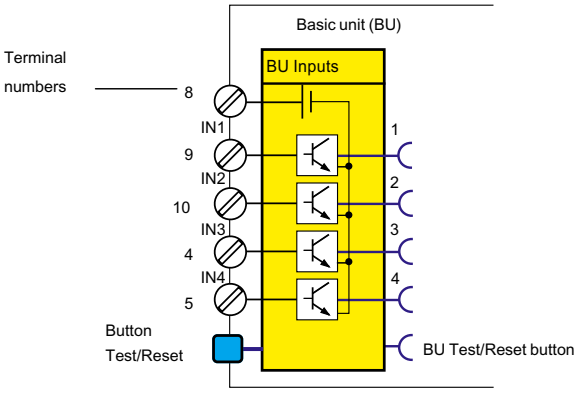


Figure 4-64 Schematic of the "BU Inputs" function block

Application examples

The inputs can be used, for example, for connecting the start and stop buttons of the local control station, which can then be assigned to the "Local Control Station" function block.
If assigned accordingly, the input signals can also be used to activate function blocks such as "Reset" or "External Fault."

Power supply to the inputs

See Chapter on "Wiring basic units, expansion modules and the decoupling module" in SIMOCODE pro – System Manual (https://support.industry.siemens.com/cs/ww/en/view/109743957).

Settings

Table 4-59 "Basic unit inputs" settings

Inputs	Description
Debounce time	You can set a debounce time for the inputs, if required. Range: 6, 16, 26, 36 ms (default: 16 ms)

4.6.3 Operator panel buttons

Description

The operator panel contains buttons 1 to 4 as well as the "TEST / RESET" button. Correspondingly, the "OP Buttons" function block is available in SIMOCODE pro with five sockets.

Note

The "OP Buttons" function block can only be used if the operator panel (OP) is connected and configured in the device configuration!

Note

The operator panel with display does not have a Test / Reset button. The allocated functions can be carried out via the operator panel menu or via softkeys. Similarly, the corresponding status signal will then be available at the "OP Test / Reset Button" socket.

- Operator panel, buttons 1 to 4: Buttons 1 to 4 are usually used to input control commands for the motor feeder. Control commands can be, for example:
  - Motor ON (ON >), Motor OFF (OFF) for a direct starter
  - Motor CCW (ON <), Motor OFF (OFF), Motor CW (ON >) for a reversing starter
  - Motor SLOW (ON >), Motor FAST (ON >>), Motor OFF (OFF) for a Dahlander circuit.

However, buttons 1 to 4 are not rigidly assigned to the above mentioned control commands, and can be assigned to other functions via different internal connection of the respective function block socket in SIMOCODE pro.

- "TEST / RESET" button. Operator control block: The function of the "TEST/RESET" button is generally assigned to fixed functions:
  - Reset function for the acknowledgement of pending faults
  - Test function for carrying out device tests.
  - Operation of the memory module or the addressing plug

Nevertheless, the status of the "TEST/RESET" button can be picked off at the corresponding socket of the function block and assigned to further functions in SIMOCODE pro.

See also chapters Test / Reset (Page 200) as well as "Setting the PROFIBUS DP address" and "Backing up and saving parameters" in the SIMOCODE pro – System Manual (https://support.industry.siemens.com/cs/ww/en/view/109743957).

Operator panel buttons

The following figure shows the front view of the operator panel and the buttons:

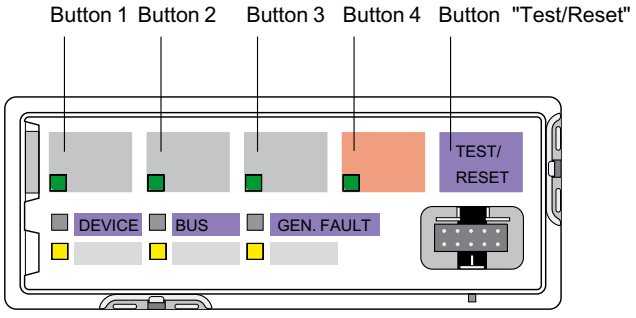


Figure 4-65 Operator panel buttons

Buttons on the operator panel with display

The following figure shows the front view of the operator panel with display and the buttons:

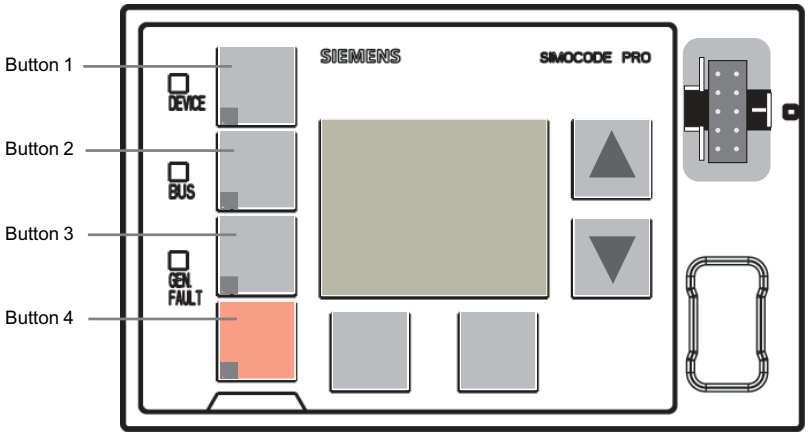


Figure 4-66 Buttons on the operator control block with display

Schematic

The following schematic shows the "OP buttons" function block:

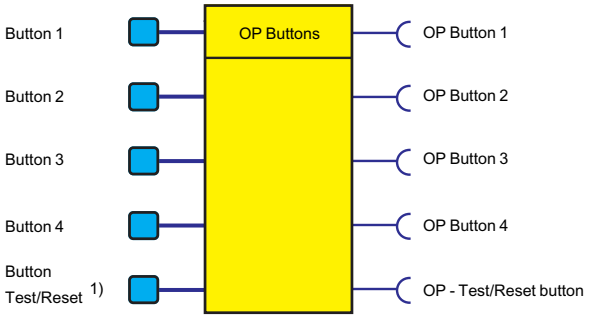


Figure 4-67 Schematic of the "OP Buttons" function block

1) For menu-assisted operation on the operator panel with display

4.6.4 Digital module inputs

Description

SIMOCODE pro has two "DM Inputs" function blocks, each with 4 binary inputs connected to common potential. You can connect, for example, the buttons for a local control station to the inputs. These signals can be further processed in SIMOCODE pro by internally connecting the sockets of the "DM Inputs" function blocks.

Note

"DM Inputs" function blocks can only be used if the corresponding digital modules (DM) or a multifunction module (MM) are connected and configured in the device configuration!

Each "DM Inputs" function block consists of:

- Input terminals ⊘ located on the outside of the digital module, corresponding to the sockets "DM Input 1" to "DM Input 4"
- Sockets in SIMOCODE pro that can be connected to any plugs, e.g. to the "Control Stations" function block

The following are available:

- A function block "DM1 Inputs" on the SIMOCODE pro S multifunction module
- Two function blocks "DM1 inputs" and "DM2 inputs" on the SIMOCODE pro V basic unit.

Schematic

The following schematic shows the "DM1 / DM2 Inputs" function blocks:

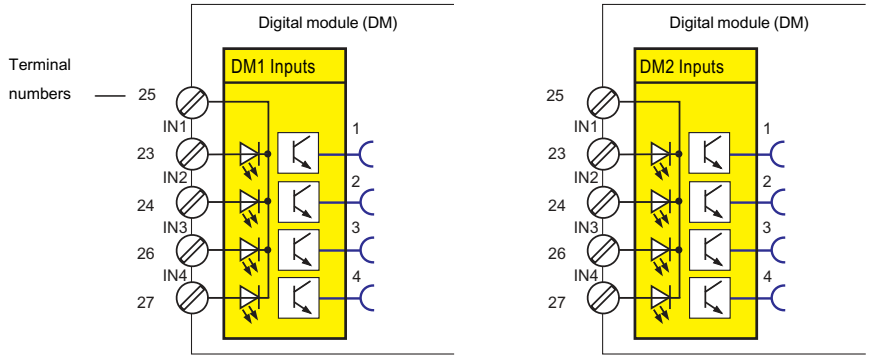


Figure 4-68 Schematic of the "DM1 / DM2 Inputs" function blocks

The following schematic shows the "DM1 Inputs" function block as a DM-F Local fail-safe digital module:

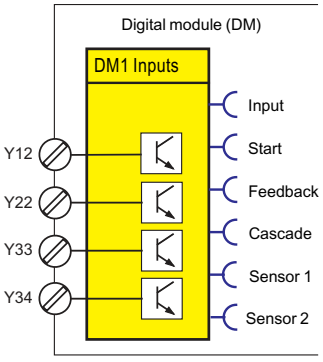


Figure 4-69 Schematic of the "DM1 Inputs" function block as a DM-F Local fail-safe digital module

Table 4-60 Inputs, "DM1 Inputs" function block as a DM-F Local fail-safe digital module

Input	Description
Input	1 - Ready to switch on - logical linking of sensor inputs 1 and 2 and the cascading input, consideration also of discrepancy or cross-fault errors
Start	Start: Start input state (Y33)

Input	Description
Feedback	Feedback: Feedback circuit state (Y34): 1 - closed, 0 - open
Cascading	Cascading input state (1)
Sensor 1	Sensor circuit 1 state (Y12)
Sensor 2	Sensor circuit 2 state (Y22)

The following schematic shows the "DM1 Inputs" function block as a DM-F PROFIsafe fail-safe digital module:

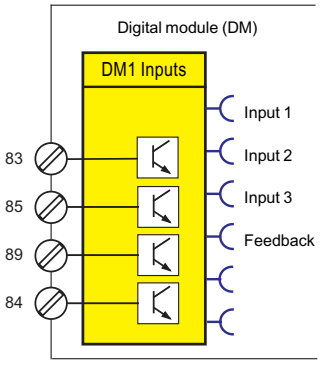


Figure 4-70 Schematic "DM1 Inputs" function block as a DM-F PROFIsafe fail-safe digital module

Table 4-61 Inputs, "DM1 Inputs" function block as a DM-F PROFIsafe fail-safe digital module

Input	Description
input 1	IN1 (84) state
input 2	IN2 (85) state
input 3	IN3 (89) state
Feedback	Feedback circuit state FBC (91): 1 - closed, 0 - open
Sensor 1	—
Sensor 2	—

Application examples

Digital modules allow the number of binary inputs and binary outputs on basic unit to be increased in increments. The high-performance SIMOCODE pro V devices can thus be extended, for example, to a maximum of twelve binary inputs and seven binary outputs. If assigned accordingly, the input signals can be also used to activate, for example, function blocks such as "Reset" or "External Fault". An external fault can be, for example, the binary signal of an external speed monitor, signaling that the nominal speed of a motor has been undershot.

Power supply to the inputs

See "Description of system components → Digital module" and "Description of system components → Fail-safe digital modules" in SIMOCODE pro – System Manual (https://support.industry.siemens.com/cs/ww/en/view/109743957).

Settings

Table 4-62 "DM1 / DM2 Inputs" settings

Inputs	Description
Debounce time	You can set a debounce time for the inputs, if required. Range: 6, 16, 26, 36 ms (default: 16 ms). These values apply to digital modules with a 24 V DC input supply. The values are approximately 40 ms higher for digital modules with input supplies of 110 to 240 V AC/DC.

Note

Delays for the digital module inputs can only be set, or are only relevant, if "monostable" or "bistable" is set for digital module 1.

If digital module 1 is a DM-F PROFIsafe, then the debouncing time cannot be set.

If digital module 1 is a DM-F Local, then the debouncing times are set using the DIP switch on the front of the DM-F Local.

Non-safety functions (fail-safe digital modules)

- If digital module1 is a DM-F Local, it is a digital module with non-safety inputs, relay outputs and diagnostics in a SIMOCODE pro system.
- If digital module 1 is a DM-F PROFIsafe, it is a digital module with non-safety inputs, relay outputs and diagnostics in a SIMOCODE pro system.

Detailed information on fail-safe digital modules: See "Description of system components → Fail-safe digital modules" in SIMOCODE pro – System Manual (https://support.industry.siemens.com/cs/ww/en/view/109743957).

4.6.5 Temperature module inputs

Description

SIMOCODE pro has a "TM1 Inputs" function block with three analog sockets corresponding to the three sensor measuring circuits of the temperature module. The temperature (in K) of the three measuring circuits can be read from these sockets and processed internally. An additional analog socket always supplies the maximum temperature of all three measured temperatures. Furthermore, the two binary sockets of the function block represent the status of the sensor measuring circuits. The analog values can be processed internally and / or transmitted cyclically to the automation system via the "Cyclic Send" function blocks.

Note

The "TM1 Inputs" function block can only be used if the temperature module (TM) or the multifunction (MM) is connected and configured in the device configuration!

Schematic

The following schematic shows the "TM Inputs" function block:

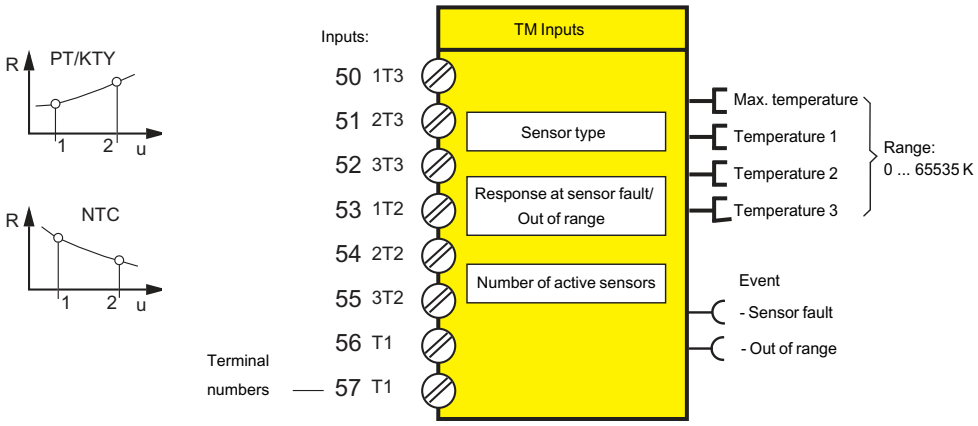


Figure 4-71 Schematic of the "TM Inputs" function block

Notes on wiring

You can connect up to three 2-wire or 3-wire temperature sensors to a temperature module.

You can connect a 2-wire or 3-wire temperature sensor to a multifunction module.

See "Wiring basic units, expansion modules and the decoupling module" in SIMOCODE pro – System Manual (https://support.industry.siemens.com/cs/ww/en/view/109743957) for further information.

Application examples

Among other things, you can monitor the following motor components:

- Motor windings
- Motor bearings
- Motor coolant temperature
- Motor gearbox oil temperature

The individual temperatures of the three sensor measuring circuits can be monitored independently of each other by connecting free limit monitors.

Settings

Table 4-63 Temperature module input settings

Temperature module	Description
Sensor type	PT100 (default), PT1000, KTY83, KTY84, NTC
Response [1] to sensor fault/out of range	Deactivated, signal, warn (default), trip

Temperature module	Description
Number of active sensors	1 sensor, 2 sensors, 3 sensors (default)
1) see Table "Sensor fault / Out of range response"	

Table 4-64 "Sensor fault / Out of range" response

Response	Sensor fault/Out of range
deactivated	X
signal	X
warn	X (d)
trip	X
delay	—

See also "Tables of responses of SIMOCODE pro" in Chapter Important notes (Page 7).

4.6.6 Analog module inputs

Description

SIMOCODE pro has an "AM1 Inputs" function block with two analog sockets, corresponding to the two analog inputs of the analog module. The effective analog value of each input can be read from these sockets and processed internally. An additional binary socket of the function block represents the status of the analog measuring circuits. The analog values can be processed internally and / or transmitted cyclically to the automation system via the "Cyclic Send" function blocks.

Note

The "AM1 Inputs" function block can only be used if the respective analog module (AM) has been connected and configured in the device configuration!

Schematic

The following schematic shows the "AM1 Inputs" function block:

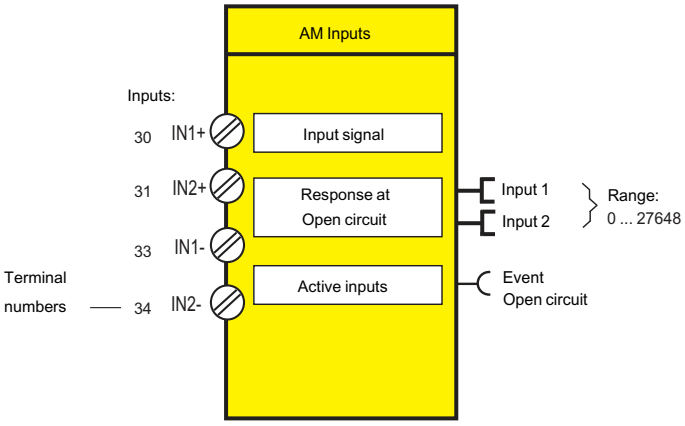


Figure 4-72 Schematic of the "AM1 Inputs" function block

Application examples

Typical applications are:

- Fill-level monitoring for implementing dry running protection for pumps
- Monitoring of pollution in a filter using a differential pressure transducer.

Settings

Table 4-65 Analog module input settings

Analog module	Description
Input signal	0 to 20mA (default), 4 to 20 mA
Response to open circuit	Signal, warn (default), tripping
Active inputs	1 input (default), 2 inputs

Notes

Note

The value of the analog module inputs is in S7 format.

Note

The inputs of the analog module are passive inputs, i.e. to configure an analog input circuit, each input will require an additional, isolated external current source connected in series. If the output of the analog module is not being used by another application, it can also be used as a current source for an analog module input circuit. The "Start value of value range" and the "End value of value range" of the analog module output have to be set to 65535 for this. Thus, the maximum possible current will always be available via the analog module output.

4.6.7 Cyclic Receive

Description

With the "Cyclic Receive" function blocks, you can specify which cyclic data from the automation system will be further processed in SIMOCODE pro. These will normally be PLC / PCS binary control commands. Connection with the "Control stations" function block in SIMOCODE pro will allow the motor to be controlled via PROFIBUS DP / PROFINET / EtherNet/IP. Direct connection of the analog value with the "AM Output" function block will result in, for example, the cyclic output of the value sent via the communication bus at the output of the analog module.

The "Cyclic receive" function blocks consist of:

- 16 bits (byte 0 and byte 1 for binary information)
- One word (= two bytes, byte 2 to 3 for an analog value, freely programmable) for basic type 1.

Overall there are four "Cyclic Receive" function blocks (0, 1, 2/3, 4/5).

Schematic

The following schematic shows the "Cyclic receive" function blocks:

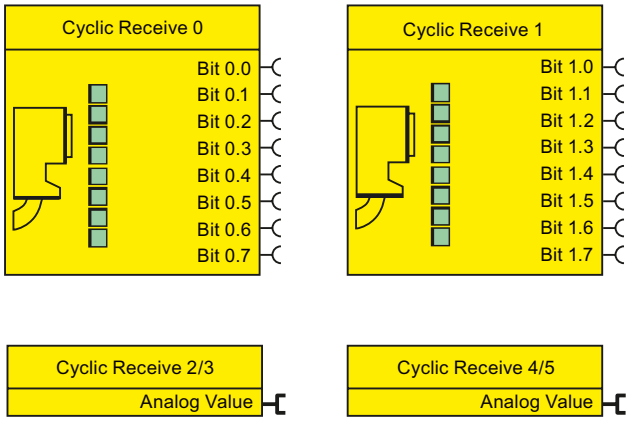


Figure 4-73 Function schematic of cyclic receive data

Cyclic services

The cyclic data is exchanged between master and slave in every communication cycle. The master sends the cyclic receive data (Cyclic Receive) to SIMOCODE pro each time. SIMOCODE pro responds by sending the cyclic send data (Cyclic Send) to the master.

4.6.8 Acyclic Receive

Description

In addition to "Cyclic Receive", it is possible to transfer further data acyclically to SIMOCODE pro via PROFIBUS DP. With the "Acyclic receive" function block, you can specify which acyclic information from the PROFIBUS DP will be further processed in SIMOCODE pro. With the "Acyclic receive" function block, you can specify which information will be further processed in SIMOCODE pro.

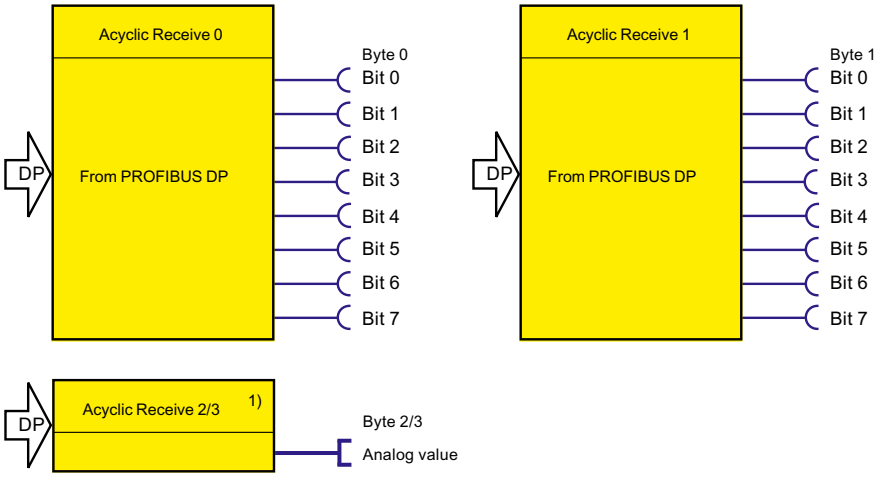
The "Acyclic receive" function blocks consist of:

- Eight bits each (byte 0 and byte 1 for binary information)
- One word (= two bytes, byte 2 to 3 for an analog value, freely parameterizable).

Overall there are three "Acyclic receive" function blocks (0, 1, 2/3)

Schematic

The following schematic shows the "Acyclic receive" function blocks:



1) BU2 with basic type 1 only

Figure 4-74 Function schematic of acyclic receive data

Acyclic services

Acyclic data are transferred only on request.
The information (4 bytes) can be found in data record 202. This data record can be written by every master (PLC or PC) that supports the acyclic services of PROFIBUS DPV1. Connection monitoring is activated every time the data record is received. The content of the data record is deleted after a 5-second time-out has elapsed.

4.6.9 OPC UA Receive

Description

In addition to "Cyclic Receive," it is possible to transfer further data to SIMOCODE pro via OPC-UA. With the "OPC UA Receive" function block, you can specify which information will be further processed in SIMOCODE pro. For this, you only have to link the sockets of the "OPC-UA Receive" function blocks to any other function blocks in SIMOCODE pro.

The "OPC-UA Receive" function blocks consist of:

- Eight bits each (= two bytes, byte 0 and byte 1 for binary information)
- One word (= two bytes, byte 2 to 3 for an analog value, freely parameterizable).

A total of three "OPC-UA Receive" function blocks (0, 1, 2/3) are provided.

Schematic

The following schematic shows the "OPC-UA Receive" function blocks:

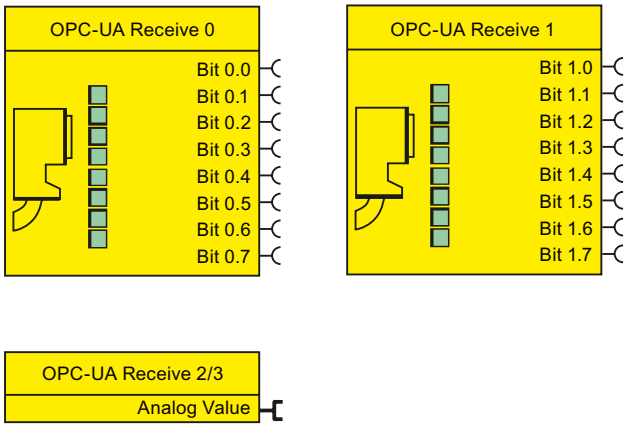


Figure 4-75 Schematic of the "OPC-UA Receive" function blocks

4.7 Analog value recording

4.7.1 Analog value recording description of functions

The "Analog Value Recording" function block can be used to record any analog values (2 bytes / 1 word) in SIMOCODE pro over a set period of time. For example, you can use this function block to record the characteristic curve of the motor current during motor startup.

The recording is made directly in SIMOCODE pro, related to the motor feeder, and independently of the communication bus or the automation system. Every analog value present at the "Allocated analog value" analog socket is recorded and saved. Recording starts on the basis of the edge (positive / negative) via any binary signal at the trigger input of the function block. Up to 60 values can be saved internally in the device. The time frame of the recording is indirectly determined by the selected sampling rate:

Sampling time = sampling rate[s] * 60 values

The pre-trigger can be used to specify how far in advance the recording should commence before the trigger signal is issued. The pre-trigger is set as a percentage of the entire sampling time. In addition, with SIMOCODE ES you can also export the measured curve into a *.csv file for further processing, for example, in MS Excel.

4.7.2 Measured curve, function block and analog value recording application example

Measured curve

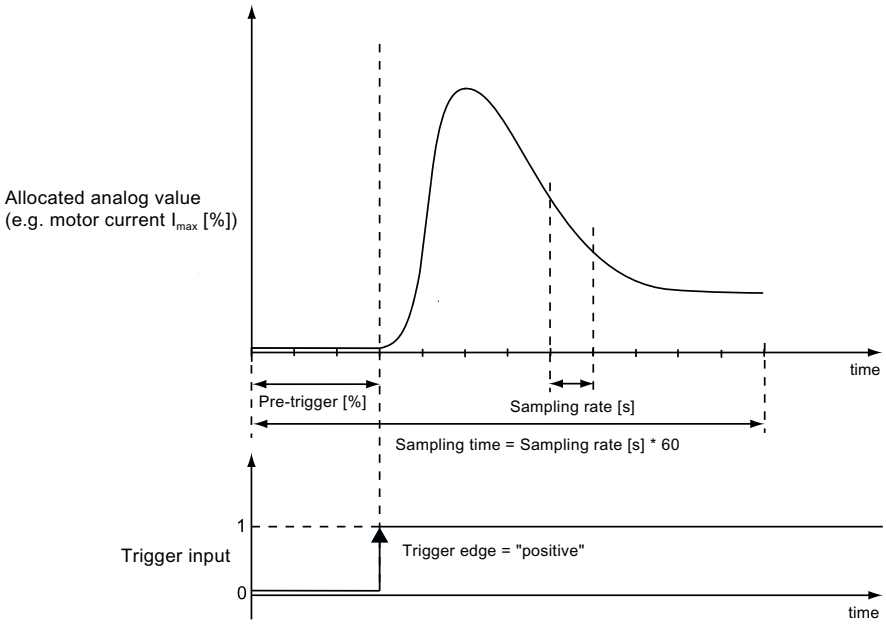


Figure 4-76 Analog value recording of measured curve

The old measured curve will be overwritten in SIMOCODE pro each time a new trigger signal is sent to the trigger input.

Schematic

The following schematic shows the "Analog Value Recording" function block:

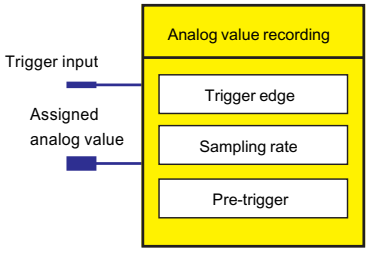


Figure 4-77 Schematic of the "Analog Value Recording" function block

Settings

Table 4-66 "Analog value recording" settings

Signal / value	Range
Trigger input	Activate analog value recording with any signal (any sockets, e.g. device inputs, current flowing)
Allocated analog value	Any value (1 word / 2 bytes) in SIMOCODE pro
Trigger edge	positive (default) / negative
Sampling rate	0.1 to 50 s, in steps of 0.1 s (default: 0.1 s)
Pre-trigger	0 to 100 % in steps of 5 % (default: 0 %)

Application example

Record the motor current when the motor starts / sampling time = 12 s / pre-trigger = 25 % (3 s):

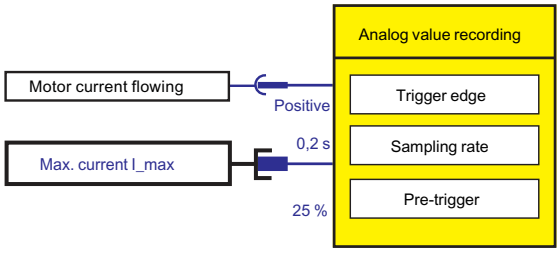


Figure 4-78 Application example of the analog value recording

4.8 Standard functions

4.8.1 Overview of standard functions

Description

So-called "Standard functions" in the form of function blocks are also stored in SIMOCODE pro, and can be used as required.
These function blocks may contain:

- Plugs
- Sockets in the form of status information
- Setting values, e.g. the response when an external fault occurs ("signal," "warn," or "trip").

Schematic

The following schematic shows the general representation of the function block of a standard function:

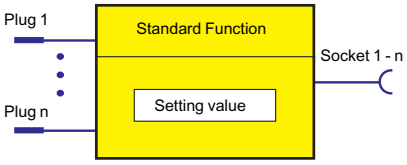


Figure 4-79 General representation of the function block of a standard function

Scope and application

These function blocks work independently of the selected control function and can be used as optional supplements. They are ready to use and only require activating by connecting the plug(s) of the respective function block. Depending on the device series, the system offers several different function blocks for such standard functions.

Table 4-67 Function blocks

Standard function block	SIMOCODE pro					
	BP	GP		HP		
	C	S	V PN GP	V PB	V MR	V PN, V EIP
Test	2	2	2	2	2	2
Reset	3	3	3	3	3	3
Test Position Feedback (TPF)	1	1	1	1	1	1
External fault	4	4	4	6	6	6
Operational Protection Off (OPO)	—	—	—	1	1	1
Power failure monitoring (UVO)	—	—	—	1	1	1

Standard function block	SIMOCODE pro					
	BP	GP		HP		
	C	S	V PN GP	V PB	V MR	V PN, V EIP
Emergency start	1	1	1	1	1	1
Watchdog (PLC / PCS monitoring)	1	1	1	1	1	1
Time stamping	—	—	—	1	—	—
Safety-related tripping	—	—	—	1		1

4.8.2 Test / Reset

Test / Reset description

The function of the "TEST / RESET" button on the basic unit or operator panel is generally dependent upon the operating state of the device:

- Reset function: If a fault occurs
- Test function: In other operating states.

In addition to the TEST / RESET buttons, SIMOCODE pro allows internal Test / Reset tripping via the "Test" function blocks. The "Test" function block consists of one plug.

In total, two function blocks, "Test 1" and "Test 2," are provided, each function block having a slightly different function:

- Test 1: Tests / trips the output relays
- Test 2: Does not trip the output relays (normally for testing via the bus).

Schematic

The following schematic shows a general representation of the "Test / Reset" function blocks:

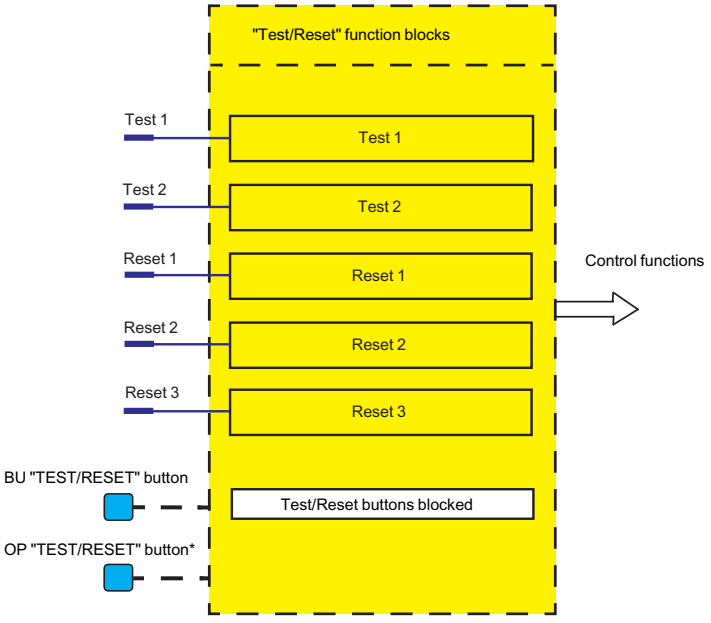


Figure 4-80 "Test / Reset" function blocks

1) The operator panel with display does not have a "TEST/RESET" button. The respective functions can be carried out via the operator panel menu or via softkeys.

Testing

Testing can be carried out as follows:

- Via the "TEST / RESET" button on the basic unit and on the operator panel (can be deactivated), as well as via PC with SIMOCODE ES software.
- Via the plugs of the internal "Test 1" or "Test 2" function blocks
- Via the menu of the operator panel with display (e.g. the "Commands" menu item).

Testing can be terminated at any time - it does not influence the thermal motor model of the overload function, i.e. after switching off via test, the system can be reset immediately. Tripping only occurs for Test 1 when the operating mode is set to "Remote."

Reset function

Resetting can be carried out as follows:

- Via the "TEST / RESET" button on the basic unit and on the operator panel (can be deactivated), as well as via PC with SIMOCODE ES software.
- Using the "Reset input" plug of the internal function blocks via the plugs of the internal function blocks "Reset 1," "Reset 2," and "Reset 3."
- Via the menu of the operator panel with display (e.g. the "Commands" menu item).

The "Reset" function block consists of one plug.

There are three function blocks "Reset 1" to "Reset 3."

All reset inputs (sockets) have equal priority (or function).

Test function

A SIMOCODE pro function test can also be initialized via the test function. The test function comprises the following steps:

- Lamp / LED test (test function activated for < 2 s)
- Test of the device functionality (test function activated for 2 to 5s)
- Switching off the QE (test function activated for > 5 s). The QE can only be switched off using the "Test 1" function block and in the "Local 1-3" operating mode using the "TEST/RESET" button on the basic unit / operator panel.

Test phases

The following table shows the test phases performed when the "TEST / RESET" button is pressed for the required length of time:

Table 4-68 States of the status LEDs / contactor controls during testing

Test phase	**State**	**Without main current**		**With main current**	
		OK	**fault** *)	**OK**	**Fault**
Hardware test / lamp test					
< 2 s	"DEVICE" LED	◯ orange	◯ green	◯ orange	◯ green
	"GEN.FAULT" LED	◯	◯	◯	◯
	Contactor control	Unchanged	Unchanged	Unchanged	Unchanged
	Show QL *)	◯	◯	◯	◯
Results of the hardware test / lamp test					
2 to 5 s	"DEVICE" LED	◯ green	◯ red	◯ green	◯ red
	"GEN.FAULT" LED	◑	◯	⊗	◯
	Contactor control	Unchanged	Deactivated	Unchanged	Deactivated
Relay test					
> 5 s	"DEVICE" LED	◯ green	◯ red	◯ green	◯ red
	"GEN.FAULT" LED	◯	◯	◯	◯
	Contactor control	Deactivated	Deactivated	Deactivated	Deactivated

◯ LED lighted / switched on
◑ LED flashing
⊗ LED flickering
◯ LED off
*) "Fault" only displayed after 2 s

Test settings

Table 4-69 Test settings

Test 1 to 2	Description
Input	Activation of the "Test" function block by any signal (any sockets, e.g. device inputs, communication bus control bits, etc.).
Test / Reset buttons blocked	The blue TEST/RESET buttons on the basic unit and the operator panel are usually intended for acknowledging faults and for performing a device test. The buttons can be disabled with "TEST/RESET keys disabled". These can then be used for other purposes.

Acknowledgment of faults

Generally, the following applies to the acknowledgement of faults:

- Faults can only be acknowledged
  - if the cause of the fault has been eliminated
  - if there is no "ON" control command pending.
- A reset will not be possible if the cause of the fault has not been eliminated and / or if an "ON" control command is pending. The reset will be saved depending on the type of fault. Saving a reset is indicated by the "GEN. FAULT" LED on the basic unit and on the operator panel. The LED changes from flashing to continuous signal.

Automatic acknowledgement of faults

Faults are automatically acknowledged in the following cases:

- A reset has been saved and the cause of the fault is no longer present (user has previously acknowledged the fault)
- Auto reset of an overload trip or thermistor trip if motor protection reset = Auto (an automatic acknowledgment is issued here after expiry of the cooling down period). The motor cannot start immediately since reset cannot be performed when an ON command is pending.
- If a configured module fails, all related faults will be acknowledged automatically. However, a configuration fault will be generated (exception: operator panel, if parameterized accordingly). This ensures that a module fault does not cause the general fault to be acknowledged automatically.
- If a function or module is deactivated in the device configuration (via parameterization), all related faults are acknowledged automatically. The motor cannot start immediately since parameters cannot be entered if an ON command is pending.
- If a parameter of a function is changed from "trip" to "warn", or to "signal" or "deactivated", all related faults will be acknowledged automatically.
- For an external fault: With its own parameter: "Auto-Reset."

Reset settings

Table 4-70 Reset settings

Reset 1 to 3	Description
Input	Activation of the "Reset" function block by any signal (any sockets, e.g. device inputs, communication bus control bits, etc.).
TEST/RESET buttons blocked	The blue Test / Reset buttons on the basic unit and the operator panel are usually intended for acknowledging faults and for performing a device test. The buttons can be disabled with "TEST/RESET keys disabled". These can then be used for other purposes. On the operator panel with display, the buttons are disabled via a menu function (default: not disabled).

4.8.3 Test position feedback (TPF)

Description

You can carry out the "Cold run" function test using the "Test Position Feedback (TPF)" function block. For this purpose, the function block input (plug) must be connected to the respective socket. The activated test position will be indicated by the flashing QL of the control function.

The "Test Position Feedback (TPF)" function block consists of

- one plug
- a "Status - test position" socket. It is set if a signal is pending at the input.
- one "Fault - test position feedback error" socket. It is set when
  - "TPF" is activated although current is flowing in the main circuit
  - "TPF" is activated and current is flowing in the main circuit.

In total, one "Test Position Feedback" function block is available.

Note

When the test position is enabled, the QLE / QLA sockets of the control function are activated, to indicate test operation of the motor feeder via a flashing button LED, for example.

Schematic

The following schematic shows the "Test Position Feedback" function block:

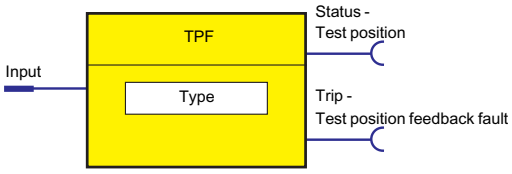


Figure 4-81 "Test Position Feedback" function block

Cold run

If the motor feeder is in the test position, its main circuit is isolated from the network. However, the control voltage is connected.

The "cold run" function test is performed with the feeder in this state. This means the motor feeder is tested without a current in the main circuit.

To differentiate this function from normal operation, it must be enabled via the socket on the function block.

Feedback stating that the motor feeder is isolated from the line voltage on the primary current side can be implemented, for example, via an auxiliary contact of the main switch in the motor feeder that is connected to any device input (terminal). This is then internally connected to the "Test position feedback (TPF) - Input" plug of the function block. When using current / voltage measuring modules, this type of auxiliary contact is entirely unnecessary. The "TPF" function block can be activated by monitoring for undervoltage ("Voltage Monitoring" function block).

Thereafter, the contactor outputs can be set via the control stations (see Chapter Description of functions of control stations (Page 73)), enabling the current-free status to be tested.

If current flows erroneously during test operation, the contactor outputs are switched off by "Fault - Test Position Feedback (TPF)."

Fault message "Fault - Test Position Feedback (TPF)" and acknowledgment

Note

"Fault - Test Position Feedback (TPF)" will be generated if:

- "TPF" is activated, although current is flowing in the motor feeder
- "TPF" is activated and current is flowing in the motor feeder.

Acknowledge with "Reset."

Settings

Table 4-71 Test Position Feedback (TPF) settings

Test Position Feedback (TPF)	Description
Input	Activation of the "Test position feedback (TPF)" function block by any signal (any sockets, e.g. device input)
Type	Specification of the input logic: • NO contact (1-active) (default) • NC contact (0-active)

4.8.4 External fault

Description

The "External Fault 1 to 6" function blocks can be used to monitor any statuses and/or external devices, to generate fault messages and, if necessary, to switch off the motor. To do this, the inputs (plugs) of the External Fault function blocks must be connected to any sockets (e.g. device inputs, communication bus control bits, etc.). External faults can also be "marked" in SIMOCODE pro. This facilitates their allocation to the actual malfunction. Example: monitoring the rotational speed of the motor using an external speed monitor.

The "External Fault" function block consists of:

- two plugs (1 plug for setting, 1 plug for resetting)
- one "Event - external fault" socket. It is set if a signal is pending at the input.

The following are available:

- Four "External Faults 1 to 4" function blocks for the SIMOCODE pro C and pro S basic units
- Six "External Faults 1 to 6" function blocks for the SIMOCODE pro V PB, pro V MB RTU, pro V PN and pro V EIP basic units

Schematic

The following schematic shows the "External Fault" function blocks:

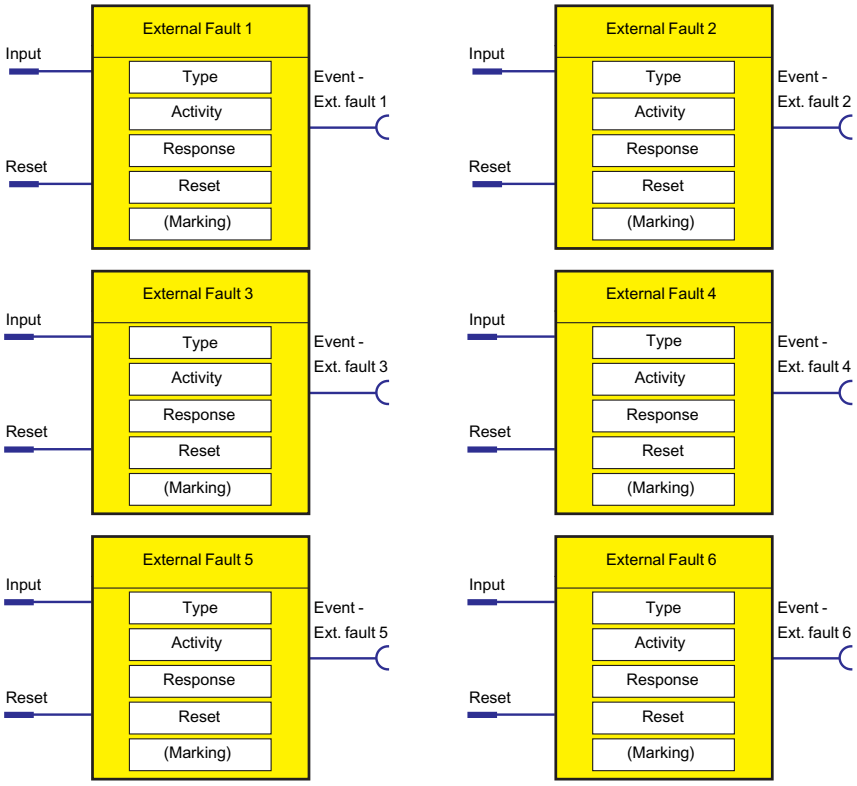


Figure 4-82 "External Fault" function blocks

Special reset options:

A specific reset input is also available in addition to the other reset options (remote reset, Test / Reset buttons, OFF command reset). Furthermore, Auto-Reset can also be activated. See table below.

Settings

Table 4-72 "External Fault" settings

External fault 1 to 6	Description
Input	Activation of the "External Fault" function block by the monitored signal (any sockets, e.g. device inputs, communication bus control bits, etc.)
Type	Specification of the input logic: • NO contact (1-active) (default) • NC contact (0-active)
Active status	Specify in which motor operating state the external fault is to be evaluated: • Always (default): Always evaluate, regardless of whether the motor is running or at a standstill • Only when motor on: Evaluation only if motor is switched ON.

External fault 1 to 6	Description
Response	Specification of the response to an external fault when activated via the input (see the following table and Chapter Important notes (Page 7)).
Reset	Acknowledge the "External fault" fault via any signal (any sockets, e.g. device inputs, communication bus control bits, etc.)
Reset also by	Specification of further (common) acknowledgement options using additional reset types: • Test/Reset buttons on the basic unit and the operator panel or, in the case of the operator panel with display, via the menu (panel reset) (default) • Remote reset: Acknowledgment via reset 1 to 3, DPV1, "Reset" command (default) • Auto reset: The fault resets itself after the cause has been eliminated (after removal of the activation signal) • OFF command reset: "OFF" control command, resets the fault
Marking [1)]	No parameters. Optional marking for designating the event, e.g. "Speed >," e.g. with SIMOCODE ES. Range: maximum 10 characters.

1) Certain special characters are not displayed on the operator panel with display when assigning a name for the external faults.

Note

Changing the marking of all Ethernet and PROFINET connections

Note for firmware versions <V3.0.0 (PROFINET devices) and <V2.0.0 (EtherNet/IP devices)

Each change to the marking requires that the communication interface be restarted when the web server is active.

A new start interrupts all Ethernet and PROFINET links and reestablishes them afterward.

"External fault" response

Table 4-73 "External fault" response

Response	External fault
trip	X
warn	X
signal	X (d)
deactivated	—

4.8.5 Operational Protection Off (OPO)

4.8.5.1 Response to positioner control function

Description of Operational Protection Off (OPO)

The "Operational Protection Off (OPO)" function block returns the positioner to a safe position. To do this, the input (plug) must be connected to an appropriate socket (e.g. device inputs, communication bus control bits, etc.).

The "Operational Protection Off" function block consists of

- one plug
- one "Status - OPO" socket. It is set if a signal is pending at the input.
- one "Fault - OPO Fault" socket. It is set when the respective, safe end position has been reached.

In total, one "Operational Protection Off (OPO)" function block is available for the pro V basic units.

The following table shows the basic operating principle:

Table 4-74 Basic operating principle of Operational Protection Off (OPO) for the "Positioner" control function

OPO	**Initial position when OPO is pending**				
	Positioner is open	Positioner opens	Positioner stop/OFF	Positioner closes	Positioner is closed
Reaction to OPO					
Parameterized response "Positioner closes"	Fault reset: With close command	Fault reset: With close command	Fault reset: With close command	—	—
	→ Positioner closes	→ Positioner closes	→ Positioner closes	→ Positioner closes	
Parameterized "Positioner opens" response	—	—	Fault reset: With open command	Fault reset: With open command	Fault reset: With open command
		← Positioner opens	← Positioner opens	← Positioner opens	← Positioner opens

Schematic

The following schematic shows the "Operational Protection Off (OPO)" function block:

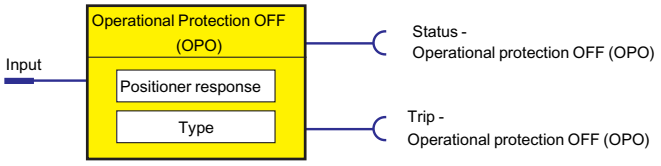


Figure 4-83 "Operational Protection Off (OPO)" function block

Settings

Table 4-75 Operational Protection Off settings

Operational Protection Off (OPO)	Description
Input	Activation of the "Operational Protection Off" function block by the monitored signal (any sockets, e.g. device inputs, etc.)
Positioner response	Specification of the response for the "Positioner" control function when activated via the input: • CLOSE: Positioner runs to the end position in the "CLOSED" direction (default). • OPEN: Positioner moves to the "Open" end position
Type	Specification of the input logic • NO contact (1-active) (default) • NC contact (0-active)

Safety guidelines

Note

A "Fault - Operational Protection Off (OPO)" fault message is not generated if the "OPO" command attempts to run the positioner to the end position if it is approaching or has already reached this end position.

Note

No other control command (counter command or stop command) is performed while "Operational protection Off (OPO)" is active.

Note

The "Fault - Operational protection Off (OPO)" fault message must be acknowledged by the open or closed control command, depending on the present "OPO" end position.

Note

Acknowledgment is performed even if the desired end position has not yet been reached.

Note

The fault message is available as diagnosis via the communication bus.

4.8.5.2 Response to other control functions

For other control functions, the following scenarios can be differentiated between for OPO:

- Motor in operation: The motor is switched Off with a "Fault - Operational Protection Off (OPO)" fault.
- The motor is off. Initially no fault. The "Fault - Operational Protection Off (OPO)" fault only occurs when an "ON command" is issued.

4.8.6 Power failure monitoring (UVO)

Description

The "Power Failure Monitoring (UVO)" function block is activated via the plug. This is performed via an external voltage relay that is connected to the function block via the binary inputs of SIMOCODE pro.

Sequence (see timing charts below):

1. All contactors (QE) are disconnected immediately after the monitoring relay has been operated/the input has been activated (UVO).
2. If the voltage is restored within the "power failure time", the motor will be reset to its previous state considering the signals of the control stations. This can either take place immediately or with a time delay (restart time delay).
3. If the "power failure time" elapses before the voltage returns, the device signals a fault (UVO fault).

Prerequisite: The SIMOCODE pro control voltage is buffered and not interrupted.

In total, one "Power Failure Monitoring" function block is available for the pro V basic units.

Schematic

The following schematic shows the "Power Failure Monitoring (UVO)" function block:

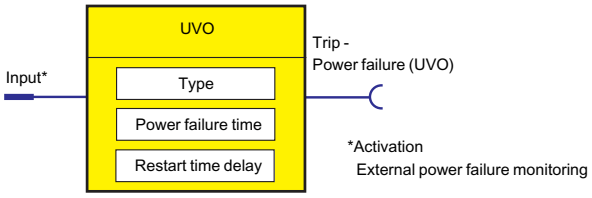


Figure 4-84 "Power Failure Monitoring (UVO)" function block

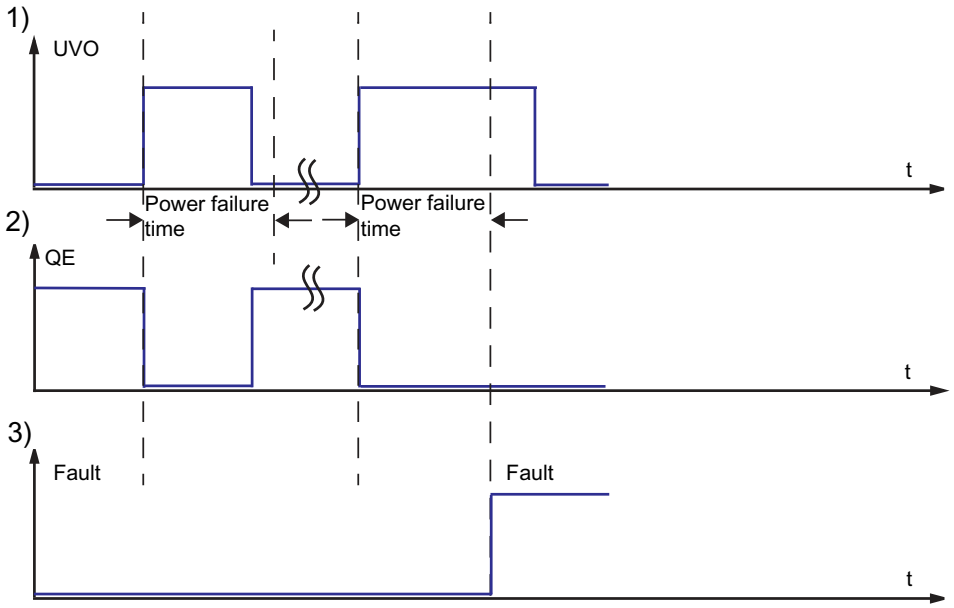


Figure 4-85 Power failure monitoring (UVO) sequence charts

Settings

Table 4-76 Power failure monitoring settings

Power failure monitoring (UVO)	Description
Input (activation)	Activation of the "Power Failure Monitoring (UVO)" function block by the monitored signal (any socket, e.g. device inputs, communication bus control bits, etc.)
Type	Specification of the type of power failure monitoring: • Deactivated (default setting) • No interruption of device power supply. The SIMOCODE pro control supply voltage is maintained. The failure of the line voltage must be detected, for example, by a separate voltage relay.
Power failure time	Time that starts when the power fails. If the line voltage is restored within the power failure time, all drives which were running prior to the power failure are reconnected automatically. If the line voltage is not restored within the power failure time, the drives remain disconnected and the "Fault - Power failure (UVO)" message is generated. Once the line voltage has been restored, this fault message can be acknowledged with "Reset". Range: • 0 to 25.5 s in increments of 0.1 s • 26 to 255 s, in increments of 1 s • 256 to 2550 s in increments of 10 s.
Restart time delay	The restart time delay can be set so that not all motors restart simultaneously. (Line voltage would otherwise dip again.) Range: 0 to 255 s (default: 0 s)

4.8.7 Emergency start

Description

Emergency start deletes the thermal memory from SIMOCODE pro each time it is activated. This allows the motor to be immediately restarted after an overload trip. This function can be used to:

- enable an immediate reset and restart after an overload trip
- delete the thermal memory (motor model) during operation, if required.

NOTICE
Thermal overload of the motor possible! If emergency starts are performed too frequently this may result in thermal overloading of the motor!

Since the emergency start is "edge-triggered", this function cannot permanently affect the thermal motor model. An emergency start is carried out as follows:

- Using the plug of the function block. To do this, the input (plug) of the function block must be connected to any socket (e.g. device inputs, communication bus control bits, etc.).

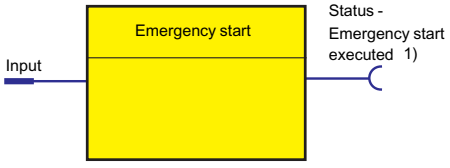
The "Emergency Start" function block consists of:

- one plug
- one "Status - emergency start executed" socket. It is set when an emergency start has been executed.

Overall, there is one "Emergency start" function block available.

Schematic

The following schematic shows the "Emergency Start" function block:



1) The "Emergency start executed" signal is triggered by the edge (input) and reset when the current flows.

Figure 4-86 Emergency Start function block

Settings

Table 4-77 Emergency start settings

Emergency start	Description
Input	Activation of the "Emergency Start" function block by any signal (any sockets, e.g. device inputs, communication bus control bits, etc.).

4.8.8 Safety-related tripping

Description

Note

Please note that the information made available for further processing is in the form of non-safety-related signals.

Note

Please note that the safety-related tripping function block does not itself represent a safety-related function.

The safety function of the DM-F Local is determined exclusively by the setting of the DIP switch on the module.

The safety function of the DM-F PROFIsafe is determined by the fail-safe program in the F-CPU.

Further information: See Manual SIMOCODE pro fail-safe digital modules (https://support.automation.siemens.com/WW/view/en/50564852).

The DM-F Local Safety-related tripping function block consists of 3 sockets:

- Event - DM-F LOCAL ok: The DM-F LOCAL is ON.
- Event - safety-related tripping: A safety-related tripping has been performed.
- Status - enabling circuit closed: The enabling circuit is closed.

The DM-F PROFIsafe Safety-related tripping function block consists of 3 sockets:

- Event - PROFIsafe active: Fail-safe communication between the F-CPU and the DM-F PROFIsafe is active.
- Event - safety-related tripping: A safety-related tripping has been performed.
- Status - enabling circuit closed: The enabling circuit is closed.

There is 1 "Safety-related tripping" function block each for SAFETY (Local) and PROFIsafe on the SIMOCODE pro V High Performance basic units.

Schematic

The following schematic shows the "Safety-related tripping" function block:

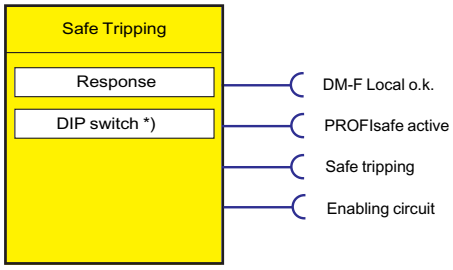


Figure 4-87 "Safe Tripping" function block

SET / RESET button on DM-F Local

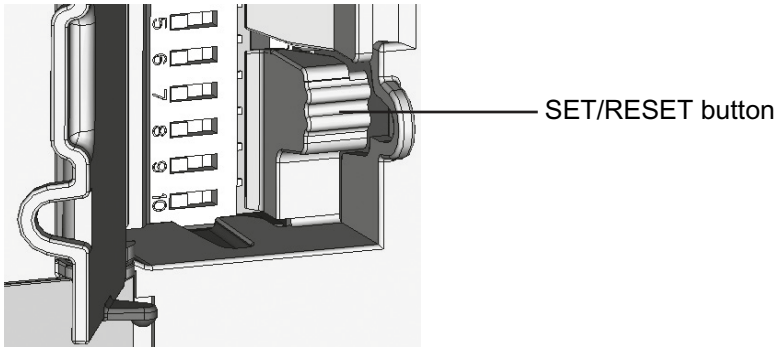


Figure 4-88 SET / RESET button

See ManualSIMOCODE pro fail-safe digital modules (https://support.automation.siemens.com/WW/view/en/50564852).

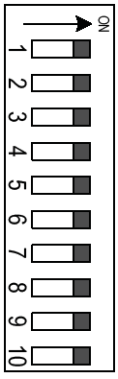
DANGER

Automatic starting after power failure. Risk of death or serious injury.

In the case of automatic starting after a power failure, the enabling circuits are connected without pressing the Start button.

Settings of the DIP switches on the DM-F Local

Table 4-78 Settings of the DIP switches (DM-F Local)

Switch setting		OFF / ON
1		With /without cross-circuit detection
2		1 NC + 1 NO evaluation / 2 NC evaluation
3		2x 1-channel / 1x 2-channel
4		Debounce time for sensor inputs 50 ms / 10 ms
5		Sensor input automatic start / monitored start
6		Cascading input automatic start / monitored start
7		With / without startup testing
8		With automatic starting / without automatic starting after power failure

Note

The target setting of the DIP switches in the SIMOCODE ES user interface (can be made using the mouse pointer) is transferred to the basic unit on download but does not affect the function of the DM-F Local digital module. The desired function is thus saved as soon as the parameterization has been created.

You must set the effective parameterization via the DIP switches on the front of the DM-F Local (see table below and/or the manual "SIMOCODE pro fail-safe digital modules (https://support.automation.siemens.com/WW/view/en/50564852)"). The basic unit compares the target setting (from the download) with the actual setting on the DM-F Local. If these differ, "Configuration deviation" is output!

Description of the settings of the DIP switches on the DM-F Local

Table 4-79 Description of the settings of the DIP switches, DM-F Local

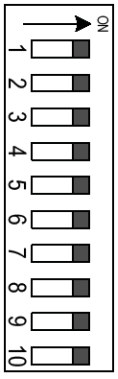
DIP switches (DM-F Local)	Description
With/without cross-circuit detection	Cross-circuit detection is only possible with floating sensors. The sensors must be connected between T1 - Y12, Y33 and T2 - Y22, Y34. The device anticipates the T1 terminal test signal at the terminals Y12 and Y33, and the T2 terminal test signal at the terminals Y22 and Y34. The device detects a sensor fault if the signal at the Y12, Y33 or the Y22, Y34 terminals is not identical to the test signals T1, T2. Cross-circuit detection must be deactivated if electronic sensors such as light arrays or laser scanners are connected. The DM-F Local now no longer monitors the sensor inputs for cross-circuit detection. Usually, the outputs of safety sensors (OSSD) are already monitored for cross-circuits in the sensor itself. If "Without cross-circuit detection" is set on the device, the test outputs T1, T2 are deactivated and may no longer be connected. At the Y12, Y22, Y33, and Y34 inputs, the DM-F LOCAL expects a +24 V DC signal from the same current source as the one from which the device receives its power supply (possible only in the case of DM-F LOCAL-1AB00) or from T3 (static +24 V DC). In the case of the DM-F LOCAL-1AU00 device version, it is imperative to connect the T3 terminal to the floating sensor contacts due to the electrical isolation between the input circuit and the sensor power supply.
1 NC + 1 NO evaluation / 2 NC evaluation	In addition to 2-channel connection of the same types of sensor contacts (NC / NC), sensors with opposite types of contacts (NC / NO), as are frequently used for magnetically-operated switches, can also be evaluated. In this case, ensure that the NC contact is connected to Y12 and the NO contact to Y22.
2x 1-channel / 1x 2-channel	• 2 sensors with one contact each (2x 1-channel) (NC / NC). It is expected that both sensors are AND-connected. Simultaneity is not monitored. • 1 sensor with two contacts each (1x 2-channel) (NC / NC). The system expects both contacts to be simultaneously open.
Debounce time for sensor inputs 50 ms / 10 ms	Any change in the sensor signal during the debounce time is not evaluated. • Debounce time 50 ms: Changes in the switch position of strongly bouncing contacts are suppressed (e.g. position switches on heavy protective doors). • Debounce time 10 ms: The shorter debounce time permits faster tripping in the case of bounce-free sensors (e.g. light arrays).
Sensor input automatic start / monitored start	• Automatic start: The enabling circuits are switched to the operative position as soon as the starting condition at sensor inputs Y12, Y22, Y34 and terminal 1 have been fulfilled. The start button connection terminal Y33 is not queried. • Monitored start: The enabling circuits are switched to the operative position, as soon as the starting condition at sensor inputs Y12, Y22, Y34 and terminal 1 have been fulfilled and the start button at terminal Y33 has subsequently been actuated (start with the falling edge).
Cascading input automatic start / monitored start	• Automatic start: The enabling circuits are switched to the active position as soon as the switch-on condition at cascading input 1 is satisfied, i.e. as soon as a static +24 V DC signal is present (e.g. from T3). • Monitored start: The enabling circuits are switched to the operative position as soon as the starting condition at cascading input 1 has been fulfilled, i.e. as soon as a static +24 V DC signal is present (e.g. from T3), and the start button at terminal Y33 has subsequently been actuated (start with the falling edge).

DIP switches (DM-F Local)	Description
With / without startup testing	After a power failure, startup testing requires that the sensors at Y12 and Y22 are actuated once by the system operator.
With automatic starting / without automatic starting after power failure	The DM-F Local can be parameterized in such a way that the enabling circuits automatically switch to the operative position after a power failure, i.e. without actuation of the start button Y33. Prerequisites: • Y12, Y22 or the cascading input 1 are set to "monitored start." • The starting condition at the sensor inputs and at the cascading input has been fulfilled. • Valid actuation of the start button prior to the power failure, i.e. the enabling circuits were in the operative position.

Settings of the DIP switches (DM-F PROFIsafe)

Before commissioning the DM-F PROFIsafe, set the PROFIsafe address as follows:

Table 4-80 Settings of the DIP switches (DM-F PROFIsafe)

Switch setting		Value
$1 = 2^0$		1
$2 = 2^1$		2
$3 = 2^2$		4
$4 = 2^3$		8
$5 = 2^4$		16
$6 = 2^5$		32
$7 = 2^6$		64
$8 = 2^7$		128
$9 = 2^8$		256
$10 = 2^9$		512

If 1 DIP switch is at ON, the respective value is active. If more than 1 DIP switch is at ON, the respective values must be added.

- Briefly press the SET / RESET button. LEDs 1 to 10 indicate the current PROFIsafe address.
- Setting the PROFIsafe address:
  - Switch off the supply voltage
  - Set the DIP switch configuration
  - Switch on the supply voltage again.

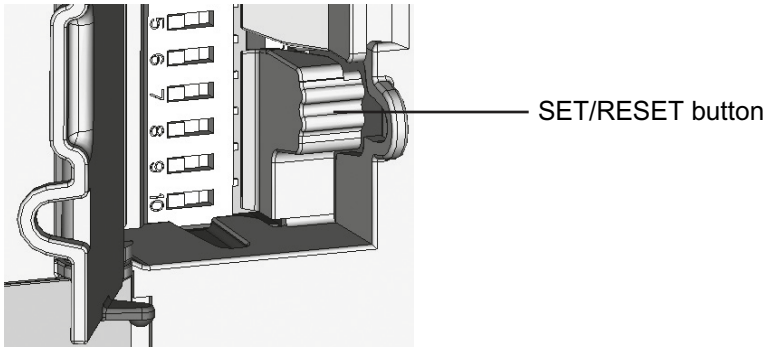


Figure 4-89 SET / RESET button

"Safety-related tripping" response

Here, you set the SIMOCODE pro response to safety-related tripping via DM-F Local or DM-F PROFIsafe.

Note

The response of the modules is not influenced by this setting. If the conditions for safety-related disconnection are met, the enable circuits are always disabled!

Table 4-81 "Safety-related tripping" response

Response	Safety-related tripping
trip	X (d)
Deactivated	X
signal	X
warn	X

Note

In the event that the option "DM-F LOCAL / Separate PROFIsafe function from control function" has been activated under "Motor control > Control function > Operating mode," only "deactivated", "signal," or "warn" can be set as the response, not "trip."

"Safety-related tripping" reset

Here, you can select manual or automatic acknowledgment of SIMOCODE pro faults caused by safety-related tripping.

Reset: Manual (default), Auto

4.8.9 Watchdog (Bus monitoring, PLC/PCS monitoring)

Description

The "Watchdog" function block monitors communication with the PLC via communication bus, as well as the operating state of the PLC in the "Remote" operating mode.

Bus monitoring

With this type of monitoring, the "Fault - bus" fault is generated if

- "Bus monitoring" is active.
- In the "Remote" operating mode (mode selector S1 = 1 and S2 = 1), cyclic data transfer between the PLC and SIMOCODE pro is interrupted, e.g. by interruption of the bus connection.
- "Status - Bus o.k." can always be evaluated. If SIMOCODE pro is cyclically exchanging data with the PLC, "Status - Bus o.k." is set to "1".

PLC / PCS monitoring

With this type of monitoring, the "Fault - PLC/PCS" message is generated if

- "PLC / PCS monitoring" is active.
- For example, the PROFIBUS DP switches to the "CLEAR" status or the PROFINET switches to the "Hold/Stop" status when in the "Remote" operating mode (mode selector S1=1 and S2=1).

The "Status - PLC / PCS in Run" can always be evaluated. If the PROFIBUS DP is in the "CLEAR" state, for example, "Status - PLC/PCS in Run" is set to "0".

If the "PLC/PCS monitoring - input" is connected primarily to the "Cyclic receive - bit 0.7" bit, the status of the PLC is deduced from this bit only.

Schematic

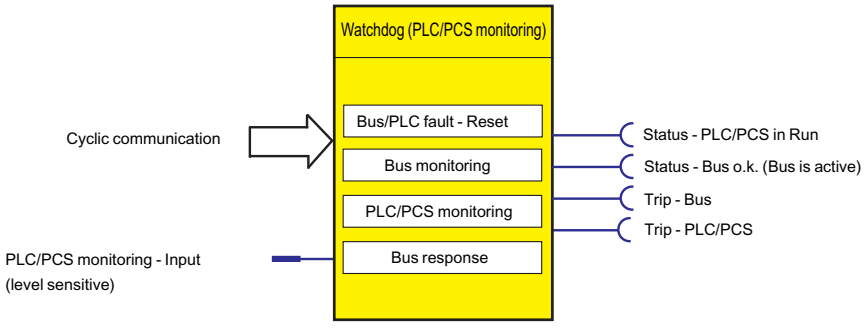


Figure 4-90 "Watchdog (PLC / PCS Monitoring)" function block

NOTICE
PROFIBUS DP "Bus monitoring" and "PLC / PCS monitoring" can only be effective if the DP slave watchdog function is activated in the DP master system.

Settings

Table 4-82 Watchdog settings

Watchdog	Description
PLC / PCS monitoring - Input	Activates the "Watchdog" function block using the monitored signal (any sockets, e.g. the communication bus control bits, etc.)
Bus monitoring	• Activated (default): If a bus fault occurs, the "Fault - Bus" fault message is generated and must be acknowledged • Deactivated: No fault message; however, the "Status - Bus o.k." information can be evaluated at any time.
PLC / PCS monitoring	• Activated (default): If a bus fault occurs, the "Fault - PLC/PCS" fault message is generated and must be acknowledged. • Deactivated: No fault message; however, the "Status - SPS/PLS in Run" information can be evaluated at any time.
Bus/PLC fault - reset	You can select whether faults are to be acknowledged automatically or manually. Range: Manual / Auto (default: manual).

"Bus fault" / "PLC / PCS fault" response

Table 4-83 "Bus fault" / "PLC / PCS fault" response

Response	Bus fault	PLC/PCS fault
Fault	X (d)	X (d)
warn	-	-
signal	-	-
deactivated	X	X

4.8.10 Timestamping

Description

SIMOCODE pro V PB can timestamp up to eight digital signals with high temporal precision (10 ms). In the process, every change in the state of the digital signals will be recorded.

Possible areas of application are:

- Precise chronological recording of faults in a procedural system
- Analysis of system-wide interrelationships
- Recording and signaling of time-critical signal changes

Requirements

To use SIMOCODE pro V time stamping, the DP master being used must support time synchronization functions via PROFIBUS (e.g. DP master connections for SIMATIC S7-400), or a master clock must be used (e.g. SICLOCK).

Process in STEP 7

Time-of-day synchronization for SIMOCODE pro V is activated in STEP 7 HW Config in the slave properties under "Time Synchronization".

Note

The set synchronization interval must correspond to the configuration of the clock master.

For SIMOCODE pro, transmission of time stamped information is analogous to transmission with SIMATIC S7 IM 153-2. Therefore, the "FB 62 TIMESTMP" function block can be used for further processing of time stamped information in the CPU, to transmit time stamped messages from the "Standard Library → Miscellaneous Blocks" library.

Note

The "LADDR" parameter contains the diagnostic address of the DP slave from STEP 7 HW Config. In DP mode "DPV1" of the DP master – integrated via OM SIMOCODE pro – LADDR2 contains the diagnostic address of slot 2 of SIMOCODE pro. For all other configurations, LADDR2 will contain the same address as LADDR.

In contrast to the STEP7 online help for the FB62, when integrating via GSD, the slot number of the module is transmitted with Slot 1 for signal messages, and with Slot 0 for special messages.

You will find further information about the FB 62 in the STEP7 online help.

Schematic

The following schematic shows the "Timestamping" function block:

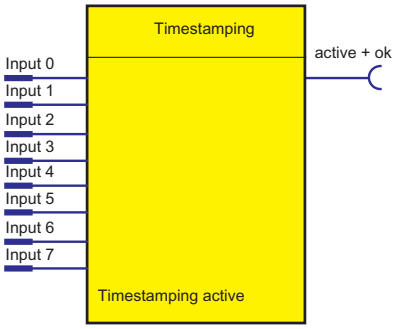


Figure 4-91 "Timestamping" function block

The "Timestamping" function block comprises eight "Timestamping - input 0 to input 7" plugs.

Overall, there is one "Timestamping" function block available.

4.9 Logic modules

4.9.1 Overview of logic modules

Description

Freely programmable logic modules are function blocks that process input signals and supply binary or analog output signals according to their internal logic components. Logic modules can contain:

- Plugs
- An internal logic component
- Sockets
- Settings, e.g. the time for a timer.

Schematic

The following schematic shows a general representation of a logic module:

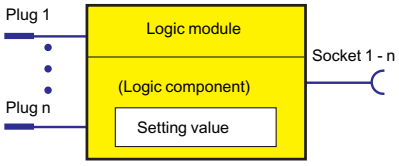


Figure 4-92 General representation of a logic module

Scope and application

You can use the logic modules to carry out additional functions for your application. These can be used, for example, to implement logical operations, time relay functions and counter functions. Depending on the device series, the system provides several logic modules:

Table 4-84 Freely-programmable logic modules

Logic module	SIMOCODE pro						
	BP	GP		HP			
	C	S	V PN GP	V PB	V MB RTU	V PN	V EIP
Truth tables 3 inputs / 1 output	3	4	8	6	6	8	8
Truth table 2 inputs / 1 output	—	2	2	2	2	2	2
Truth tables 5 inputs / 2 outputs	—	—	1	1	1	1	1
Timer	2	2	6	4	4	6	6
Counter	2	2	6	4	4	6	6
Signal conditioning	2	4	6	4	4	6	6
Non-volatile elements	2	2	4	4	4	4	4

Logic module	SIMOCODE pro						
	BP	GP		HP			
	C	S	V PN GP	V PB	V MB RTU	V PN	V EIP
Flashing	3	3	3	3	3	3	3
Flicker	3	3	3	3	3	3	3
Limit monitor	—	—	6	4	4	6	6
Calculation modules (calculators)	—	—	4	2 [1)]	2	4	4
Analog multiplexer	—	—	1	—	—	1	1
Pulse width modulator	—	—	1	—	—	1	1
1) Only for basic unit SIMOCODE pro V PB from version *E03*							

4.9.2 Truth table for 3I / 1O

Description

The truth table for 3I / 1O consists of

- Three plugs
- one logic component
- one socket

You can choose which of the eight possible input conditions an output signal should be generated for.

The following are available:

- three truth tables (1 to 3) for the SIMOCODE pro C basic unit
- four truth tables (1 to 4) for the SIMOCODE pro S basic unit
- six truth tables (1 to 6) for the SIMOCODE pro V PB and pro V MR basic units
- eight truth tables (1 to 6, 10, 11) for the SIMOCODE pro V PN (GP) and pro V EtherNet IP basic units.

Schematic

The following schematic shows the "Truth Table for 3I / 1O" logic modules:

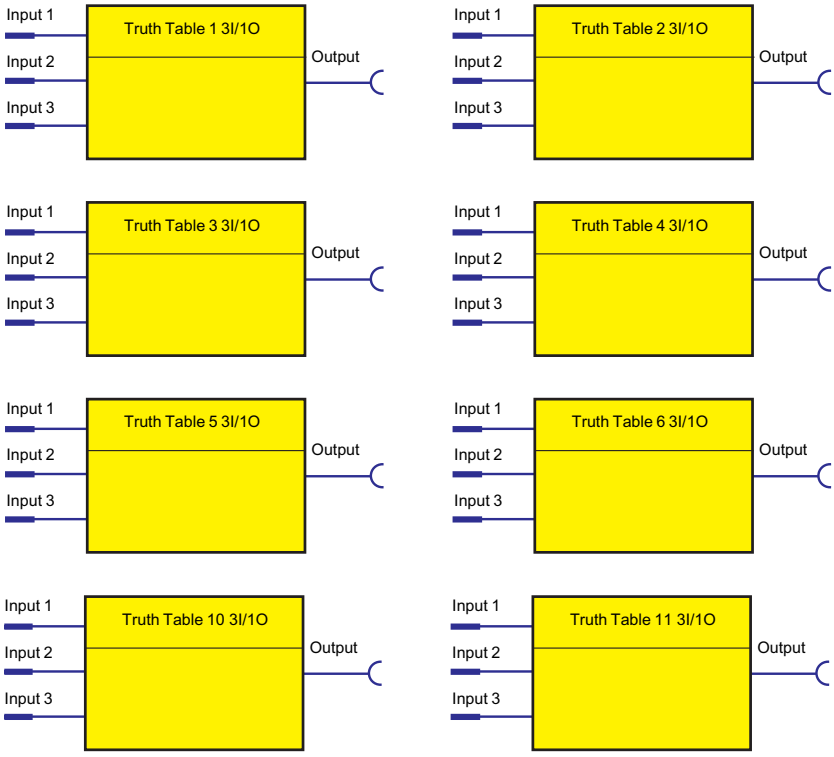
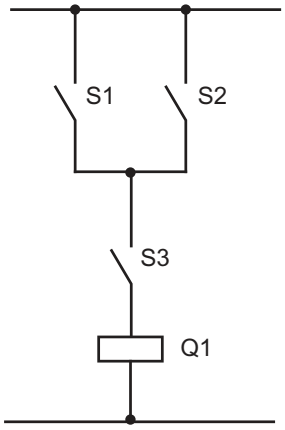


Figure 4-93 "Truth Table for 3I / 1O" logic modules

Example

You want to implement the following circuit:

Circuit:



Q1 switches with:
(S1 or S2) and S3
or
S1 and S2 and S3

Truth table, input conditions colored in gray:

S1= Input 1	S2= Input 2	S3= Input 3	Q1= Output
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	0
1	1	1	1

Figure 4-94 Example of a truth table

Circuit and parameterization

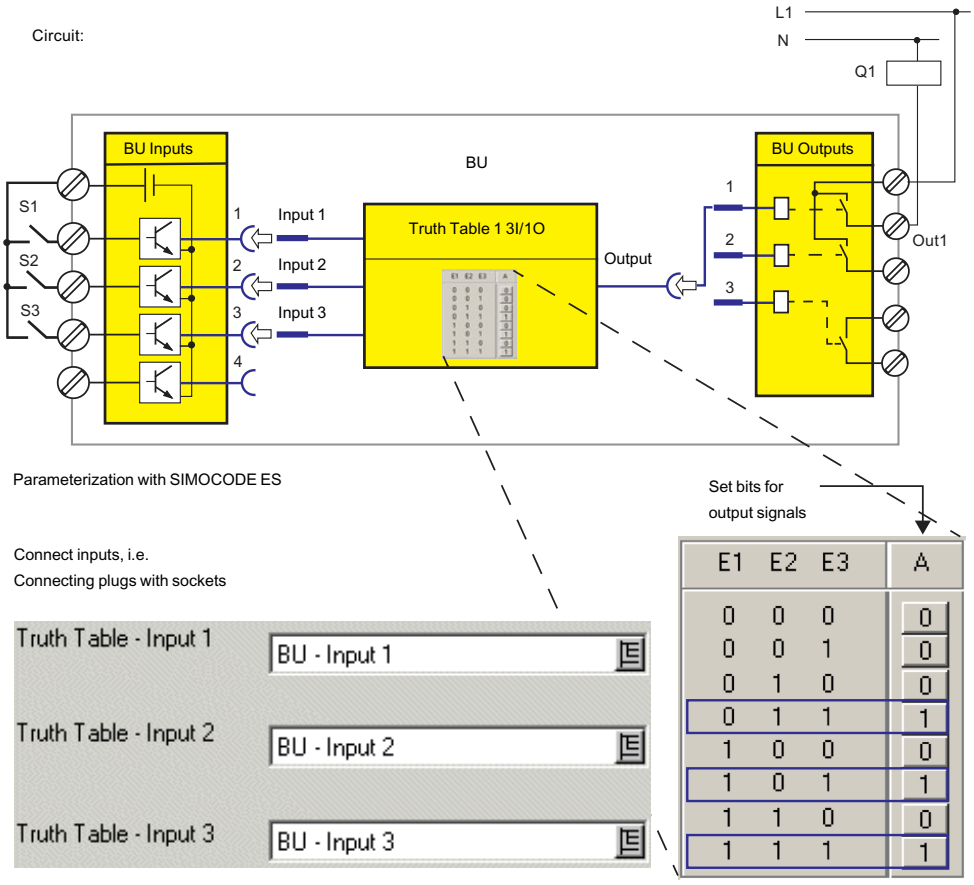


Figure 4-95 Example circuit and parameterization for truth table 3I / 1O

Settings

Table 4-85 Settings for truth table 3I/1O

Truth table for 3I / 1O	Description
Inputs 1 to 3	Activation of the truth table by any signal (any sockets, e.g. device inputs, communication bus control bits, etc.)

4.9.3 Truth table for 2I / 1O

Description

The truth table for 2I / 1O consists of:

- Two plugs
- one logic component
- one socket.

You can choose which of the four possible input conditions an output signal should be generated for.

In total, two truth tables (7 to 8) are available.

Schematic

The following schematic shows the "Truth Table for 2I / 1O" logic modules:

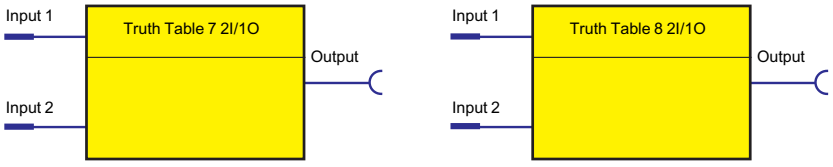
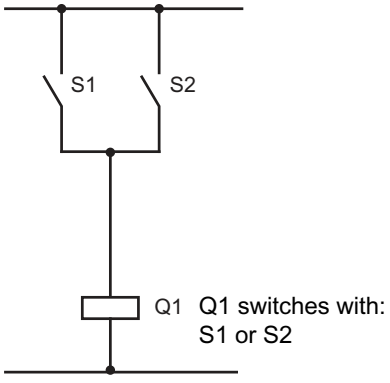


Figure 4-96 "Truth Table for 2I / 1O" logic modules

Example

You want to implement the following circuit:

Circuit:



Truth table, input conditions colored in gray:

S1= Input 1	S2= Input 2	Q1= Output
0	0	0
0	1	1
1	0	1
1	1	1

Figure 4-97 Example of truth table 2I / 1O

Settings

Table 4-86 Settings for truth table 2I/1O

Truth table for 2I / 1O	Description
Inputs 1 to 2	Activation of the truth table by any signal (any sockets, e.g. device inputs, communication bus control bits, etc.)

4.9.4 Truth table for 5I / 2O

Description

The truth table for 5I / 2O consists of:

- five plugs
- one logic component
- Two sockets.

You can choose which of the 32 possible input conditions a maximum of two output signals should be generated for.

In total, one truth table 9 is available for the SIMOCODE pro V basic units.

Schematic

The following schematic shows the "Truth Table for 5I / 2O" logic modules:

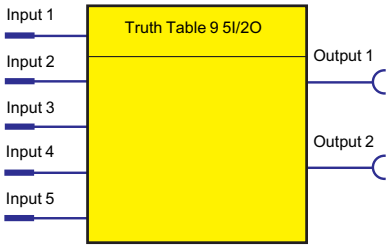


Figure 4-98 "Truth Table for 5I / 2O" logic modules

Settings

Table 4-87 Settings for truth table for 5I / 2O

Truth table 9 (5I / 2O)	Description
Input 1 to 5	Activation by any signal (any sockets, e.g. device inputs, control bits from the communication bus, etc.)

4.9.5 Counter

Description

Counters are integrated in the SIMOCODE pro system. These are activated via the plugs "+" or "-".

The counter output switches to "1" when the preset limit is reached. The counter is reset with "Reset".

The current actual value is available as a socket for further internal processing and can also be transmitted to the automation system.

- Plug +: Increases the actual value by 1 (maximum: limit).
- Plug –: Reduces the actual value by 1 (minimum: 0).
- Reset: Resets the actual value to 0.

The counter consists of

- three plugs (input +, input – and reset)
- one logic component
- one socket
- One "Actual value" analog socket with the current value in the range between 0 and the limit. The value is retained even in the event of a power failure.

The following are available:

- two counters (1 to 2) for the SIMOCODE pro C and pro S basic units
- four counters (1 to 4) for the SIMOCODE pro V PB and pro V MR basic units
- six counters (1 to 6) for the SIMOCODE pro V PN (GP) and pro V EIP basic units.

Schematic

The following schematic shows the "Counters" logic modules:

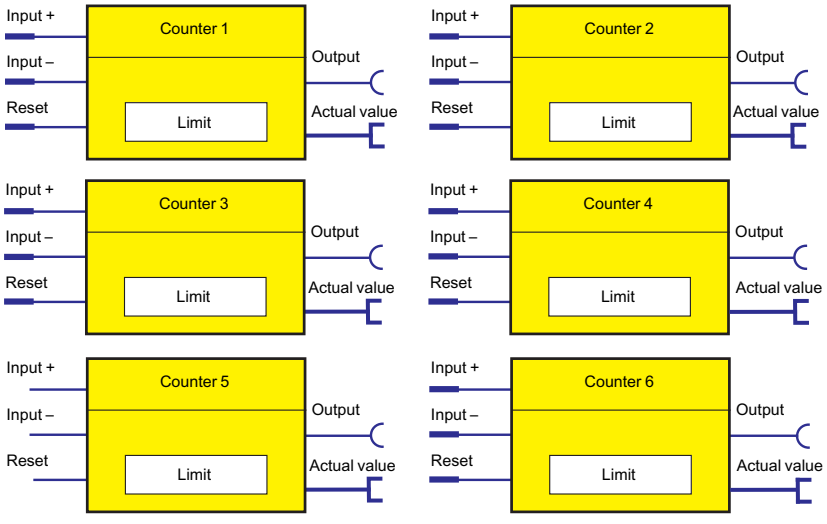


Figure 4-99 "Counter" logic modules

Note

The time between the events to be counted depends on

- The input delay
- The device cycle time.

Note

The actual value remains the same

- During parameterization or failure of the supply voltage
- If there are simultaneous input signals at input + and input -.

Note

The output is always 0 if a reset is pending.

Note

Since the counter sets the output as soon as the actual value has reached the preset value, the output is permanently set at a value = 0 as long as no reset is applied.

Settings

Table 4-88 Counter settings

Counters 1 to 6	Description
Input +	Increments actual value by 1 Activation by any signal (any sockets, e.g. device inputs, control bits from the communication bus, etc.)
Input -	Decrements the actual value by 1. Activation by any signal (any sockets, e.g. device inputs, control bits from the communication bus, etc.)
Reset	Reset the actual value to 0 (count value and output). Activation by any signal (any sockets, e.g. device inputs, control bits from the communication bus, etc.)
Limit	Value that can be reached when counting and at which the counter issues an output signal. Range: 0 to 65535 (default: 0)

4.9.6 Timer

Description

The timer consists of:

- two plugs (input and reset)
- one socket
- one "Actual value" analog socket with the actual value.

The current actual value is available as a socket for further internal processing and can also be transmitted to the automation system.

If an input signal is pending, the timer issues an output signal according to the chosen timer type:

- With closing delay
- With closing delay with memory
- With OFF delay
- With fleeting closing

The following are available:

- two timers (1 to 2) for the SIMOCODE pro C and SIMOCODE pro S basic units
- four timers (1 to 4) for the SIMOCODE pro V PB and pro V MR basic units
- six timers (1 to 6) for the SIMOCODE pro V PN and pro V EIP basic units.

Schematic

The following schematic shows the "Timers" logic modules:

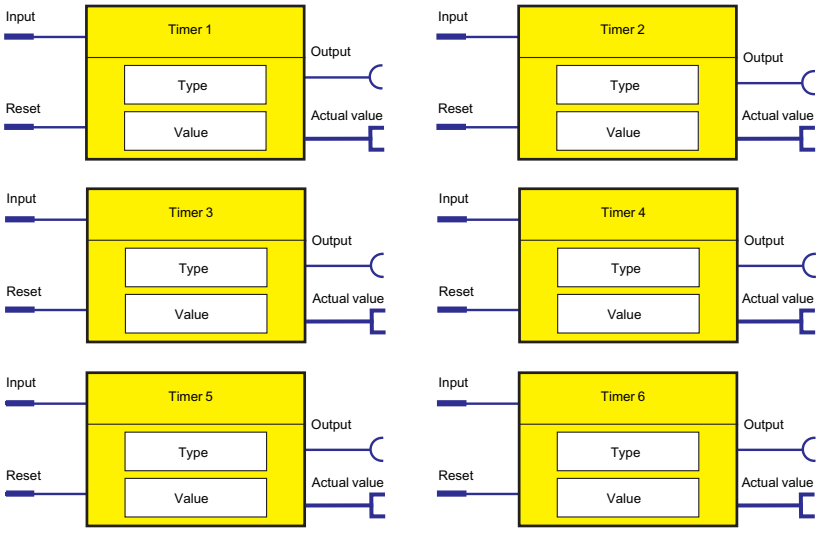


Figure 4-100 "Timer" logic modules

Note

The output is always 0 if a reset is pending.

Note

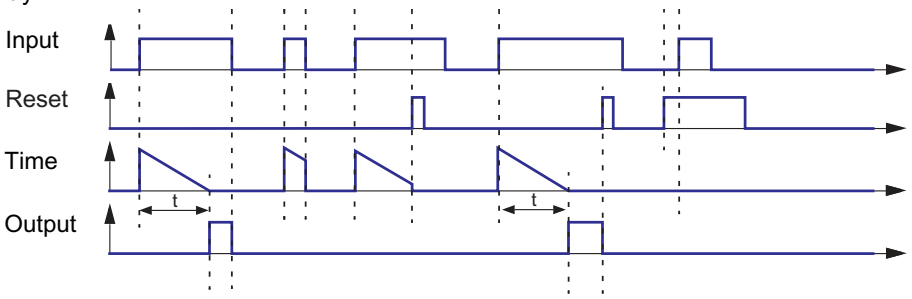
The response of the plugs of all timers (input, reset) has been completely changed to level-active for the SIMOCODE pro C basic unit from version *E05* and higher and the SIMOCODE pro V PB basic unit from version *E03* and higher. Use of an unchanged parameter file utilizing integrated timers may thus result in a different response if such basic units are used. For example, if "Fixed level - '1'" is set at the timer input, the timer function is automatically restarted after the timer reset occurs. However, in timers with the parameterized type = "With fleeting closing", there is no change in the response.

Output response of the timer

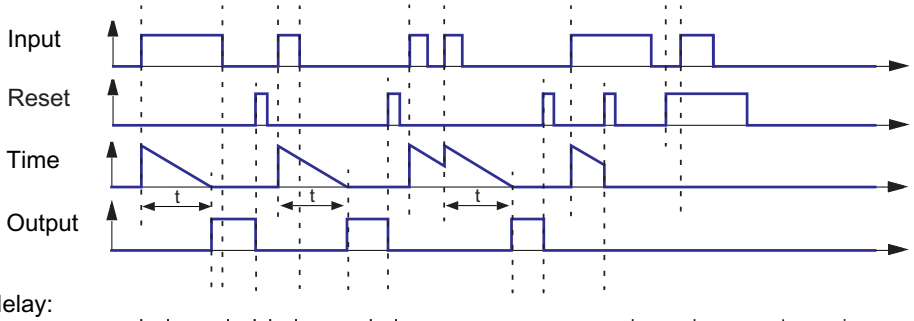
For

- SIMOCODE pro C basic unit **up to** version *E05*
- SIMOCODE pro V PB basic unit **up to** version *E03*

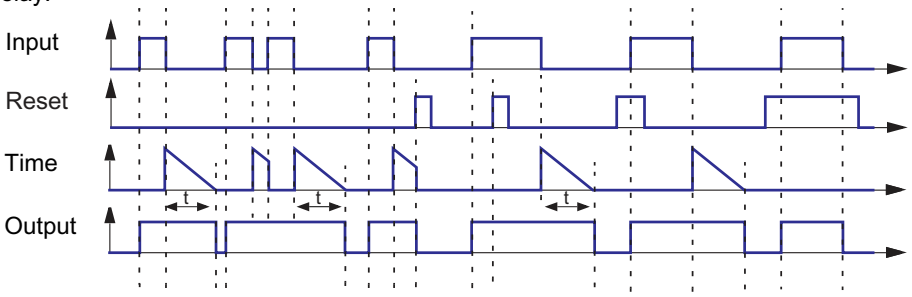
With closing delay:



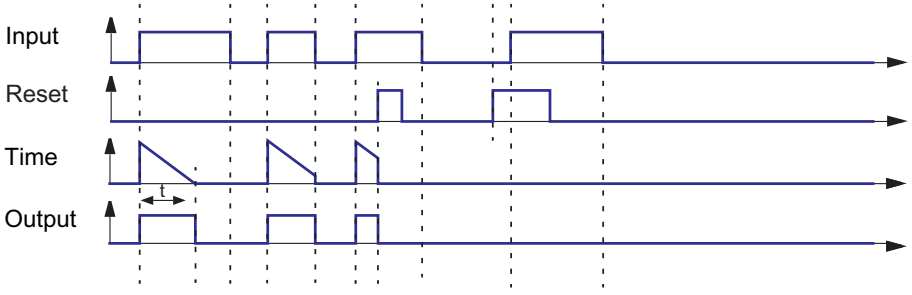
With closing delay with memory:



With opening delay:



Fleeting closing:

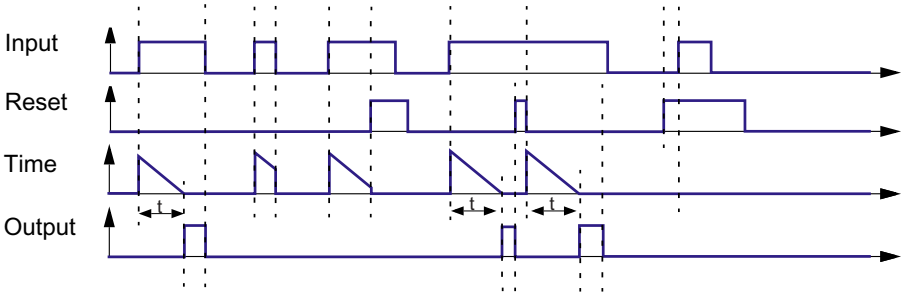


Output response of the timer

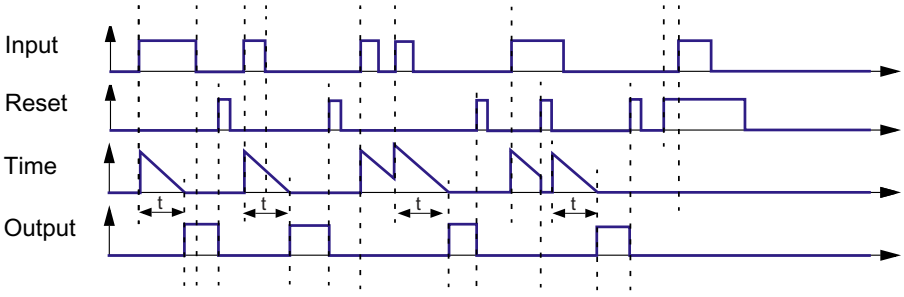
For

- SIMOCODE pro C basic unit **from** version *E05*
- SIMOCODE pro V PB basic unit **from** version *E03*
- SIMOCODE pro S basic unit
- all other SIMOCODE pro V basic units

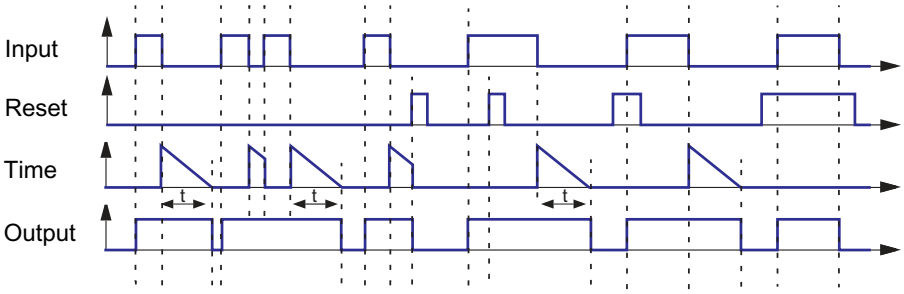
With closing delay:



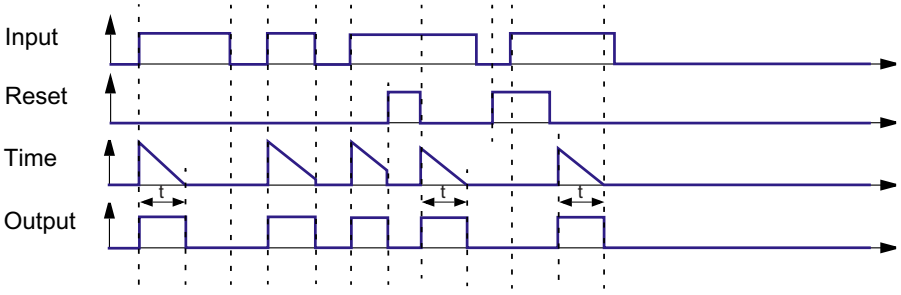
With closing delay with memory:



With opening delay:



Fleeting closing:



Timer settings

Table 4-89 Timer settings

Timers 1 to 6	Description
Input	Activation by any signal (any sockets, e.g. device inputs, control bits from the communication bus, etc.)
Reset	Resetting the actual value to 0. Activation by any signal (any sockets, e.g. device inputs, control bits from the communication bus, etc.)
Type	Different output responses Range: With closing delay (default), closing delay with memory, with OFF delay, with fleeting closing
Value	Time during which the timer provides an output signal when activated, depending on the output response (type). Range: 0 to 6553.5, unit 100 ms (default: 0)

4.9.7 Signal conditioner

Description

If an input signal is pending, the signal conditioning issues an output signal according to the selected signal conditioning type:

- Non-inverting
- Inverting
- Edge rising with memory
- Edge falling with memory

You can set the output response.

The signal conditioning consists of:

- two plugs (input and reset)
- one logic component
- one socket

The following are available:

- two signal conditionings (1 to 2) for the SIMOCODE pro C basic unit
- four signal conditionings (1 to 4) for the SIMOCODE pro S, pro V PB, and pro V MR basic units
- six signal conditionings (1 to 6) for the SIMOCODE pro V PN (GP) and pro V EIP basic units.

Schematic

The following schematic shows the "Signal conditioning" logic modules:

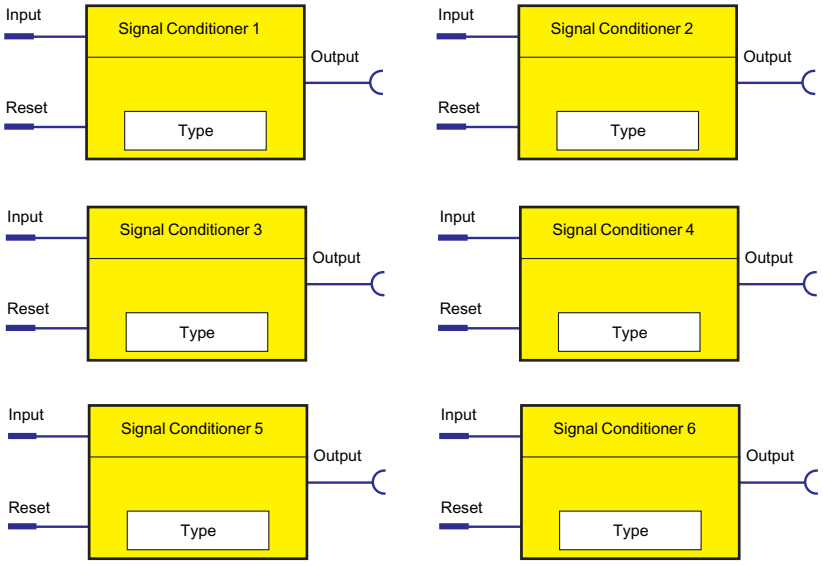


Figure 4-101 "Signal conditioning" logic modules

Note

The output is always 0 if a reset is pending.

Types of signals / output responses

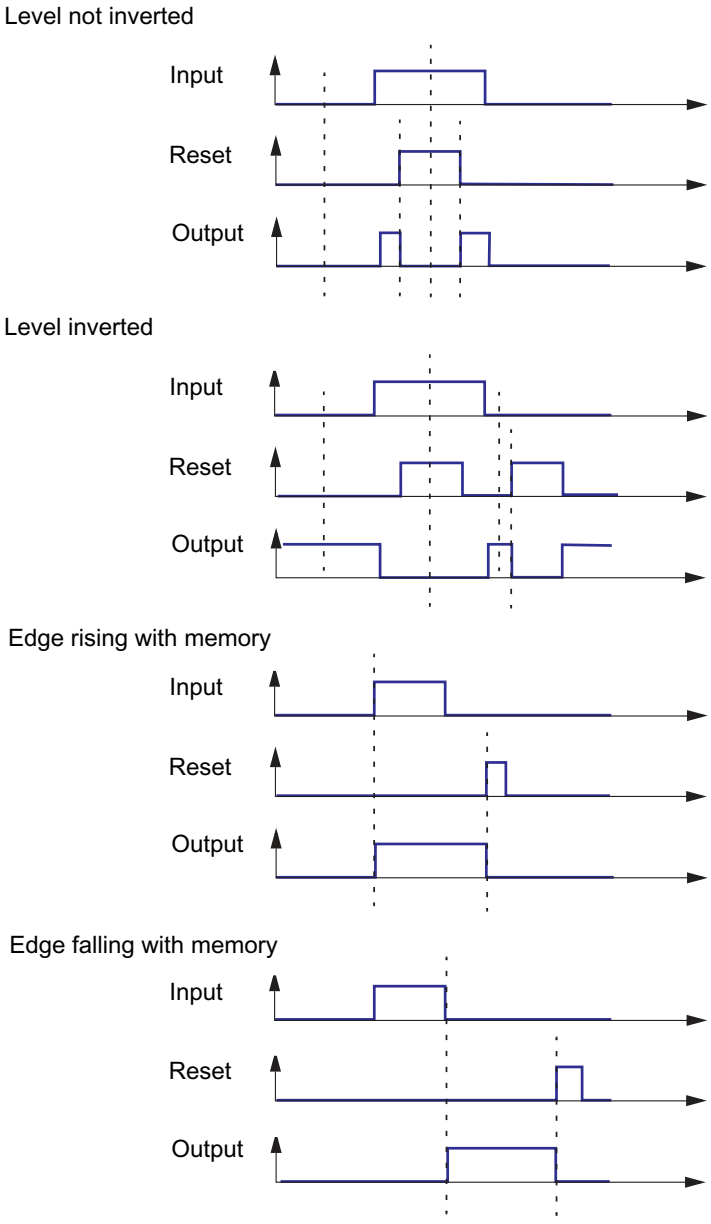
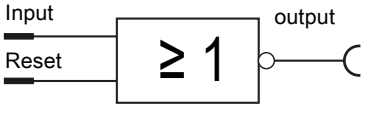


Figure 4-102 Types of signals/output responses of the signal conditioning

NOR function

You can implement a NOR function with the "inverting" type of signal:

Input	Reset	Output	Schematic
0	0	1	
1	0	0	
0	1	0	
1	1	0	

Settings

Table 4-90 Signal conditioning settings

Signal conditioning 1 to 6	Description
Input	Activation by any signal (any sockets, e.g. device inputs, control bits from the communication bus, etc.)
Reset	Resetting the signal conditioning to 0. Activation by any signal (any sockets, e.g. device inputs, control bits from the communication bus, etc.)
Type	Different output responses. Range: Level Non-inverting (default), level inverting, edge rising with memory, edge falling with memory

4.9.8 Non-volatile elements

Description

Non-volatile elements behave like signal conditioning. However, these output signals are retained after a power supply failure.

If an input signal is pending, the non-volatile element issues an output signal according to the selected type:

- Non-inverting
- Inverting
- Edge rising with memory
- Edge falling with memory

You can set the output response.

The non-volatile element consists of

- two plugs (input and reset)
- one logic component
- one socket

The following are available:

- two non-volatile elements (1 to 2) for the SIMOCODE pro C and SIMOCODE pro S basic units
- four non-volatile elements 1 to 4 for the SIMOCODE pro V basic units

Schematic

The following schematic shows the "Non-volatile element" logic modules:

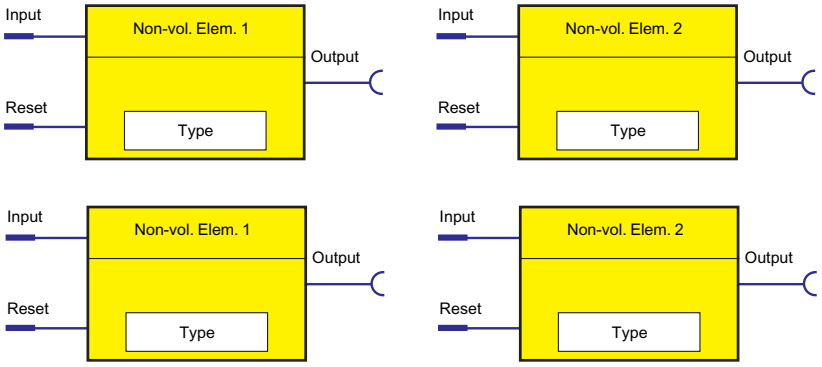
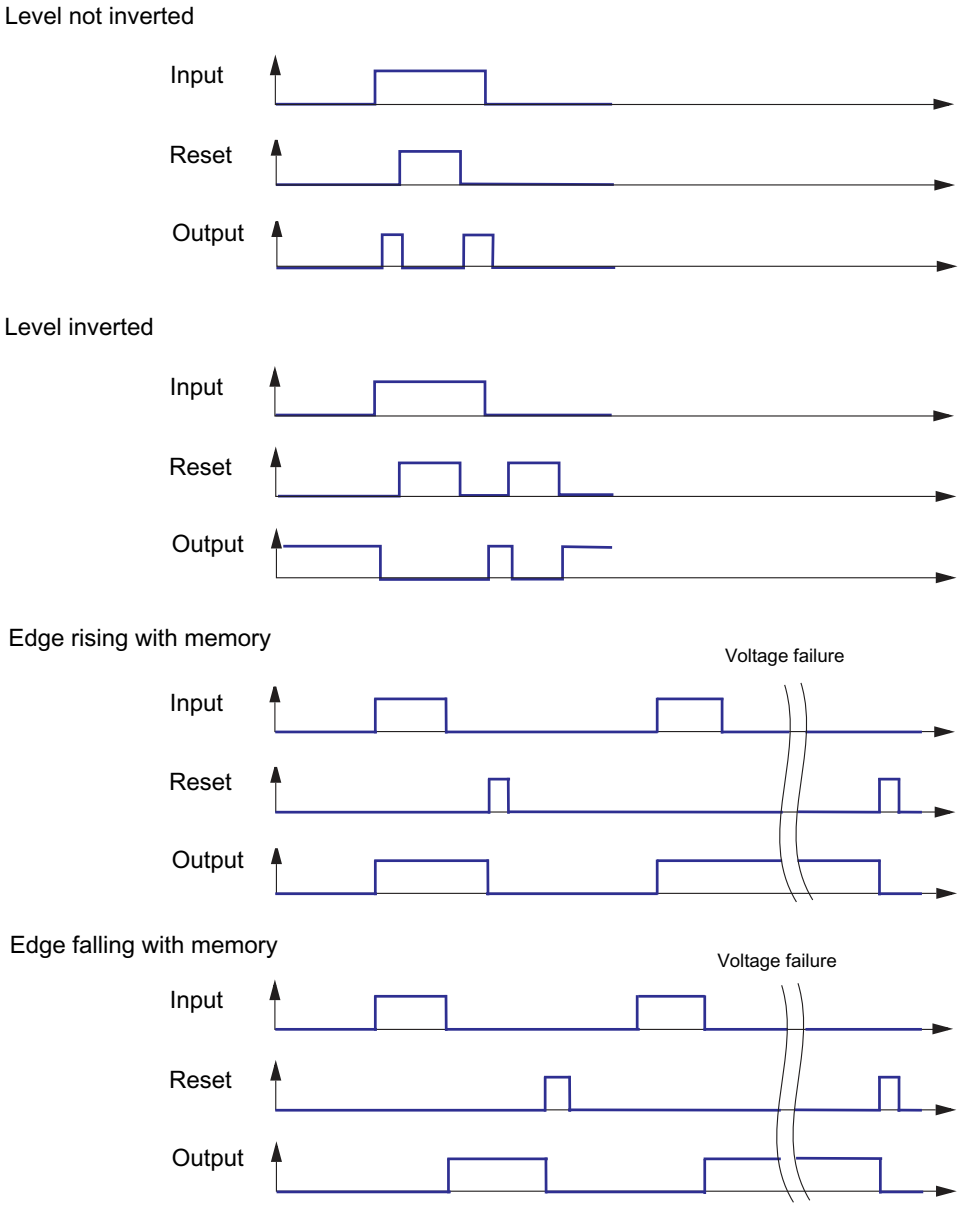


Figure 4-103 "Non-volatile Element" logic modules

Note

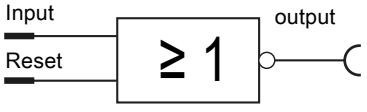
The output is always 0 if a reset is pending.

Types of signals / output responses



NOR function

You can implement a NOR function with the "inverting" type of signal:

Input	Reset	Output	Schematic
0	0	1	
1	0	0	
0	1	0	
1	1	0	

Settings

Table 4-91 Non-volatile element settings

Non-volatile elements 1 to 4	Description
Input	Activation by any signal (any sockets, e.g. device inputs, control bits from the communication bus, etc.)
Reset	Resetting the signal conditioning to 0. Activation by any signal (any sockets, e.g. device inputs, control bits from the communication bus, etc.)
Type	Different output responses Range: Non-inverting (default), inverting, edge rising with memory, edge falling with memory

4.9.9 Flashing

Description

If an input signal is pending at its plug, the "Flashing" logic module issues a signal to its socket, which alternates between binary 0 and 1 at a fixed frequency of 1 Hz. You can use this to make the LEDs on the operator panel flash, for example. The logic module consists of:

- one plug
- one logic component
- one socket

In total, 3 "Flashing" logic modules (1 to 3), are available.

Schematic

The following schematic shows the "Flashing" logic modules:

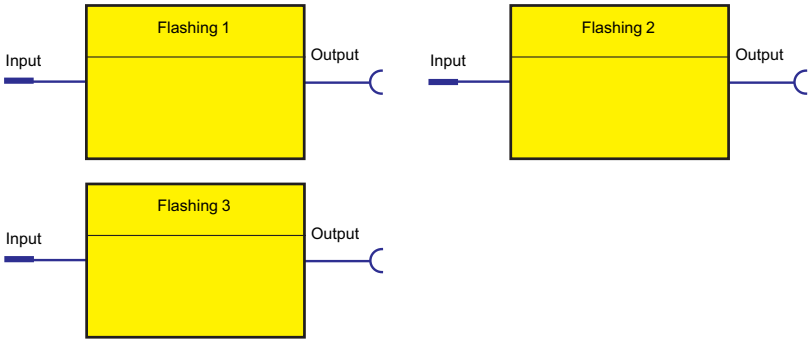


Figure 4-104 "Flashing" logic modules

Settings

Table 4-92 Flashing settings

Flashing 1 to 3	Description
Input	Activation by any signal (any sockets, e.g. device inputs, events, status, etc.)

4.9.10 Flickering

Description

You can use the "Flicker" logic modules to assign the "Flicker" function to the operator-panel LEDs, for example.

The "Flicker" function block provides an output signal with a frequency of 4 Hz when an input signal is present.

The function block consists of:

- one plug
- one logic component
- one socket

A total of three logic modules, "Flicker" (1 to 3), are available.

Schematic

The following schematic shows the "Flicker" logic modules:

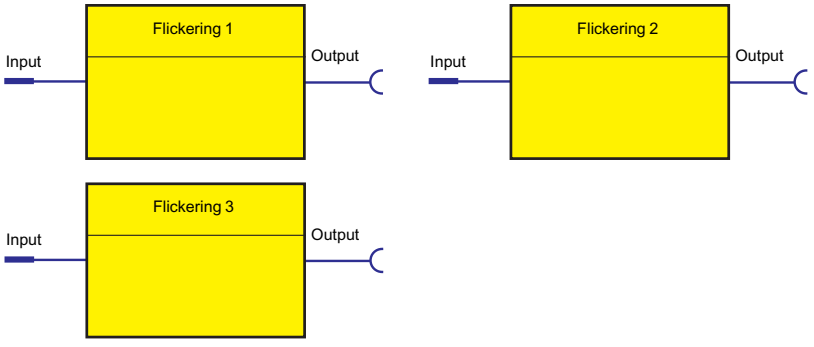


Figure 4-105 "Flicker" function blocks

Settings

Table 4-93 Flicker settings

Flicker 1 to 3	Description
Input	Activation by any signal (any sockets, e.g. events, etc.)

4.9.11 Limit monitor

Description

With the limit monitor, any analog values (2 bytes/1 word) can be monitored for upper and lower limit violations.

The limit monitor issues the "Limit" signal at its socket.

In addition, limit monitors can be "marked" according to their function.

Example: Monitoring the individual sensor measuring circuits of the temperature module (Temperature 1 to 3) for overtemperature.

The limit monitor consists of:

- one analog plug
- one logic component
- one socket

The following are available:

- four limit monitors (1 to 4) for the SIMOCODE pro V PB and pro V MR basic units
- six limit monitors (1 to 6) for the SIMOCODE pro V PN (GP) and pro V EIP basic units

Schematic

The following schematic shows the "Limit monitor" logic modules:

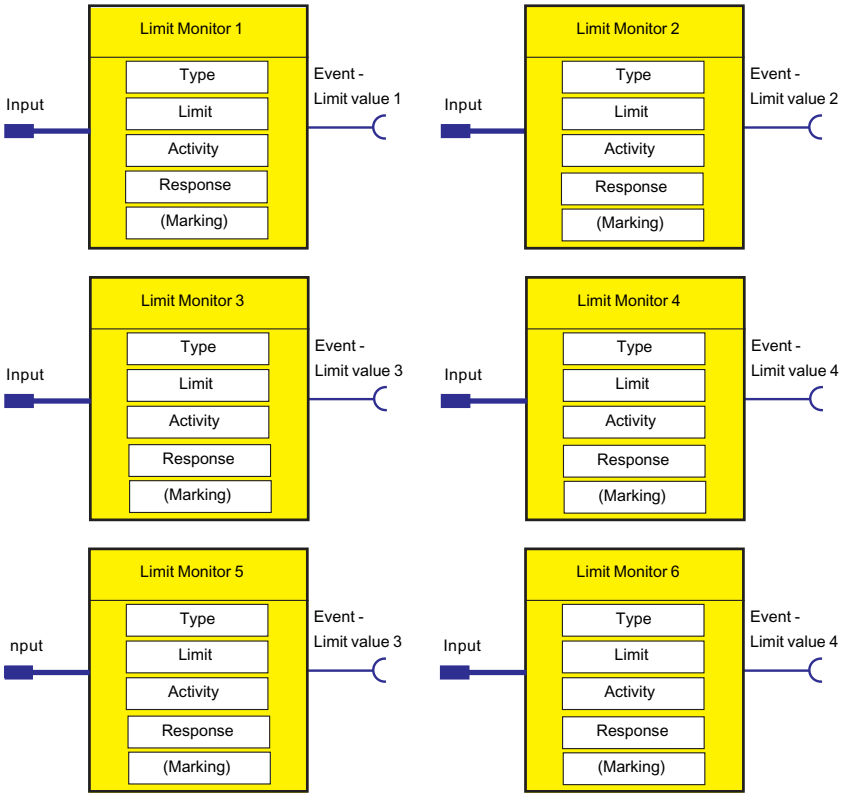


Figure 4-106 "Limit Monitor" logic modules

Response

Table 4-94 Limit monitor response

Response	Limits 1 to 6
trip	—
warn	—
signal	X (d)
deactivated	—
delay	0 to 25.5 s (default: 0.5 s)

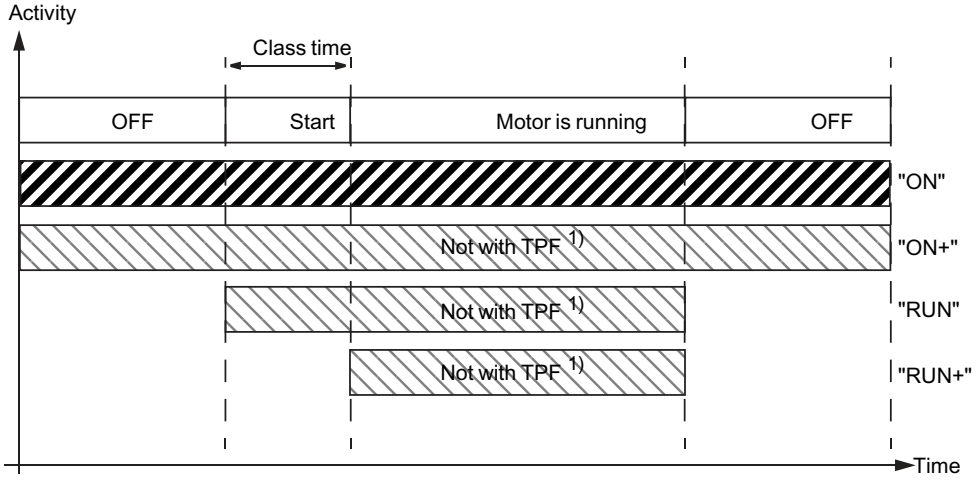
See also "Tables of responses of SIMOCODE pro" in Chapter Important notes (Page 7).

Functional principle

The limit signal issued depends on:

- the operating state of the motor
- the TPF function
- the parameterized "active status":
  - ON
  - ON+
  - RUN
  - RUN+

The following display shows a flow chart with the different "active status" parameters.



1) TPF: There is test position feedback, the motor feeder is in the test position, i.e. its main circuit is isolated from the network. However, the control voltage is connected.

Figure 4-107 Active status of limit monitor

Settings

Table 4-95 Limit monitor settings

Limit monitor	Description
Input	Analog plug of the limit monitor for linking to the analog value to be monitored (2 bytes), e.g. maximum current I_max, remaining cooling down period, actual value of timers, etc.
Type	Specifies if the limit has to be monitored for overshooting (default) or undershooting.

Limit monitor	Description
Active status	Determines in which motor operating state the limit monitor is to be evaluated: • ON, i.e. always (default) evaluate, regardless of whether or not the motor is running • ON+, i.e. always evaluate, regardless of whether or not the motor is running Exception: "TPF", i.e. motor feeder is in test position • RUN, i.e. evaluate only if the motor is in the ON state and not in the test position (TPF). • RUN+, i.e. evaluate only if the motor is running and the startup procedure is finished (i.e. the "Start active" message is no longer active) and there is no test position feedback (TPF); example: Cos phi monitoring
Limit	Monitor response value. The return value is always determined by the "Limit monitor - Delay" parameter. Range: 0 to 65535 (default: 0)
delay	Specifies the time period for which the limit must be constantly overshot before the "Event - Limit" output is set. Range: 0 to 25.5 s (default: 0.5 s)
Marking [1)]	No parameters. Optional marking for identifying the message, e.g. "Limit>"; range: max. 10 characters.

1)

NOTICE

Changing the marking of all Ethernet and PROFINET connections

Note for firmware versions <V3.0.0 (PROFINET devices) and <V2.0.0 (EtherNet/IP devices)

Each change to the marking requires that the communication interface be restarted when the web server is active. A new start interrupts all Ethernet and PROFINET links and reestablishes them afterward.

Note

When using limit monitors, always ensure that the correct range and unit are used for the analog values connected to the limit input. These always have a direct influence on the unit of the limit value to be set. The units and ranges of all relevant analog values can be found in chapters "Data record 94 - Measured values" and "Data record 95 - Service data/statistical data" in the manual SIMOCODE pro - Communication (https://support.industry.siemens.com/cs/ww/en/view/109743960).

Table 4-96 Examples of typical units and ranges in SIMOCODE pro

	Unit	Range
Temperatures (e.g. max. temperature)	1 K	0 - 65535
Operating hours	1 s	0 - 4294967295
Motor stop time	1 h	0 - 65535
Active power	1 W	0 - 4294967295
Apparent power	1 VA	0 - 4294967295
Timer actual value	100 ms	0 - 65535

	Unit	Range
Currents (e.g. max. current I_max)	1 % of I_s	0 - 65535
Analog module inputs	—	0 to 27648 (S7 format)

Thus, for example, a limit of 473 (K) must be parameterized for a limit monitor to monitor a maximum temperature of 200 °C.

4.9.12 Calculators (calculation modules) 1, 2

Description

The two logic modules "Calculator 1" and "Calculator 2" integrated in SIMOCODE pro V basic units are capable of the standard calculation modes and enable all analog values featured in SIMOCODE pro to be adapted, calculated, and converted, for example:

- Conversion of the measured temperatures from K (Kelvin) to °F or °C
- Conversion of the motor current from [%] to [A]
- Conversion of the 0/4 to 20mA signals of the analog module directly into fill levels, pressures, and flow rates.

The analog value (2 bytes / 1 word) present at the analog sockets is calculated using a defined formula and using freely-selectable parameters (numerators, denominators, operators, offsets). The result of the calculation is output as an analog value (2 bytes/1 word) at the analog socket of the logic module for further processing.

Each calculator consists of:

- one analog plug (Calculator 1) or two analog plugs (Calculator 2)
- one logic component
- one analog socket

Schematic

The following schematic shows the "Calculators" logic modules:

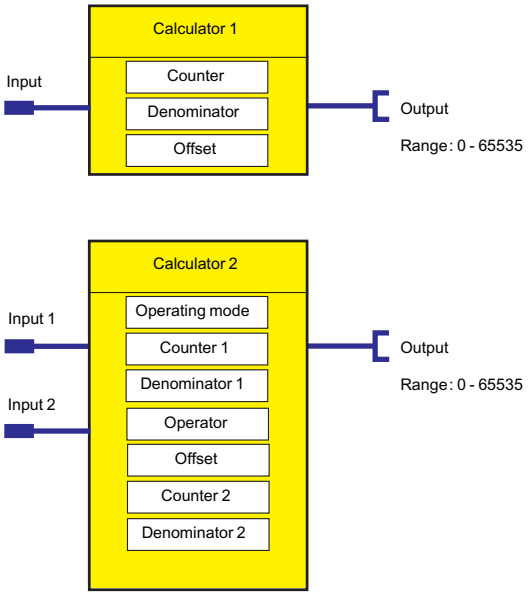


Figure 4-108 "Calculators" logic modules

Modes for calculator 2

The mode of the "Calculator 2" logic module can be changed via the "Operation mode" parameter:

- Operating mode 1: The analog value at input 1 is combined with the analog value at input 2 using a predefined formula and taking into account the specified parameters (numerators, denominators, offsets, operators). The result is available as an analog value (1 word / 2 bytes) at the output of the function block for further processing.
- Operating mode 2: The analog values at input 1 and input 2 are processed together as a double word. Input 1 represents the high word and input 2 the low word. The result is calculated by means of the formula defined for this operating mode using the specified parameters (numerators, denominators, offsets) and is output by the function block as 1 word /2 bytes. In mode 2, it is also possible to process double words (e.g. active power, apparent power) and to display them (2 bytes / 1 word).

Settings

Table 4-97 Calculator settings

Calculator	Description
Calculator 1 - Input	Any value (2 bytes / 1 word)°; Range: 0 - 65535
Calculator 1 - Output	Calculated value (2 bytes/1 word); range: 0 - 65535
Calculator 1 - Numerator	Range: -32766 to +32767, increment 1
Calculator 1 - Denominator	Range: 0 - 255, increment 1

Calculator	Description
Calculator 1 - Offset	Range: -32766 to +32767, increment 1
Calculator 2 - Input 1	Any value (2 bytes / 1 word); Range: 0 - 65535
Calculator 2 - Input 2	Any value (2 bytes / 1 word); Range: 0 - 65535
Calculator 2 - Output	Calculated value (2 bytes / 1 word); Range: 0 - 65535
Calculator 2 - Numerator 1	Range: -128 to +127, increment 1
Calculator 2 - Denominator 1	Range: 0 - 255, increment 1
Calculator 2 - Numerator 2 [1)]	Range: 0 - 255, increment 1
Calculator 2 - Denominator 2 [1)]	Range: -128 to +127, increment 1
Calculator 2 - Offset	Range: -2147483648 to +2147483647, increment 1
Calculator 2 - Operation mode	1 or 2
Calculator 2 - Operator[1)]	+, -, *, /
1) Only relevant for operating mode = 1	

Note

Special aspect

If the numerator and/or the denominator have the value "0", these values are treated as "1" inside the device.

Calculator formulas

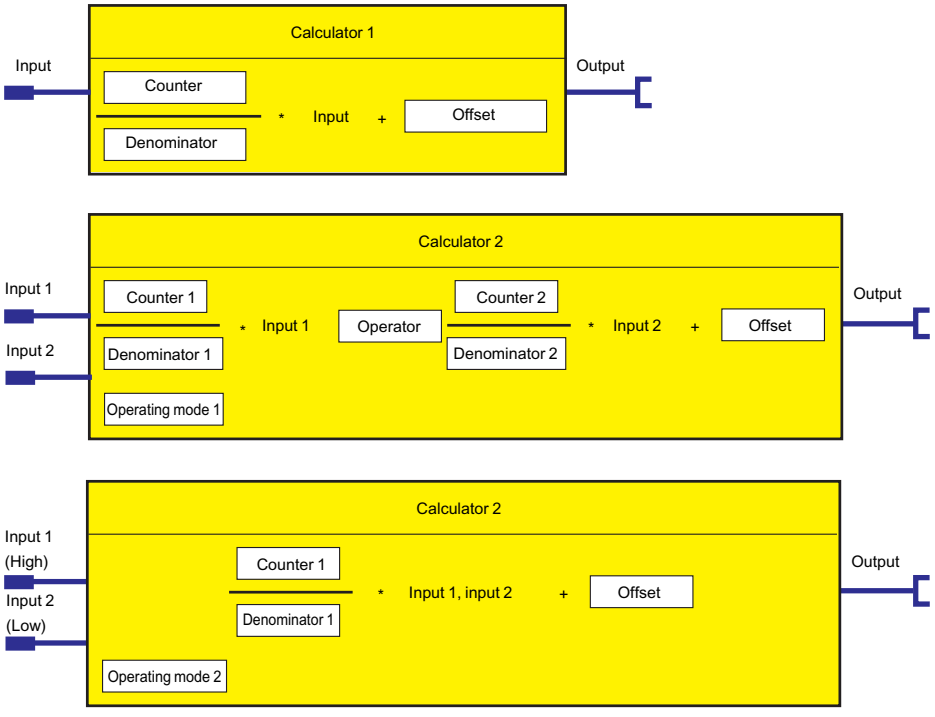


Figure 4-109 Calculator formulas

Examples of calculators

Example 1 - Calculator

Conversion of the maximum temperature of the temperature module from K to °C

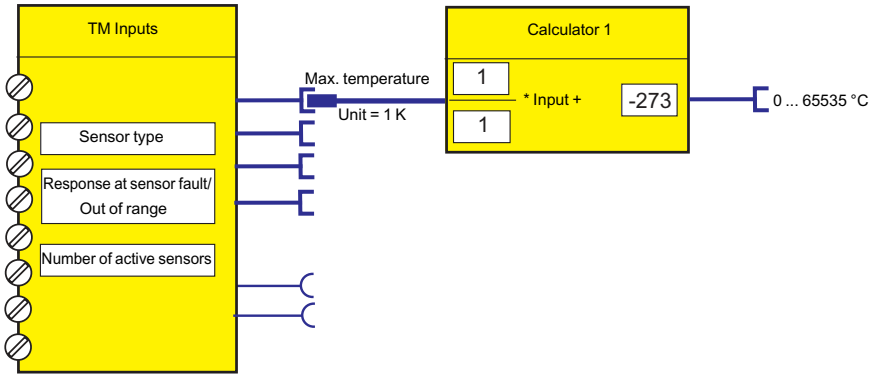


Figure 4-110 Example 1 - Calculator

Example 2 - Calculator

Conversion of the maximum temperature of the temperature module from K to °F

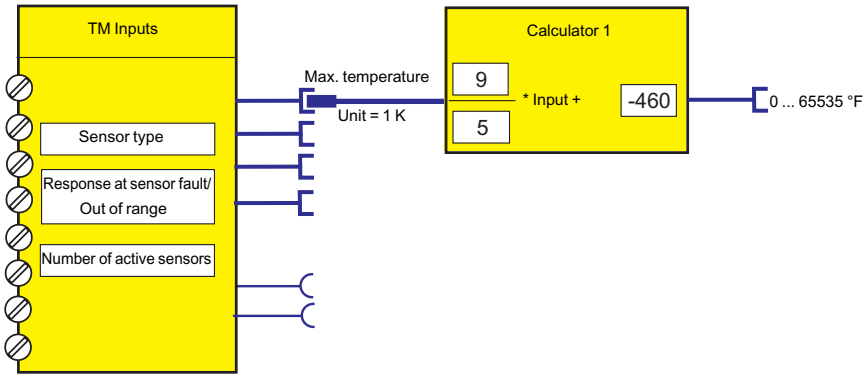


Figure 4-111 Example 2 - Calculator

Example 3 - Calculator

Conversion of motor current I_max from % to A (e.g. current setting I_s = 3.36 A) (only possible for motors with one rotational speed)

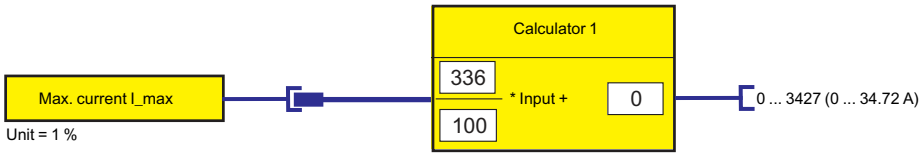


Figure 4-112 Example 3 - Calculator

4.9.13 Calculators (calculation modules) 3, 4

Description

Using the "Calculator 3" and "Calculator 4" function blocks (for SIMOCODE pro V PN (GP) and pro V EIP basic units only), analog values can be processed according to the following arithmetic:

Output = Input 1 [Operator 1] Input 2 [Operator 2] Input 3 [Operator 3] Input 4.

You can connect the corresponding analog signals to the 4 inputs "Calculator 3/4 - Inputs 1 to 4". As operators "Calculator 3/4 - Operator 1 to 3," you can choose one of the four standard operators ("+", "-", "*," or "/").

With "Calculator 3/4 - Priority 1 to 3," you can specify the processing sequence (high, medium, low). You must clearly define a priority for each operator. The priority determines the processing sequence comparable to the placement of a term inside parentheses.

Example:

Output = I1 OP1 I2 OP2 I3 OP3 I4, where

- OP1 = "*"; Medium,
- OP2 = "+"; High,
- OP3 = "-"; Low

Associated equation: Output = (I1 * (I2 + I3)) - I4.

If you interconnect the input to the device-internal analog output data element "Output 1 - Fixed level", the input is assigned the constant "Const x" (x = 1 - 4). In this case, the respective edit field for the constant is activated. You can enter a value between 0 and 65535.

The "Calculator 3" and "Calculator 4" function blocks each consist of:

- Four analog plugs
- One analog socket
- Logic.

Schematic

The following schematic shows the "Calculator 3" and "Calculator 4" logic modules:

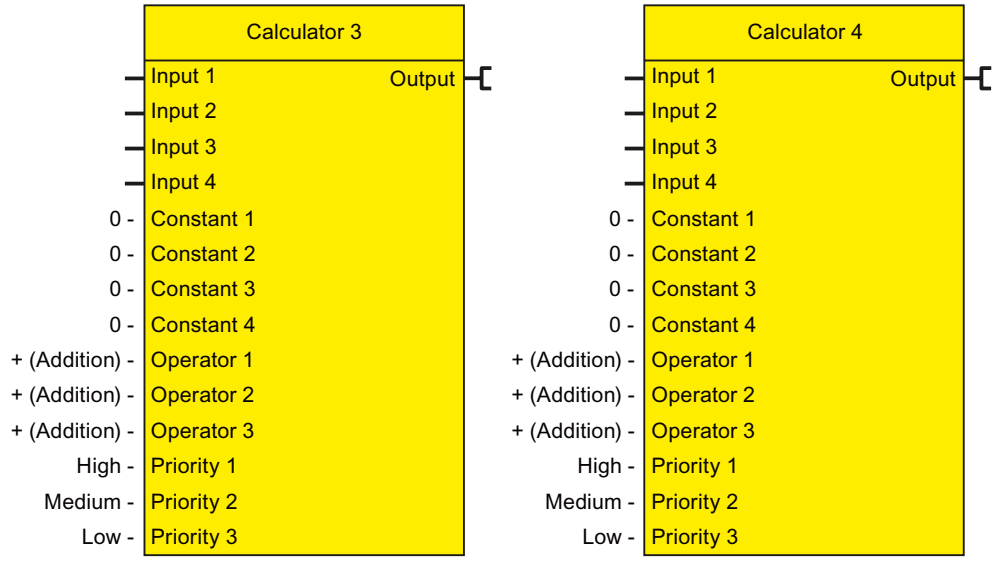


Figure 4-113 "Calculator 3" and "Calculator 4" function blocks

Settings Calculator 3, 4

Table 4-98 Settings Calculator 3, 4

Calculators 3, 4	Description
Input	Any analog value
Output	Calculated analog value
Constant 1 to 4	Any analog value; range: 0 to 65535 (default: 0)
Operator 1 to 3	• "+": Addition • "-": Subtraction • "*": Multiplication • "/": Subtraction
Priority 1 to 3	• Priority 1: high (default), medium, low • Priority 2: medium (default), low • Priority 3: Low

Note

Special aspect

If the numerator and/or the denominator have the value "0", these values are treated as "1" inside the device.

Formula Calculators 3, 4

Input 1 [Operator 1] Input 2 [Operator 2] Input 3 [Operator 3] Input 4 = Output

4.9.14 Analog multiplexer

Description

The analog multiplexer (for SIMOCODE pro V PN (GP) /pro V EIP basic units only) outputs one of 4 possible analog values at the inputs 1 to 4, depending on control signals S1 and S2.

If you interconnect the input to "Fixed level," the input is assigned the constant "Const x" (x = 1 ... 4). In this case, the respective edit field for the constant is activated. You can enter a value between 0 and 65535.

The "Analog Multiplexer" function block consists of:

- two digital plugs (control signal 1 and 2)
- Four analog plugs (Input 1 to 4)
- One analog socket
- Logic.

Schematic

The following schematic shows the Analog Multiplexer logic module:

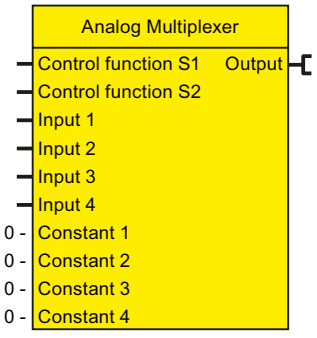


Figure 4-114 Analog multiplexer function block

Settings Analog Multiplexer

Table 4-99 Settings Analog Multiplexer

Analog multiplexer	Description
Control signal S1 to S4	Activation by any signal (any sockets, e.g. device inputs, control bits from the communication bus, etc.)
Input 1 to 4	Any analog value or "Fixed level"

Analog multiplexer	Description
Output	Output value according to panel (see below)
Constant 1 to 4	Any analog value; range: 0 to 65535

Table 4-100 Analog multiplexer panel

S1	S2	Output
0	0	= Input 1
0	1	= Input 2
1	0	= Input 3
1	1	= Input 4

Analog multiplexer example

Pressing an operator panel button multiple times will output the maximum motor current and the three phase currents one after the other (e.g., via the output of the analog module):

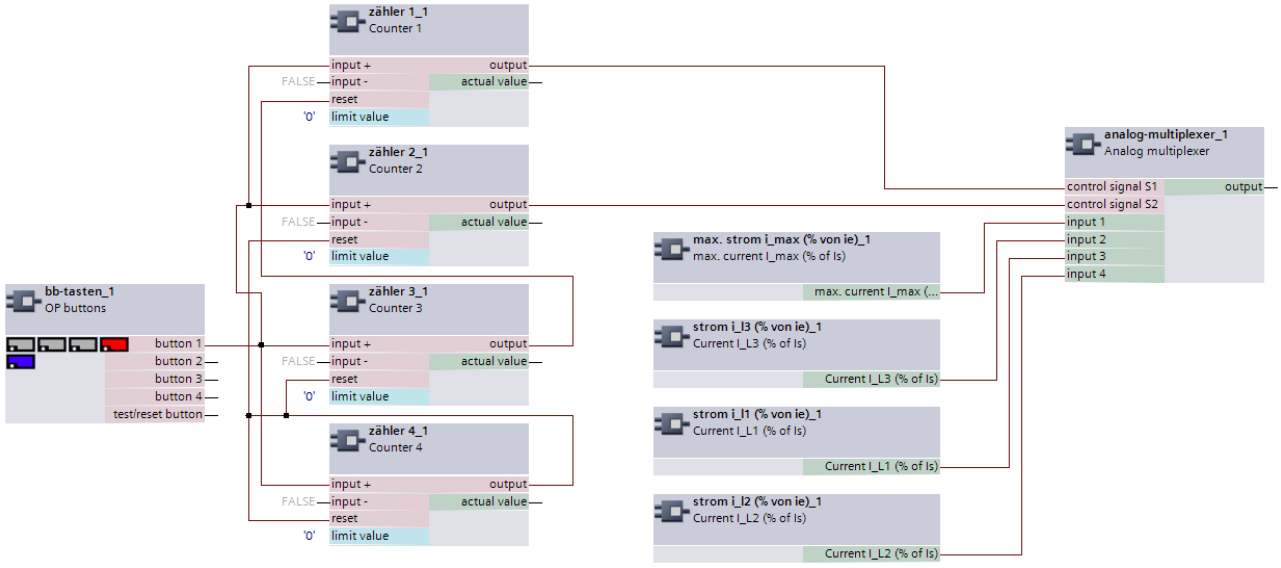


Figure 4-115 Analog multiplexer example

- Pressing the OP button 1x: Phase current IL1
- Pressing the OP button 2x: Phase current IL2
- Pressing the OP button 3x: Phase current IL3
- Pressing the OP button 4x: Maximum motor current I_max.

4.9.15 Pulse width modulator

Description

The pulse width modulator (PWM) (for SIMOCODE pro V PN (GP) /pro V EIP basic units only) modulates the analog input value into a digital output signal "PWM Output" with a variable duty factor that is proportional to the analog input value.

If you interconnect the input to "Fixed value," the input is assigned the parameterized constant "Input (const)." In this case, the edit field for the constant is activated. You can enter a value between 0 and 65535.

The "Pulse Width Modulator" function block consists of:

- one analog plug (input)
- One digital socket (PWM output)
- Logic.

Schematic

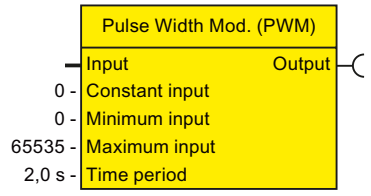


Figure 4-116 "Pulse width modulator" function block

Settings Pulse Width Modulator

Pulse width modulator	Description
Input	Activation by any analog signal or "Fixed value"
Constant input	Any constant; range: 0 to 65535 (default: 0)
Input Minimum	Any constant; range 0 to 65535 (default: 0)
Input Maximum	Any constant; range 1 to 65535 (default: 65535)
PWM duration	0.2 - 6553.5 s (default: 2)

Pulse width modulator formulas

- Length of 1-signal = PWM period * (PWM Input - PWM Input Minimum)/(PWM Input Maximum - PWM Input Minimum)
- Length of 0-signal = PWM period - Length of 1-signal.

Note

Signal duration

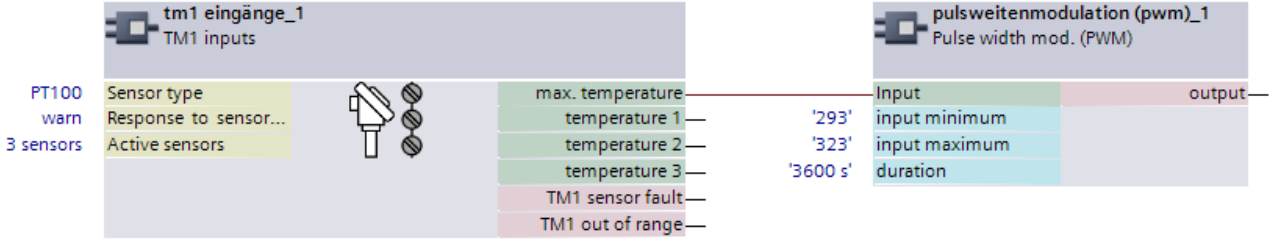
The shortest signal duration for 0 and 1 is 0.1 s in each case.

If a duration for the 1 signal that is shorter than 0.1 s results from calculation, the output will remain permanently 0, while for a duration for the 0 signal shorter than 0.1 s the output remains permanently 1.

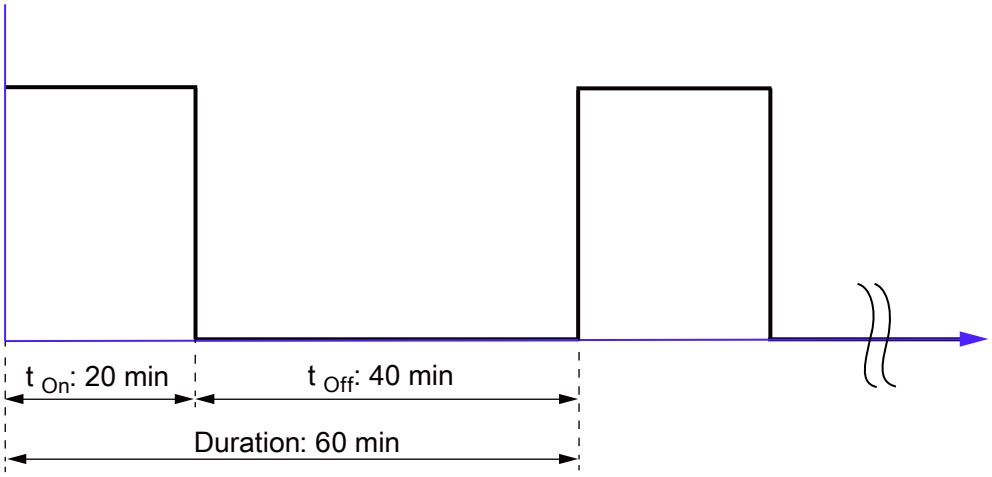
Example - Pulse width modulator

A load will be switched on and off with a duration of 60 minutes, dependent on a measured value (e.g., temperature).

- If the measured value exceeds a maximum value of 50 °C (323°K), the load will be switched on permanently, and if it falls below 20 °C (293°K), it will be switched off permanently.
- If the measured value falls within the range between the minimum and maximum value, the On duration will be proportional to the measured value.



- Duration: 60 min (3600 s)
- Lower limit: 20°C (293 K)
- Hi limit: 50°C (323 K).



- At 20°C (293 K): OFF
- At 30°C (303 K): 20 min ON and 40 min OFF
- At 40°C (313 K): 40 min ON and 20 min OFF
- At 50°C (323 K): ON.

List of abbreviations

A

A.1 List of abbreviations

See SIMOCODE pro – System Manual (https://support.industry.siemens.com/cs/ww/en/view/109743957).

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