SIPROTEC

High Voltage Bay Control Unit 6MD66

V 4.2

Manual

C53000-G1876-C102-3

Disclaimer of liability

We have checked the text of this manual against the hardware and software described. Exclusions and deviations cannot be ruled out; we accept no liability for lack of total agreement.

The information in this manual is checked periodically, and necessary corrections will be included in future editions. We appreciate any suggested improvements.

We reserve the right to make technical improvements without notice.

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4.20.03

Preface

Purpose of this Manual

This manual describes the functions, operation, installation and start-up of the High Voltage Bay Control Unit 6MD66. In particular it contains:

1. Descriptions of device functions and settings;
2. Instructions for Installation and Commissioning;
3. Compilation of the technical specifications;
4. As well as a compilation of the most significant data for experienced users in the Appendix.

General information about design, configuration, and operation of SIPROTEC® 4 devices are laid down in the SIPROTEC® 4 system manual.

Target Audience

Engineers, commissioning engineers, personnel concerned with adjustment, checking, and service of selective protective equipment, automatic and control facilities and personnel of electrical facilities and power plants.

Scope of Validity of the Manual

This manual is valid for SIPROTEC® 4 High Voltage Bay Control Unit 6MD66; Firmware version V 4.2.

Indication of Conformity

This product complies with the directive of the Council of the European Communities on the approximation of the laws of the member states relating to electromagnetic compatibility (EMC Council Directive 89/336/EEC) and concerning electrical equipment for use within certain voltage limits (Low-voltage Directive 73/23/EEC).

This conformity is proved by tests conducted by Siemens AG in accordance with Article 10 of the Council Directive in agreement with the generic standards EN 50 081 and EN 50 082 for EMC directive, and with the standard EN 60 255-6 for the low-voltage directive. This device was designed and produced for industrial use according to the EMC standard.

The product conforms with the international standard of the series IEC 60 255 and the German standard DIN 57 435/ Part 303 (corresponds to VDE 0435/Part 303).

Additional Support

Should further information on the System SIPROTEC® 4 be desired or should particular problems arise which are not covered sufficiently for the purchaser's purpose, the matter should be referred to the local Siemens representative.

Training Courses

Individual course offerings may be found in our Training Catalogue, or questions may be directed to our training centre in Nuremberg.

Instructions and Warnings

The warnings and notes contained in this manual serve for your own safety and for an appropriate lifetime of the device. Please observe them!

The following warning terms and standard definitions are used:

DANGER! indicates that death, severe personal injury or substantial property damage **will** result if proper precautions are not taken.

Warning indicates that death, severe personal injury or substantial property damage **can** result if proper precautions are not taken.

Caution indicates that minor personal injury or property damage can result if proper precautions are not taken. This particularly applies to damage on or in the device itself and consequential damage thereof.

Note indicates information about the device or respective part of the instruction manual which is essential to highlight.

WARNING!

Hazardous voltages are present in this electrical equipment during operation.

Non–observance can result in death, personal injury or substantial property damage.

Only qualified personnel shall work on and around this equipment. It must be thoroughly familiar with all warnings and safety notices of this manual as well as with the applicable safety regulations.

The successful and safe operation of this device is dependent on proper handling, installation, operation, and maintenance by qualified personnel under observance of all warnings and hints contained in this manual.

In particular the general erection and safety regulations (e.g. IEC, DIN, VDE, EN or other national and international standards) regarding the correct use of hoisting gear must be observed.

Definition

QUALIFIED PERSONNEL

For the purpose of this instruction manual and product labels, a qualified person is one who is familiar with the installation, construction and operation of the equipment and the hazards involved. In addition, he has the following qualifications:

– Is trained and authorized to energize, de-energize, clear, ground and tag circuits and equipment in accordance with established safety practices.

– Is trained in the proper care and use of protective equipment in accordance with established safety practices.

– Is trained in rendering first aid.

Typographic and Symbol Conventions

To designate terms which refer in the text to information of the device or for the device, the following fonts are used:

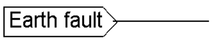
`Parameter Names`, i.e. designators of configuration or function parameters which may appear word-for-word in the display of the device or on the screen of a personal computer (with DIGSI®), are marked in bold letters of a monospace type style. The same goes for the titles of menus.

`Parameter Options`, i.e. possible settings of text parameters, which may appear word-for-word in the display of the device or on the screen of a personal computer (with DIGSI®), are written in italic style, additionally. The same goes for the options of the menus.

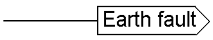
`“Indications”`, i.e. designators for information, which may be output by the relay or required from other devices or from the switch gear, are marked in a monospace type style in quotation marks.

Deviations may be permitted in drawings when the type of designator can be obviously derived from the illustration.

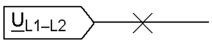
The following symbols are used in drawings:



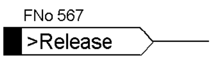
device-internal logical input signal



device-internal logical output signal

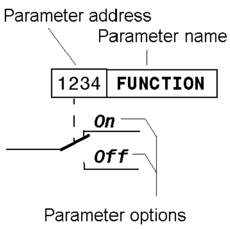


internal input signal of an analogue quantity



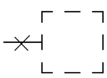
external binary input signal with number No. (binary input, input indication)

external binary output signal with number No. (device indication)

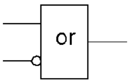


Example of a parameter switch designated with the address and the possible settings

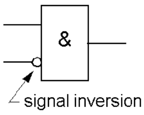
Besides these, graphical symbols are used according to IEC 60 617–12 and IEC 60 617–13 or similar. Some of the most frequently used are listed below:



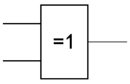
Input signal of an analogue quantity



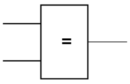
OR gate



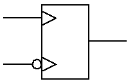
AND gate



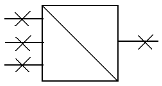
Exclusive–OR gate (antivalence): output is active, if only **one** of the inputs is active



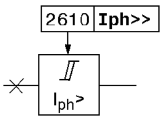
Coincidence gate (equivalence): output is active, if **both** inputs are active or inactive at the same time



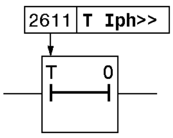
Dynamic inputs (edge–triggered) above with positive, below with negative edge



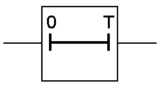
Formation of one analogue output signal from a number of analogue input signals



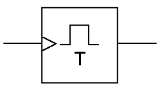
Limit stage with setting address and parameter designator (name)



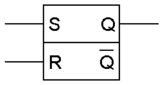
Timer (pickup delay T, example adjustable) with setting address and parameter designator (name)



Timer (dropout delay T, example non-adjustable)



Dynamic triggered pulse timer T (monoflop)



Static memory (RS-flipflop) with setting input (S), resetting input (R), output (Q) and inverted output ($\overline{Q}$)

Contents

Introduction

1

The SIPROTEC® 6MD66 devices are introduced in this section. An overview of the devices is presented in their application, characteristics, and scope of functions.

1.1 Overall Operation

The digital, high voltage SIPROTEC® 6MD66 bay control units are equipped with a powerful microprocessor system. All tasks, from issuing commands to circuit breakers to the acquisition of measured quantities are processed in a completely digital way.

Analogue inputs

The measuring inputs (I_{Lx}, V_x) convert the currents and voltages coming from the transformers and adapt them to the level appropriate for the internal processing of the device. The device has 3 current and 4 voltage inputs.

The current and voltage inputs can be used separately for measured value acquisition. Within the scope of configuration, one- or three-phase evaluation functions are available for evaluation of the analogue inputs and evaluation after the Aron connection.

With voltage inputs, both phase-earth and phase-phase voltages can be applied. In addition to a three-phase system, another reference voltage for synchronisation tasks or a displacement voltage V_n can be measured via the fourth voltage input.

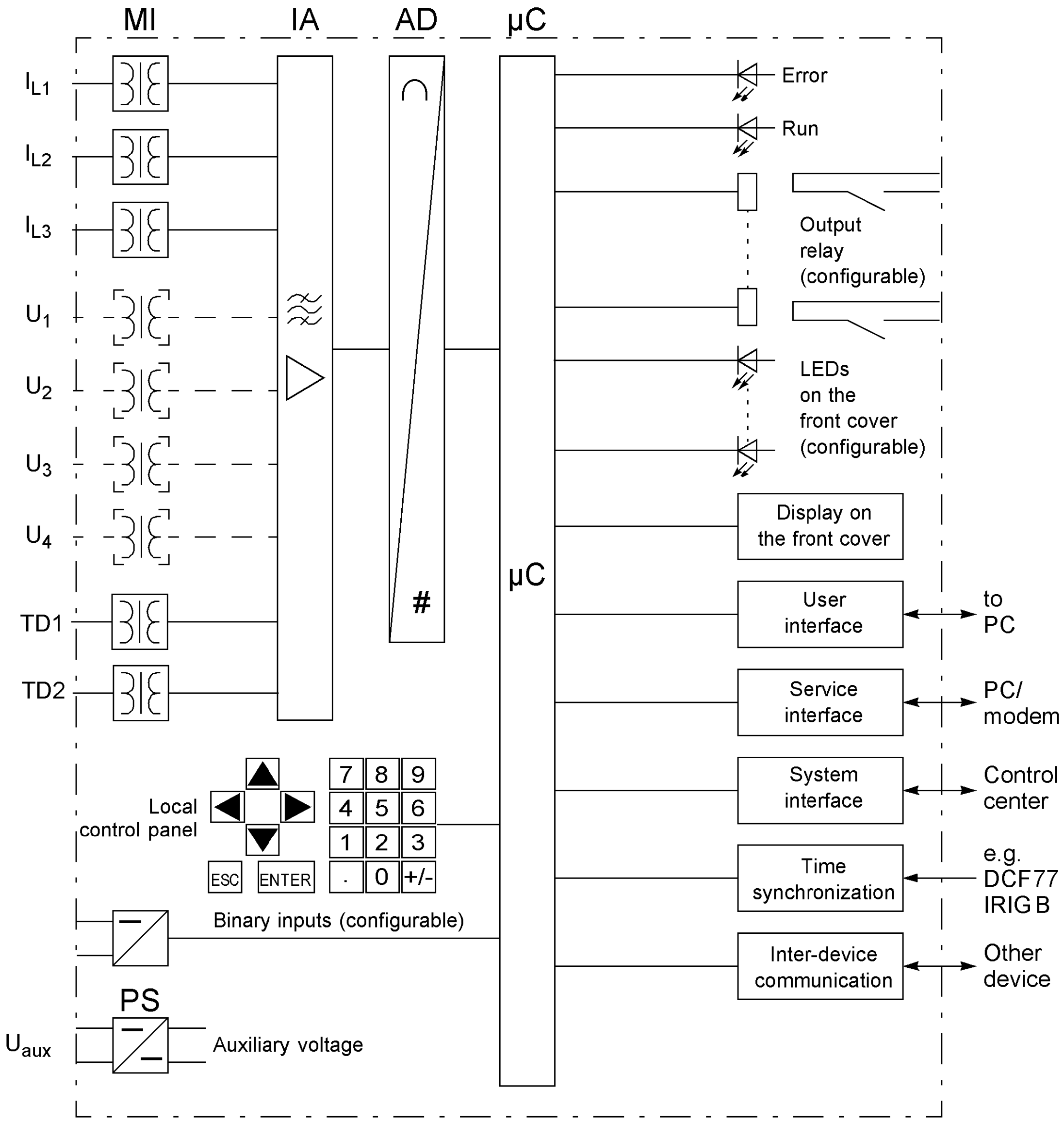


Figure 1-1 Hardware structure of the High Voltage Bay Control Unit 6MD66

Furthermore, two measuring transducer inputs are available.

The analogue values are transferred further to the IA input amplifier group.

The input amplification IA stage provides high-resistance terminations for the analogue input quantities. It consists of filters that are optimised with regard to bandwidth and processing speed.

The analogue-to-digital (AD) stage consists of a multiplexor, an analogue-to-digital (A/D) converter and memory components for the transmission of digital signals to the microcomputer system.

Microcomputer system

The control functions and the measurement quantities are processed in the microcomputer system µC. They especially consist of:

- Control of command outputs,
- Processing of indication inputs,

- Recording of indications,
- Control of signals for logical functions,
- Filtering and conditioning of the measured signals,
- Continuous monitoring of the measured quantities
- Monitoring the communication with other devices,
- Querying of limit values and time sequences,
- Management of the operating system and the associated functions such as data recording, real-time clock, communication, interfaces, etc.

Binary Inputs and Outputs

Binary inputs and outputs from and to the computer system are routed via the I-/O modules (inputs and outputs). The computer system obtains the information from the system (e.g remote resetting) or the external equipment (e.g. blocking commands). Outputs are, in particular, commands to the switchgear units and indications for remote signalling of important events and statuses.

Front elements

With devices with integrated or detached operator panel, information such as messages related to events, states, measured values and the functional status of the device are provided via light-emitting diodes (LEDs) and a display screen (LCD) on the front panel.

Integrated control and numerical keys in conjunction with the LC display allow local communication with the device. Via these elements all information of the device such as configuration and setting parameters, operating messages and measured values can be accessed.

In addition, control of circuit breakers and other equipment is possible from the front panel of the device.

Serial interfaces

A serial **PC** interface is provided for local communications with the device through a personal computer using the operating program DIGSI®. This permits convenient operation of all functions of the device.

A separate **Service** Port can be provided for remote communications via a modem, or substation computer using DIGSI® 4. This port is especially well suited for the fixed wiring of the devices to the PC or operation via a modem.

Via the serial **system** interface all device data can be transferred to a central evaluation unit or to a control center. This interface may be provided with various protocols and physical transmission schemes to suit the particular application.

Communication with other SIPROTEC® 4 devices which also have inter relay communication can occur via the serial interface to the (optional) on the device rear. Communication is achieved regardless of the connection to the central device SICAM SAS and a redundancy to the system interface.

A further interface is provided for the **time synchronization** of the internal clock via external synchronization sources.

Further communication protocols can be realised via additional interface modules.

Power Supply

The before-mentioned function elements and their voltage levels are supplied with power by a power supplying unit (Uaux or PS). Voltage dips may occur if the voltage supply system (substation battery) becomes short-circuited. Usually, they are bridged by a capacitor (see also Technical Data).

1.2 Applications

The high-voltage SIPROTEC® 6MD66 bay controllers are integrated components of the SICAM energy automation system. Command outputs and indication inputs are especially adapted to the requirements of high-voltage technology.

When connecting the circuit breaker, the High Voltage Bay Control Unit can check if the synchronisation conditions of the two subnetworks to be combined are met (synchrocheck). This makes the use of an additional external synchronisation device unnecessary. The synchronisation conditions can be configured conveniently with the DIGSI® operating program. The device distinguishes between synchronous and asynchronous networks and reacts differently on the connection.

Control functions

The device provides a control function which can be accomplished for activating and deactivating switchgears via integrated operator panel, system interface, binary inputs, and the serial port using a personal computer with DIGSI®.

The status of the primary equipment can be transmitted to the device via auxiliary contacts connected to binary inputs. The present status (or position) of the primary equipment can be displayed on the device, and used for interlocking or plausibility monitoring. The number of the operating equipment to be switched is limited by the binary inputs and outputs available in the device or the binary inputs and outputs allocated for the switch position indications. Depending on the primary equipment being controlled, one binary input (single point indication) or two binary inputs (double point indication) may be used for this process.

The capability of switching primary equipment can be restricted by a setting associated with switching authority (Remote or Local), and by the operating mode (interlocked/non-interlocked, with or without password request).

Processing of interlocking conditions for switching (e.g. system interlocking) can be established with the aid of integrated, user-configurable logic functions.

Messages and Measured Values

The operating messages provide information about conditions in the power system and the device. Measurement quantities and values that are calculated can be displayed locally and communicated via the serial interfaces.

Device indications can be assigned to a number of LEDs, externally processed via output contacts, linked with user-definable logic functions and/or issued via serial interfaces.

Communication

For communication with external operator and control systems and Inter relay communication, serial interfaces are available.

A 9-pin DSUB socket on the front panel is used for local communication with a personal computer. By means of the SIPROTEC® 4 operating software DIGSI®, all operational and evaluation tasks can be executed via this **PC** interface, such as specifying and modifying configuration parameters and settings, configuring user-specific logic functions, retrieving operational messages and measured values, inquiring device conditions and measured values, issuing control commands.

Depending on the individual ordering variant, additional interfaces are located on the rear side of the device. They serve to establish an extensive communication with other digital operating, control and memory components:

The **service** interface can be operated via electrical data lines or fibre optics and also allows communication via modem. For this reason, remote operation is possible via personal computer and the DIGSI® operating software, e.g. to operate several devices via a central PC.

The **system** interface ensures the central communication between the device and the substation controller. The service interface can be operated through data cables or fibre optic cables.

The device has a field bus coupling with PROFIBUS FMS. The PROFIBUS FMS according to DIN 19 245 is an open communication standard with particularly wide acceptance in process control and automation engineering, with especially high performance. A profile has been defined for the PROFIBUS communication that covers all of the information types required for process control engineering. The integration of the devices into the power automation system SICAM® can also take place with this profile.

Alternatively, the device can be operated via PROFIBUS DP.

In addition, standardised protocols in accordance with IEC 60 870–5–103 are available for data transmission. The integration of the devices into automation systems from other manufacturers can also take place with this profile.

Optionally, you can use an additional serial interface for Inter relay communication. It takes over communication with other SIPROTEC® 4 devices, regardless if the device is connected to the control center.

Note

The Appendix contains a list of the functions which can be handled via the respective interfaces.

1.3 Characteristics

General features

- Powerful 32-bit microprocessor system.
- Complete digital processing and control of measured values, from the sampling of the analogue input quantities to the initiation of outputs for, as an example, tripping or closing circuit breakers or other switchgear devices.
- Total electrical separation between the internal processing stages of the device and the external transformer, control, and DC supply circuits of the system because of the design of the binary inputs, outputs, and the DC converters.
- Complete set of functions necessary for the proper control of feeders or busbars.
- Easy device operation through an integrated operator panel or by means of a connected personal computer running DIGSI.
- Continuous calculation and display of measured and metered values on the front of the device
- Constant monitoring of the measurement quantities, as well as continuous self-diagnostics covering the hardware and software.
- Communication with central control equipment via serial interfaces is possible through the choice of data cable, modem, or fibre optic cable, as an option.
- Optional for direct communication between the devices, regardless of their connection to the control center.
- Battery-buffered clock that can be synchronised with an IRIG-B (via satellite) or DCF77 signal, binary input signal, or system interface command.
- Commissioning aids such as connection check, status indication of all binary inputs and outputs, easy check of system interface and influencing of information of the system interface during test operation

Synchronisation of the circuit breakers

- Checking of the synchronisation conditions of both subnetworks.
- Differentiation between synchronous and asynchronous networks.
- Consideration of the circuit breaker operating times with asynchronous networks.
- Saving of up to eight parameter sets for synchronisation to be able to consider the differing properties of circuit breakers.

Control

- High security against incorrect switchings via system and bay related interlocking checks, including the information of neighbouring bays via inter relay communication.
- High variance with regard to switchgear types and operating modes.

Switching authority and switching mode

- Keylock switches for defining the control authority and the control mode.
- Logging keylock-switch positions.

Measured values

- Connection of measured values in accordance with one- or three-phase system or Aron connection.
- Flexible measured value processing with configurable measuring packets.

Metered values

- Formation of metered values from measured values
- Acquisition of pulse metered values via the binary inputs

User-defined functions

- Freely programmable links between internal and external signals for the implementation of user-defined logic functions.
- Logic functions for Boolean and mathematical equations.
- Switching sequences and interlocks.
- Time delays and measured value set point interrogation.

Monitoring functions

- Increased reliability thanks to monitoring of internal measuring circuits, auxiliary power supply, hardware and software.
- Monitoring of communication including the evaluation of the number of faulty transmission messages.

Inter relay communication

- Direct exchange of information between the SIPROTEC® 4 devices, even without a connection to the SICAM control centre.
- An interlocked control is also possible if the connection to the control centre or the control centre itself is disturbed.

Further functions

- Battery-buffered clock which can be synchronised via a synchronisation signal (DCF 77, IRIG B via satellite receiver), binary input or system interface.
- Indication storage for the last 200 operational indications with real-time assignment.

■

Functions 2

This chapter describes the numerous functions available on the SIPROTEC® 6MD66. It shows the setting possibilities for each function in maximum configuration. There are instructions for reporting setting values and formulae, where required.

Additionally it may be defined which functions are to be used.

2.1 General functions

The function parameters can be changed via the operator or service interface with a personal computer using DIGSI®. The procedure is described in detail in the SIPROTEC ® System Description /1/.

2.1.1 Functional scope

2.1.1.1 Description

The High Voltage Bay Control Unit 6MD66 has functions whose scope can be adapted to the system conditions. Some functions (e.g. control authorization and mode) are available by default, whereas other functions must be added within the framework of configuration. The functional scope of the device is specified within the scope of configuration.

Configuring functional scope

In DIGSI®, dialog box **Functional scope**, the functions Measuring transducer (various types) and Synchronization (1 to 8) are configured as **Enabled** or **Disabled**.

Functions that are configured as **Disabled** are not processed by the 6MD66: There are no indications, and corresponding settings (functions, limit values) are not displayed.

Functions that are not needed can be hidden.

2.1.1.2 Configuration Notes

Configuration of Function Scope

Configuration settings can be entered using a PC and the operating program DIGSI® and transferred via the front serial port, or via the service interface. Operation via DIGSI® is described in the SIPROTEC® System Description /1/.

For changing **configuration parameters in the device**, **password no.7** is required (for parameter set). Without the password, the settings may be read, but cannot be modified and transmitted to the device.

The functional scope with the available options is set in the **Functional Scope** dialog box to match plant requirements.

2.1.1.3 Settings

Addr.	Parameter	Setting Options	Default Setting	Description
0	**MU V_1**	Disabled Enabled	Disabled	Measurement V
0	**MU I_1**	Disabled Enabled	Disabled	Measurement I
0	**MU1P_1**	Disabled Enabled	Enabled	Measurement 1phase 1.packet
0	**MU1P_2**	Disabled Enabled	Disabled	Measurement 1phase 2.packet

Addr.	Parameter	Setting Options	Default Setting	Description
0	**MU1P_3**	Disabled Enabled	Disabled	Measurement 1phase 3.packet
0	**MU3P_1**	Disabled Enabled	Enabled	Measurement 3phase 1.packet
0	**MUAron_1**	Disabled Enabled	Disabled	Measurement Aron 1.packet
0	**Synchronizing 1**	Disabled Enabled	Disabled	Synchronizing Function 1
0	**Synchronizing 2**	Disabled Enabled	Disabled	Synchronizing Function 2
0	**Synchronizing 3**	Disabled Enabled	Disabled	Synchronizing Function 3
0	**Synchronizing 4**	Disabled Enabled	Disabled	Synchronizing Function 4
0	**Synchronizing 5**	Disabled Enabled	Disabled	Synchronizing Function 5
0	**Synchronizing 6**	Disabled Enabled	Disabled	Synchronizing Function 6
0	**Synchronizing 7**	Disabled Enabled	Disabled	Synchronizing Function 7
0	**Synchronizing 8**	Disabled Enabled	Disabled	Synchronizing Function 8

2.1.2 Power System Data 1

2.1.2.1 Description

To function, the device requires the **Rated Frequency** of the network. The default preset value must only be changed if the network of the application field has a different **Rated Frequency**.

2.1.2.2 Configuration Notes

Rated Frequency

The **Rated Frequency** of the network in which the device is operating is set under the address 214. A default value is preset.

2.1.2.3 Settings

Addr.	Parameter	Setting Options	Default Setting	Description
214	**Rated Frequency**	50 Hz 60 Hz	50 Hz	Rated Frequency

2.1.3 Device, General Settings

2.1.3.1 Description

The behaviour of 6MD66 devices can be set individually with various settings.

The devices are equipped with an illuminated LC display for displaying process and device information. The light for the display is normally off.

Illumination is controlled:

- via an operator action,
  - **ON**, on actuating any key on the operator control panel or
  - **OFF**, after 10 minutes if no further operator input follows.
- via the binary input “`>Light on`” (if configured correspondingly),
  - **ON**, if “`>Light on`” ON or,
  - **OFF**, after the time set under **`T Backlight on`**.

The lighting can also be switched on and off with DIGSI® via the operator interface or the service interface.

Indications of the device

“`Device OK`”

Indication: The device is ready for operation.

The life contact is switched ON and the error LED is switched OFF with this message.

Value: ON

“`Reset Device`”

Indication: The device has performed a startup.

Special communication indication: It is announced on the PROFIBUS that the SIPROTEC-VD has started the PD service (only the logged on partner).

Value: ON

“`Initial Start`”

Indication: The device has performed an initial restart.

All buffers were cleared (additional information for start-up indication).

Value: ON

“`Resume`”

Indication: The device has performed a restart.

All buffers remained intact (additional information for start-up indication).

Value: ON

“`Reset LED`”

Tagging command for acknowledging the LEDs of SICAM or DIGSI®.

Value: ON

“`>Light on`”

Display on/off via binary input.

Value: ON/OFF

"Chatter ON"

Central chatter suppression message.

This message indicates if the chatter suppression responded during a binary message subject to the chatter processing.

Value: ON, the chatter suppression responded for at least one object.

Value: OFF, chatter suppression did not respond for any objects.

"Error PwrSupply"

Indication: The power supply unit is faulty.

Value: ON

"Fail Battery"

Indication: The battery is faulty.

Value: ON

"DataStop"

Data transmission blockage for indications, metered and measured values.

With data transmission blockage on, all information in the monitoring direction is marked with the **transmission blockage** bit. The actual transmission blockage is performed in the control center.

Value: ON/OFF

">DataStop"

Predefined binary input for tagging "DataStop"

Value: ON/OFF

"Test mode"

This operating mode is used for device tests during commissioning or maintenance. In test mode, all information in monitoring direction is marked with UBF test bit. This procedure serves to avoid that events caused by the test mode initiate unwanted reactions (horn, derived commands and indications, etc.) in higher-level system components (DIGSI® or SICAM). This operating mode can be activated and deactivated by a tagging command in DIGSI®.

Value: ON/OFF

"HWTestMod"

Hardware test mode: DIGSI® switches ON this operating mode if the user activates the functions Set binary input, Set output relay, Set messages, for example, in start-up mode. DIGSI® switches OFF the hardware test mode when leaving the start-up area. After the switch-off command, the "Hardware test mode OFF" message is output and an initial device start-up is initiated after a period of 5 seconds.

Value: ON/OFF

">Time Synch"

Input for the external minute pulse.

Value (fleeting): ON

"SynchClock"

Acknowledgement of a clock synchronisation.

Value (fleeting): ON

"Clock SyncError"

Indication: Clock synchronisation error.

Value: ON, the synchronizing event is missing after the parametrized tolerance time.

Value: OFF, a synchronizing event has again arrived.

“DayLightSav-Time” Indication: Daylight saving time switchover.

Value: ON, a time synchronisation job with summertime was detected by the date-clocktime processing.

Value: OFF, a time synchronisation job without daylight saving time was detected.

“Settings Calc.” Annunciation that a parametrization is current.

Value: ON, the function is reserved for parametrization.

Value: OFF, the function has been enabled again.

“Settings Check” Message that the device operates with new parameters which are not yet saved (on-line parameterization).

Value: ON, the test has begun.

Value: OFF, the test is ended, i.e. the device is either operative again, or the new parameters have been saved permanently, or no parameter check is current.

“Level-2 change” The indication is issued as ON, as soon as the parameter set loaded via DIGSI® was changed by an online parametrisation and the device operates with these new parameters. The indication is OFF as long as the parameter set loaded via DIGSI® is not changed or is again issued as OFF, if a parameter set was completely newly loaded and the unit operates with these parameters. The information value of the message (ON/OFF) is preserved during an initial and a resume.

Value: ON, parameter changes online at the unit or via parametrisation command.

Value: OFF, parameter set completely reloaded.

“Local change” Indication that the local operation setting was cancelled.

This message is reserved for DIGSI®.

“Error Board 1” Indication: The BG1 module either does not exist or is defective.

Value: ON

“Event Lost” Fleeting indication Indication lost

“Error FMS1” Fault in the PROFIBUS FMS connection, fibre optic cable 1 with double ring connection

“Error FMS2” Fault in the PROFIBUS FMS connection, fibre optic cable 2 with double ring connection

IRC fault Fault in inter relay communication

2.1.3.2 Configuration Notes

`T Backlight on` The hold time of the **display lighting** (on triggering via a signalling contact) can be set in this range. A default value is preset. This value is always valid for the automatic illumination switch-off after an operator action.

`DIGSI backplane` The setting is automatically derived from the MLFB number set (item 12, functional interface). The interface should be bypassed only in exceptional cases.

2.1.3.3 Settings

Addr.	Parameter	Setting Options	Default Setting	Description
401	**`T Backlight on`**	1 .. 60 min	10 min	Time Backlight on
402	**`DIGSI backplane`**	Disabled Port C Port D	Disabled	Serviceport for DIGSI

2.1.3.4 Information

No.	Message	Type of Information	Description
	>Light on	EM	>Back Light on
	DataStop	IE	Stop data transmission
	Test mode	IE	Test mode
	HWTestMod	IE	Hardware Test Mode
	SynchClock	IE_W	Clock Synchronization
	Error FMS1	AM	Error FMS FO 1
	Error FMS2	AM	Error FMS FO 2
3	>Time Synch	EM_W	>Synchronize Internal Real Time Clock
16	>DataStop	EM	>Stop data transmission
51	Device OK	AM	Device is Operational and Protecting
55	Reset Device	AM	Reset Device
56	Initial Start	AM	Initial Start of Device
60	Reset LED	AM_W	Reset LED
67	Resume	AM	Resume
68	Clock SyncError	IE	Clock Synchronization Error
69	DayLightSavTime	AM	Daylight Saving Time
70	Settings Calc.	AM	Setting calculation is running
71	Settings Check	AM	Settings Check
72	Level-2 change	AM	Level-2 change
73	Local change	AM	Local setting change
110	Event Lost	AM_W	Event lost
125	Chatter ON	AM	Chatter ON
147	Error PwrSupply	AM	Error Power Supply
177	Fail Battery	AM	Failure: Battery empty
183	Error Board 1	AM	Error Board 1

No.	Message	Type of Information	Description
184	Error Board 2	AM	Error Board 2
185	Error Board 3	AM	Error Board 3
186	Error Board 4	AM	Error Board 4
187	Error Board 5	AM	Error Board 5
188	Error Board 6	AM	Error Board 6
189	Error Board 7	AM	Error Board 7

2.1.4 Protocol

2.1.4.1 Description

When detecting an interruption in communication between a SIPROTEC® 4 device and the PROFIBUS-DP Master, marking "`SysIntErr.`" (fault at system interface) is set to ON in the SIPROTEC® 4 device. The message is registered in the event buffer. Following, it can be processed in CFC and allocated to LEDs and output relays.

The state of the outputs or switching elements has not changed compared to the state before interruption of the communication.

After communication has been reestablished the message is set to OFF and data are taken from the telegrams again received by the PROFIBUS-DP Master.

2.1.4.2 Information

No.	Message	Type of Information	Description
	SysIntErr.	IE	Error Systeminterface

2.2 Command processing

2.2.1 General

2.2.1.1 Description

The source of command are recorded in the event log at the moment of the command output.

The following source of command are possible:

Cause text	Command source
SC = Local	Local control using the keypad on the local user interface of the device
SC = SICAM	Local control of central device (e.g. SICAM®)
SC = Remote	Remote control of central device
SC = Auto	Automatic command of central device (e.g. SICAM® CFC)
SC = Auto device	Automatic command of device
SC = DIGSI	Control using DIGSI®

2.2.2 Control Device

2.2.2.1 Description

Devices with integrated or detached operator panel can control switchgear via the operator panel of the device.

Requirements

The number of switchgear devices to be controlled is limited by the

binary inputs present

binary outputs present

Operation using the SIPROTEC® 4 device

Commands can be initiated using the keypad on the local user interface of the relay. For this purpose, there are three independent keys located below the graphic display. The key CTRL causes the control display to appear in the LCD. Control of switching devices only is possible within the control display, since the two control keys OPEN and CLOSE only become active as long as the control display is present. The LCD must be changed back to the default display for other, non-control, operational modes.

The navigation keys ▲, ▼, ◀, ▶ are used to select the desired device in the Control Display. The I key or the O key is then pressed to convey the intended control command.

Consequently, the switch icon in the control display flashes in setpoint direction. At the lower display edge, the user is requested to confirm his switching operation via the ENTER key. Next a security check takes place. After the security check is completed, the ENTER key must be pressed again to carry out the command. If this confirmation is not performed within one minute, the setpoint flashing changes again to the corresponding actual status. Cancellation via the `Esc` key is possible at any time before the control command is issued.

During normal processing, the control display indicates the new actual status after the control command was executed and the message “`command end`” at the lower display edge. In case of control commands with feedback, the message “`FB reached`” is displayed for a short time before this.

If the selected control command is not accepted, because an interlocking condition is not met, then an error message appears in the display. The message indicates why the command was not accepted (see also SIPROTEC® 4 System Description /1/). This message must be acknowledged with Enter before any further control commands can be issued.

Operation using the DIGSI®

Control devices can be controlled via the operator control interface by means of the DIGSI® operating program installed on a PC.

The procedure to do so is described in the SIPROTEC® System Description /1/ (Control of Switchgear).

Operation using the SCADA Interface

Control of switching devices can be performed via the serial system interface and a connection to the substation control and protection system. Please check MLFB order number to ensure that your individual relay has a SCADA interface module that supports this. Within the device also specific settings have to be made to the serial interface (see SIPROTEC® System Description /1/).

Note

The switching commands (annunciations) listed in the following Information List are examples preset. As they are only examples they may be deleted or overwritten by the user.

2.2.2.2 Information

No.	Message	Type of Information	Description
	Q0	BR_D2	circuit breaker Q0
	Q0	DM	circuit breaker Q0
	Q1	BR_D2	bus disconnector Q1
	Q1	DM	bus disconnector Q1
	Q2	BR_D2	bus disconnector Q2
	Q2	DM	bus disconnector Q2
	Q8	BR_D2	earthing isolator Q8
	Q8	DM	earthing isolator Q8
	Q9	BR_D2	feeder disconnector Q9
	Q9	DM	feeder disconnector Q9
	ReleaseQ0	IE	Release circuit breaker Q0
	ReleaseQ1	IE	Release bus disconnector Q1
	ReleaseQ2	IE	Release bus disconnector Q2

No.	Message	Type of Information	Description
	ReleaseQ8	IE	Release earthing isolator Q8
	ReleaseQ9	IE	Release feeder disconnector Q9

2.2.3 Control Authorization

2.2.3.1 Description

For the control of switchgear there are several types of commands that have to be considered.

Usercases

Operation of circuit breakers, disconnectors and ground electrodes

Raising and lowering transformer LTCs

Control of Petersen coils

Manually overriding/updating information of process-dependent objects

Establishing internal settings

Setting and resetting internal buffers or data stocks

Adding/removing additional information

Requirements

For more information see SIPROTEC® System Description

Commands to the system

These are all commands that are directly output to the switchgear to change their process state:

- Switching commands for the control of circuit breakers (asynchronous), disconnectors and ground electrodes,
- Step Commands, e.g. raising and lowering transformer LTCs
- Setpoint commands with configurable time settings, e.g. to control Petersen coils

Device-internal commands

These commands do not directly operate command outputs. They serve for initiating internal functions, communicating the detection of status changes to the device or for acknowledging them.

- Manual overriding commands to manually update information on process-dependent objects such as indications and switching states, e.g. if the communication with the process is interrupted. Manually overridden objects are flagged as such in the information status and can be displayed accordingly.
- Tagging commands are issued to establish internal settings, e.g. deleting / presetting the switching authority (remote vs. local), a parameter set changeover, data transmission block to the SCADA interface, and measured value setpoints.
- Acknowledgment and resetting commands for setting and resetting internal buffers or data stocks.
- Information status command to set/reset the additional information "information status" of a process object, such as:
  - Acquisition blocking
  - Output blocking.

Sequence in the command path

Security mechanisms in the command path ensure that a switch command can be carried out only if the test of previously established criteria has been successfully completed. In addition to general fixed prescribed tests, for each resource separately further interlocks can be configured. The actual execution of the command job also is then monitored. The entire sequence of a command is described briefly in the following.

Checking a command job

Please observe the following:

- Command entry, e.g. using the keypad on the local user interface of the device
  - Check password ⇒ access rights
  - Check switching mode (interlocking activated/deactivated) ⇒ selection of deactivated interlocking status.
- User configurable Interlocking checks
  - Switching authority
  - Device Position Check (scheduled vs. actual comparison)
  - Interlocking, Zone Control (logic using CFC)
  - Interlocking, System Interlocking (centrally, using SICAM)
  - Double Operation (interlocking against parallel switching operations)
  - Protection Blocking (blocking of switching operations by protective functions)
- Fixed command checks
  - Internal process time (software watch dog which checks the time for processing the control action between initiation of the control and final close of the relay contact)
  - Configuration in Process (if configuration is in process, commands are denied or delayed)
  - Equipment enabled as output (if an piece of equipment was configured, but not configured to a binary input, the command is denied)
  - Output Blocking (if output blocking has been programmed for the circuit breaker, and is active at the moment the command is processed, then the command is denied)
  - Module hardware error
  - Command in Progress (only one command can be processed at a time for one piece of equipment, object-related Double Operation Block)
  - 1-of-n check (for multiple allocations such as common contact relays it is checked if a command procedure was already ininitiated for the output relays concerned).

Command execution monitoring

The following is monitored:

- Interruption of a command because of a Cancel Command
- Running Time Monitor (feedback monitoring time)

Switchgear interlocking

Switchgear interlocking checks in a SICAM®/SIPROTEC® system are divided in the following groups:

- System interlocking relies on the system database in the central control system
- Zone controls, relies on the object image (feedbacks) in the field device and information of the neighbouring fields via IRC.

The extent of the interlocking checks is determined by configuration.

Switching objects that require system interlocking in a central control system are assigned to a specific parameter inside the bay unit (via configuration matrix).

For all commands, operation with interlocking (normal mode) or without interlocking (test mode) can be selected:

- for Local commands, by activation of "Normal/Test"-key switch,
- for automatic commands, via command processing by CFC and Deactivated Interlocking Recognition,
- for local / remote commands, using an additional interlocking disable command, via PROFIBUS.

Interlocked/de-interlocked Switching

The configurable command checks in the SIPROTEC® 4 devices are also called "standard interlocking". These checks can be activated via DIGSI ® (interlocked switching/tagging) or deactivated (non-interlocked).

De-interlocked or non-interlocked switching means that the configured interlock conditions are not tested.

Interlocked switching means that all configured interlocking conditions are checked within the command processing. If a condition is not fulfilled, the command is rejected, marked with a minus sign (e.g. "**CO–**"), and a message to that effect is output.

The following table shows some types of commands and messages. For the device the messages designated with *) are displayed in the event logs, for DIGSI® they appear in spontaneous indications.

Type of Command	Control	Cause	Indication
Control issued	Switching	CO	CO+/–
Manual tagging (positive / negative)	Override	MT	MT+/–
Output blocking, Acquisition blocking	Acquisition blocking	ST	ST+/– *)
Information status command, Output blocking	Output blocking	OB	OB+/– *)
Abort command	Abort	CA	CA+/–

The "plus" appearing in the message is a confirmation of the command execution. The command output has a positive result, as expected. The "minus" is a negative confirmation and means that the result was unexpected. The command was rejected.

Possible command replies and their causes are dealt with in /1/. Figure 2-1 shows the **operational indications** relating to command execution and operation response information for a successful operation of the circuit breaker.

Interlocking checks can be configured individually for all switching devices and markings. Other internal commands such as overriding or abort are not tested, i.e. are executed independently of the interlockings.

```
EVENT LOG
---------------------
19.06.01 11:52:05,625
QO          CO+ close

19.06.01 11:52:06,134
QO          FB+ close
```

Figure 2-1 Example of an operational annunciation for switching circuit breaker 52

Standard Interlocking Defaults (fixed programming)

The standard interlockings contain the following fixed programmed tests for each switching device, which can be individually enabled or disabled using parameters:

- Device Status Check (setpoint = actual): The switching command is rejected, and an error indication is displayed if the circuit breaker is already in the set position. If this check is enabled, then it applies whether switch interlocking is activated or deactivated.
- System Interlocking: For checking the system interlocking a locally issued command to the central unit is instigated with switching authority = local. A switching device that is subject to system interlocking cannot be switched by DIGSI®.
- Zone Control: Logic combinations deposited in the device using CFC are scanned and taken into consideration for interlocked switching.
- Blocked by protection: This interlocking option enabled for devices with integrated protection functions has no significance and no effect on the 6MD66 device version.
- Double operation locking: Parallel switchings are mutually interlocked; when a switching is being processed a second one cannot be executed.
- LOCAL switching authority: A switching command from the user interface of the device (command with command source LOCAL) is only allowed if the Key Switch (for devices without key switch via configuration) is set to LOCAL.
- DIGSI switching authority: Switching commands that are issued locally or remotely via DIGSI (command with command source DIGSI) are only allowed if the Key Switch (for devices without key switch via configuration) is set to REMOTE. If a DIGSI-PC communicates with the device, it deposits here its virtual device number (VD). DIGSI must have the same virtual device number (with REMOTE switching authority). Switch commands of the remote control are rejected.
- REMOTE switching authority: A remote control command (command with initiator source REMOTE) is only allowed if the Key Switch (for devices without key switch via configuration) is set to REMOTE.

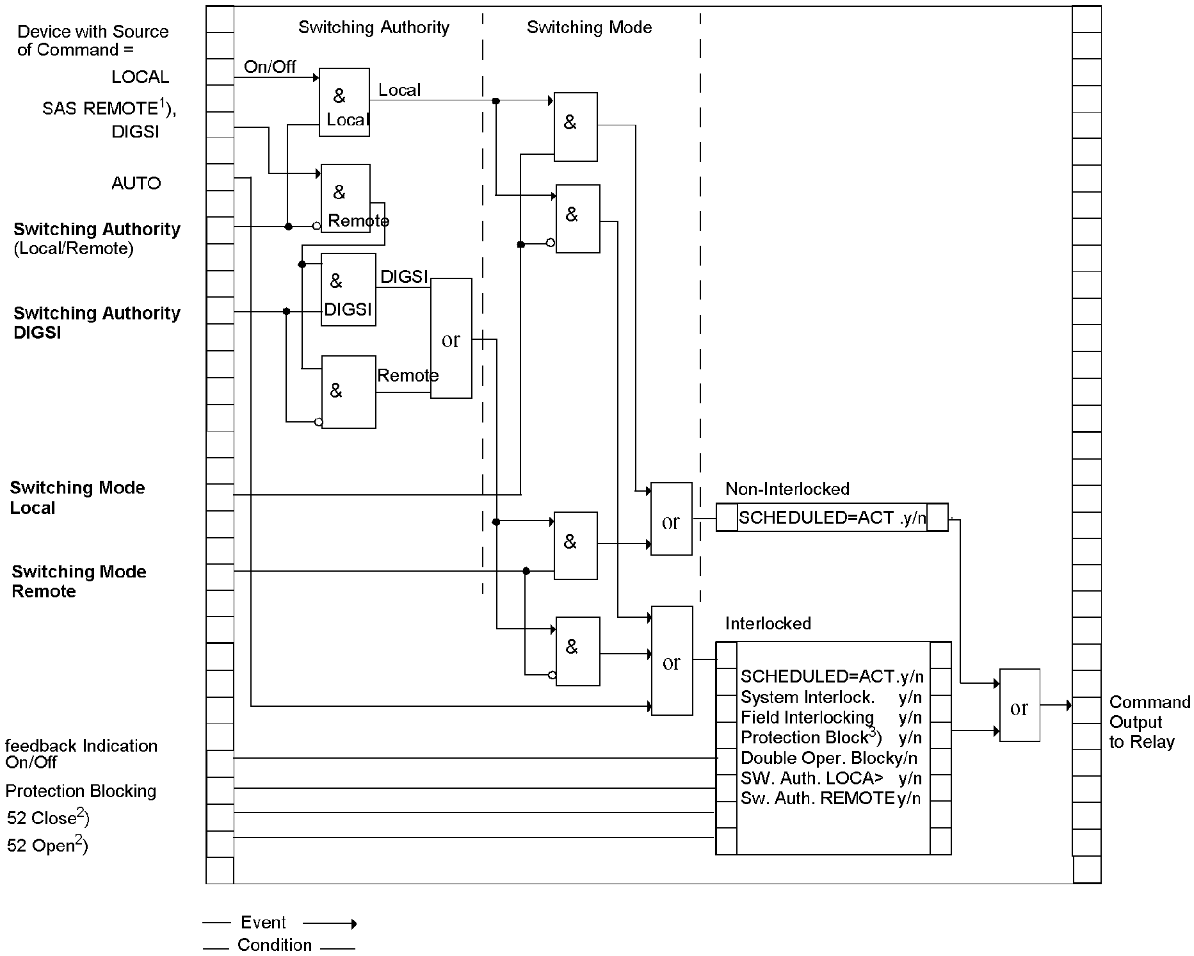


Figure 2-2 Standard interlocking arrangements

1) Initiator source REMOTE also includes LOCAL. (LOCAL command via the power system management in the station, REMOTE command via telecontrol station to power system management and from power system management to the device)

2) Release from testing of interlocking conditions

3) Not relevant for 6MD66

For devices with operator panel the display shows the configured interlocking reasons. They are marked by letters explained in the following table.

Table 2-1 Interlocking Commands

Interlocking Commands	Command	Display
Switching authority	L	L
System interlocking	SI	A
Zone Control	Z	Z
SET = ACTUAL (switch direction check)	P	P
Blocked by protection [1]	B [1]	B [1]

[1] Not relevant for 6MD66

The following figure shows all interlocking conditions (which usually appear in the display of the device) for three switchgear items with the relevant abbreviations explained in the previous table. All parameterized interlocking conditions are indicated.

```
Interlocking   01/03
--------------------
Q0 Close/Open S – Z P B
Q1 Close/Open S – Z P B

Q8 Close/Open S – Z P B
```

Figure 2-3 Example of configured interlocking conditions

Switching authority (for devices with operator panel)

The interlocking condition "Switching Authority" serves to determine the switching authorization. It enables the user to select the authorized command source. For devices with operator panel the following switching authority ranges are defined in the following priority sequence:

- LOCAL
- DIGSI®
- REMOTE

The object "Switching Authority" serves to interlock or enable LOCAL control, but not remote or DIGSI commands. The 6MD66 is equipped with two key switches. The top switch is reserved for the switching authority. The condition "LOCAL" allows commands from the user interface of the relay. The position "REMOTE" enables remote control.

The "Switching authority DIGSI" object is used for interlocking and allows commands to be initiated using DIGSI®. Commands are allowed for both a remote and a local DIGSI® connection. When a (local or remote) DIGSI PC logs on to the device, it enters its Virtual Device Number (VD). The device only accepts commands having that VD (with switching authority = OFF or REMOTE). When the DIGSI PC logs off, the VD is removed.

Commands are checked for their source SC and the device settings, and compared to the information set in the objects "Switching authority" and "Switching authority DIGSI".

Configuration:

Switching authority available:	y/n (create appropriate object)
Switching authority DIGSI® available:	y/n (create appropriate object)
Specific object (e.g. switching device):	Switching authority LOCAL (check for Local status): y/n
Specific object (e.g. switching device):	Switching authority REMOTE (check for LOCAL) REMOTE, or DIGSI commands: y/n

Table 2-2 Interlocking logic

Current Switching Authority Status	Switching authority DIGSI	Command issued with SC[3)]=LOCAL	Command issued from SC=LOCAL or REMOTE	Command with SC=DIGSI
LOCAL (ON)	Not registered	not allocated	Interlocked [2)] - "switching authority LOCAL"	Interlocked - "DIGSI not registered"
LOCAL (ON)	registered	not allocated	Interlocked [2)] - "switching authority LOCAL"	Interlocked [2)] - "switching authority LOCAL"
REMOTE (OFF)	Not registered	Interlocked [1)] - "switching authority REMOTE"	not allocated	Interlocked - "DIGSI not registered"
REMOTE (OFF)	registered	Interlocked [1)] - "switching authority DIGSI"	Interlocked [2)] - "switching authority DIGSI"	not allocated

1) also "available" for: –switching authority LOCAL (check for local status): n"

2) also "available" for: –Switching authority REMOTE (check for LOCAL, REMOTE, or DIGSI status): n"

3) VQ = Source of command

SC = Auto SICAM:

Commands that are initiated internally (command processing in the CFC) are not subject to switching authority and are therefore always "available".

Switching Authority (for devices without operator panel)

The dongle cable sets the switching authority of the device to "REMOTE". The specifications of the previous section apply.

Switching Mode (for devices with operator panel)

The switching mode determines whether selected interlocking conditions will be activated or deactivated at the time of the switching operation.

The following switching modes (local) are defined:

- Local commands (SC=LOCAL)
  - interlocked (normal), or
  - non-interlocked switching.

The 6MD66 is equipped with two key switches. The bottom switch is reserved for the switching mode. The "Normal" position allows interlocked switching while the "Interlocking OFF" position allows non-interlocked switching.

The following switching modes (remote) are defined:

- Remote or DIGSI® commands (SC = LOCAL, REMOTE, or DIGSI)
  - interlocked, or
  - non-interlocked switching. Here de-interlocking occurs through a separate de-interlocking job. The position of the key-switch is irrelevant.
  - For commands from CFC (SC = AUTO SICAM), please observe the notes in the DIGSI CFC manual /3/ (block: BOOL after command).

Switching Mode (for devices without operator panel)

The dongle cable sets the switching mode of the device to "Normal". The specifications of the previous section apply.

Zone controls

Zone controlled / field interlocking (e.g. via CFC) includes the verification that predetermined switchgear position conditions are satisfied to prevent switching errors (e.g. disconnector vs. ground switch, ground switch only if no voltage applied) as well as verification of the state of other mechanical interlocking in the switchgear bay (e.g. High Voltage compartment doors).

Interlockings via the IRC are handled like zone controls.

Interlocking conditions can be programmed separately, for each switching device, for device control CLOSE and/or OPEN.

The enable information with the data "switchgear is interlocked (OFF/NV/FLT) or enabled (ON)" can be set up,

- directly, using a single point or double point indication, key-switch, or internal indication (marking), or
- by means of a control logic via CFC.

The current status is queried for a control command and updated cyclically. The assignment is done via "Release object CLOSE/OPEN".

System interlocking

The system interlockings are then considered (allocation via central unit).

Double operation locking

Parallel switching operations are interlocked. On arrival of a command all command objects are tested which are also subject to the blockage, as to whether a command is current for them. While the command is being executed, the block is in turn active for all other commands.

Device Status Check (setpoint = actual)

For switching commands, a check takes place whether the selected switching device is already in the scheduled/desired position (scheduled/actual comparison). This means, if a circuit breaker is already in the CLOSED position and an attempt is made to issue a closing command, the command will be refused, with the operating message "scheduled condition equals actual condition". Switching devices in the fault position are not interlocked by software means.

De-interlockings

De-interlockings can be bypassed to perform switching operations. This is either done internally by adding a bypass code to the command, or globally by so-called switching modes.

- SC=LOCAL
  - The switching modes "interlocked (latched)" or "non-interlocked (unlatched)" can be set via the key switch. The position "Interlocking OFF" corresponds to non-interlocked switching and serves the special purpose of unlocking the standard interlocks.
- REMOTE and DIGSI®
  - Commands issued by SICAM® or DIGSI® are unlocked via global switching mode REMOTE. For de-interlocking a separate job must be issued. De-interlocking is done in each case only for one switch action and only for commands of the same origin source.
  - Job: command to object "Switching mode REMOTE", ON

  – Job: switching command to "switching device"
- Derived command via CFC (automatic command, SC=Auto SICAM):
  – Behaviour configured in the CFC block ("BOOL to command").

2.2.3.2 Information

No.	Message	Type of Information	Description
	KeySwitch1	DM	Key Switch 1 (Local/Remote)
	Cntrl Auth	IE	Control Authority
	KeySwitch2	DM	Key Switch 2 (Interlocking OFF/ON)
	ModeLOCAL	IE	Controlmode LOCAL
	ModeREMOTE	IE	Controlmode REMOTE
	CntrlDIGSI	GW	Control DIGSI

2.2.4 Process Data

2.2.4.1 Description

During the processing of the commands, independent of the further message routing and processing, command and process feedback information are sent to the message processing centre. These messages contain information on the cause. With the corresponding allocation (configuration) these messages are entered in the event list, thus serving as a report.

Usercases

Messages and Operating Messages in Relation to Switching Operations

Requirements

A listing of possible operating messages and their meaning as well as the command types needed for tripping and closing of the switchgear or for raising and lowering of transformer taps are described in the SIPROTEC® System Description /1/.

Acknowledgement of Commands to the Device Front

All messages with the source of command LOCAL are transformed into a corresponding response and shown in the display of the device.

Acknowledgement of commands to Local/Remote/Digsi

The acknowledgement of messages with source of command Local/ Remote/DIGSI are sent back to the initiating point independent of the routing (configuration on the serial digital interface).

The acknowledgement of commands is therefore not executed by a response indication as it is done with the local command but by ordinary command and feedback information recording.

Monitoring of feedback information

The processing of commands monitors the command execution and timing of feedback information for all commands. At the same time the command is sent, the monitoring time is started (monitoring of the command execution). This time controls whether the device achieves the required final result within the monitoring time. The monitoring time is stopped as soon as the feedback information arrives. If no feedback information arrives, a response "Timeout command monitoring time" appears and the process is terminated.

Commands and information feedback are also recorded in the event list. Normally the execution of a command is terminated as soon as the feedback information (FB+) of the relevant switchgear arrives or, in case of commands without process feedback information, the command output resets and a message is output.

The "plus" sign appearing in a feedback information confirms that the command was successful. The command was as expected, in other words positive. The "minus" is a negative confirmation and means that the command was not executed as expected.

2.3 Indication processing

2.3.1 Description

Message processing in High Voltage Bay Control Unit 6MD66 is provided to assure a save and instantaneous transmission of information to the control centre. This is done by giving priority to feedback information from commands before measured values and other messages. Thus the user quickly gets an overview on the current status of the station even when data exchange is very high.

Message processing comprises the following

- Communication with the Substation Controller Utilizing the Priorization Principle
- Transmission of data to the bay devices connected via inter-relay communication
- Creation of group alarms in accordance with the configuration in CFC
- Display of the event list of the device, memorization of 200 messages
- Display of the signalizing LEDs (in accordance with the configuration carried out)

LED Display and Binary Outputs (output relays)

Important events and conditions are displayed, using LEDs on the front panel of the relay. The device furthermore has output relays for remote indication. All LEDs and binary outputs indicating specific messages can be freely configured. The relay is delivered with a default setting. The Appendix of this manual deals in detail with the delivery status and the allocation options.

The output relays and the LEDs may be operated in a latched or unlatched mode (each may be individually set).

The latched conditions are protected against loss of the auxiliary voltage. They are reset

- On site by pressing the LED key on the relay,
- Remotely using a binary input configured for that purpose,
- Using one of the serial interfaces.

Condition messages should not be latched. Also, they cannot be reset until the criterion to be reported has reset. This applies to messages from monitoring functions, or similar.

A green LED displays operational readiness of the relay ("RUN"), and cannot be reset. It goes out if the self-check feature of the microprocessor recognizes an abnormal occurrence, or if the auxiliary voltage is lost.

When auxiliary voltage is present, but the relay has an internal malfunction, then the red LED ("ERROR") lights up and the processor blocks the relay.

Further information on the functionality, allocation of indications, on how to read out information via DIGSI® and the operator panel of the device etc. can be found in the SIPROTEC® System Description /1/.

2.4 Measured value processing

2.4.1 Measurement

2.4.1.1 Description

The Measured values parameter group is used for compiling the user-defined measured values. These measured values are created via DIGSI® CFC or arrive via inter relay communication.

Usercases

Limit measured values are used to indicate when a measured value recorded as the operational measured value has exceeded the upper or lower limits.

Measured values

The two measuring transducer inputs (±20 mA) contained in the device are already specified in the default setting. These measuring transducer inputs supply non-linearized values which can be converted via DIGSI® CFC to measured values such as pressure or temperature.

Derived measured values are inserted from the information catalog.

Information on configuration of the user-defined measured values can be found in SIPROTEC® System Description /1/.

2.4.1.2 Information

No.	Message	Type of Information	Description
996	Td1=	MW	Transducer 1
997	Td2=	MW	Transducer 2

2.4.2 General transducer blocks

2.4.2.1 Description

The measuring transducer blocks form various operands from these input quantities.

The measuring transducer function is explained via the following function blocks:

- Measuring transducer U (MU U)
- Measuring transducer I (MU I)
- Measuring transducer one-phase (MU1P)
- Measuring transducer three-phase (MU3P)
- Measuring transducer Aron (MUAron)

The individual measuring transducer blocks have to be **activated** in the **functional scope** of the device and are then displayed in the DIGSI® configuration matrix with their input channels and output quantities. They are assigned to current and voltage channels of the device. The output quantities can be assigned to various destinations, e.g. system interface, CFC or the display.

A functional description of the individual measuring transducer blocks and a list of the accompanying parameters and information can be found in the following chapters.

Table 2-3 Connection examples for a rated transformer voltage $V_{n\ secondary}$ from 100 V

Connection variants	Input voltages Secondary	Functions	Parameter Transformer $V_{n\ sec}$	Comments
Star connection	3 x $Vfeeder_{LE}$ = 57.7 V 1 x V_{LE} = 57.7 V	Measuring transducer 3-phase	100 V	for feeder operational measurements
		Measuring transducer 1-phase	100 V	for reference operational measurements
		SYNC function 1 to SYNC function 5	57.7 V[1]	for synchronisation function
Star connection Vfeeder**delta connection** Vref	3 x $Vfeeder_{LE}$ = 57.7 V 1 x V_{LL} = 100 V	Measuring transducer 3-phase	100 V	for feeder operational measurements
		Measuring transducer 1-phase	173.2 V[2]	for reference operational measurements
		SYNC function 6 to SYNC function 8	100 V	for synchronisation function
Aron connection	2 x $Vfeeder_{LL}$ = 100 V 1 x V_{LL} = 100 V	Measuring transducer Aron	173.2 V[2]	for feeder operational measurements
		Measuring transducer 1-phase	173.2 V[2]	for reference operational measurements
		SYNC function 6 to SYNC function 8	100 V	for synchronisation function
Star connection, neutral earthed power supply	3 x $Vfeeder_{LE}$ = 100 V 1 x V_{LE} = 100 V	Measuring transducer 3-phase	173.2 V[2]	for feeder operational measurements
		Measuring transducer 1-phase	173.2 V[2]	for reference operational measurements
		SYNC function 1 to SYNC function 5	100 V	for synchronisation function

1) Within the SYNC function, the parameter **V transformer$_{n\ secondary}$** corresponds to the secondary input voltage.

2) Within the measuring transducer packets, the parameter **V transformer$_{n\ secondary}$** is secondary to the √ 3 x input voltage.

2.4.3 Parameterizing transducer blocks

2.4.3.1 Description

Configuration is to be performed in the High Voltage Bay Control Unit in each individual case. The device contains pre-defined measuring transducer blocks which can be activated individually.

Configuring the measuring transducer

The configuration of measured values is fundamentally different from the configuration of other SIPROTEC® 4 devices. It is explained with an example using the function block **Measuring transducer 3-phase**.

Selecting the functional scope

First select the measuring transducer blocks from the DIGSI® **Functional scope** dialog box which are to be contained in the functional scope of the device.

For this purpose, open the device and click **Functional scope** in the function selection.

Select the **available** entry on the **Measurement 3phase 1.packet** line in the **Scope** column and confirm with OK. The measurement transducer block is activated.

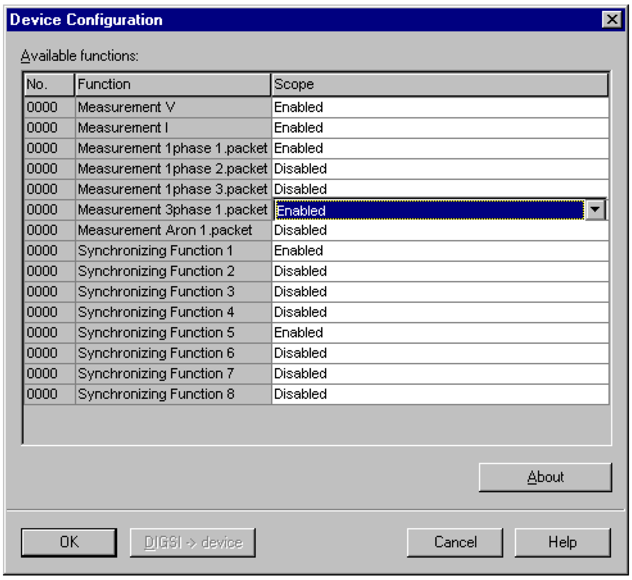


Figure 2-4 Functional scope dialog box

Parameterizing

Click the **Measuring transducer** object under **Parameters** in the tree view of DIGSI®. The available measuring transducer blocks are listed in the list box.

Open **Measurement 3phase 1.packet** via the context menu and set the values of parameters **Secondary Voltage Nominal Value** (0.00 V to 200.0 V) and **Secondary Current Nominal Value** (0.00 A to 5.00 A) depending on your requirements.

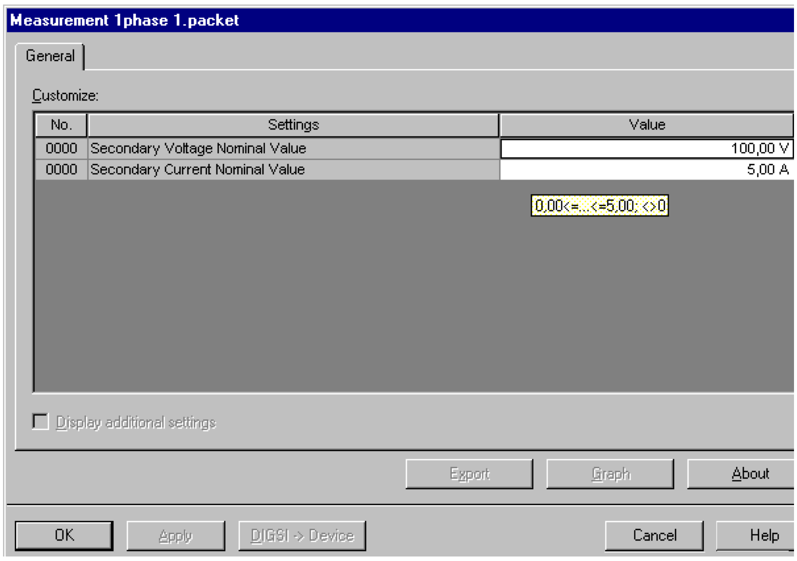


Figure 2-5 Dialog box for setting the parameters

Allocating a measuring transducer

Following configuration, the inputs and outputs of the activated measuring transformer block in the allocation matrix of DIGSI® are interconnected and the properties of the individual measured values, such as transmission threshold, are configured and interconnection in the CFC is performed.

Allocating measured value channels

Open the allocation matrix of the device and select **Only measured and metered values** as the information type. The **MU3P_1** group is displayed.

Allocate the measured value channels **Mvchn** to the voltage/current inputs as the **source**.

Allocating measured values

Allocate the **calculated measured values** to a **destination**, e.g. to the system interface, the inter relay communication, the CFC or the display.

Configuring measured values

Configure the properties of the measured values.

In the **Information item, No.** column of the allocation matrix, right-click the information item whose properties you would like to configure and open the **Object properties** dialog box via the **Properties**... context menu.

Select the **Measured value description** tab and make the settings.

The Measured value description tab is not relevant for the information items MP1_PHI (phase angle), MP1_WLF (active power factor) und MP1_BLF (reactive power factor) and therefore not available.

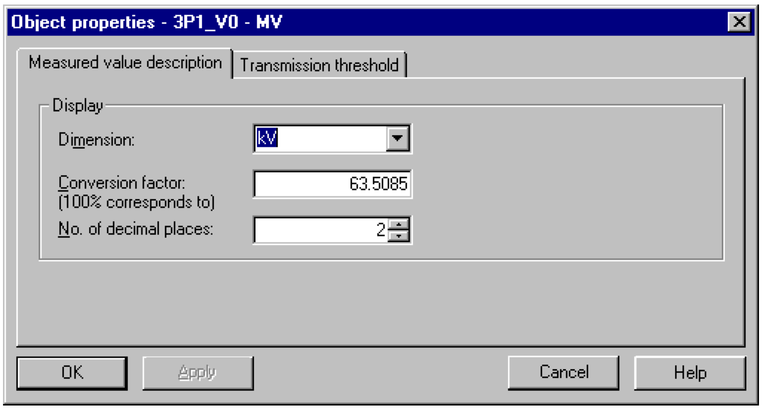


Figure 2-6 Object properties dialog box, Measured value description tab

Select the **Transmission threshold** tab and make the settings.

- **Use central threshold (10 %)**

  Select this check box to use the factory-preset threshold value of 10 %. This deactivates all the other input and output options in this tab.

- **Parameterised threshold**

  Enter a value between 0 and 2000 in this spin box. The set value multiplied by 0,1 % results in the threshold value. This value is used without any further conditions, provided that neither the **Central threshold** check box, nor a defined switching object, has been selected.

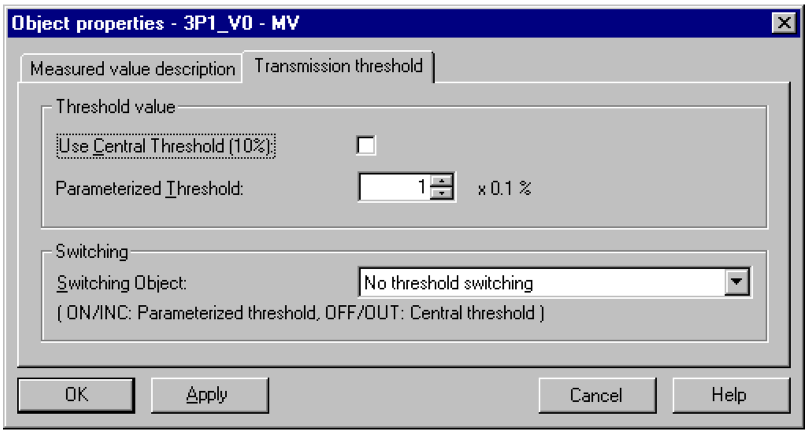


Figure 2-7 Object properties dialog box, Transmission threshold tab

Configure the **object properties** of the phase angle **3P1_PHI**.

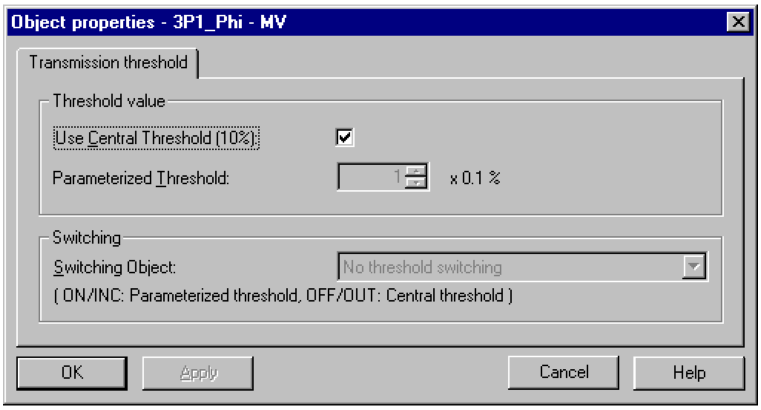


Figure 2-8 Object properties dialog box, Transmission threshold tab

Allocate the information item 3P1_PHI to C (CFC) as the destination and then link this in the corresponding CFC chart.

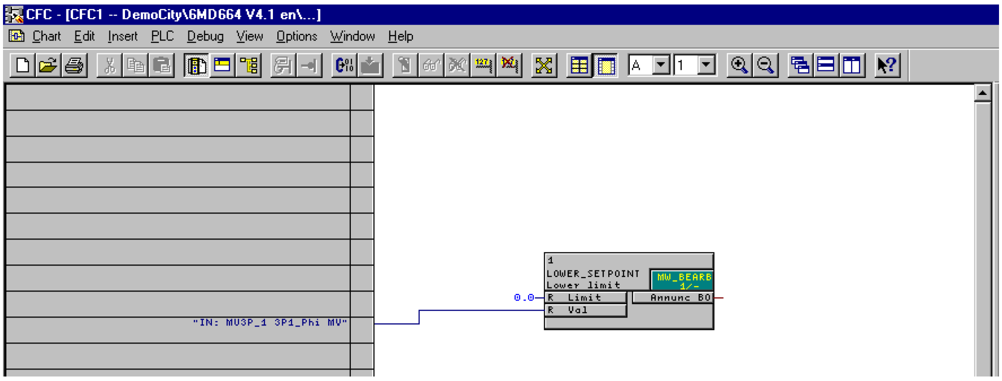


Figure 2-9 Example, **3P1_PHI** link in CFC chart

Configure the object properties of the block (e.g. LOWER_SETPOINT). For this purpose, right-click the **Limit** input of the block and select **Object properties** from the context menu.

Observe the working range of -180 ° to +180 °; the value 100 (%) corresponds to 360 °.

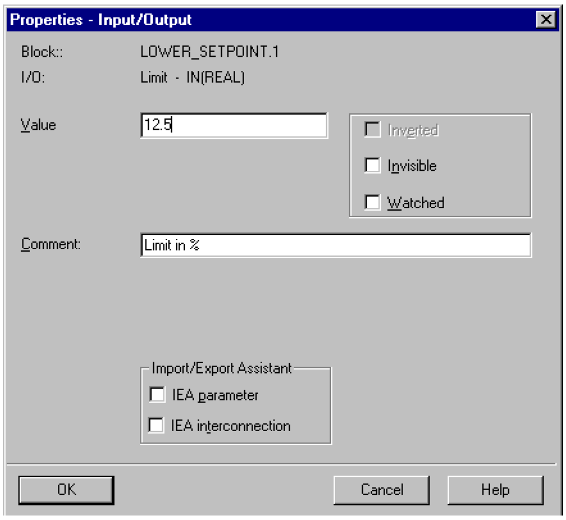


Figure 2-10 Example, properties of the LOWER_SETPOINT block

The set value 12.5 corresponds to an angle of 45 °.

2.4.4 Measurement U 1.packet

2.4.4.1 Description

This packet serves to measure an individual **voltage**. The function provides the r.m.s. value of the fundamental component.

The frequency of the voltage is determined from the input signal. If the secondary input voltage on the device falls below **10 V$_{eff}$**, the frequency is marked as invalid. The overflow occurs when the secondary input voltage on the device exceeds **120 V$_{eff}$**. The rated value of the frequency is taken from **`P.System Data 1`**.

Routing of the measurement input to the respective measured value channel Voltage and the routing of the measuring results is performed with DIGSI®.

Specifications for secondary transformer voltage are made in the properties dialog box of **`MU U_1`**.

Information on allocation can be obtained from the SIPROTEC® System Description /1/.

2.4.4.2 Configuration Notes

`SecVoltgNomVal` The factory-preset rated transformer voltage can be set in the predefined range.

2.4.4.3 Settings

Addr.	Parameter	Setting Options	Default Setting	Description
0	**SecVoltgNomVal**	0.00 .. 200.00 V; < > 0	100.00 V	Secondary Voltage Nominal Value

2.4.4.4 Information

No.	Message	Type of Information	Description
	Input U/I	MK	Voltage or Current Input U/I
	U	MW	Voltage U
	f	MW	frequency

2.4.5 Measurement I 1.packet

2.4.5.1 Description

This packet serves to measure an individual **current**. The function provides the r.m.s. value of the fundamental component.

The frequency of the current is determined from the input signal. If it falls below 10% of the rated value, the frequency is marked as invalid. The rated value of the frequency is taken from **P.System Data 1**.

Routing of the measurement input to the respective measured value channel Current and the routing of the measuring results is performed with DIGSI®.

Specifications for secondary transformer current are made in the properties dialog box of **MU I_1**.

Information on allocation can be obtained from the SIPROTEC® System Description /1/.

2.4.5.2 Configuration Notes

SecCurrNomVal The secondary factory-preset rated transformer current can be set in the predefined range.

2.4.5.3 Settings

Addr.	Parameter	Setting Options	Default Setting	Description
0	**SecCurrNomVal**	0.00 .. 5.00 A; < > 0	1.00 A	Secondary Current Nominal Value

2.4.5.4 Information

No.	Message	Type of Information	Description
	MwCh_I	MK	Current Input I
	I	MW	Current I
	f	MW	frequency

2.4.6 Measurement 1phase 1.packet

2.4.6.1 Description

This packet serves to perform a **monophase measurement** (current and voltage). The measuring results of the phase current and the phase voltage are r.m.s. values of the corresponding fundamental component.

The **phase current** is set to the **current input** of the measuring transducer, whereas the **phase voltage** is set to the **voltage input**.

The **r.m.s. values** calculated from these two input signals, the **active power**, the **reactive power**, the **apparent power**, the **cos** Φ, the **sin** Φ and Φ the linked sizes and **frequency** calculated from the voltage (see information overview) are then present at the **measuring transducer output**.

The frequency is determined from the applied phase voltage. If the secondary input voltage on the device falls below **10** $\mathbf{V_{eff}}$, the frequency is marked as invalid. The overflow occurs when the secondary input voltage on the device exceeds **120** $\mathbf{V_{eff}}$. The rated value of the frequency is taken from **`Power System Data 1`**.

Routing of the measurement inputs to the respective measured value channels Phase current and Phase voltage and the routing of the measuring results is performed with DIGSI®.

Specifications for secondary transformer current and secondary transformer voltage are made in the properties dialog box of **`MU1P_1`**.

Information on allocation can be obtained from the SIPROTEC® System Description /1/.

2.4.6.2 Configuration Notes

`SecVoltgNomVal` The factory-preset rated transformer voltage can be set in the predefined range.

`SecCurrNomVal` The secondary factory-preset rated transformer current can be set in the predefined range.

2.4.6.3 Settings

Addr.	Parameter	Setting Options	Default Setting	Description
0	**SecVoltgNomVal**	0.00 .. 200.00 V; < > 0	100.00 V	Secondary Voltage Nominal Value
0	**SecCurrNomVal**	0.00 .. 5.00 A; < > 0	1.00 A	Secondary Current Nominal Value

2.4.6.4 Information

No.	Message	Type of Information	Description
	1P1Input_U	MK	1P1 Voltage Input U
	1P1Input_I	MK	1P1 Current Input I
	1P1_U	MW	1P1 Voltage U
	1P1_I	MW	1P1 Current I
	1P1_P	MW	1P1 Active Power P
	1P1_Q	MW	1P1 Reactive Power Q
	1P1_S	MW	1P1 Apparent Power S
	1P1_φ	MW	1P1 Phase Angle Phi
	1P1_cosφ	MW	1P1 Active Power Factor Cosine Phi
	1P1_sinφ	MW	1P1 Reactive Power Factor Sine Phi
	1P1_f	MW	1P1 Frequency of U

2.4.7 Measurement 3phase 1.packet

2.4.7.1 Description

This packet serves to perform a three-phase measurement (current and voltage). The measuring results of the phase currents, phase voltages, phase-to-phase voltages, zero sequence current and zero sequence voltage are RMS values of the corresponding fundamental compound.

The following phase currents are applied at the current inputs of the measuring transducer: $\mathbf{I_{L1}}$, $\mathbf{I_{L2}}$ and $\mathbf{I_{L3}}$, as were the voltages $\mathbf{V_{L1}}$, $\mathbf{V_{L2}}$ and $\mathbf{V_{L3}}$.

The **r.m.s. values** of the phase currents calculated from these six input signals, **phase voltages**, **phase-to-phase voltages**, **zero sequence current**, **phase voltages**, **phase-to-phase voltages**, **zero sequence current**, **zero sequence voltage**, **active power**, **reactive power**, **apparent power**, **cos** Φ, **sin** Φ and Φ the linked sizes and **frequency** calculated from the voltage $\mathbf{V_{L1}}$ (see Information overview table) are applied at the output of the measuring transducer.

The frequency is determined from the applied phase voltage V_{L1}. If the secondary input voltage on the device falls below **10** $\mathbf{V_{eff}}$, the frequency is determined from the phase voltage V_{L2} or V_{L3}. If all three voltages are too low, the rated frequency is used as frequency. In this case, the combined variables and the frequency itself are marked invalid. The phase-to-phase voltages and the zero variables start to fluctuate depending on the deviation from the rated frequency. The overflow occurs when the secondary input voltage on the device exceeds **120 V_{eff}**. The rated value of the frequency is taken from **Power System Data 1**.

Routing of the measurement inputs to the respective measured value channels Phase currents and Phase voltages and the routing of the measuring results is performed with DIGSI®. The direction of rotation can be changed by exchanging the phases. Enter the display factors for the primary values for each required output when routing the results. In this context, it must be observed that the phase-to-phase value is indicated for the phase-ground voltages if the phase-to-phase voltage (rated voltage) was set as primary value.

Specifications for secondary transformer current and secondary transformer voltage are made in the properties dialog box of **MU3P_1**. The phase-to-phase voltage is used as the value for the secondary transformer voltage.

2.4.7.2 Configuration Notes

SecVoltgNomVal The factory-preset rated transformer voltage can be set in the predefined range.

SecCurrNomVal The secondary factory-preset rated transformer current can be set in the predefined range.

2.4.7.3 Settings

Addr.	Parameter	Setting Options	Default Setting	Description
0	**SecVoltgNomVal**	0.00 .. 200.00 V; < > 0	100.00 V	Secondary Voltage Nominal Value
0	**SecCurrNomVal**	0.00 .. 5.00 A; < > 0	1.00 A	Secondary Current Nominal Value

2.4.7.4 Information

No.	Message	Type of Information	Description
	3P1InputU1	MK	3P1 Voltage Input U1
	3P1InputU2	MK	3P1 Voltage Input U2
	3P1InputU3	MK	3P1 Voltage Input U3
	3P1InputI1	MK	3P1 Current Input I1
	3P1InputI2	MK	3P1 Current Input I2
	3P1InputI3	MK	3P1 Current Input I3
	3P1_U0	MW	3P1 Zero Sequence Voltage
	3P1_U1	MW	3P1 Phase to Earth Voltage U1
	3P1_U2	MW	3P1 Phase to Earth Voltage U2
	3P1_U3	MW	3P1 Phase to Earth Voltage U3
	3P1_U12	MW	3P1 Phase to Phase Voltage U12
	3P1_U23	MW	3P1 Phase to Phase Voltage U23
	3P1_U31	MW	3P1 Phase to Phase Voltage U31
	3P1_I0	MW	3P1 Zero Sequence Current

No.	Message	Type of Information	Description
	3P1_I1	MW	3P1 Phase Current I1
	3P1_I2	MW	3P1 Phase Current I2
	3P1_I3	MW	3P1 Phase Current I3
	3P1_P	MW	3P1 Active Power Three Phase
	3P1_Q	MW	3P1 Reactive Power Three Phase
	3P1_S	MW	3P1 Apparent Power Three Phase
	3P1_φ	MW	3P1 Phase Angle Three Phase
	3P1_cosφ	MW	3P1 Active Power Factor Three Phase
	3P1_sinφ	MW	3P1 Reactive Power Factor Three Phase
	3P1_f	MW	3P1 Frequency

2.4.8 Measurement Aron 1.packet

2.4.8.1 Description

The **ARON switching** enables the complete calculation of a three-phase system with only two voltage transformers and two current transformers. The measuring results of the phase currents, phase voltages, phase-to-phase voltages, zero sequence current and zero sequence voltage are r.m.s. values of the corresponding fundamental compound.

Two phase currents (e.g. IL2 and IL3) and **two phase-to-phase voltages** (e.g. VL1L2 and VL1L3) are applied to the **measuring transducer inputs**.

The **r.m.s values of phase currents** calculated from these four input signals, **phase voltages**, **phase-to-phase voltages**, **zero sequence current**,**zero sequence voltage**, **active power**, **reactive power**, **apparent power**, **cos** Φ, **sin** Φ and Φ the linked sizes and **frequency** calculated from the voltage **VL1L2** (see Information overview table) are then applied at the **measuring transducer output**.

The frequency is determined by means of the applied V_{L1L2} voltage. If the secondary input voltage on the device falls below **10** $\mathbf{V_{eff}}$, the frequency is determined by means of the V_{L1L3} voltage. If both voltages are too low, the rated frequency is used as frequency. In this case, the combined variables and the frequency itself are marked invalid. The phase-to-phase voltages and the zero variables start to fluctuate depending on the deviation from the rated frequency. The rated value of the frequency is taken from **`Power System Data 1`**.

Routing of the measurement inputs to the respective measured value channels Currents and Voltages and the routing of the measuring results is performed with DIGSI®. Enter the display factors for the primary values for each required output when routing the results.

2.4.8.2 Configuration Notes

`SecVoltgNomVal` The factory-preset rated transformer voltage can be set in the predefined range.

`SecCurrNomVal` The secondary factory-preset rated transformer current can be set in the predefined range.

2.4.8.3 Settings

Addr.	Parameter	Setting Options	Default Setting	Description
0	**SecVoltgNomVal**	0.00 .. 200.00 V; < > 0	100.00 V	Secondary Voltage Nominal Value
0	**SecCurrNomVal**	0.00 .. 5.00 A; < > 0	1.00 A	Secondary Current Nominal Value

2.4.8.4 Information

No.	Message	Type of Information	Description
	A1Input_U1	MK	A1 Voltage Input U1
	A1Input_U2	MK	A1 Voltage Input U2
	A1Input_I1	MK	A1 Current Input I1
	A1Input_I2	MK	A1 Voltage Input I2
	A1_U12	MW	A1 Phase to Phase Voltage U12
	A1_U13	MW	A1 Phase to Phase Voltage U13
	A1_I2	MW	A1 Phase Current I2
	A1_I3	MW	A1 Phase Current I3
	A1_P	MW	A1 Active Power P
	A1_Q	MW	A1 Reactive Power Q
	A1_S	MW	A1 Apparent Power S
	A1_φ	MW	A1 Phase Angle Phi
	A1_cosφ	MW	A1 Active Power Factor Cosine Phi
	A1_sinφ	MW	A1 Reactive Power Factor Sine Phi
	A1_f	MW	A1 Frequency

2.5 Metered value processing

2.5.1 Description

The device can add up couner pulses of an external counter recorded via a binary input. Additionally, the bay control unit can calculate energy values from measured values.

Operation of pulse metered value

The High Voltage Bay Control Unit 6MD66 forms the metered value as a sum of the externally generated counter pulses of a power meter. The pulses are read in via a binary input. The metered value receives a unit based on the following table. It has the same precision as the external counter and can also be an adjusted metered value.

Operation of metered values calculated from measured values

With the metered values calculated from measured values , the High Voltage Bay Control Unit 6MD66 forms the power from the applied current and voltage values or from any desired measured values and integrates this calculated power value over time. The result is an energy value with the precision of the device (0.5 %), i.e. an operating metered value which cannot be used for adjustment.

Table 2-4 Operating metered values

Measured values		Possible units
W_p+	Real power, output	kWh, MWh, GWh
W_p–	Real power, input	kWh, MWh, GWh
W_q+	Reactive power, output	kVARh, MVARh, GVARh
W_q–	Reactive power, input	kVARh, MVARh, GVARh

The following types of information can be allocated to a metered value window in the DIGSI® allocation matrix.

- Metered values calculated from measured values
- Pulse metered value

The same operations are possible with pulse and metered values calculated from measured values, e.g. reset - to set back to a specified value etc..

Using the pulse metered value

In this example, the active power of a 3-phase system is to be integrated over time and displayed as a metered value. The pulse output of an external device which supplies the active power pulse accordingly, is to be applied to a binary input of the device. The power corresponding to a pulse must be known.

Inserting a pulse metered value

Open the allocation matrix of the device and select **Only measured and metered values** as the information type.

Create the group **Energy** in the allocation matrix.

Open the information catalog and select the line **Pulse (PMV)** under **PowerMeter → Pulse**.

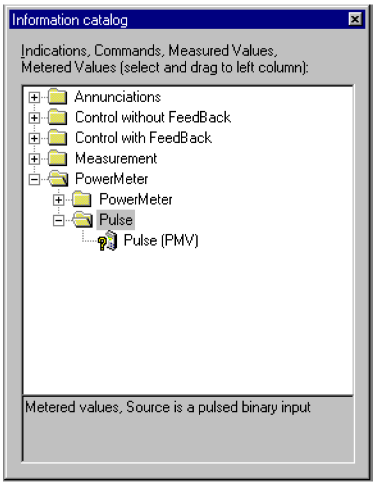


Figure 2-11 Selecting information type pulse metered value

Drag the selected information type with the left mouse button into the **Energy** group in the allocation matrix.

Configuring a pulse metered value

Allocate the inserted pulse metered value in the allocation matrix to a binary input as the source.

Allocate the inserted pulse metered value in the allocation matrix to the destination **Metered value window**.

Configuring a pulse metered value

The properties of the pulse metered values can be configured via a dialog box.

Right-click on the information item **PulseMV** in the **Information** column, **Display text** in the allocation matrix.

Select **Properties**... from the context menu. The **Object properties** dialog box is opened.

Select the tab **Measured value description** and enter the unit **kWh** and the desired number of decimal places.

Enter the value which corresponds to a pulse of the external counter in the unit selected above into the input box **Conversion factor**. For example, enter 0.1 if a pulse corresponds to the energy 0.1 kWh and the unit kWh was selected above.

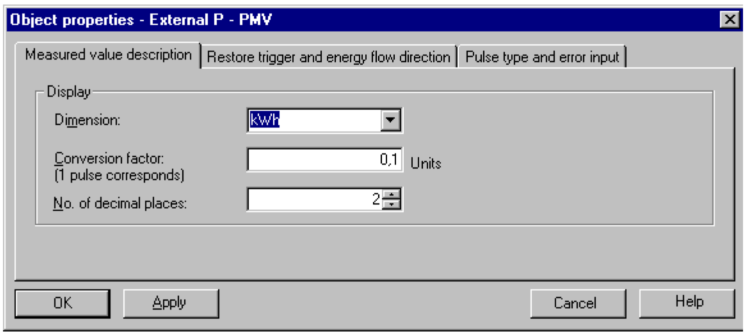


Figure 2-12 Object properties dialog box, Measured value description tab

Select the tab **Restore trigger** and **energy flow direction** and enter the restore trigger and energy flow direction.

Select the **Cyclic** option if the metered value is to be transmitted to the control center at cyclic intervals. Otherwise select the **None** option. By pressing the **Settings** button, you end up in the dialog box for setting the corresponding **time interval**. **One minute is preset**.

Note

The settings made in the **Cyclical restoring** tab apply **globally** for all metered values.

Under Energy flow direction, you define whether the metered value summates the quantity of exported or imported energy by selecting one of the two options.

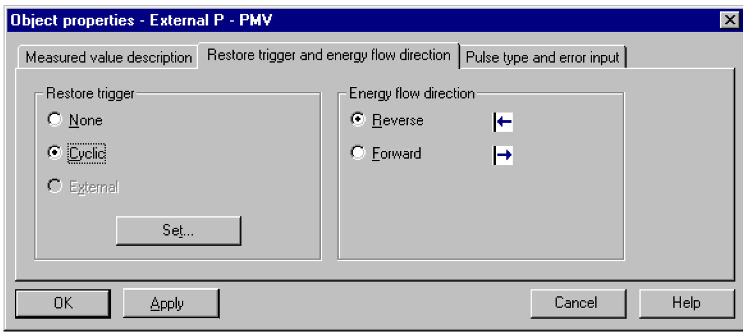


Figure 2-13 Object properties dialog box, Restore trigger and energy flow direction tab

Select the tab **Pulse type and error input** and make your settings there.

Select the **Wiping pulse / S0** option if the rising edge of a single pulse is to increment the metered value by one. Select the **Double current pulse** option if the falling edge of a double current pulse is to increment the metered value by one.

As soon as you route a pulse metered value to a binary input, the next binary input can be automatically routed as an fault input. A signal to this fault input can mark the count as corrupt. If you use this procedure, select the **Use fault input** checkbox. If it is not selected, the binary input following the metered pulse input is available to another application.

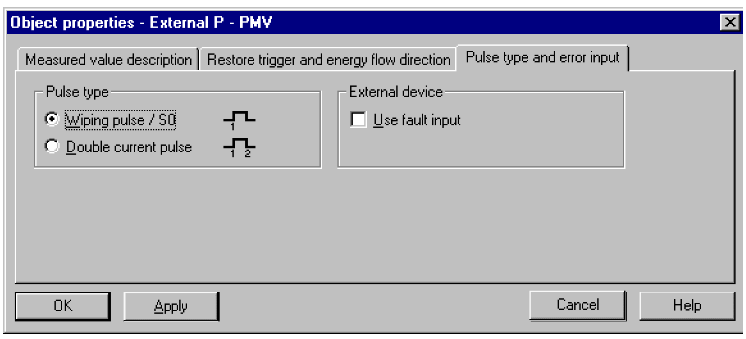


Figure 2-14 Object properties dialog box, Pulse type and error input tab

Accept the settings with **OK**.

Use metered values calculated from measured values

In this example, the active power of a 3-phase system is to be integrated over time and displayed as a metered value. Here, a measuring transducer packet **MU3P_1** which must be identified as available in the function scope of the device is used. It is configured with the **secondary voltage nominal value** 100.00 V and the **secondary current nominal value** 1 A. The rated data of the network is 110 kV and 20 kA.

Inserting metered values calculated from measured values

Open the allocation matrix of the device and select **Only measured and metered values** as the information type.

Open the information catalog and select the line **PowerMeter (MVMV)** under **PowerMeter → PowerMeter**.

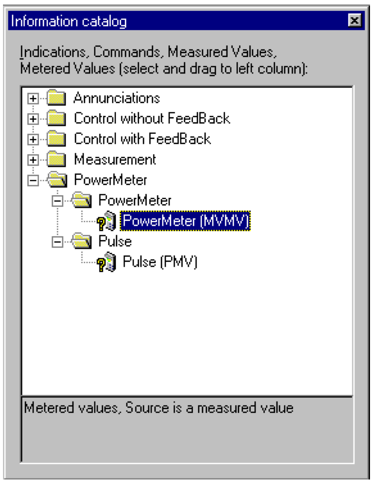


Figure 2-15 Selecting information type measured value metered value

Drag the selected information type with the left mouse button into the **MU3P_1** group in the allocation matrix.

Allocating metered values calculated from measured values

Allocate the inserted information item to the source **Measured value** in the allocation matrix and select **3P1_P** from the list.

Allocate the inserted information item to the **Metered value window** destination in the allocation matrix.

Configuring metered values calculated from measured values

The properties of the metered values calculated from measured values can be configured via a dialog box.

Right-click on the information item **MeasVMV** in the **Information** column, **Display text** in the allocation matrix.

Select **Properties...** from the context menu. The **Object properties** dialog box is opened.

Select the tab **Measured value description** and enter the unit **MWh** and 2 as the number of decimal places.

Using the conversion factor, you can convert the input signal to match the selected unit and data of the measuring transducer. The conversion always refers to the 100 % value of the input signal with measured values. If a measuring transducer packet supplies the currents and voltages as the power 3811 MW at a 100 % value, this is the energy value which accumulates in a MWh. This value divided by 60,000 is to be entered as the conversion factor.

The High Voltage Bay Control Unit generates 60,000 values per hour internally, which are used for the conversion factor.

Enter the calculated value **0.0635** into the Conversion factor input box (3811 MW divided by 60,000).

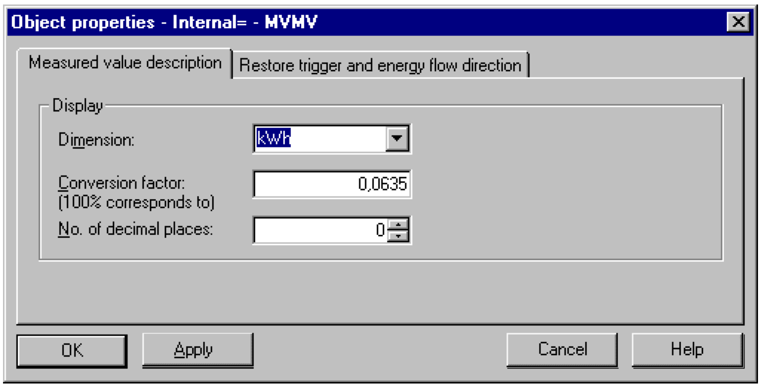


Figure 2-16 Object properties dialog box, Restore trigger and energy flow direction tab

Select the tab **Restore trigger and energy flow direction** and enter the restore trigger and energy flow direction.

Select the **Cyclic** option if the metered value is to be transmitted to the control center at cyclic intervals. Otherwise select the **None** option.

By pressing the **Settings** button, you end up in the dialog box for setting the corresponding **time interval**. **One minute is preset**.

Note

The settings made in the **Cyclical restoring** tab in this dialog box apply **globally** for all metered values.

Under **Energy flow direction**, you define whether the metered value summates the quantity of exported or imported energy by selecting one of the two options.

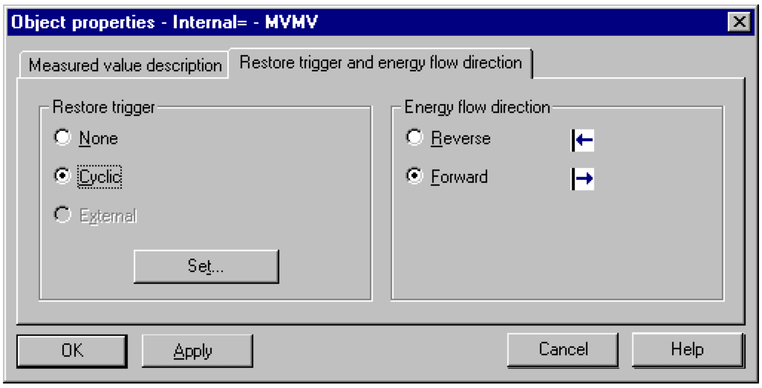


Figure 2-17 Object properties dialog box, Restore trigger and energy flow direction tab

Accept the settings with **OK**.

2.6 Threshold-Switch

2.6.1 Description

Using the Threshold switch function, you can set transmission thresholds and allocate the threshold switches to individual or multiple measured values.

The threshold value procedure consists of the Transmission threshold configuration dialog and the threshold switch.

Transmission threshold

The **transmission threshold** determines the transmission frequency of measured values. It is specified in percentage. If zero is selected as the threshold value for the transmission threshold, each measured value will be transmitted to the higher-level station. A threshold value not equal to zero results in all changes to new measured values being added compared to the last measured value transmitted. If the sum of the changes reaches the set percentage, a new measured value is transmitted at the next possible point in time.

Perform the settings in the DIGSI® configuration matrix. You can set the central threshold, configured threshold and switching object in the **object properties** of the measured value, tab **Transmission threshold**.

- Use **central threshold** (10%): Select this check box to use the factory-preset threshold value of 10 %. This de-activates all the other input and output options in this tab.
- **Parameterised threshold**: Set the desired value in this rotating box. The set value multiplied by 0.1 % results in the threshold value.
- **Switching object**: A changeover from the central and the parameterised threshold can be initiated by the status of a message. From the drop-down menu, select the indication whose status shall initiate a changeover.

Threshold switch

The group **Software switch** (in the DIGSI® configuration matrix) contains all potential switching objects. **Threshold 1** is the preset value.

You can add additional thresholds (single point indications) from the information catalog. Assign the threshold value switch to one or several measured values via the **Switching object** setting in the measured-value object properties.

2.6.2 Information

No.	Message	Type of Information	Description
	ThreshVal1	IE	Threshold Value 1

2.7 Circuit breaker synchronisation

If the **synchronisation function** of the device is active, the device can check whether the synchronisation conditions of both subnetworks are fulfiled (synchrocheck) when the circuit breaker is closed.

The device distinguishes between **synchronous** and **asynchronous** networks and reacts differently on the connection.

Synchronous networks exhibit small differences regarding phase angle and voltage modulus. The circuit breaker operating time does not need to be considered.

On the contrary, asynchronous networks include bigger differences and the time window for switching on is passed more quickly. Consequently, the circuit breaker operating time must be considered in this case. The control command is automatically pre-dated by this time in order to ensure that the circuit breaker contacts close exactly at the right time. The automation functions enabled in the device allow to automatically use various reference voltages of the active busbar for synchronization (whereby the individual reference voltage depends on the isolator position). It is possible to save and hold available for operation maximally eight different setting groups for the synchronisation function. In this way, it is possible to consider the various features of several circuit breakers.

The synchronisation groups six to eight differ from the groups one to five essentially due to the connection of the voltage transformers. Various connection examples can be found in the Appendix.

2.7.1 SYNC Function group 1

2.7.1.1 Description

The SIPROTEC® 4 device 6MD66 has configuration options for eight different synchronisation functions. The function and operation is described in the following using the **`SYNC function 1`**. Special features of SYNC functions 6 to 8 are compiled separately.

functioning

The synchronisation function is used for connecting two subnetworks in a substation control system or for operational switch on or on the protection level after a three-pin short or long interruption. The synchronisation function ensures that the connection is only performed if both subnetworks are synchronous to each other or the deviation is within the defined limits.

The connection is performed if the following conditions are met at the moment of establishing the isolated connection:

- Voltage magnitudes **`Umin`** < | V | < **`Umax`**
- Difference of voltage magnitudes | ΔV | < Δ **`Umax`**
- Frequencies **`fmin`** ≤ f ≤ **`fmax`**
- Difference of frequencies Δ f < Δ **`fmax`**
- Difference of angles $\Delta \alpha < \Delta \alpha_{max}$

For safety reasons, connection is only permitted below the curve shown in the diagram for large differences in frequency and long circuit-breaker operating times.

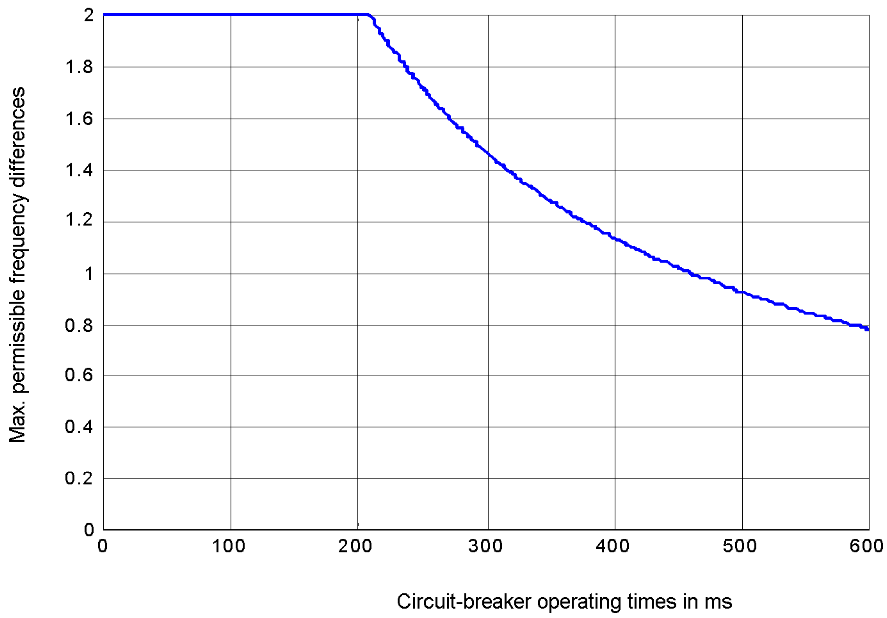


Figure 2-18 Maximum permissible difference in frequency as a function of the circuit-breaker operating time

The **Dead bus** and **Dead line connection** are special cases. In this case, connection is made depending on the configuration under the following conditions:

- Dead Line | V_{pp} | > **Umin** and | V_{line} | < **Udead** and **fmin** ≤ f_{pp} ≤ **fmax**
- Dead bus | V_{pp} | < **Udead** and | V_{line} | > **Umin** and **fmin** ≤ f_{line} ≤ **fmax**
- Dead line & Dead bus | V_{pp} | < **Udead** and | V_{line} | < **Udead**

Busbar voltage $\mathbf{V_{pp}}$ and feeder voltage $\mathbf{V_{line}}$ are assigned to voltages **V1** and **V2** depending on how the device is connected. Connection examples can be found in the Appendix.

The connection is performed on an idle busbar, on an idle feeder or on both.

A **synchronisation comparison** with the runtime of the synchronisation function can be executed by means of definitely applied voltages (normal case) or by means of a voltage application via relay.

The synchronisation comparison including an application of the voltage is necessary e.g. for multiple busbars or in case of a failure of the coupling circuit breaker (backup switching). Additional preparatory switching operations as well as the selection of the subsettings group are necessary for applying the voltage at the time of the comparison. The settings must be stored in the control device for each combination of subnetworks.

The measuring channels of the reference and feeder voltage must be assigned to each synchronisation module individually.

Voltage application

If the voltage application is used, the user must set a switching sequence with the following components:

- Voltage application
- Synchronisation
- voltage deselection

The voltage application option ensures that a 250 ms delay is considered in the measuring algorithm after the synchronisation start. In this way, the measured values can stabilize.

Field of application internal control, internal synchronisation

The synchronisation with internal control and internal synchronisation is the standard application with 6MD66. Maximally 8 synchronisation modules (SYNC functions group 1 to 8) with different settings groups are available.

The assignment of the synchronisation-requiring control device to the corresponding synchronisation settings group is performed via the **`SyncSD`** setting (control device to be synchronised).

At the time of the switching operation, the module selection can be controlled dynamically via the **Sync. effective** input message. The **Sync. effective** input message can be configured to a binary input, CFC or IRC. Unsynchronised switching is performed if no synchronisation function is effective (**Sync. effective OFF**).

In this case, the contact between the control and the synchronisation function is performed internally via messages:
- “`>Sy1 Meas`” (Measurement request)
- “`Sync. CloseRel`” (Enable switch-on)
- “`Sync. synchron`” (in case of an error)

Field of application external control, internal synchronisation

The 6MD66 also enable the synchronisation via an external control and internal synchronisation.

To directly connect an external control (e.g. AR), the setting of the **control device to be synchronised** must be set to **low**.

At the time of the switching operation, the module selection can be controlled dynamically via the **Sync. effective** input message. The **Sync. effective** input message can be configured to a binary input, CFC or IRC. Unsynchronised switching is performed if no synchronisation function is effective (**Sync. effective OFF**).

In this case, the contact between the control and the synchronisation function is performed internally via messages:
- “`>Sy1 Meas`” (Measurement request), on binary input
- “`Sync. CloseRel`”, on relay (for outputting the switch-on command)
- “`Sync. synchron`”, to relay

Subfunctions

The synchronisation check is composed of the two subfunctions control and synchronisation.
- The **control** function ensures the coordination of the complete command procedure:
  – Coordination of the different switching directions
  – Standard interlockings such as timeout protection
  – Command connection/disconnection of the command relays
  – Command logging CO+/-, FB+/- and COE.
  – Feedback to the operator (operator response).
- The **Synchronisation** function processes the **measuring** phase of:
  – “`>Sy1 Meas`” (Measurement request), start of measurement, to
  – “`Sync. CloseRel`”, switching release.

Command processing phases with synchrocheck

Depending on the setting and the current process condition, the individual phases of the command processing are executed, skipped or the command processing is aborted. When integrating the synchronisation procedure into a switching sequence, the deselection phases must be processed correspondingly also in case of an abort.

- **Voltage application**: The voltage application (applying measured values at the time of the switching operation) is optional. It is, for example, set via a switching sequence in CFC. The corresponding measured values must be switched to the device analogue inputs via relays.
- **Selection of the SYNC function group**(if necessary): The SYNC function group selection (selection of a function module with its settings and messages) is optional. The selection is only required if several SYNC function modules are actually switched active. It is, for example, set via a switching sequence in CFC. The selection is performed by activating the input indication “`>Sy1 eff.`” effective.
- **Switchgear interlocking**: This phase executes the control subfunction. It serves to execute all switchgear interlocking checks and to state if switching is permitted or not.

  In additon to this, it is checked if maximally one synchronisation function (measuring phase) is active.
- **Checking start conditions**: This phase executes the control subfunction. A check determines whether switching is to occur with or without synchronisation. It serves to execute all switchgear interlocking checks and to state if switching is permitted or not.

  In additon to this, it is checked if maximally one synchronisation function (measuring phase) is active.

  – **Control direction**:

    Control command = **ON**: Continue with synchronisation check.

    Control command = **OFF**: Continue with control phase (no synchronisation required).

  – **Synchronisation check**:

    Checks whether the control device concerned shall be switched on synchronised or evaluation of the number of input messages “`>Sy1 eff.`” **= ON**.

  – **Analysis of the operating mode**

    Evaluation of the input indications of the selected block.

Table 2-5 **Start conditions check** phase, SYNC function module selection

Number of SYNC function blocks including the control device to be switched	Number of input messages “>Sy1 eff.” = ON	Reaction
0	Irrelevant	Unsynchronised control device, continue with **control** phase
≥ 1	0	Unsynchronised switching, continue with **control** phase

Number of SYNC function blocks including the control device to be switched	Number of input messages “`>Sy1 eff.`” = ON	Reaction
≥ 1	1	Unambiguous allocation, continue with operating mode analysis and activated block
>1	>1	Error, abort with BF (too many blocks effective)

Table 2-6 **Start conditions check** phase, operating mode analysis

“`Sync. Error`”	“`Sync. CloseRel`”	Reaction
ON	Irrelevant	Abort with BF-
OFF	ON	Switching enable, continue with **control** phase
OFF	OFF	Continue with **Measuring** phase, tripping by: >SyMeasON

- **Measuring**: This phase executes the synchronisation subfunction.
  This phase is coordinated by means of input indications:
  – “`>Sy1 Meas`”, start/stop of measurement
  – “`>Sy1 dirCO`”, bypassing
  – “`>Sy1 block`”, block switching enable

  The actual measuring procedure with the output messages starts afterwards:
  – “`Sync. CloseRel`”, switching enable (continue with control phase)
  – “`Sync. Error`”, synchronisation failed
  – “`Sync. block`”, switching enable blocked
  – “`Sync.MonTimeExc`”, monitoring time exceeded

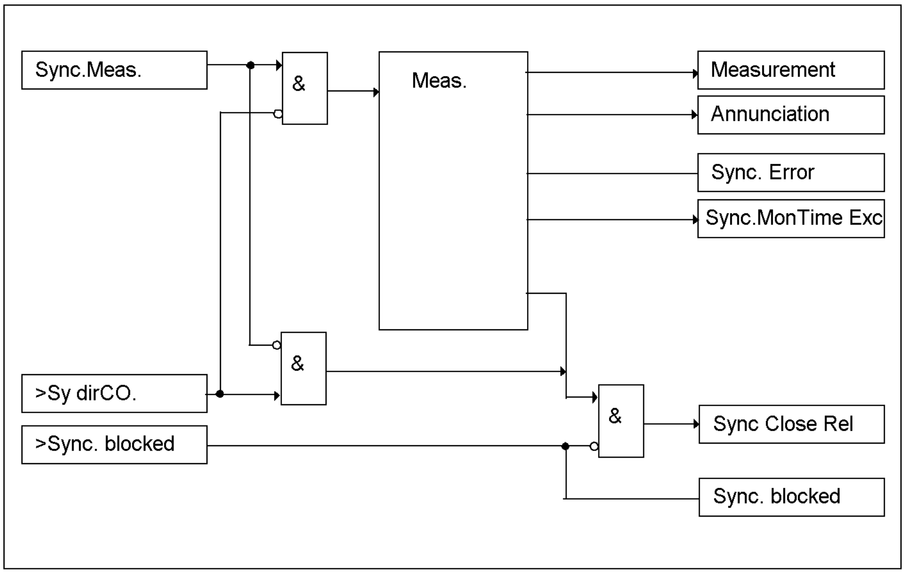


Figure 2-19 Input indications and output indications of the synchronisation function

Table 2-7 Controlling the **measuring** phase

Action	Measuring	Reaction
“>Sy1 Meas”. ON and “>Sy1 dirCO” = ON and “Sync. block” = OFF		Switching enable: “Sync. CloseRel” ON
“>Sy1 Meas” ON and “>Sy1 dirCO”. = OFF	Start	
“>Sy1 Meas”. OFF	Stop	
Synchronisation conditions reached, or “>Sy1 dirCO”. ON and “Sync. block” = OFF	Stop	Switching enable: “Sync. CloseRel” ON
Synchronisation conditions reached, or “>Sy1 dirCO” ON and “Sync. block” = ON	Stop	
“Sync. block” = OFF	Irrelevant	Switching releases are given: “Sync. block” OFF
“Sync. block” = ON	Irrelevant	Switching enables are blocked: “Sync. block” ON
Monitoring time exceeded **T-SYN. DURATION**	Stop	Indication: “Sync.MonTimeExc” ON
Errors (problems in the synchronisation function)	Stop	Indication: “Sync. Error” ON

A measurement request `“>Sy1 Meas”` ON in the state `“>Sy1 block”` ON corresponds to the measurement initiation in the SINAUT LSA.

An abort of the **measuring** phase is initiated via `“>Sy1 Meas”` OFF.

- **Control**: This phase executes the control subfunction.

  The command procedure is aborted for:
  – Abort command with **AC+**
  – Monitoring time exceeded **`T-SYN. DURATION`** with **CO-**
  – `“Sync. Error”` ON, synchronisation failed with **CO-**

  The command procedure is started via the following indication:
  – `“Sync. CloseRel”` ON, switching enable comes with **CO+**

  The normal command sequence runs afterwards.

- **Deselection of the SYNC function block**: The action selection of the SYNC function block must be terminated. This is also true for an abort of the command procedure.
- **Voltage deselection**: The voltage application action must be terminated. This is also true for an abort of the command procedure.

Interfaces

The following data are relevant for the user as an interface:

- **Commands**,
  Commands to the circuit breaker/the function from different initiators.
- **Input indications**,
  Indications for controlling the synchronisation function.
- **Output indications**,
  Indications on the state of the synchronisation function and indications on switch-impeding criteria.
- **Measuring channels**,
  Allocation of the logical inputs of the synchronisation function on the voltage transformer (analogue input).
- **Measured values**,
  calculated measured values of the synchronisation function.
- **Indications**,
  Indications on the command procedure (such as CO+/CO-).
- **Settings**,
  Settings for configuring properties.

Commands

Table 2-8 **Start conditions check** phase, operating mode analysis

Code	Explanation
Command ON/OFF to **SyncSD**	Control command from different initiators. ON: Control command for switching the control device on. (with or without synchronisation procedure) OFF: Control command for switching the control device off. (without synchronisation procedure)
Command abort - to **SyncSD**, or - to all	Abort command, a running command procedure, the synchronisation or switching procedure must be aborted. Abort of the synchronisation procedure is without conditions. Abort of the synchronisation procedure is only possible for a command with operating mode "impulse, interruptible".

Input indications

The input indications are enabled once per synchronisation settings group. For this reason, they are configured as often as synchronisation settings groups are required.

Table 2-9 Input indications, function blocks SYNC function group

Code	Explanation
“>Sy1 eff.”	Function effective. Activation and deactivation of a function block. In the "Testing start conditions" phase, the module SYNC function group is selected by means of this indication. For selecting a block or for a unique emergency control, a switching sequence must be set via CFC, e.g. for emergency control: - effective OFF - command ON - effective ON An emergency control can also be reached via “>Sy1 dirCO” ON, however only if “>Sy1 block” OFF. ON: The block is effective. OFF: The block is ineffective (unsynchronised switching).
“>Sy1 block”	Block switching enable. The synchronisation functions normally (the measuring function is executed), but a switching enable is prevented. The blocking of the switching enable is signalled via the “Sync. block” output indication. ON: switching enables are blocked. OFF: switching enables are provided.
“>Sy1 dirCO”	Bypassing. The measuring function is bridged, i.e. a measurement for “>Sy1 block” OFF immediately initiates a switching enable. ON: The measuring function is skipped or stopped with “>Sy1 Meas”. ON. The switching enable is provided. OFF: The measuring function is started with “>Sy1 Meas” ON.

Code	Explanation
“>Sy1 Meas”	Start/stop of the (measuring) synchronisation function. ON: The synchronisation function is started. OFF: The synchronisation function is aborted.
“>Sy1U1>U2<”	Switch test V2 dead on / off. ON: Connection occurs even if voltage V2 is missing. (The threshold value for dead line or busbar can be configured.)
“>Sy1U1<U2>”	Switch test V1 dead on / off: ON: Connection occurs even if voltage V1 is missing. (The threshold value for dead line or busbar can be configured.)
“>Sy1U1<U2<”	Swtich test V1 & V2 dead on / off. ON: Connection occurs even if voltages V1 and V2 are missing. (The threshold value for dead line or busbar can be configured.)

Measuring channels

The input measuring channels describe a measured-value channel and can be configured directly on an analogue input in the matrix.

Table 2-10 Input measuring channels, function blocks FB_SYNC 1 to 5

Code	Explanation
“Sy1 ChU1”	Channel of voltage V1.
“Sy1 ChU2”	Channel of voltage V2.

Output indications

Status messages are output from the synchronisation function. The status messages are output in the context of the active FB_SYNC function module.

Table 2-11 Output messages of the synchronisation function

Code	Explanation
“Sync. CloseRel”	Synchronisation conditions exist, switching is enabled. ON: This immediately leads to a switching command (triggering of command relays).
“Sync. Error”	Error, problems within the synchronisation function.
“Sync. block”	Blocking by external event.
“Sync.MonTimeExc”	Monitoring time exceeded
“Sync. synchron”	The networks meet the synchronisation conditions for asynchronous or synchronous networks.
“Sync. U1> U2<”	Condition V2 dead exists.
“Sync. U1< U2>”	Condition V1 dead exists.
“Sync. U1< U2<”	Condition V1 & V2 dead exists.
“Sync. Vdiff>”	The difference voltage amount is greater than the setting. The corresponding SVK_Udiff measured-value indication is transmitted additionally.
“Sync. fdiff>”	The difference voltage amount is greater than the setting. The corresponding SVK_Fdiff measured-value indication is transmitted additionally.

Code	Explanation
“Sync. α diff>”	The amount of the difference angle is greater than the setting. The corresponding SVK_Fdiff measured-value message is transmitted additionally, provided that the Fdiff < FdiffSyn condition is met.
“Sync. f1>>”	The f1 frequency is greater than the fmax setting. The corresponding SVK_F1 measured-value message is transmitted additionally.
“Sync. f1<<”	The f1 frequency is smaller than the fmin setting. The corresponding SVK_F1 measured-value message is transmitted additionally.
“Sync. f2>>”	The f2 frequency is smaller than the fmax setting. The corresponding SVK_F2 measured-value message is transmitted additionally.
“Sync. f2<<”	The f2 frequency is smaller than the fmin setting. The corresponding SVK_F2 measured-value indication is transmitted additionally.
“Sync. U1>>”	The V1 voltage is greater than the Vmax setting. The corresponding SVK_Usyn1 measured-value indication is transmitted additionally.
“Sync. U1<<”	The V1 voltage is smaller than the Vmin setting. The corresponding SVK_Usyn1 measured value indication is transmitted additionally, provided that Dead Bus is not switched on or that no Dead Bus voltage was set.
“Sync. U2>>”	The V2 voltage is greater than the Vmax setting. The corresponding SVK_Usyn2 measured-value indication is transmitted additionally.
“Sync. U2<<”	The V2 voltage is smaller than the Vmin setting. The corresponding SVK_Usyn2 measured value indication is transmitted additionally, provided that Dead Line is not switched on or that no Dead Line voltage was set.

Output messages

The measured values are calculated by the measuring function and made available for display or further processing (e.g. for limit-value determination in CFC).

It is determined by means of configuration if a measured value is enabled or disabled.

The measured values are calculated for each function module SYNC function group. The storage is performed independent of the information objects.

Table 2-12 Synchronisation measured values

Code	Explanation
“Sync. U1”	Synchronisation voltage “Sync. U1” is generally also the reference voltage.
“Sync. U2”	Synchronisation voltage “Sync. U2” is generally also the feeder voltage.
“Sync. Vdiff”	Difference of synchronisation voltages “Sync. U1” and “Sync. U2”.

Code	Explanation
“Sync. α”	Angles between the voltages “Sync. U1” and “Sync. U2”.
“Sync. f1”	Frequency of the synchronisation voltage “Sync. U1”.
“Sync. f2”	Frequency of the synchronisation voltage “Sync. U2”.
“Sync. fdiff”	Frequency difference between f(“Sync. U1”) and f(“Sync. U2”).

2.7.1.2 Configuration Notes

T-CB close The circuit breaker closing (operating) time indicates the runtime of the circuit breaker including all relay and contactor pickup times. It can be specified in the predefined range. A default value is preset.

Balancing U1/U2 Adaptation of the V1 and V2 voltages is possible with the **Balancing U1/U2**. It can be specified in the predefined range. A default value is preset.

α **Tr. U1-U2** The phase angle shift is set with the angle adaptation initiated by the transformer vector group. The angle faults of imprecise primary transformers can also be corrected. The phase angle can be set in the predefined range. A default value is preset.

SecTransNomVal1 Here, the secondary rated transformer voltage V1 of the measured-value input for the relevant reference voltage must be set on the input/output modules. In this context, it must be observed that, in case of a measuring voltage application, transformers with the same transformation ratio and the same connection must be used for all connectable voltages. The voltage can be set in the predefined range. A default value is preset.

SecTransNomVal2 Here, the secondary rated transformer voltage V2 of the measured-value input for the relevant reference voltage must be set on the input/output modules. In this context, it must be observed that, in case of a measuring voltage application, transformers with the same transformation ratio and the same connection must be used for all connectable voltages. The voltage can be set in the predefined range. A default value is preset.

SyncSD Synchronizable control device. The synchronization function can be used for controlling an internal or external command procedure. In case of an internal command processing, a connection to the control device to be synchronized is established at the parameter **SyncSD**. The command is initiated via a control command to the control device, e.g. from the control display. In case of an external command processing, the parameter is "empty".

Umin The lower voltage limit **Umin** specifies the minimum voltage which may be connected. It can be specified in the predefined range. A default value is preset.

Umax The upper voltage limit **Umax** specifies the maximum voltage which may be connected. It can be specified in the predefined range. A default value is preset.

Udead The voltage threshold indicates the voltage maximum up to which a line or busbar is detected as dead. It can be specified in the predefined range. A default value is preset.

Sync.U1>U2<

This parameter serves to specify if a connection is to take place in case of a healthy busbar and a dead line or dead generator (Dead Line). The default setting is No.

Sync.U1<U2>

This parameter serves to specify if a connection is to take place in case of a dead busbar and a healthy line (Dead Bus). The default setting is No.

Sync.U1<U2<

This parameter serves to specify if a connection is to take place in case of a dead busbar and a dead line (Dead Line and Dead Bus). The default setting is No.

T-SYN. DURATION

The maximum duration of synchronisation check must be set here. If the connection cannot be established successfully within this period, the synchronization procedure is aborted. It can be specified in the predefined range. A default value is preset.

fmin

This setting defines the minimum of the frequency range in which the synchronous connection is permissible. The working range of the measuring procedures is not influenced. The lower limit of the frequency working range must be lower than its upper limit. It can be specified in the predefined range. A default value is preset.

fmax

This setting defines the maximum of the frequency range in which the synchronous connection is permissible. The working range of the measuring procedures is not influenced. The upper limit of the frequency working range must be higher than its lower limit. It can be specified in the predefined range. A default value is preset.

UdiffAsyn

This setting indicates the maximum voltage difference of the amounts of V_{syn1} and V_{syn2} for asynchronous conditions. It can be specified in the predefined range. A default value is preset.

fdiff

This setting indicates the maximum frequency difference up to which a connection is permissible for asynchronous systems. It can be specified in the predefined range. A default value is preset.

f SYNCHRON

This setting indicates the maximum frequency difference up to which a connection is permissible for synchronous systems. It can be specified in the predefined range. A default value is preset.

UdiffSyn

This setting indicates the maximum voltage difference of the amounts of V_{syn1} and V_{syn2} for synchronous conditions. It can be specified in the predefined range. A default value is preset.

αdiff

This parameter indicates the maximum angle difference between the voltages of the subsystems, for which the connection is performed. It becomes effective if the frequency difference of the subsystems $D_f \leq F_{diffSyn}$ is valid. The angle can be set in the predefined range. A default value is preset.

T SYNCHRON

This parameter indicates the switch delay time for synchronous systems. This is the minimum period, the **UdiffSyn** (maximum permissible voltage difference), **f SYNCHRON** (maximum permissible frequency difference) and **αdiff** (angle difference) which must remain in the parameterized range until the control command is initiated. If a value leaves the parameterized range, the time counter is reset. It can be specified in the predefined range. A default value is preset.

Note

To obtain a stable connection range, the measured values have a hysteresis:

± 10 % or ± 1 V for voltages (the respectively lower value is valid).

± 20 mHz for frequencies.

± 1 ° for angles.

2.7.1.3 Settings

Addr.	Parameter	Setting Options	Default Setting	Description
0	**T-CB close**	0.01 .. 0.60 sec	0.06 sec	Closing (operating) time of CB
0	**T-SYN. DURATION**	1.00 .. 600.00 sec	30.00 sec	Maximum duration of synchronism-check
0	**fmin**	95 .. 105 %	95 %	Minimum frequency
0	**fmax**	95 .. 105 %	105 %	Maximum frequency
0	**SyncSD**	synchronizable switching device		
0	**Balancing U1/U2**	0.80 .. 1.20	1.00	Balancing Factor U1/U2
0	α **Tr. U1-U2**	0 .. 360 °	0 °	Angle adjustment U1-U2 (Trafo)
0	**SecTransNomVal1**	0 .. 170 V; < > 0	100 V	Secondary Transformer Nominal Value 1
0	**SecTransNomVal2**	0 .. 170 V; < > 0	100 V	Secondary Transformer Nominal Value 2
0	**Umin**	20 .. 125 V	90 V	Minimum Voltage for Synchronization
0	**Umax**	20 .. 140 V	110 V	Maximum Voltage for Synchronization
0	**Udead**	1 .. 60 V	5 V	Voltage Treshold for Dead Line/ Dead Bus
0	**Sync.U1>U2<**	YES NO	NO	Synchronize to U1> and U2<
0	**Sync.U1<U2>**	YES NO	NO	Synchronize to U1< and U2>
0	**Sync.U1<U2<**	YES NO	NO	Synchronize to U1< and U2<
0	**UdiffSyn**	0.5 .. 40.0 V	2.0 V	Maximum voltage difference, synchronous
0	**fdiff**	0.03 .. 2.00 Hz	0.10 Hz	Maximum frequency difference, syn.
0	α**diff**	2 .. 60 °	10 °	Maximum angle difference, syn.
0	**UdiffAsyn**	0.5 .. 40.0 V	2.0 V	Maximum voltage differnece, asynchronous

Addr.	Parameter	Setting Options	Default Setting	Description
0	**f SYNCHRON**	10 .. 40 mHz	10 mHz	Frequency diff. treshold Sync/ Async.
0	**T SYNCHRON**	0.00 .. 60.00 sec	0.05 sec	Switch Delay for synchronous systems

2.7.1.4 Information

No.	Message	Type of Information	Description
	Sy1 ChU1	MK	Sync1, Voltage input U1
	Sy1 ChU2	MK	Sync1, Voltage input U2
	>Sy1 eff.	EM	>Sync1 effective
	>Sy1 block	EM	>Sync1 block
	>Sy1 dirCO	EM	>Sync1 direct Command Output
	>Sy1 Meas	EM	>Sync1 Measuement only
	>Sy1U1>U2<	EM	>Sync1 switch to U1> and U2<
	>Sy1U1<U2>	EM	>Sync1 switch to U1< and U2>
	>Sy1U1<U2<	EM	>Sync1 switch to U1< and U2<
	Sync. CloseRel	AM	Sync. Release of CLOSE Command
	Sync. Error	AM	Synchronization Error
	Sync. block	AM	Sync. blocked
	Sync.MonTimeExc	AM	Sync. Monitoring Time exceeded
	Sync. synchron	AM	Sync. Synchron
	Sync. U1> U2<	AM	Sync. Condition U1> U2< fulfilled
	Sync. U1< U2>	AM	Sync. Condition U1< U2> fulfilled
	Sync. U1< U2<	AM	Sync. Condition U1< U2< fulfilled
	Sync. Vdiff>	AM	Sync. Voltage difference exceeded
	Sync. fdiff>	AM	Sync. frequency difference exceeded
	Sync. α diff>	AM	Sync.angle difference exceeded
	Sync. f1>>	AM	Sync. frequency f1 too high
	Sync. f1<<	AM	Sync. frequency f1 too low
	Sync. f2>>	AM	Sync. frequency f2 too high
	Sync. f2<<	AM	Sync. frequency f2 too low
	Sync. U1>>	AM	Sync. voltage U1 too high
	Sync. U1<<	AM	Sync. voltage U1 too low
	Sync. U2>>	AM	Sync. voltage U2 too high
	Sync. U2<<	AM	Sync. voltage U2 too low
	Sync. U1	MW	Sync. voltage U1
	Sync. U2	MW	Sync. voltage U2
	Sync. Vdiff	MW	Sync. voltage difference U1,U2
	Sync. α	MW	Sync. angle between U1,U2
	Sync. f1	MW	Sync. frequency f1
	Sync. f2	MW	Sync. frequency f2
	Sync. fdiff	MW	Sync. frequency difference f1, f2

2.7.2 SYNC function group 6

2.7.2.1 Description

The SYNC function groups 6 to 8 offer other variations for connection of the voltage transformer. Connection examples can be found in the Appendix.

SYNC function groups 6 to 8 do not differ from SYNC function groups 1 to 5 in terms of function, operation and configuration options. They are described in detail in Chapter 2.7.1.

With SYNC function groups 6 to 8, two channels with phase-to-earth voltage (V11 and V12) are to be allocated for voltage V1. The phase-to-phase voltage V1 is to be formed from these voltages. The relevant phase-to-phase voltage is to be connected to voltage input V2.

Measuring channels

The input measuring channels describe a measured-value channel and can be configured directly on an analogue input with DIGSI®.

Table 2-13 Input measuring channels, function blocks FB_SYNC 6 to 8

Code	Explanation
`“Sy6 ChU11”`	Channel of phase-to-earth voltage V11LE. This value is required for calculating a phase-phase voltage V1.
`“Sy6 ChU12”`	Channel of phase-to-earth voltage V12LE. This value is required for calculating a phase-phase voltage V1.
`“Sy6 ChU2”`	Channel of voltage V2.

2.7.3 Parameterizing SYNC function

2.7.3.1 Description

Synchronisation is a function which must be set as available in the functional scope.

Inserting the synchronisation function

First select the required synchronisation functions as **available** in the **Functional scope** dialog box in DIGSI®.

For this purpose, open the device and click **Functional scope** in the function selection and confirm with OK.

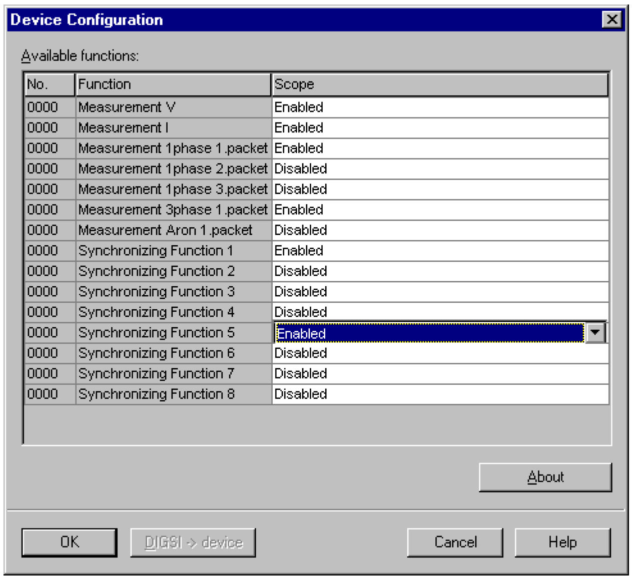


Figure 2-20 Specifying functional scope

Configuring synchronisation

Click **Synchronisation** in the tree view of DIGSI®. The available synchronisation function groups are displayed in the list box under **Function selection**. Double-click the function group (e.g. SYNC function group 1) which you would like to configure. The dialog box for configuration is opened. It contains the tabs **System data**, **General**, **Asyn. condition** and **Syn. Condition**.

Select the tab **System data** and make your settings.

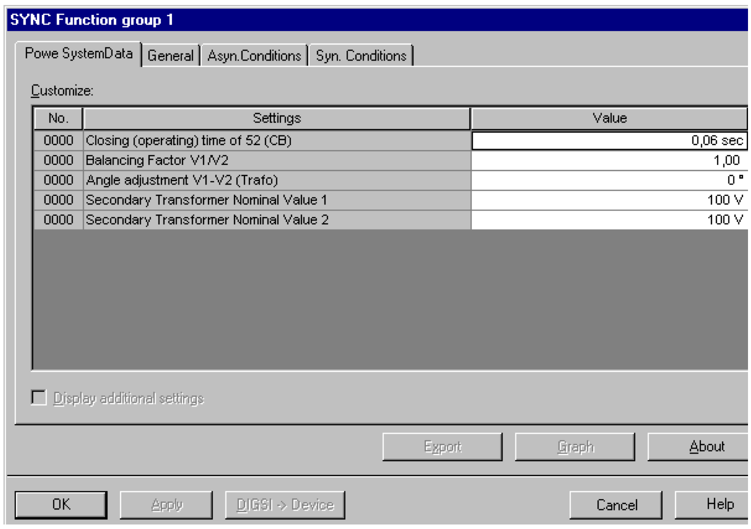


Figure 2-21 Synchronization, System data tab

Make additional settings in the tabs **General**, **Asyn. condition** and **Syn. Condition**.

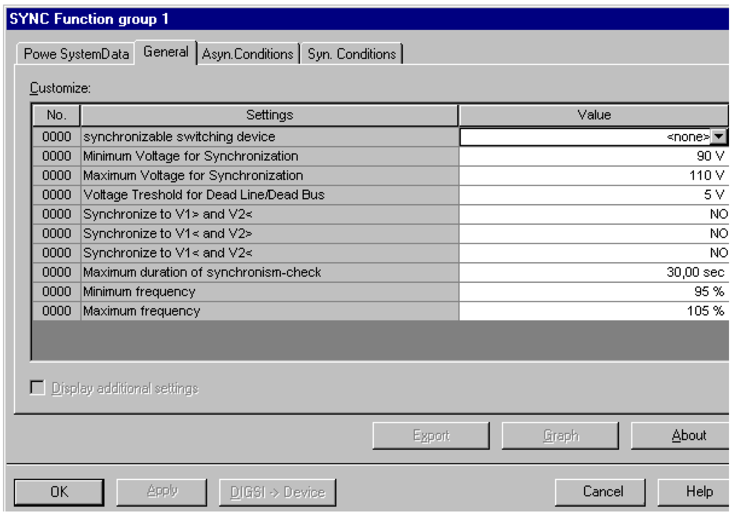


Figure 2-22 Synchronization, General tab

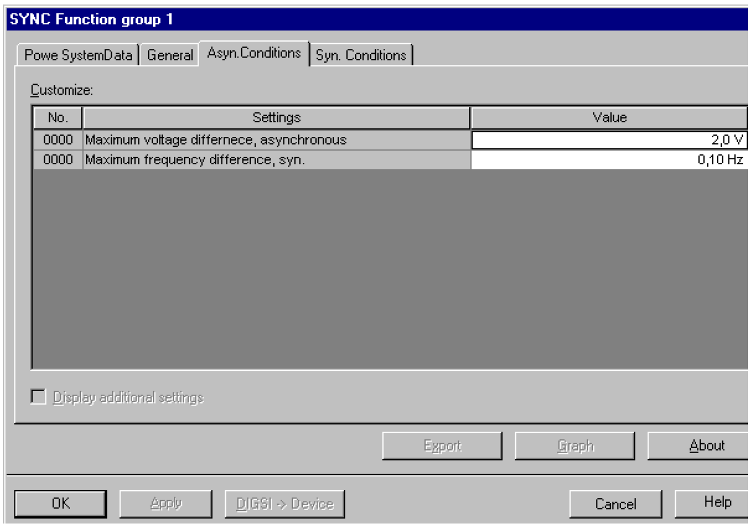


Figure 2-23 Synchronization, Asyn. tab Condition

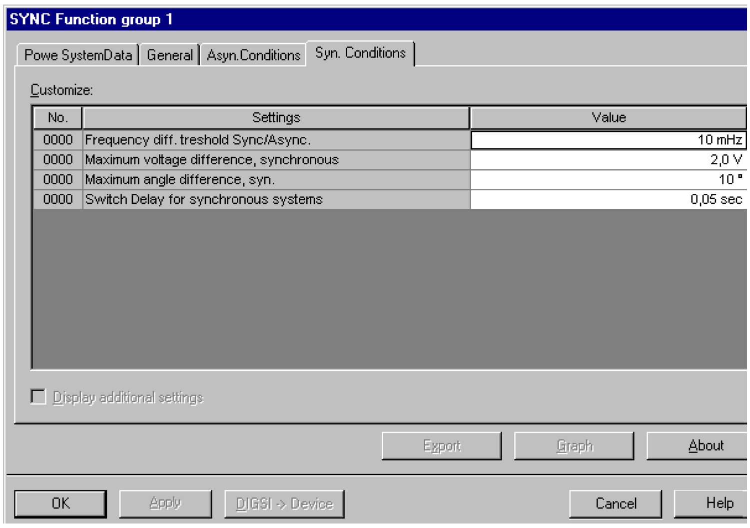


Figure 2-24 Synchronization, Syn. Conditions tab

Exit configuration of synchronisation with OK.

2.8 Inter relay communication

2.8.1 Description

Inter relay communication, abbreviated **IRC**, allows the exchange of information between SIPROTEC® 4 devices without a SICAM SAS control centre. For this purpose, the devices are connected to each other via an RS485 connection or via an external converter and fibre optic cable. Process information such as indications and measured values (RMS values) are transferred via this bus.

Configuration of the Inter relay communication is performed with the DIGSI® operating program.

Communication works cyclically on the basis of an image protocol. The cycle time is constant in fault-free operation and dependent on the baud rate, the amount of process information and the number of connected devices. All SIPROTEC® 4 devices which communication which each other are called users of an IRC combination. An IRC combination can handle a maximum of sixteen users.

Usercases

An Inter relay communication setup always makes sense if the same process information needs to made available to several SIPROTEC® 4 devices. Instead of sending the same process information to several SIPROTEC® 4 devices per single line wiring, it is only sent to a single SIPROTEC® 4 device. The other SIPROTEC® 4 devices receive the required process information via the serial IRC bus.

An application for the Inter relay communication could be the interlocking conditions within a bay with a $1^1/_2$ circuit breaker method operated with three bay controllers.

The OLM (Optical Link Module) interface modules required for an optical connection of the IRC user can be found in the accessory list in the Appendix.

Requirements

Certain requirements must be fulfilled to build an IRC combination

The participating SIPROTEC® 4 devices must be suited toward Inter relay communication.

A corresponding communications module must be installed in the SIPROTEC® 4 devices.

The DIGSI® operating program must be installed on the PC.

The project must contain at least two SIPROTEC® 4 devices which fulfill the requirements for Inter relay communication and an IRC combination (can be created via configuration).

Function principle

The IRC is based on the **Master-Slave principle**. One SIPROTEC® 4 device of the IRC combination operates as the master. All other users are slaves. The master sends queries to all the slaves one after the other. On receiving this query, each slave transmits its particular process information meant for the IRC combination. The master collects all the process information it receives and collates it, together with its own information, into a single message. It then sends this message to all the slaves. From this message, each slave then extracts the process information which is relevant to the particular slave.

Note

Due to the cyclical method of operation of the IRC, only indications whose value changes are pending longer than 20 ms are transferred.

Electrical RS485 connection

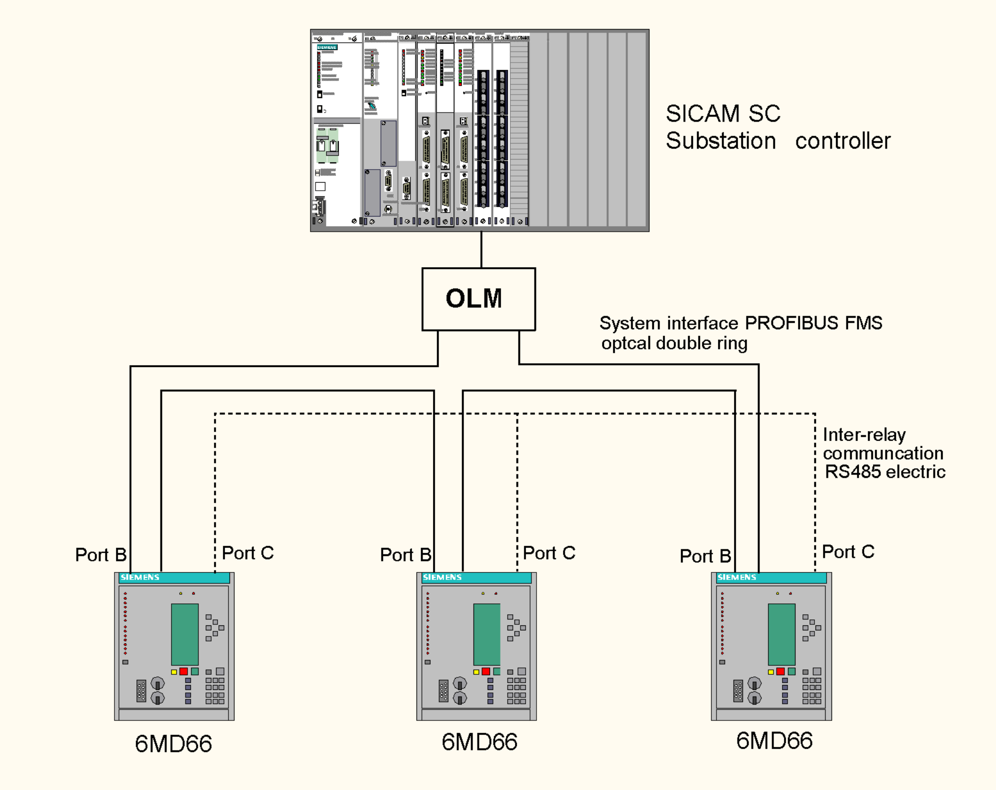


Figure 2-25 Connection of bay controllers to inter relay communication (electrical)

The connection between the devices occurs electrically via an RS485 interface. The electrical connections are terminated with resistors at the ends (first and last device), which are set via jumpers in the 6MD66 device. The jumper settings can be found in Chapter **Installation and Commissioning**.

One of the following operating modes can be selected in DIGSI® using the serial interface settings.

Table 2-14 Operating mode of the IRC interface (electrical)

Transmission mode	Baud rate
HDLC	125 KBaud, 250 KBaud, 1 MBaud, 1.25 MBaud
UART	115 KBaud or 250 KBaud

Optical connection OLM

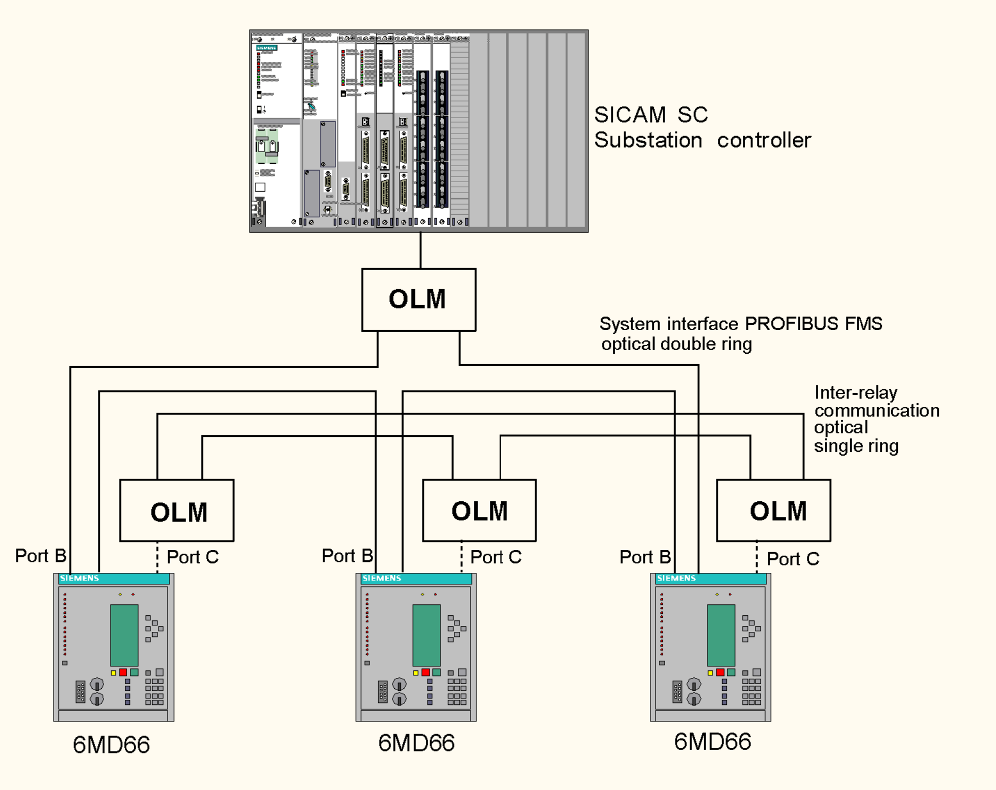


Figure 2-26 Connection of bay controllers to inter relay communication (optical)

An OLM is used as an interface converter (optical/electrical). The connection from the 6MD66 device to the OLM occurs electrically via an RS485 interface. The electrical connections are to be terminated with resistors. These terminating resistors are set with jumpers in the 6MD66 device and with DIL switches (S1, switches 1 and 2) in the OLM. The jumper settings can be found in Chapter **Installation and Commissioning**.

The connection of the interface converters is optical (in series) and its operation is asynchronous. A theoretical baud rate of 9600 Baud to 115200 Baud is set with a DIL switch (S2, switch 5 off, 6 on, 7 on, 8 off). One of the following operating modes can be selected in DIGSI® using the serial interface settings.

Table 2-15 Operating mode of the IRC interface (optical)

Transmission mode	Baud rate
HDLC	125 KBaud
UART	500 KBaud

Application

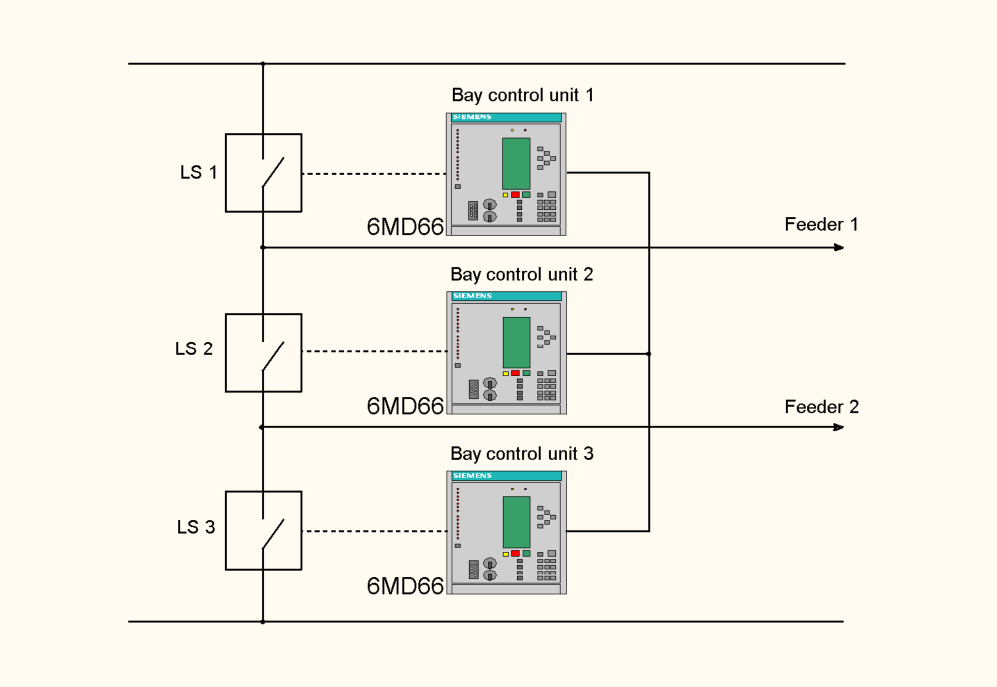


Figure 2-27 $1^1/_2$-Circuit breaker method, disconnector and earth electrode not shown

Configuring inter relay communication

The procedure for configuring the devices connected with each other in the Inter relay communication is explained in the following sections.

Insert SIPROTEC® 4 device

Objects of type **SIPROTEC device** are inserted into the project structure from the device catalog via drag and drop. Right-click an object of type **Folder**. In the context menu, click **Insert new object** → **SIPROTEC device**. The window **Device catalog** opens. Alternatively click **Device catalog** in the context menu.

When selecting a device type, note that this must be suitable for a Inter relay communication. After placing the object within the project, the dialog box **Properties - SIPROTEC device** opens, as usual.

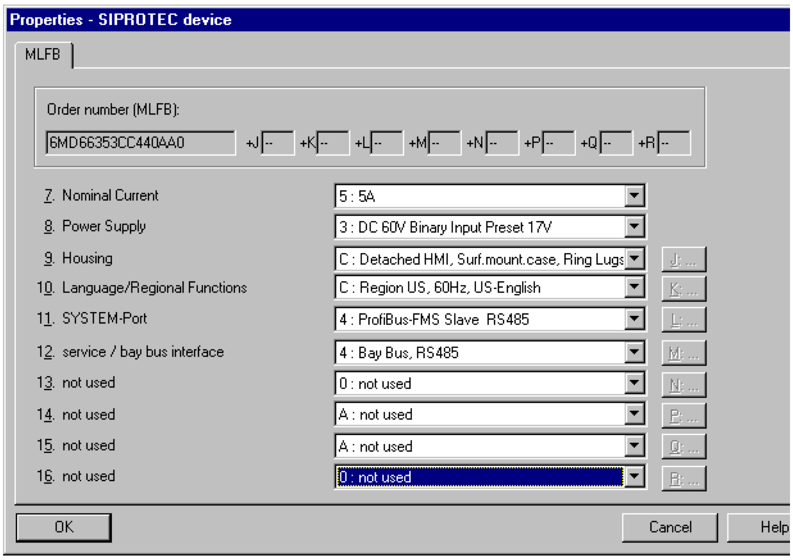


Figure 2-28 Properties SIPROTEC device dialog box

Importing a SIPROTEC® 4 device

In addition to inserting a new device, a device which is already available in another project can be imported into the project structure. It is to be noted here that a device can then only participate in an IRC combination if it is imported as a **SIPROTEC device**. A **SIPROTEC variant** cannot participate in an IRC combination, as the VD address is not unique.

Right-click an object of type Folder. In the context menu, click **Import device**.... The **Import device** dialog box opens.

Select the alternative **As SIPROTEC** device and confirm with **OK**.

Specifying the device model

Select an order number (MLFB number) to specify the device model in DIGSI®. It is important to select the entry **Inter Relay Communication** from the drop-down list box **Function interface**. Click **OK** when you have defined the entire device model.

Proceed in a similar manner with the rest of the objects of type **SIPROTEC device** which are to be users of the IRC combination.

An object of type **IRC combination** is inserted with the DIGSI® Manager. The users of an IRC combination and the required transmission parameters are specified here.

Inserting an IRC combination

The users of an IRC combination and the required transmission parameters are defined in an object of type **IRC combination**. This object also contains information about the update status of an IRC combination.

You can only insert an object of type **IRC combination** within an object of type **Folder**.

Right-click an object of type **Folder**. In the context menu, click **Insert new object** → **IRC combination**.

Within a project you can insert any number of objects of type **IRC combination**.

The placement of the object within the project does not have any effect on its functionality. Each SIPROTEC® 4 device suitable for an IRC combination is available within a project as a participant to each object of type **IRC combination**.

You must only remember that each SIPROTEC® 4 device can only function as a user of a single IRC combination at any one time. However, you should select the placement taking clarity of layout into account.

Several IRC combinations can also be managed within a single project. Each IRC combination is represented here by its own object of type **IRC combination**.

IRC failure indication

For devices selected via the MLFB number, an additional **IRC_Fault** failure indication is generated in the **Device** group of the device matrix. This failure indication can be allocated individually.

This failure indication is set to **ON** by the IRC failure monitor at the beginning of the failure and to **OFF** during establishment connection after the transmission of the current state of process information. When a failure occurs in a device (master or slave), the IRC failure indications for all other devices arrive at the other devices simultaneously.

The master repeats the slave query in case of faulty messages. The number of repetitions is configurable. A large number of repetitions (with message errors or a poor connection) extends the cycle time of the bus. Only one repetition should be set for fibre-optic connections.

After a connection failure, the master attempts to establish a new connection after a configurable number of bus cycles (pauses). As each (failed) connection establishment extends the bus cycle time, the number of pauses should be as large as possible. Otherwise, a large number of pauses extends the time until a failed device operates on the bus again. A good output value here is 10 bus cycles.

Selecting a combination user

An IRC combination can comprise up to sixteen users. These users are stored as a property of the object type IRC combination. To select the user of an IRC combination, open the Properties dialog box of the respective object.

Right-click the object of type **IRC combination**. Click **Object properties** in the context menu. The dialog box **Properties - IRC combination** opens. Select the **User** tab.

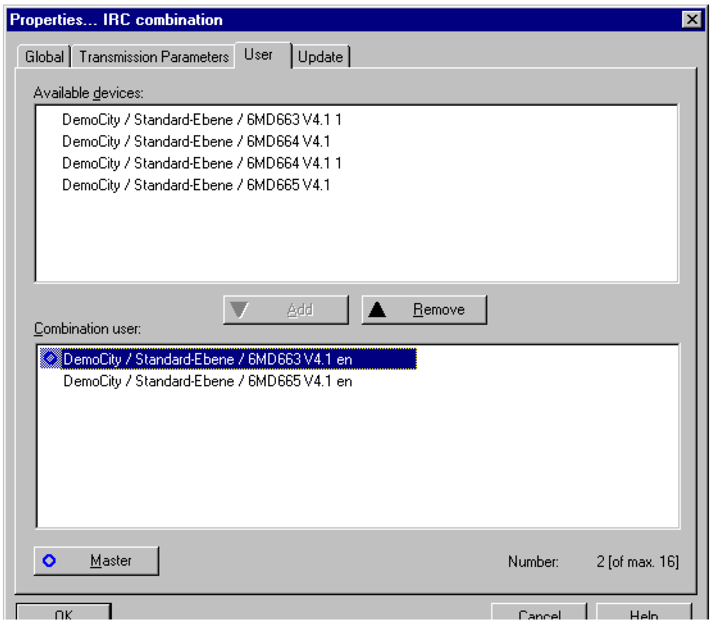


Figure 2-29 Properties dialog box â IRC combination, User tab

Available devices

The names of all SIPROTEC® 4 devices which can operate as users for the processed IRC combination are shown in the box **Available devices**. These are the devices from the current project which fulfill the requirements for Inter relay communication, and which are not already users of another IRC combination. In addition to the name of a SIPROTEC® 4 device, its position within the project is also displayed.

Selecting a user

To add a SIPROTEC® 4 device to the IRC combination, select its name in the box **Available devices**. Then click on Add.

To remove a SIPROTEC® 4 device from the IRC combination, select its name in the **Combination users** box. Then click Remove.

Several devices can be added to, or removed from, the IRC combination simultaneously through multiple selection. Alternatively, add or remove a SIPROTEC® 4 device with a double-click on its name in the appropriate box.

An **IRC combination** can comprise a **maximum** of **sixteen users**. When this number has been reached, a fault indication is displayed as soon as you want to add another SIPROTEC® 4 device.

Specifying a master

Each IRC combination requires a SIPROTEC® 4 device as a master. The first SIPROTEC® 4 device you select is automatically defined as the master. The master device is labelled in the box **Combination users** with a blue circle to the left of the name of the device.

If another SIPROTEC® 4 device is to be used as a master, select its name in the box **Combination users**. Then click **Master**.

If the device labelled as the master is removed from the combination, the first SIPROTEC® 4 device in the list of users is automatically defined as the new master.

Basically, any device in the IRC combination can function as a master. The master function requires additional processor performance. You should therefore select a device which is subjected to the least usage by the actual program run.

Accepting settings

To apply your settings, click **OK**. The **Properties - IRC combination** dialog box is closed.

Allocating information of the individual devices involved

The purpose of the IRC combination is to distribute process information between SIPROTEC® 4 devices. You must therefore make the following decisions for each SIPROTEC® 4 device participating in an IRC combination:

- Which process information from the SIPROTEC® 4 device should be made available to the other devices in the IRC combination?
- Which process information from the SIPROTEC® 4 device should be assignable to process information received from the IRC combination?

You make this selection for each SIPROTEC® 4 device individually in the DIGSI® allocation matrix.

Open the SIPROTEC device with the DIGSI® device processing function. Double-click the object **Allocate** to display the device matrix.

IRC columns

One column with the name **O** is provided in the device matrix for the **IRC combination as source** and **IRC combination as destination**. These columns are fundamentally only visible when the functionality of the IRC has been defined in the device model. These columns are shielded as soon as you select the information filter **Only commands**. This is explained by the fact that commands cannot be swapped within an IRC combination.

Allocable Information types

The following information types can be allocated within an IRC combination:

- Single point indication (only SI, not SI_F)
- Double point indication (only OI, not OI_F)
- Internal single indication (only IS, not IS_F), can only be allocated as destination, use as SI source
- Internal double point indication
- Bit pattern indication
- Transformer tap indication
- Limit value
- User-defined limit value
- Measured value
- User-defined measured value
- External counter

Routing information to the IRC source

Information that is routed to **IRC as source** can be assigned to information of other users of the IRC combination during the course of the run process. Information received from an IRC combination is represented within the SIPROTEC® 4 device by information specific to this device. The assignment between received information and device-specific information takes place with the combination matrix.

Routing information to the IRC destination

Information that is routed to **IRC as destination** can be forwarded to other users of the IRC combination. This forwarding procedure is also defined using the combination matrix.

Routing rules

Several rules must be observed when routing information. A consistency check monitors whether these rules are complied with.

- Information initiated by a device or a function (e.g. device ready) cannot be routed as a source.
- Information can only be routed to the **IRC as source** if it has not already been routed to another source. Similarly, any item of information routed to the **IRC as source** may not be routed to any other sources.
- An item of information cannot be simultaneously routed to the **IRC as source** and to the **IRC as target**.
- Overall, **32 items of information** can be routed to the **IRC as target**.
- Source and destination must be the same data type (e.g. correct: type SI to SI or ExtSi; incorrect: type SI to OI).

Routing information between the devices involved

You have specified information for each individual SIPROTEC® 4 device within an IRC combination with the device matrix.

You must decide,

- what information is to be transmitted from which source device to which destination device, and
- what information is to be created in the destination device by the information it has received.

Note

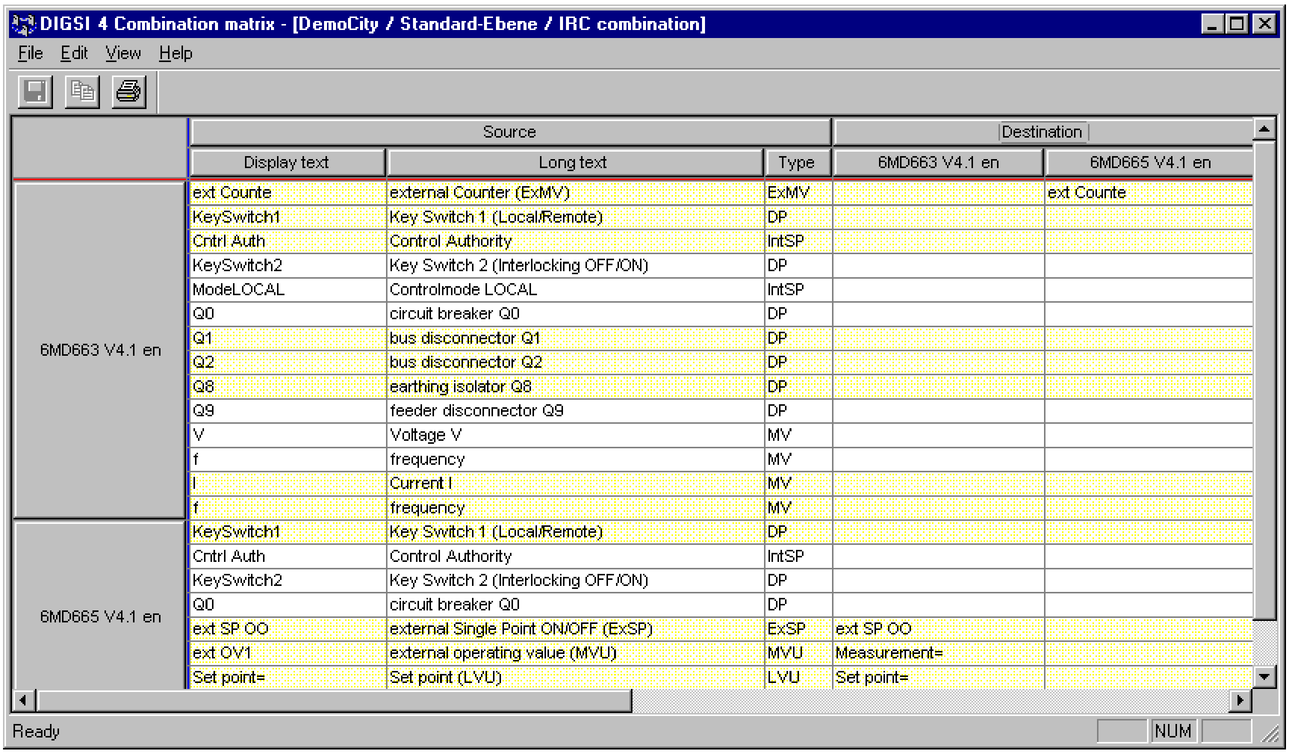
The combination matrix is structured similarly to the device matrix. The mechanisms, e.g. to hide and show lines and column, are identical to those of the device matrix. An extensive description of combination matrix operation can be found in the SIPROTEC® System Description /1/.

Combination matrix

Several requirements must be fulfilled in order to open the combination matrix:

- The combination matrix may not already have been opened for another IRC combination.
- The IRC combination for which the combination matrix is to be opened must comprise at least two SIPROTEC® 4 devices.
- No SIPROTEC® 4 device which functions as a user in the combination may be opened for editing.

Right-click an object of type **IRC combination**. Click **Open object** in the context menu. Alternatively, you can double-click the object. The combination matrix opens.



	Source			Destination	
	Display text	Long text	Type	6MD663 V4.1 en	6MD665 V4.1 en
6MD663 V4.1 en	ext Counte	external Counter (ExMV)	ExMV		ext Counte
	KeySwitch1	Key Switch 1 (Local/Remote)	DP		
	Cntrl Auth	Control Authority	IntSP		
	KeySwitch2	Key Switch 2 (Interlocking OFF/ON)	DP		
	ModeLOCAL	Controlmode LOCAL	IntSP		
	Q0	circuit breaker Q0	DP		
	Q1	bus disconnector Q1	DP		
	Q2	bus disconnector Q2	DP		
	Q8	earthing isolator Q8	DP		
	Q9	feeder disconnector Q9	DP		
	V	Voltage V	MV		
	f	frequency	MV		
	I	Current I	MV		
	f	frequency	MV		
6MD665 V4.1 en	KeySwitch1	Key Switch 1 (Local/Remote)	DP		
	Cntrl Auth	Control Authority	IntSP		
	KeySwitch2	Key Switch 2 (Interlocking OFF/ON)	DP		
	Q0	circuit breaker Q0	DP		
	ext SP OO	external Single Point ON/OFF (ExSP)	ExSP	ext SP OO	
	ext OV1	external operating value (MVU)	MVU	Measurement=	
	Set point=	Set point (LVU)	LVU	Set point=	

Figure 2-30 IRC combination matrix

Structure of the combination matrix

After opening the combination matrix you will see that it is divided up both horizontally and vertically. Several columns or rows can be visually combined into blocks by clicking the button at the top or left margin of the combination matrix.

Horizontally, the matrix is divided into two main data areas: **Source** and **Destination**. Information is compiled vertically in groups.

- **Source**

  Information serves as the source. It is described by the display text, the long text and the type. In the combination matrix, all information is displayed which you have routed to the destination **IRC combination** for each SIPROTEC® 4 device individually in the device matrix.

- **Destination**

  The destination designates the SIPROTEC® 4 device to which information is forwarded. A destination column is shown in the combination matrix for each user device in an IRC combination.

- **Group**

  A group represents the scope of information that a user of an IRC combination makes available to the other users. A group is therefore shown in the combination matrix for each SIPROTEC® 4 device contained in an IRC combination. Each group bears the same name as the related SIPROTEC® 4 device.

Routing information items

Information which has been routed in the device matrix to the **IRC as destination** is made available in the combination matrix as source information. Conversely, all information which has been routed in the device matrix to **IRC as source** is made available in the combination matrix as destination information. Note that the destination information is not visible until a routing action takes place.

To route a source information to a specific SIPROTEC® 4 device in the combination matrix, click the common cell of **Information** and **Destination** device. The cell is transformed into a drop-down list box. It offers the display texts of the destination information routed as the source in the destination device and which is of the same data type. Select one of these information packets. Repeat this procedure for all the remaining assignments.

Routing rules

Some rules must also be observed when routing information within the combination matrix. Their compliance is also monitored, however, as with the device matrix via automatic consistency checking.

- Only one source information packet may be assigned to a destination information packet. However, a source information packet can be routed to several destination information packets.
- The sort and type of source and destination information packets must be identical. You cannot, for example, route a single message to an output indication. However, there are two exceptions: incoming-outgoing indications and in-out indications can be routed between each other. This also applies to double point indications and double point indications with fault positions.

Saving and terminating routings

All your routings must be explicitly saved. Click **File** → **Save as** in the menu bar for this.

To close the combination matrix click **File** → **Exit** in the menu bar.

Setting communication parameters for individual devices

A special communication module must be installed in each SIPROTEC® 4 device provided for Inter relay communication. This module is already installed and correctly allocated if you ordered a SIPROTEC® 4 device with Inter relay communication. For this reason, this section is only relevant for upgrading. The slot to which this communication module is connected in the SIPROTEC® 4 device is the only setting which needs to be made in the device-specific communication parameters.

Right-click the object of type **SIPROTEC device** for which you want to edit the parameter for the Inter relay communication. Click **Object properties** in the context menu. The dialog box **Properties - SIPROTEC device** opens. Select the **Inter relay communication** tab.

Note

This tab is only available if the following requirements are fulfilled simultaneously:

The current SIPROTEC® 4 device is fundamentally suitable for Inter relay communication.

Inter Relay Communication has been selected as the function interface in the Communications module tab.

The SIPROTEC® 4 device is already a user in an IRC combination.

Setting a slot

Note

A modification to the slot setting, in comparison to the delivery setting, should only be made if there is just cause and only with the required system knowledge!

The set slot and the actual slot are not automatically checked for consistency. Please carefully check your settings yourself.

In the **Slot** drop-down list box select the name of the slot in which the communications module is installed in the SIPROTEC® 4 device.

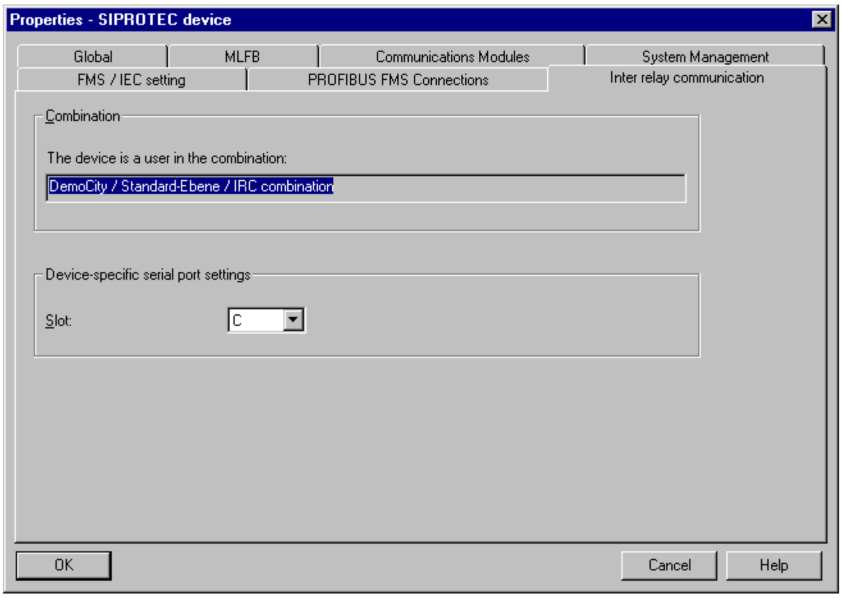


Figure 2-31 Properties - SIPROTEC device dialog box, Inter Relay Communication tab

To apply your settings, click **OK**. The **Properties - SIPROTEC device** dialog box is closed.

The parameter is not activated until the parameter set is updated.

Setting communication parameters for a combination

While the slot to which this communications module is connected is the only setting which needs to be made in the device-specific communication parameters, several settings need to be taken into consideration for the combination as a whole. The settings which need to be made are summarised in two groups:

- **Interface settings**

  These serial interface settings must be identical for all the SIPROTEC® 4 devices in the IRC combination. Otherwise the devices are not able to communicate with one another. They are therefore defined centrally for the combination.

- **Bus parameters**

  Settings relating to the bus arbitration only affect the parameter set of the SIPROTEC® 4 device which serves as the master in the IRC combination. However, as each participating SIPROTEC® 4 device can fundamentally be defined as the master, these settings are also made during configuration of the IRC combination.

Right-click the object of type **IRC combination**. Click **Object properties** in the context menu. The dialog box **Properties - IRC combination** opens. Select the **Transmission parameters** tab.

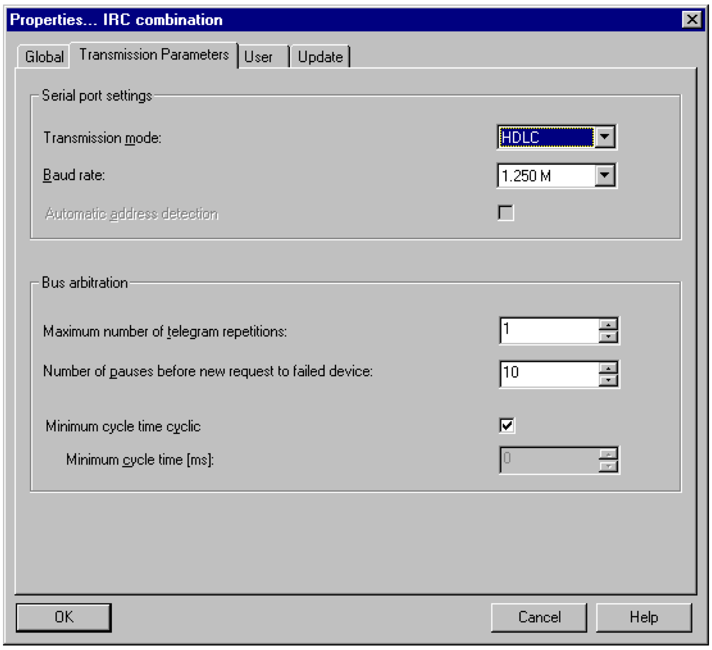


Figure 2-32 Properties dialog box - IRC combination, Transmission parameters tab

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Note

We recommend using the preset transmission parameters.

Specifying interface settings

The following interface settings can be set:

- **Transmission mode**

  Select the name of a transmission mode from this drop-down list box. At this time you can choose between **UART** and **HDLC**. HDLC ensures an approx. 15 % greater transmission density than UART using the same baud rate. The selected transmission mode must be compatible with the communications modules installed in the SIPROTEC® 4 devices in the IRC combination.

- **Baud rate**

  Select a baud rate from this drop-down list box. Which baud rates are available for selection depends on the transmission mode you have selected. The higher the transmission rate, the shorter the cycle time or the more users can be connected to the bus with the same cycle time. The processor load of the master increases when the cycle time is small and when many slaves are connected to the bus. In exceptional cases, the parameter **Minimal cycle time** must be increased for this reason.

  When using the HDLC protocol, the baud rate is to be set according to the bus configuration:

  – Line bus via RS485: 1 MBit (limited by RS485 and cable length)

– Star-shaped via optical star couplers: 512 KBit (limited by mini star couplers)

– Double ring with OLM: 1 MBit (limited by RS485)

- **Automatic address detection**

  If this check box is activated, the SIPROTEC® 4 device only considers a message it receives if it is addressed to it. This action relieves the load on the CPU of the SIPROTEC® 4 device. This option can only be selected if **UART** is set as the transmission mode.

Setting the bus arbitration

The following parameters can be set for bus arbitration:

- **Maximum number of message repeats**

  If a message is corrupted during transmission, it can be sent again. In this spin box you can enter how many attempts should be made to transmit a message. A maximum of three new transmission attempts are allowed.

- **Number of pauses before a new query is sent to a failed device**

  If a SIPROTEC® 4 device in the combination has failed, the master can exempt it from queries for a certain number of cycles. To do this, select a value between 0 and 254 in the drop-down list box.

- **Minimum cycle time**

  The cycle time defines the total duration of a cycle, during which all slave devices are queried by the master device. Select a value between 10 and 10,000 ms. from the spin box. As the length of the cycle time depends on the capacity of the master, the cycle time actually achieved may be higher than the value set in the parameters. To ensure that the master uses the shortest possible cycle time, select the check box **Minimum cycle time, continuous**.

Checking and updating parameter sets

The parameter sets of individual or all combination users must be updated either when configuring an IRC combination for the first time, or if the settings of single combination parameters have been altered, according to the modifications which have been made.

Right-click the object of type **IRC combination**. Click **Object properties** in the context menu. The dialog box **Properties - IRC combination** opens. Select the **Updating** tab.

The tab **Updating** gives an overview of the update status of the parameter sets of the individual combination users.

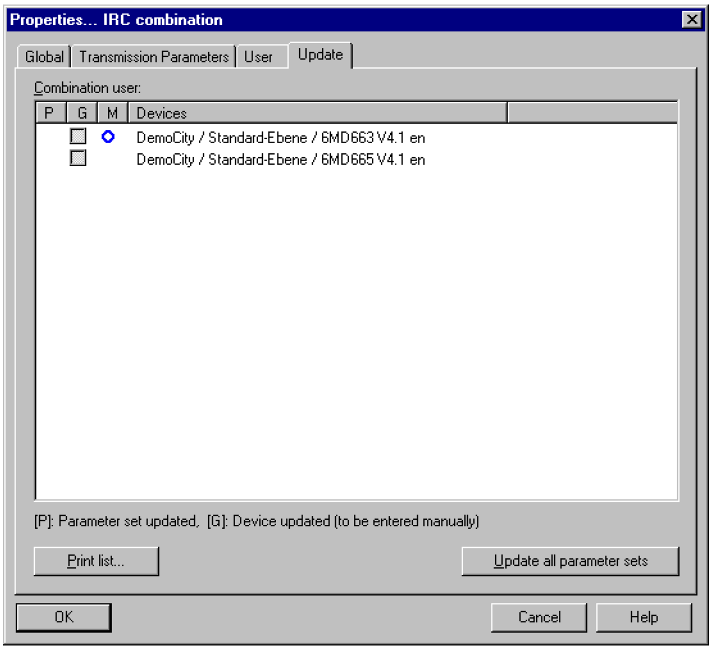


Figure 2-33 Properties dialog box — IRC combination, Updating tab

Checking the update status

Every device in DIGSI® which has a current parameter set is designated in column **P** with a check mark. If this parameter set has already been transmitted to the real SIPROTEC® 4 device, you can manually make a note of this by entering a check mark in column **G**. To do this, click in the corresponding check box. This selection can only be set if the parameter set in DIGSI® 4 is up to date.

It is automatically deleted if changes have been made which affect the parameter set of the SIPROTEC® 4 device concerned.

DIGSI® itself detects which parameter sets are no longer up to date. As soon as the update command has been issued, these parameter sets are updated one after the other. However, it is important for you to know after which modification which SIPROTEC® 4 device needs to be reinitialised.

Here is a brief overview:

- Changing the slot for the communications module: parameter set of the user concerned.
- Modification of a serial interface setting on the tab **Transmission parameters**: parameter sets of all users.
- Modification of a bus parameter in the tab **Transmission parameters**: parameter set of the master.
- Routing changes in the combination matrix: parameter sets of both users concerned.
- Routing changes in the device matrix of a SIPROTEC® 4 device to IRC as the destination: parameter set of the user concerned.
- Deleting or adding a user: parameter sets of all users.

Updating parameter sets

To update all outdated parameter sets, click **Update all parameter sets**. Messages detailing the progress of updating are shown in the **Report** window. The parameter sets are updated in DIGSI®.

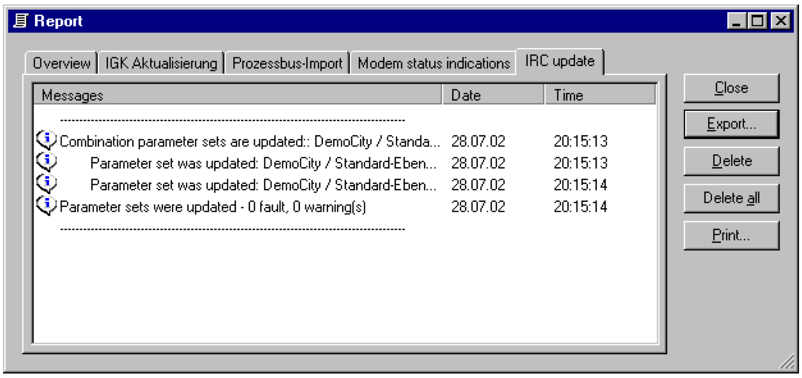


Figure 2-34 Report, IRC update tab

If you have made changes in the combination matrix, you can update these changes immediately in the affected parameter sets. Click **File** → **Save and Generate Parameter Records** on the menu bar for this.

Printing combination information

You can print the following information relating to an IRC:

- Transmission parameter settings of the IRC combination.
- The names of the SIPROTEC® 4 devices in the IRC combination, including the classification letters of the selected slots.
- Update information for each individual user in the IRC combination.

Right-click an object of type **IRC combination**. Click **Delete** → **Object contents** in the context menu. The **Print Combination Information** dialog box opens.

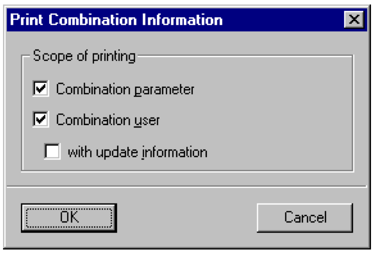


Figure 2-35 Print combination information dialog box

Specifying the scope of printing

You specify the scope of the information to be printed by selecting individual checkboxes. Subsequently click **OK**. The **Print Manager** window opens. This window allows you to call up a page preview for the information you want to print. You can influence the presentation in the **Print Manager** window.

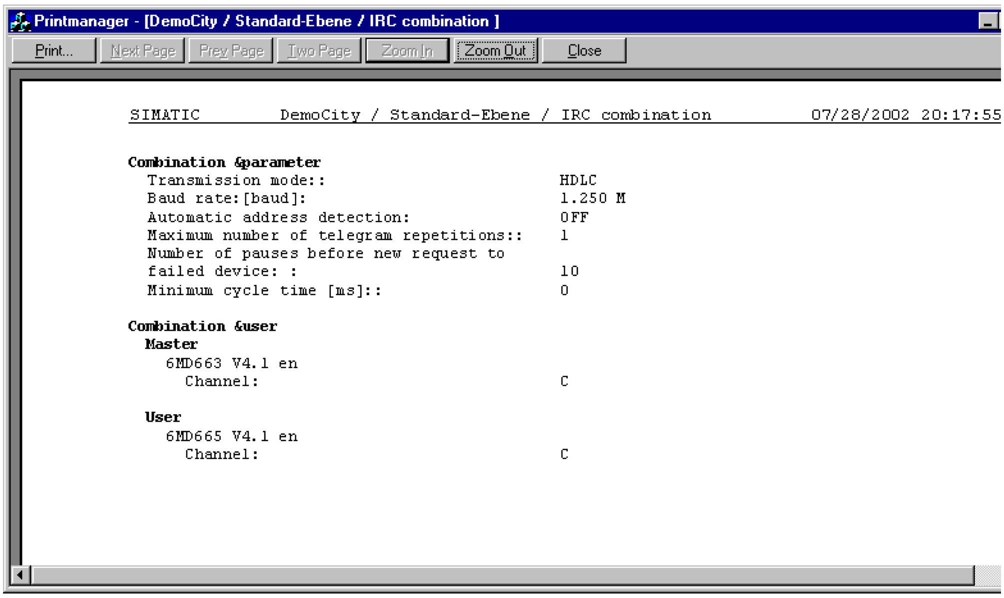


Figure 2-36 IRC combination, print manager

Scrolling

Click **Next** to show the next print page. This button is inactive if the last available print page is already being displayed. Then click **Previous** to show the previous print page. This button is inactive if the first print page is already being displayed.

Changing the display mode

Click **One page/two pages** to alternate between a single page view and a two page view.

Changing the scale of the display

Click **Zoom** to zoom the display of the print page in defined stages. This button is inactive as soon as the largest possible display size has been reached. Alternatively, click with the left mouse button for as long as the mouse cursor is in the display area. When you do this the display of the print page is also zoomed in defined stages. Click **Zoom out** to zoom out the display of the print page in defined stages. This button is inactive as soon as the smallest possible display size has been reached.

Note

An enlarged or shrunken view has no influence on the print results.

Printing information

Click **Print** to print the displayed information.

Time synchronization

In addition to transmitting the process information, the IRC can synchronise the time in the connected devices. The master, which synchronises its time via a radio clock for example, passes on the time each minute to the connected slaves. Time synchronization via IRC must be set in the slaves for this.

Open the SIPROTEC device with the DIGSI® device processing function. Double-click in the data window on **Time synchronization**. The **Time Synchronisation & Time Format** dialog box is displayed.

Select the entry **Inter relay communication** from the **Time synchronization source** list box and confirm the entry with **OK**.

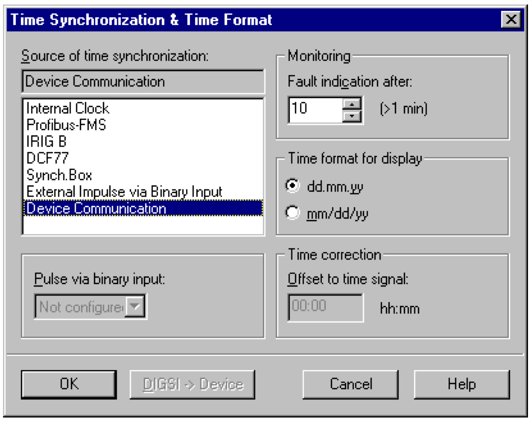


Figure 2-37 Time synchronization & time format dialog box

■

Installation and Commissioning

3

This section is primarily for personnel who are experienced in installing, testing, and commissioning protective and control systems. They must be familiar with applicable safety rules, safety regulations, and the operation of a power system. Hardware modifications that might be needed in certain cases are explained. Some of the tests require the protected line or equipment to carry load.

3.1 Installation and Connections

WARNING!

Warning of improper transport, storage, installation, and application of the device.

Non–observance can result in death, personal injury or substantial property damage.

Trouble free and safe use of this device depends on proper transport, storage, installation, and application of the device according to the warnings in this instruction manual.

Of particular importance are the general installation and safety regulations for work in a high-voltage environment (for example, ANSI, IEC, EN, DIN, or other national and international regulations.) These regulations must be observed.

3.1.1 Configuration Information

Requirements

For installation and connection, the following conditions and limitations apply:

The rated device data is checked as recommended in the SIPROTEC® System Description /1/. The compliance with these data is verified with the power system data.

Connection variants

Connection examples for the current and voltage transformer circuits are given in the Appendix.

Currents/Voltages

As the voltage inputs of the 6MD66 device have an operating range from 0 to 170 V, this means that phase-phase voltages can be assessed up to $\sqrt{3} \cdot 170$ V = 294 V.

Binary inputs and outputs

The configuration of the binary inputs and outputs, i.e. the individual adaptation to the system conditions, is described in /1/. The connections to the system are dependent on this actual configuration.

3.1.2 Hardware Modifications

3.1.2.1 General

General

Hardware modifications concerning, for instance, rated currents, the control voltage for binary inputs or termination of serial interfaces might be necessary. Follow the procedure described in this subsection, whenever hardware modifications are done.

Auxiliary voltage

The various input voltage ranges (60/110 V DC and 220 to 250 V DC) of the auxiliary voltage can be changed to one another by changing the plug-in jumpers. When the relay is delivered, these jumpers are set according to the name-plate sticker. Generally, they need not be altered (see also ordering data in the Appendix).

Life contact

The life contact of the device is a changeover contact, from which either the opener or closer can be applied to the device connections F3 and F4 via a jumper (X40). The assignment of the plug-in jumper to the contact type and the spatial arrangement of the jumper are described in the following.

Rated currents

The input transformers of the devices are set to a rated current of 1 A or 5 A with jumpers. The positioning of the plug-in jumpers has been executed in the factory according to the indications on the rating plate. All jumpers must be set for one rated current, i.e. respectively one jumper (X61 to X63) for each input transformer and additionally the common jumper X60.

Should you perform a change here, you must not forget to communicate this change to the device also via the parameter Transformer current I, secondary in the measuring transducer packets.

Control voltage for binary inputs

In the delivery status, the binary inputs are set in a way ensuring that a direct current equalling the supply voltage is set as control variable. If the rated values differ from the power system control voltage, it may be necessary to change the switching threshold of the binary inputs.

To change the switching threshold of a binary input, a jumper must be reallocated in each case.

Note

If binary inputs are used for trip circuit monitoring, note that two binary inputs (or a binary input and a replacement resistor) are connected in series. The switching threshold must lie clearly below one half of the rated control voltage.

Replacing interfaces

The serial interfaces are replacable. The interfaces which can be replaced, and how this is done, is described in the Interface modules section.

Terminating serial interfaces

If the device is equipped with a serial RS485 interface or PROFIBUS, they must be terminated with resistors at the last device on the bus to ensure reliable data transmission. For this purpose termination resistors are provided on the PCB of the CPU processor module and on the PROFIBUS interface module which can be connected via jumpers. Both jumpers must be always plugged in identically.

The termination resistors are disabled on unit delivery.

3.1.2.2 Disassembly

Disassembly of the Device

Note

It is assumed for the following steps that the device is not operative.

Work on the Printed Circuit Boards

Caution!

Caution when changing jumper settings that affect nominal values of the device

As a consequence, the ordering number (MLFB) and the ratings that are stated on the nameplate do no longer match the actual device properties.

If such changes are necessary, the changes should be clearly and fully noted on the device. Self adhesive stickers are available that can be used as replacement name-plates.

To perform work on the printed circuit boards, such as checking or moving switching elements or exchanging modules, proceed as follows:

- Prepare area of work. Provide a grounded mat for protecting components subject to damage from electrostatic discharges (ESD). The following equipment is needed:
  - screwdriver with a 5 to 6 mm wide tip,
  - 1 Philips screwdriver,
  - 5 mm socket or nut driver.
- On the rear panel, remove the studs of the subminiature socket at slot "A".
- If the device has additional system interfaces on slots "B" to "D" in addition to the service interface at slot "A", each of the diagonal screws must be removed.
- Remove the four or six caps on the front cover and loosen the screws that become accessible.
- Carefully take off the front cover. With device versions with a detached operator panel it is possible to remove the front cover of the device right after having unscrewed all screws.

Work on the plug connectors

Caution!

Mind electrostatic discharges

Non–observance can result in minor personal injury or property damage.

When handling with plug connectors, electrostatic discharges may emerge by previously touching an earthed metal surface must be avoided.

Do not plug or withdraw interface connections under power!

When performing work on plug connectors, proceed as follows:

- Release the connector of the ribbon cable between CPU processor module (1) and front cover at the front cover itself. Press the top latch of the plug connector up and the bottom latch down so that the plug connector of the ribbon cable is pressed out.

  These activities are not necessary if the device has a detached operator panel. However, on the CPU processor module (1) the 7-pin plug connector X16 behind the subminiture socket and the plug connector of the ribbon cable (connected to the 68-pin plug connector on the rear side) must be removed.
- Disconnect the plug connectors of the ribbon cable between the CPU processor module (1) and the input/output modules I/O-4 (2) and I/O-5 (3).
- Remove the modules and place them on a surface suitable for electrostatically sensitive modules (ESD).
- Check jumpers and change/remove if necessary.

Module arrangement of 6MD663

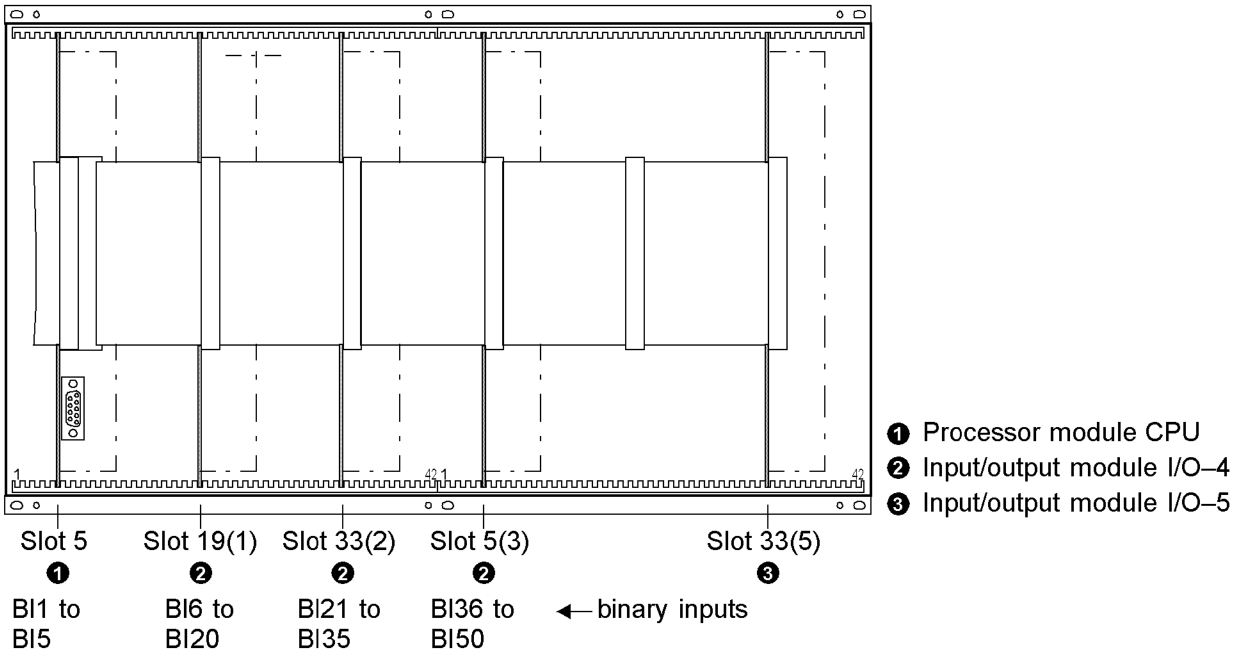


Figure 3-1 Front view of a 6MD663 device after removing the front cover (simplified and reduced in scale)

Module arrangement 6MD664

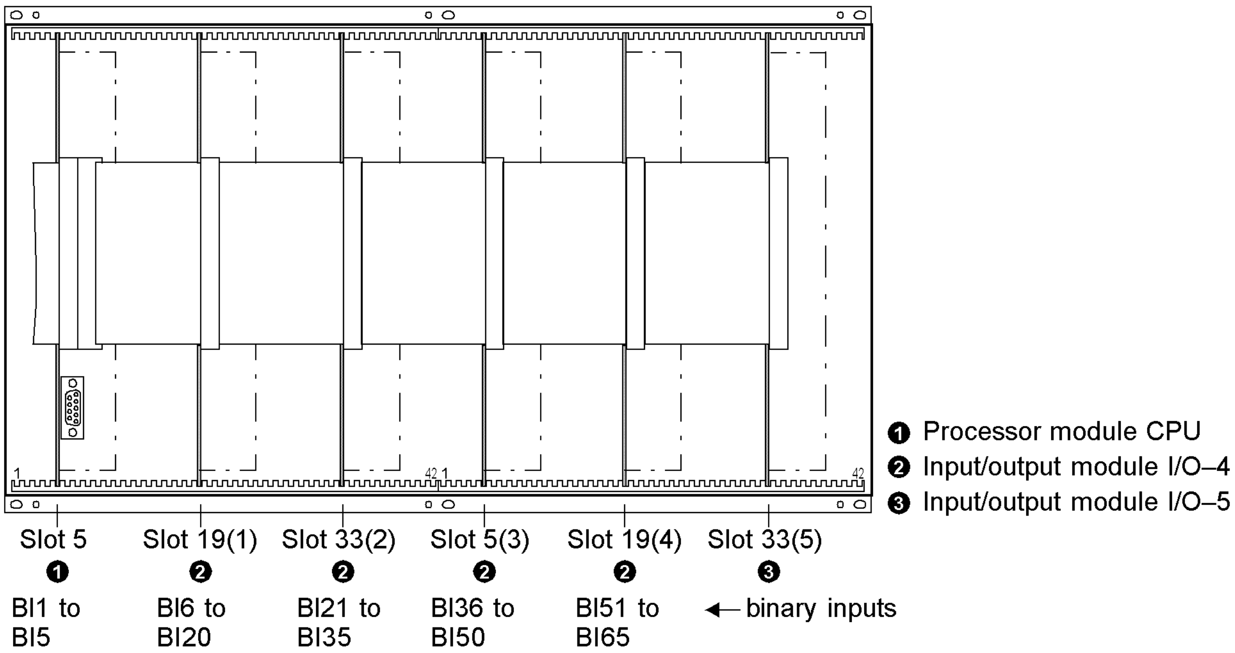


Figure 3-2 Front view of a 6MD664 device after removing the front cover (simplified and reduced in scale)

3.1.2.3 Switching elements on the PCBs

CPU processor module

Check the set rated voltage of the integrated power supply, the quiescent state of the life contact, the selected control voltages of binary inputs BI1 to BI5 and the integrated RS232/RS485 interface using the layout of the PCB of the CPU processor module and the tables below.

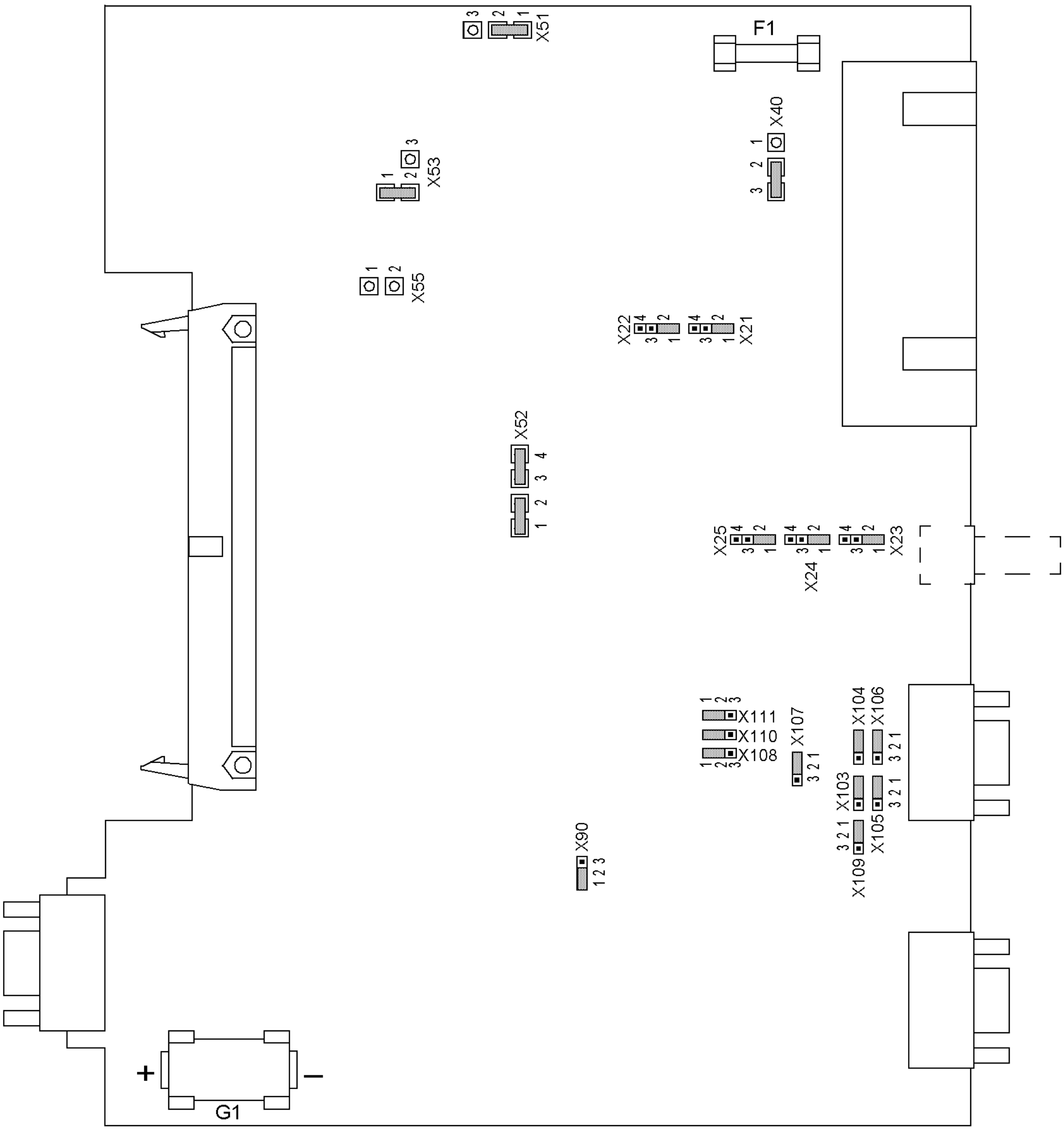


Figure 3-3 Processor module CPU with representation of the jumpers required for checking the settings

Table 3-1 Jumper setting of the rated voltage of the integrated **power supply** on the CPU processor module

Jumper	Rated voltage			
	24 to 48 V DC	60 V DC	110 V DC	220 to 250 V DC
X51	Not used	1–2	1–2	2–3
X52	Not used	1–2 and 3–4	1–2 and 3–4	2–3
X53	Not used	1–2	1–2	2–3
X54	Not used	Open	Open	1–2

Table 3-2 Jumper position of the quiescent state of the **Life contact** on the CPU processor module

Jumper	Open in the quiescent state	Closed in the quiescent state	Presetting
X40	1–2	2–3	2–3

Table 3-3 Jumper setting of the **control voltages** of the binary inputs BI1 to BI5 on the CPU processor module

Binary input	Jumper	Threshold 17 V[1)]	Threshold 73 V[2)]	Threshold 154 V[3)]
BI1	X21	1–2	2–3	3–4
BI2	X22	1–2	2–3	3–4
BI3	X23	1–2	2–3	3–4
BI4	X24	1–2	2–3	3–4
BI5	X25	1–2	2–3	3–4

1) Factory settings for devices with rated supply voltages of 24 V DC to 60 V DC
2) Factory settings for devices with rated supply voltage DC 110 V
3) Factory settings for devices with rated supply voltages of 220 V DC to 250 V DC

Table 3-4 Jumper settings of the integrated **RS232/RS485 interface** on the CPU processor module

Jumper	RS232	RS485
X105 to X110	1–2	2–3

Note

Jumpers X105 to X110 must be set to the same position.

When the device is delivered from the factory, the jumper setting corresponds to the configuration ordered and need not be changed.

The R485 interface can be converted into an RS232 interface by modifying the setting of the appropriate jumpers.

For an order with MLFB position 12 the same as 0, the interface is set to RS232.

Table 3-5 Jumper setting for **CTS (Flow control)** on the CPU processor module

Jumper	/CTS from interface RS232	/CTS triggered by /RTS
X111	1–2	2–3

The jumper is always inserted at position 2-3 at the factory.

The jumper must be set to 2–3 for the RS232 connection of DIGSI®.

Jumper setting 2–3 is also required for the connection, via star coupler or fibre optic cable; we recommend the connection cable Order No. 7XV5100–4 for this purpose.

Jumper setting 1–2 is required for a modem connection; we recommend a standard connection cable (9-pin/25-pin) for this.

Table 3-6 Jumper setting of the **termination resistors** of the **RS232/RS485 interface** on the CPU processor module

Jumper	Termination resistor Connected	Termination resistor Disconnected	Factory setting
X103	2–3	1–2	1–2
X104	2–3	1–2	1–2

Provided that they are not terminated externally via resistors, each last device must be configured via the jumpers X103 and X104.

Note

Both jumpers must always be plugged in the same way!

Jumper X90 serves for internal test purposes. The factory setting 1–2 must not be changed.

I/O-4 module

The selected control voltages of the binary inputs BE6 to BE65 are checked according to the table below. The assignment of the binary inputs to the installation location of the module can be found in Section **Module arrangement**.

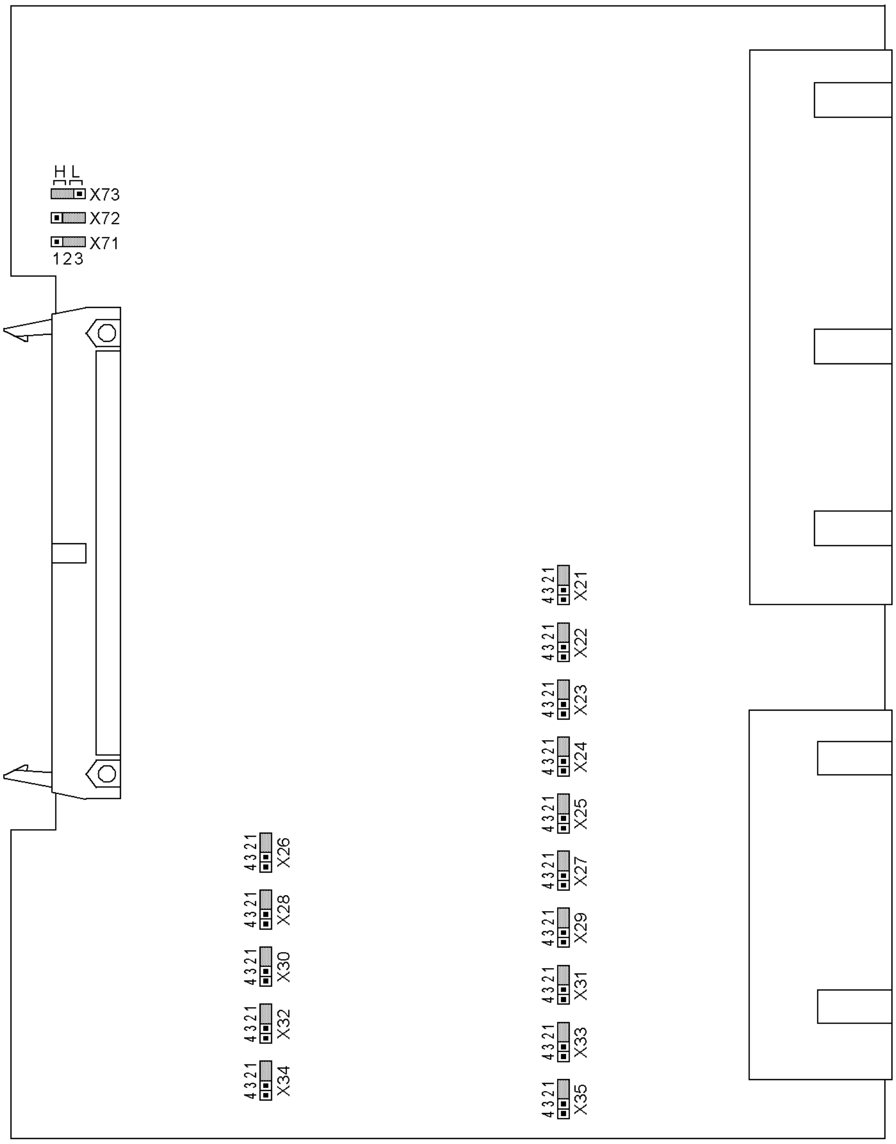


Figure 3-4 I/O-4 input/output module with representation of the jumpers required for checking the settings

Table 3-7 Jumper setting for the control voltages of the binary inputs BI6 through BI65 on the I/O-4 input/output module

Binary input				**Jumper**	**Threshold 17 V** [1]	**Threshold 73 V** [2]	**Threshold 154 V** [3]
BI6	BI21	BI36	BI51	X21	1–2	2–3	3–4
BI7	BI22	BI37	BI52	X22	1–2	2–3	3–4
BI8	BI23	BI38	BI53	X23	1–2	2–3	3–4
BI9	BI24	BI39	BI54	X24	1–2	2–3	3–4
BI10	BI25	BI40	BI55	X25	1–2	2–3	3–4
BI1	BI26	BI41	BI56	X216	1–2	2–3	3–4
BI12	BI27	BI42	BI57	X27	1–2	2–3	3–4
BI13	BI28	BI43	BI58	X28	1–2	2–3	3–4
BI14	BI29	BI44	BI59	X29	1–2	2–3	3–4
BI15	BI30	BI45	BI60	X30	1–2	2–3	3–4
BI16	BI31	BI46	BI61	X31	1–2	2–3	3–4
BI17	BI32	BI47	BI62	X32	1–2	2–3	3–4
BI18	BI33	BI48	BI63	X33	1–2	2–3	3–4
BI19	BI34	BI49	BI64	X34	1–2	2–3	3–4
BI20	BI35	BI50	BI65	X35	1–2	2–3	3–4

[1] Factory settings for devices with rated supply voltages of 24 V DC to 60 V DC

[2] Factory settings for devices with supply voltages DC 110 V

[3] Factory settings for devices with rated supply voltages of 110 V DC to 250 V DC

The jumpers X71, X72 and X73 on the I/O-4 input/output modules serve for setting the bus address. Their position may not be changed. The table shows the factory setting of the jumpers.

Table 3-8 Module address jumper settings of input/output modules I/O-4

Jumper	Insertion slot			
	Slot 19 (1)	Slot 33 (2)	Slot 5 (3)	Slot 19 (4)
X71	1–2(H)	2–3(L)	1–2(H)	2–3(L)
X72	2–3(L)	1–2(H)	1–2(H)	2–3(L)
X73	2–3(L)	2–3(L)	2–3(L)	1–2(H)

I/O-5 module

Check the set rated currents of the current input transformers here. All jumpers must be set for one rated current, i.e. respectively one jumper (X61 to X63) for each input transformer and additionally the common jumper X60.

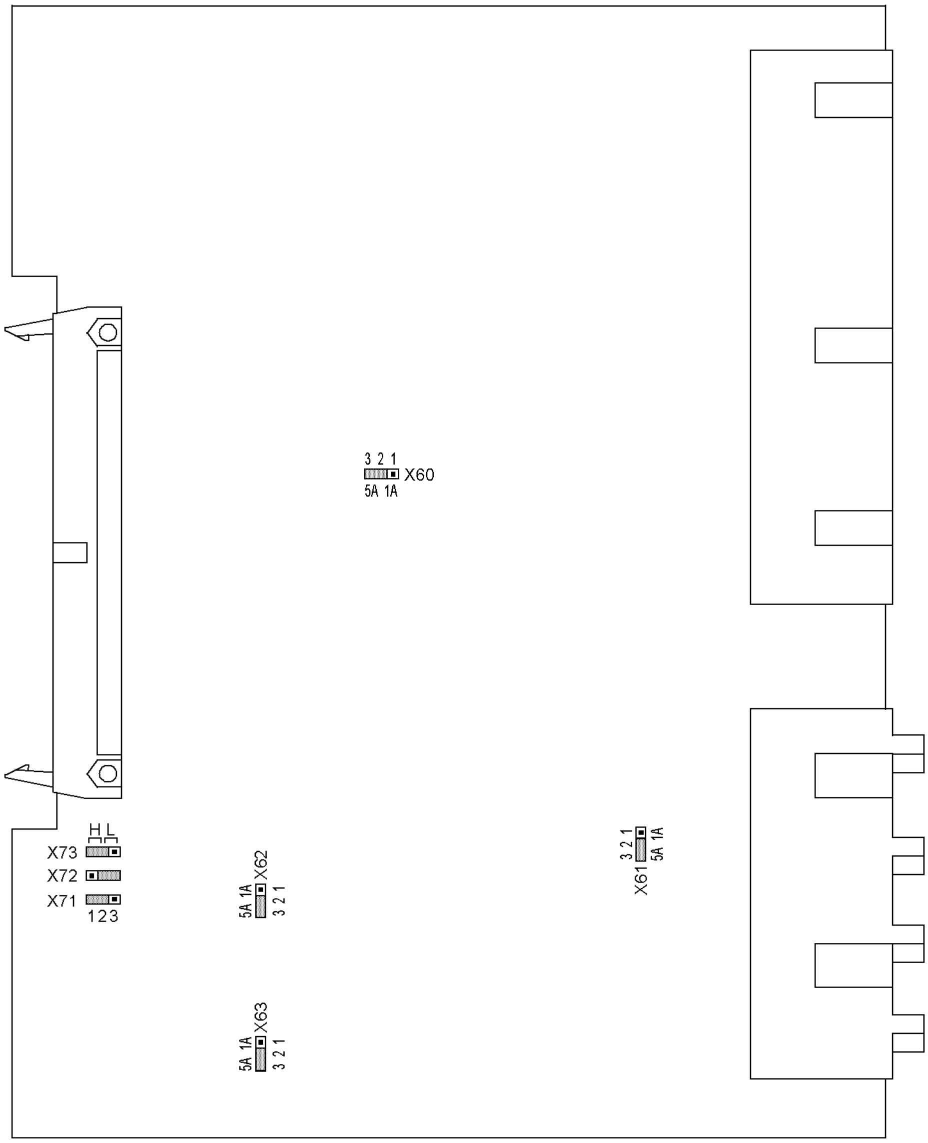


Figure 3-5 I/O-5 input/output module with representation of the jumpers required for checking the settings

Jumpers X71, X72 and X73 on the I/O–5 input/output module serve for setting the bus address. Their position may not be changed. The table shows the factory setting of the jumpers. The insertion slot of the module is described in Section **Module arrangement**.

Table 3-9 **Module address** jumper settings of input/output modules I/O-5

6MD663	
Jumper	Position
X71	2–3

X72	2–3
X73	1–2
6MD664	
Jumper	Position
X71	1–2
X72	2–3
X73	1–2

3.1.2.4 Interface Modules

Replacing interface modules

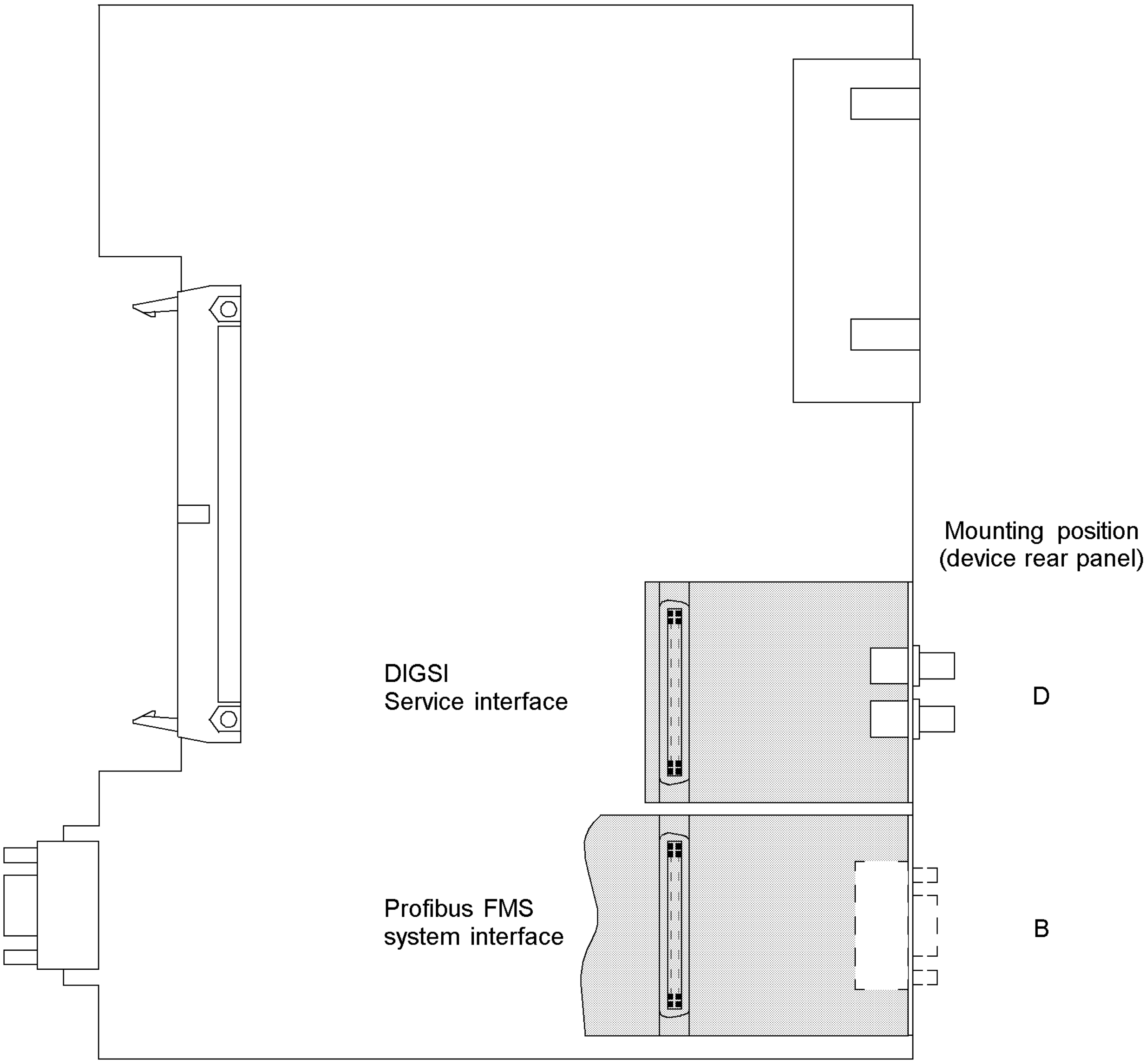


Figure 3-6 Example, CPU processor module with interface modules

Note

Please observe the following: Only interface modules with which the unit can be ordered in accordance with the factory order code (see Appendix) can be used.

Table 3-10 Exchangeable interface modules

Interface	Insertion slot	Replacement module
System interface	B	RS485
		FO 820 nm
		PROFIBUS FMS RS485
		PROFIBUS FMS Single ring
		PROFIBUS FMS Double ring
		PROFIBUS DP RS485
		PROFIBUS DP Double ring
DIGSI® Service interface	D	FO 820 nm

The order numbers of the replacement modules are listed in the Appendix.

Serial interfaces with bus capability

For bus-capable interfaces a termination is necessary at the bus for each last device, i.e. termination resistors must be connected. In the case of the 6MD66, these are variants with RS485 or PROFIBUS interfaces.

The termination resistors are located on the corresponding PROFIBUS interface module, which is located on the CPU processor module or directly on the PCB of the CPU processor module.

On delivery the jumpers are set so that the termination resistors are disconnected. Both jumpers of a module must always be plugged in the same way.

Jumper	Terminating resistor	
	switched ON	switched off
X3	1–2	2–3
X4	1–2	2–3

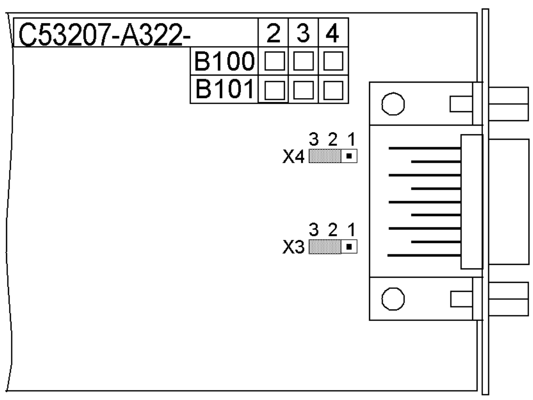


Figure 3-7 Position of the jumpers for configuration of termination resistors of the PROFIBUS FMS and PROFIBUS DP interface

Terminating resistors for the PROFIBUS interface can also be implemented externally (e.g. on the connection module). In this case, the termination resistors provided on the PROFIBUS interface module or directly on the CPU processor module card must be disconnected.

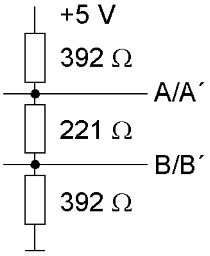


Figure 3-8 Termination of the RS485 interface (external)

Note

The RS485 interface used with this device for the inter relay communication cannot be provided with termination resistors externally as shown in the figure above, as the +5 V voltage is not routed out with this device. The RS485 interface on the processor module can be terminated directly on the processor module (see the CPU module for the jumper setting).

The external termination of the RS485 bus is only possible between the lines A/A' and B/B', each with 120 Ω at the end of the bus. The resulting resistance may not be smaller than 60 Ω.

3.1.2.5 Reassembly

To reassemble the device, proceed as follows:

- Insert the modules carefully in the housing. For the model of the device designed for surface mounting, use the metal lever to insert the CPU processor module. The installation is easier with the lever.
- First, plug the connector of the ribbon cable onto the input/output module I/O and then onto the CPU processor module. Be careful that no connector pins are bent! Don't apply force!
- Insert the plug connector of the ribbon cable between the processor module CPU and the front cover into the socket of the front cover. This action does not apply to the device version with detached operator panel. Instead of this, the connector of the ribbon cable derived from the 68-pin connector on the device rear panel must be plugged on the connector of the processor module CPU. The 7-pin X16 connector belonging to the ribbon cable must be plugged behind the subminiature socket. The plugging position is not relevant in this context as the connection is protected against polarity reversal.
- Press the latches of the plug connectors together.
- Replace the front cover and secure to the housing with the screws.
- Mount the covers.
- Re-fasten the interfaces on the rear of the device housing. This activity is not necessary if the device is designed for surface mounting.

3.1.3 Installation

3.1.3.1 Panel Flush Mounting

- Remove the four covers at the corners and 2 in the centre above and below on the front cover. This exposes the 6 elongated holes in the mounting bracket.
- Insert the device into the panel cut-out and secure with the six screws. Dimensional drawings can be found in the Technical data section.
- Replace the 6 covers.
- Connect the ground on the rear plate of the device to the protective ground of the panel. Using at least one M4 screw. The cross-sectional area of the ground wire must be equal to the cross-sectional area of any other control conductor connected to the device. The cross-section of the ground wire must be at least 2.5 mm ^{2}.
- Connections are realized via the plug terminals or screw terminals on the rear side of the device according to the circuit diagram. When using forked lugs for direct connections or screw terminal, the screws, before having inserted the lugs and wires, must be tightened in such a way that the screw heads are even with the terminal block. A ring lug must be centred in the connection chamber, in such a way that the screw thread fits in the hole of the lug. Section /1/ has pertinent information regarding wire size, lugs, bending radii, etc.

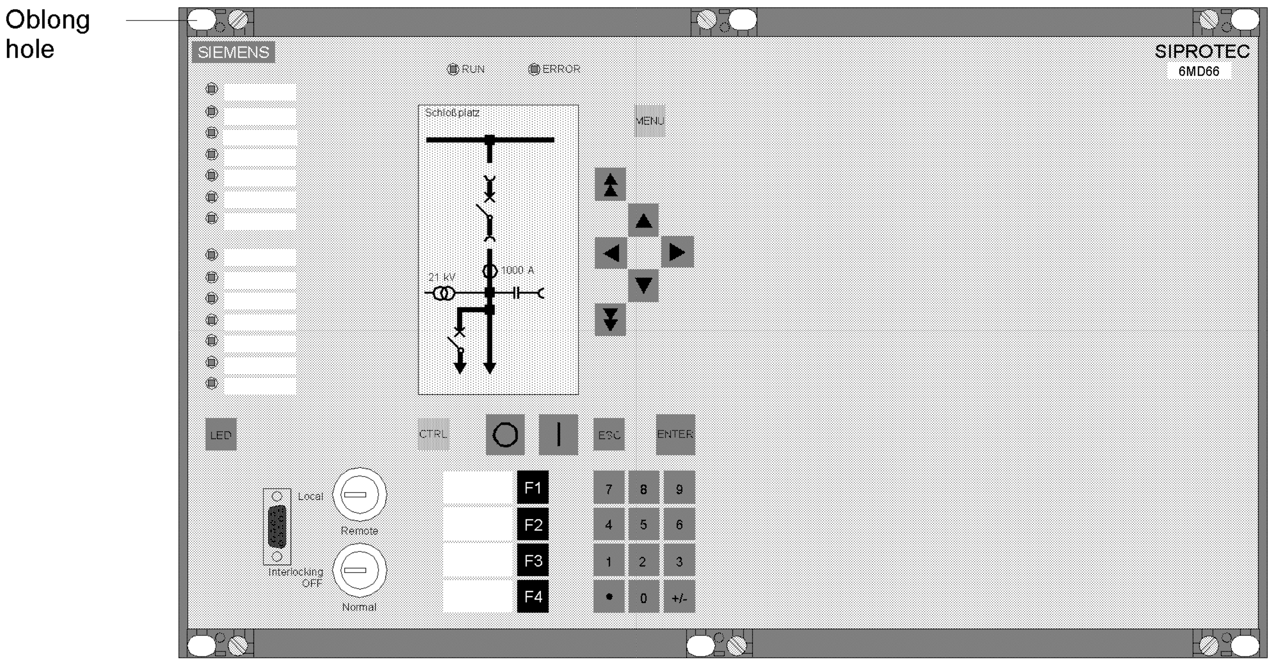


Figure 3-9 Panel flush mounting of a 6MD66

3.1.3.2 Rack Mounting and Cubicle Mounting

To install the device in a frame or cubicle, two mounting brackets are required. The ordering codes are stated in Appendix, Section A.1.

- Loosely screw the two mounting brackets in the rack or cubicle with four screws.

- Remove the four covers at the corners and 2 in the centre above and below on the front cover. This exposes the 6 elongated holes in the mounting bracket.
- Tighten the unit with 6 screws at the angle brackets.
- Reinstall the 6 covers.
- Tighten the mounting brackets to the rack or cubicle using eight screws.
- Connect the ground on the rear plate of the device to the protective ground of the panel. Using at least one M4 screw. The cross-sectional area of the ground wire must be equal to the cross-sectional area of any other control conductor connected to the device. The cross-section of the ground wire must be at least 2.5 mm ^{2}.
- Connections are realised via the plug terminals or screw terminals on the rear side of the device according to the circuit diagram. When using forked lugs for direct connections or screw terminal, the screws, before having inserted the lugs and wires, must be tightened in such a way that the screw heads are even with the terminal block. A ring lug must be centred in the connection chamber so that the screw thread fits in the hole of the lug. The SIPROTEC® System Description /1/ has pertinent information regarding wire size, lugs, bending radii, etc.

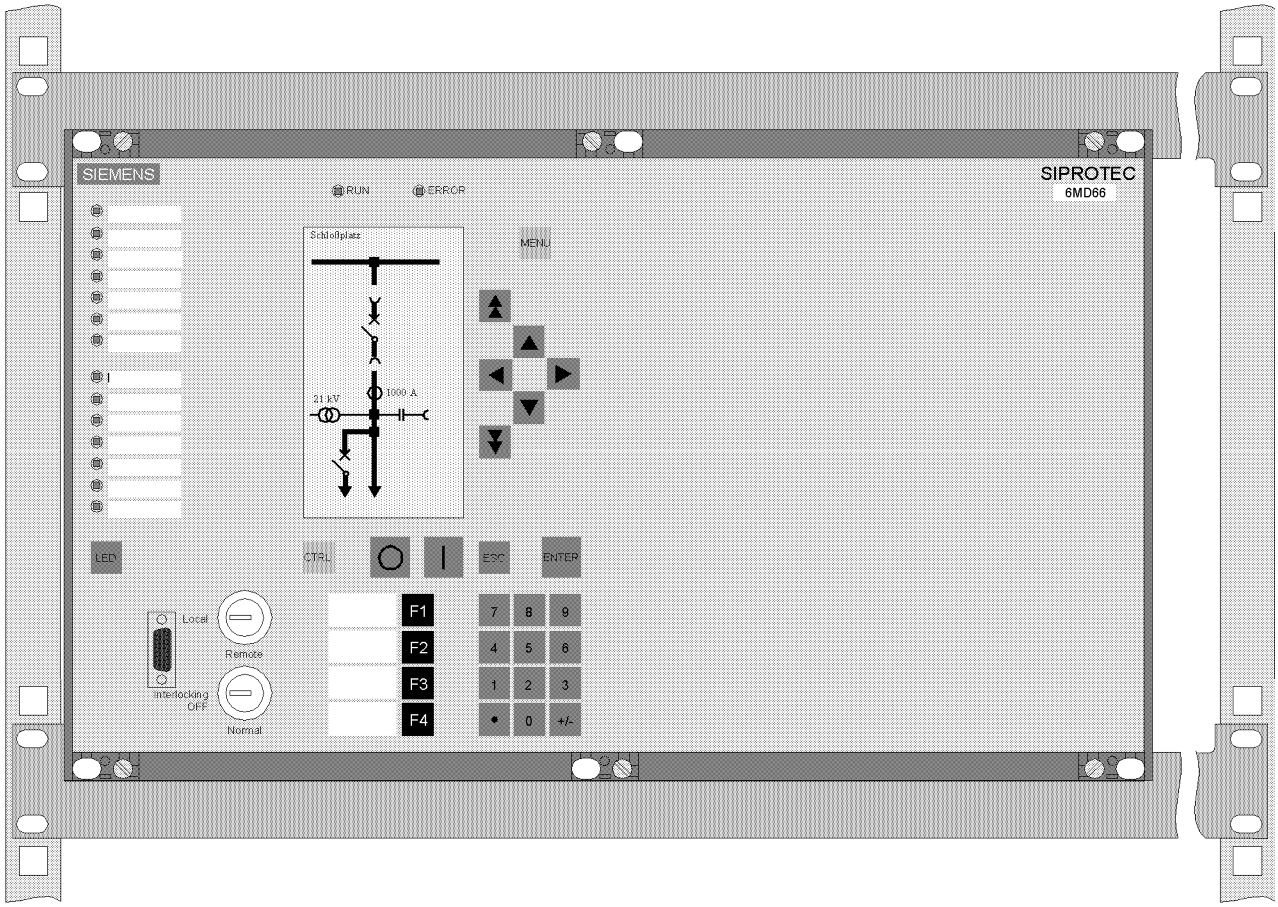


Figure 3-10 Assembly of a 6MD66 in the rack or cabinet

3.1.3.3 Mounting with detached operator panel

Caution!

Be careful when removing or plugging the connector between device and detached operator panel

Non–observance of the following measure can result in property damage. Without the cable the device is not ready for operation!

Do never pull or plug the connector between the device and the detached operator panel during operation while the device is alive!

For mounting the **device** proceed as follows:

- Tighten the device by means of 10 screws. The dimensional drawing can be found in the Technical data section.
- Connect the ground on the rear plate of the device to the protective ground of the panel. Using at least one M4 screw. The cross-sectional area of the ground wire must be equal to the cross-sectional area of any other control conductor connected to the device. The cross-section of the ground wire must be at least 2.5 mm ^{2}.
- Connections are realised via the plug terminals or screw terminals on the rear side of the device according to the circuit diagram. When using forked lugs for direct connections or screw terminal, the screws, before having inserted the lugs and wires, must be tightened in such a way that the screw heads are even with the terminal block. A ring lug must be centred in the connection chamber, in such a way that the screw thread fits in the hole of the lug. The SIPROTEC® System Description /1/ has pertinent information regarding wire size, lugs, bending radii, etc.

For mounting the **operator panel** please observe the following:

- Remove the 4 covers on the corners of the front plate. This exposes the 4 elongated holes in the mounting bracket.
- Insert the operator panel into the panel cut-out and fasten with four screws. The dimensional drawing can be found in the Technical data section.
- Mount the four covers.
- Connect the ground on the rear plate of the operator control element to the protective ground of the panel using at least one M4 screw. The cross-sectional area of the ground wire must be equal to the cross-sectional area of any other control conductor connected to the device. The cross-section of the ground wire must be at least 2.5 mm ^{2}.
- Connect the operator panel to the device. Furthermore, plug the 68-pin connector of the cable belonging to the operator panel into the corresponding connection at the rear side of the device (see SIPROTEC® System Description /1/).

3.1.3.4 Mounting without operator panel

For mounting the **device** proceed as follows:

- Tighten the device by means of 10 screws. The dimensional drawing can be found in the Technical data section.
- Connect the ground on the rear plate of the device to the protective ground of the panel. Using at least one M4 screw. The cross-sectional area of the ground wire

must be equal to the cross-sectional area of any other control conductor connected to the device. The cross-section of the ground wire must be at least 2.5 mm^2.

- Connections are realised via the plug terminals or screw terminals on the rear side of the device according to the circuit diagram. When using forked lugs for direct connections or screw terminal, the screws, before having inserted the lugs and wires, must be tightened in such a way that the screw heads are even with the terminal block. A ring lug must be centred in the connection chamber so that the screw thread fits in the hole of the lug. The SIPROTEC® System Description has pertinent information regarding wire size, lugs, bending radii, etc.

Caution!

Be careful with pulling or plugging the dongle cable

Non–observance of the following measures can result in minor personal injury or property damage:

Do never pull or plug the dongle cable while the device is alive! Without the cable the device is not ready for operation!

The connector of the dongle cable at the device must always be plugged during operation!

For mounting the **D-subminiature connector of the dongle cable** please observe the following:

- Fasten the 9-pin socket of the dongle cable with the accompanying fastening parts according to the following figure (example). The dimensional diagram for the panel or cabinet cut-out can be found in the Technical data section.
- Plug the 68-pin connector of the cable into the corresponding connection at the rear side of the device.

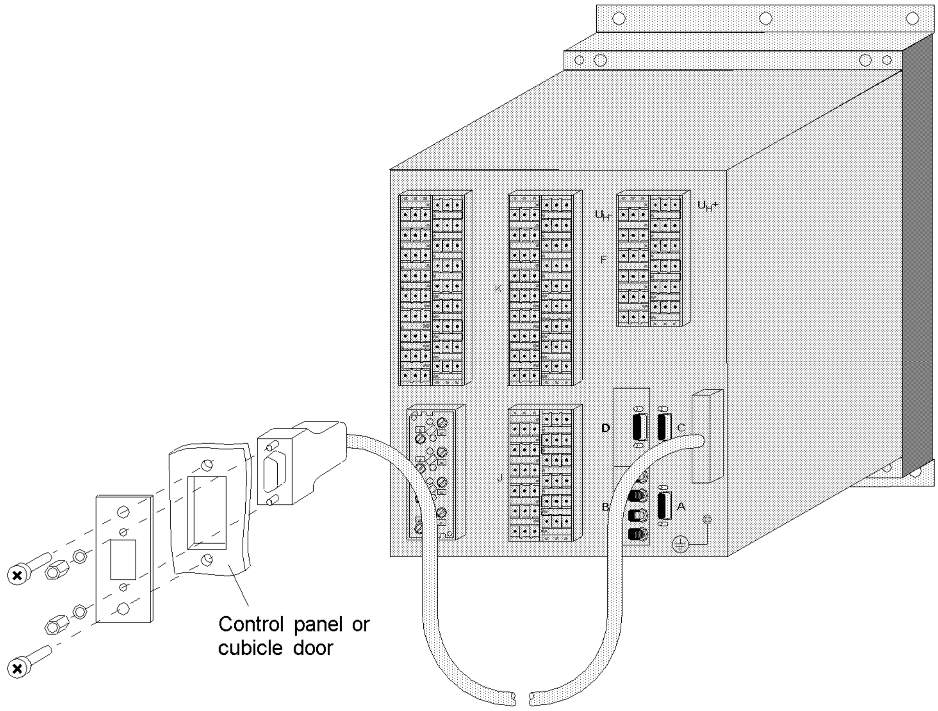


Figure 3-11 Installation of the subminiature socket of the dongle cable in the panel or cabinet door

Note

The dongle cable is included in the scope of delivery of the operator interface.

3.2 Checking Connections

3.2.1 Checking the data connections of the serial interfaces

The following tables list the pin-assignments for the various serial interfaces of the device and the time synchronization interface. The position of the connections can be seen in the following figure.

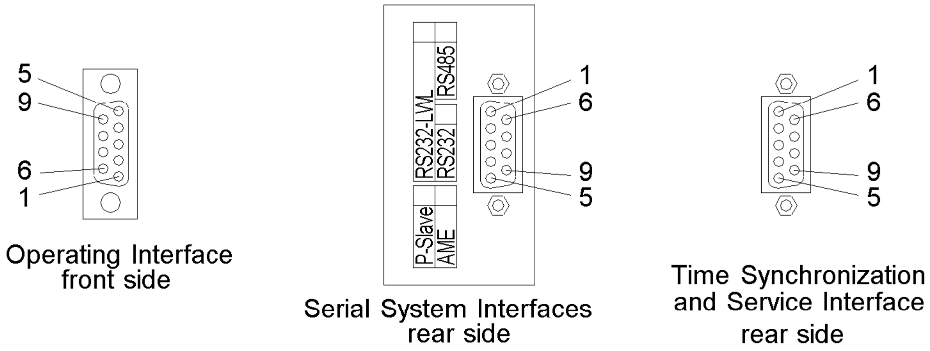


Figure 3-12 9-pin subminiature sockets

3.2.2 Operator interface

When the recommended communication cable is used, correct connection between the SIPROTEC® 4 device and the PC is automatically ensured. See the Appendix, Section A.1 for an ordering description of the cable.

3.2.3 Service / function interface

Check the data connection if the service is used to communicate with the device via hard wiring or a modem. The same applies for the IRC connection.

3.2.4 System interface

When a serial interface of the device is connected to a central substation control system, the data connection must be checked. A visual check of the transmit channel and the receive channel is important. With RS232 and fibre optic interfaces, each connection is dedicated to one transmission direction. The data output of one device must be connected to the data input of the other device, and vice versa.

With data cables, the connections are designated according to DIN 66 020 and ISO 2110:

- TxD = Data output
- RxD = Data input
- $\overline{\text{RTS}}$ = request to send

- $\overline{\text{CTS}}$ = clear to send
- GND = Signal/Chassis Ground

The cable shield is to be grounded at **both** line ends. In areas of extremely strong EMC interferences, the interference immunity factor can be improved by leading the ground wire in a separate shielded pair of strands. The following tables list the assignments of the D-subminiature connector for the various serial interfaces.

Table 3-11 The assignments of the subminiature connector for the various interfaces

Pin No.	Operator interface	RS232	RS485	PROFIBUS FMS Slave, RS485 PROFIBUS DP Slave, RS485
1	–			
2	RxD	RxD	–	–
3	TxD	TxD	A/A' (RxD/TxD-N)	B/B' (RxD/TxD–P)
4	–	–	–	CNTR–A (TTL)
5	GND	GND	C/C' (GND)	C/C' (GND)
6	–	–	–	+5 V (max. load < 100 mA)
7	–	$\overline{\text{RTS}}$	–[1]	–
8	–	$\overline{\text{CTS}}$	B/B' (RxD/TxD–P)	A/A' (RxD/TxD–N)
9	–	–	–	–

[1] Pin 7 also carries the RTS signal with RS232 level when operated as RS485 interface. Pin 7 must therefore not be connected!

3.2.5 Termination

For bus-capable interfaces a termination is necessary at the bus for each last device, i.e. termination resistors must be connected for RS485 or PROFIBUS interfaces.

The termination resistors are located on the RS485 and PROFIBUS interface module, which is located on the CPU processor module.

If the bus is extended, make sure again that only the last device on the bus has the terminating resistors switched-in, and that all other devices on the bus do not.

3.2.6 Time Synchronization Interface

It is optionally possible to process 5 V-, 12 V- or 24 V- time synchronization signals, provided that they are carried to the inputs named in the following table.

Table 3-12 D-subminiature connector assignment of the time synchronization interface

Pin No.	Designation	Signal Meaning
1	P24_TSIG	Input 24 V
2	P5_TSIG	Input 5 V
3	M_TSIG	Return Line
4	– [1]	– [1]
5	Shield	Shield Potential
6	–	–
7	P12_TSIG	Input 12 V
8	P_TSYNC [1]	Input 24 V [1]
9	SHIELD	Shield Potential

[1] assigned, but not used

3.2.7 Optical Fibers

WARNING!

Warning of Laser rays!

Non–observance of the following measure can result in death, personal injury or substantial property damage.

Do not look directly into the fibre-optic elements!

Signals transmitted via optical fibers are unaffected by interference. The fibers guarantee electrical isolation between the connections. Transmit and receive connections are shown with the symbols for transmit and for receive.

The normal setting of the character idle state for the fibre optic cable interface is "Light off". If the character idle state is to be changed, use the operating program DIGSI®, as described in the SIPROTEC® System Description /1/.

3.2.8 Checking system connections

Before the device is energized for the first time, the device should be in the final operating environment for at least 2 hours to equalize the temperature, to minimize humidity and avoid condensation. Connections are checked with the device at its final location. The plant must first be switched off and grounded.

WARNING!

Warning of dangerous voltages

Non-observance of the following measures can result in death, personal injury or substantial property damage.

Therefore, only qualified people who are familiar with and adhere to the safety procedures and precautionary measures shall perform the inspection steps.

Caution!

Be careful when operating the device on a battery charger without a battery

Non-observance of the following measure can lead to unusually high voltages and consequently, the destruction of the device.

Do not operate the device on a battery charger without a connected battery. (Limit values can be found in the technical data).

Proceed as follows in order to check the system connections:

- Protective switches for the power supply and the measured voltages must be opened.
- Check the continuity of all current and voltage transformer connections against the system and connection diagrams:
  - Are the current transformers grounded properly?
  - Are the polarities of the current transformers the same?
  - Is the phase relationship of the current transformers correct?
  - Are the voltage transformers grounded properly?
  - Are the polarities of the voltage transformers correct?
  - Is the phase relationship of the voltage transformers correct?
  - Is the polarity for current input IE correct (if used)?
  - Is the polarity for voltage input UE correct (if used for broken delta winding)?
- The short-circuit feature of the current circuits of the device are to be checked. This may be performed with an ohmmeter or other test equipment for checking continuity.
  - Remove the screws of the front cover
  - Remove the ribbon cable connected to the I/O-5 board and pull the board out until there is no contact between the board and the rear connections of the device.
  - At the terminals of the device, check continuity for each pair of terminals that receives current from the CTs.
  - Firmly re-insert the I/O board. Carefully connect the ribbon cable. Do not bend any connector pins! Do not use force!
  - At the terminals of the device, again check continuity for each pair of terminals that receives current from the CTs.
  - Attach the front panel and tighten the screws.

- Connect an ammeter in the supply circuit of the power supply. A range of about 2.5 A to 5 A for the meter is appropriate.
- Switch on m.c.b. for auxiliary voltage (supply protection), check the voltage level and, if applicable, the polarity of the voltage at the device terminals or at the connection modules.
- The current input should correspond to the power input in neutral position of the device. The measured steady state current should be insignificant. Transient movement of the ammeter merely indicates the charging current of capacitors.
- Remove the voltage from the power supply by opening the protective switches.
- Disconnect the measuring test equipment; restore the normal power supply connections.
- Apply voltage to the power supply.
- Close the protective switches for the voltage transformers.
- Verify that the voltage phase rotation at the device terminals is correct.
- Open the protective switches for the voltage transformers and the power supply.
- Check the trip and close circuits to the power system circuit breakers.
- Verify that the control wiring to and from other devices is correct.
- Check the signalling connections.
- Close the protective switches.

3.3 Commissioning

WARNING!

Warning of dangerous voltages when operating an electrical device

Non–observance of the following measures can result in death, personal injury or substantial property damage.

Only qualified people shall work on and around this device. They must be thoroughly familiar with all warnings and safety notices in this instruction manual as well as with the applicable safety steps, safety regulations, and precautionary measures.

The device is to be grounded to the substation ground before any other connections are made.

Hazardous voltages can exist in the power supply and at the connections to current transformers, voltage transformers, and test circuits.

Hazardous voltages can be present in the device even after the power supply voltage has been removed (capacitors can still be charged).

After removing voltage from the power supply, wait a minimum of 10 seconds before re-energizing the power supply. This wait allows the initial conditions to be firmly established before the device is re-energized.

The limit values given in Technical Data (Chapter 10) must not be exceeded, neither during testing nor during commissioning.

When testing the device with secondary test equipment, make sure that no other measurement quantities are connected and that the TRIP command lines and possibly the CLOSE command lines to the circuit breakers are interrupted, unless otherwise specified.

DANGER!

Hazardous voltages during interruptions in secondary circuits of current transformers

Non–observance of the following measure will result in death, severe personal injury or substantial property damage.

Short-circuit the current transformer secondary circuits before current connections to the device are opened.

For the commissioning switching operations have to be carried out. A prerequisite for the prescribed tests is that these switching operations can be executed without danger. They are accordingly not meant for operational checks.

WARNING!

Warning of dangers evolving from improper primary tests

Non–observance of the following measure can result in death, personal injury or substantial property damage.

Primary test may only be carried out by qualified personnel, who are familiar with the commissioning of protection systems, the operation of the plant and the safety rules and regulations (switching, earthing, etc.).

3.3.1 Test Mode and Transmission Block

Activation and Deactivation

If the device is connected to a central or main computer system via the SCADA interface, then the information that is transmitted can be influenced. This is only possible with some of the protocols available (see Table "Protocol-dependent functions" in the Appendix A).

If **Test mode** is active, then a message sent by a SIPROTEC® 4 device to the main system has an additional test bit. This bit allows the message to be recognized as resulting from testing and not an actual fault or power system event. Furthermore it can be determined by activating the **Transmission block** that no indications at all are transmitted via the system interface during test mode.

The SIPROTEC® System Description /1/ describes how to activate and deactivate test mode and blocked data transmission. Note that when DIGSI® is being used, the program must be in the **Online** operating mode for the test features to be used.

3.3.2 Testing System Ports

Prefacing Remarks

DANGER!

Danger evolving from operating the equipment (e.g. circuit breakers, disconnectors) by means of the test function

Non–observance of the following measure will result in death, severe personal injury or substantial property damage.

Equipment used to allow switching such as circuit breakers or disconnectors is to be checked only during commissioning. Do not under any circumstances check them by means of the testing mode during real operation performing transmission and reception of messages via the system interface.

Note

After termination of this test, the device will reboot. All annunciation buffers are erased. If required, these buffers should be extracted with DIGSI prior to the test.

The interface test is carried out Online using DIGSI®:

- Open the **Online** directory by double-clicking; the operating functions for the device appear.
- Click on **Test**; the function selection appears in the right half of the screen.
- Double-click on **Testing Messages for System Interface** shown in the list view. The dialogue box **Testing System Interface** opens (refer to the following figure).

Structure of the Test Dialogue Box

In the column **Indication** the display texts of all indications are displayed which were allocated to the system interface in the matrix. In the column **Status SETPOINT** the user has to define the value for the messages to be tested. Depending on indication type, several input fields are offered (e.g.Indication coming/ Indication going). By clicking on one of the fields you can select the desired value from the pull-down menu.

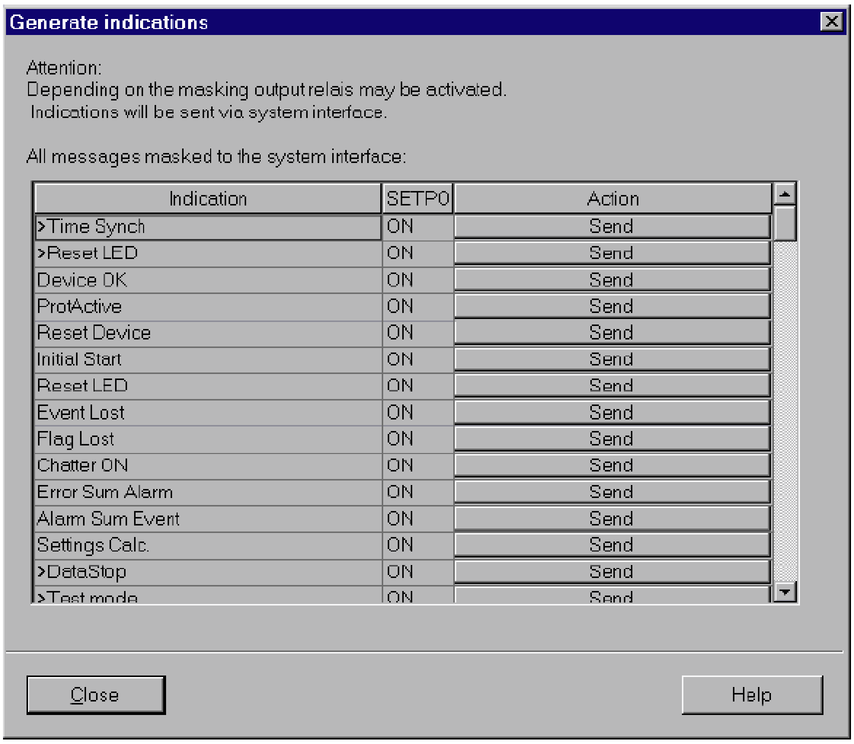


Figure 3-13 System interface test with dialog box: Generate indications — example

Changing the Operating State

Clicking for the first time on one of the field in column **Action** you will be asked for password no. 6 (for hardware test menus). After you have entered the password correctly you now can send the indications individually. To do so, click on the button **Send** on the corresponding line. The corresponding indication is issued and can be read out either from the event log of the SIPROTEC® 4 device or from the substation.

As long as the window is open, further tests can be performed.

Test in Message Direction

For all information that is transmitted to the central station test in **Status Scheduled** the desired options in the list which appears:

- Make sure that each checking process is carried out carefully without causing any danger (see above and refer to DANGER!)
- Click on Send in the function to be tested and check whether the transmitted information reaches the central station and shows the desired reaction. With this procedure the information (beginning with ">”) which is normally coupled via binary inputs is also transmitted to the central station. The function of the binary inputs itself is tested separately.

Exiting the Test Mode

To end the System Interface Test, click on **Close**. The device is briefly out of service while the start-up routine is executed. The dialogue box closes.

Test in Command Direction

The information transmitted in command direction must be indicated by the central station. Check whether the reaction is correct.

3.3.3 Checking the Binary Inputs and Outputs

Prefacing Remarks

The binary inputs, outputs, and LEDs of a SIPROTEC® 4 device can be individually and precisely controlled in DIGSI®. This feature is used to verify control wiring from the device to plant equipment (operational checks), during commissioning. This test feature should not be used while the device is in service on a live system.

DANGER!

Danger evolving from operating the equipment (e.g. circuit breakers, disconnectors) by means of the test function

Non–observance of the following measure will result in death, severe personal injury or substantial property damage.

Equipment used to allow switching such as circuit breakers or disconnectors is to be checked only during commissioning. Do not under any circumstances check them by means of the testing mode during real operation performing transmission and reception of messages via the system interface.

Note

After termination of the hardware test, the device will reboot. All indication buffers are erased. If required, these buffers should be extracted with DIGSI® prior to the test.

The hardware test can be done using DIGSI® in the online operating mode:

- Open the **Online** directory by double-clicking; the operating functions for the device appear.
- Click on **Test**; the function selection appears in the right half of the screen.
- Double-click in the list view on **Hardware Test**. The dialogue box of the same name opens (see the following figure).

Structure of the Test Dialogue Box

The dialog box is divided into three groups: **BI** for binary inputs, **REL** for output relays, and **LED** for light-emitting diodes. On the left of each group is an accordingly labelled button. By double-clicking these buttons you can show or hide the individual information of the selected group.

In the column **Status** the current status of the particular hardware component is displayed. It is displayed symbolically. The actual states of the binary inputs and outputs are displayed by the symbol of opened and closed switch contacts, those of the LEDs by a symbol of a lit or extinguished LED.

The opposite state of each element is displayed in the column **Scheduled**. The display is made in plain text.

The right-most column indicates the commands or messages that are configured (masked) to the hardware components.

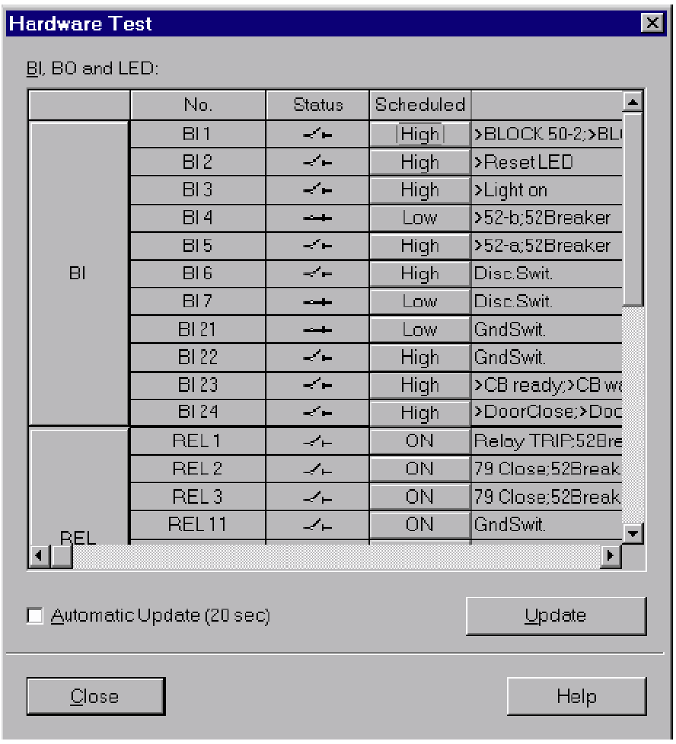


Figure 3-14 Test of the Binary Inputs/Outputs — Example

Changing the Operating State

To change the condition of a hardware component, click on the associated switching field in the **Scheduled** column.

Password No. 6 (if activated during configuration) will be requested before the first hardware modification is allowed. After entry of the correct password a condition change will be executed. Further condition changes remain possible while the dialog box is open.

Test of the Binary Outputs

Each individual output relay can be energized allowing a check of the wiring between the output relay of the 6MD66 and the system, without having to generate the indication that is assigned to the relay. As soon as the first change of state for any one of the output relays is initiated, all output relays are separated from the internal device functions, and can only be operated by the hardware test function. This means, that e.g. a

TRIP command coming from a protection function or a control command from the operator panel to an output relay cannot be executed.

Proceed as follows in order to check the output relay :

- Ensure that the switching of the output relay can be executed without danger (see above under DANGER!).
- Each output relay must be tested via the corresponding **Scheduled**–cell in the dialog box.
- Finish the testing (see margin title below –Exiting the Procedure–), so that during further testings no unwanted switchings are initiated.

Test of the Binary Inputs

To test the wiring between the plant and the binary inputs of the 6MD66 the condition in the plant which initiates the binary input must be generated and the response of the device checked.

To do so, the dialogue box **Hardware Test** must again be opened to view the physical state of the binary inputs. The password is not yet required.

Proceed as follows in order to check the binary inputs:

- Each state in the plant which causes a binary input to pick up must be generated.
- The response of the device must be checked in the **Status**–column of the dialogue box. To do this, the dialogue box must be updated. The options may be found below under the margin heading ”Updating the Display”.
- Finish the testing (see margin heading below "Exiting the Procedure").

If however the effect of a binary input must be checked without carrying out any switching in the plant, it is possible to trigger individual binary inputs with the hardware test function. As soon as the first state change of any binary input is triggered and the password no. 6 has been entered, all binary inputs are separated from the plant and can only be activated via the hardware test function.

Test of the LEDs

The LEDs may be tested in a similar manner to the other input/output components. As soon as the first state change of any LED has been triggered, all LEDs are separated from the internal device functionality and can only be controlled via the hardware test function. This implies that no LED can be switched on anymore by e.g. a protection function or operation of the LED reset key.

Updating the Display

During the opening of the dialog box **Hardware Test** the operating states of the hardware components which are current at this time are read in and displayed.

An update occurs:

- for each hardware component, if a command to change the condition is successfully performed,
- for all hardware components if the **Update**button is clicked,
- for all hardware components with cyclical updating (cycle time is 20 seconds) if the **Automatic Update (20sec)** field is marked.

Exiting the Test Mode

To end the hardware test, click on **Close**. The dialog box closes. The device becomes unavailable for a brief start-up period immediately after this. Then all hardware components are returned to the operating conditions determined by the plant settings.

3.3.4 Testing User-Defined Functions (CFC logic)

The device has a vast capability for allowing functions to be defined by the user, especially with the CFC logic. Any special function or logic added to the device must be checked.

Naturally, general test procedures cannot be given. Rather, the configuration of these user-defined functions and the necessary associated conditions must be known and verified. Possible interlocking conditions of switching devices (circuit breakers, disconnectors, earth switch) are of particular importance. They must be considered and tested.

3.3.5 Trip/Close Tests for the Configured Operating Devices

Control by Local Command

If the configured operating devices were not switched sufficiently in the hardware test already described, all configured switching devices must be switched on and off from the device via the integrated control element. The feedback information of the circuit breaker position injected via binary inputs is read out at the device and compared with the actual breaker position. With 6MD66 this is easy to do with the control display.

The switching procedure is described in the SIPROTEC® System Description /1/. The switching authority must be set in correspondence with the source of commands used. With the switch mode it is possible to select between interlocked and non-interlocked switching. Note that non-interlocked switching constitutes a safety risk.

DANGER!

A test cycle successfully started by the automatic reclosure function can lead to the closing of the circuit breaker!

Non–observance of the following described will result in death, severe personal injury or substantial property damage.

Be fully aware that OPEN-commands sent to the circuit breaker can result in a trip-close-trip event of the circuit breaker by an external reclosing device.

Control from a Remote Control Centre

If the device is connected to a remote substation via a system interface, the corresponding switching tests may also be checked from the substation. Please also take into consideration that the switching authority is set in correspondence with the source of commands used.

3.4 Final Preparation of the Device

Firmly tighten all screws. Tighten all terminal screws, including those that are not used.

Caution!

Inadmissable tightening torques

Non–observance of the following measure can result in minor personal injury or property damage:

The tightening torques must not be exceeded as the threads and terminal chambers may otherwise be damaged!

In case service settings were changed, check if they are correct. Check if power system data, control and auxiliary functions to be found with the configuration parameters are set correctly (Section 2). All desired elements and functions must be set **ON**. Ensure that a copy of the setting values is stored on the PC.

The user should check the device-internal clock and set/synchronise it if necessary, provided that it is not synchronised automatically. Refer to the SIPROTEC® System Description /1/ for more information on this.

The indication buffers are deleted under **MAIN MENU** → **Indications** → **Delete/Set**, so that in the future they only contain information on actual events and states (see also /1/). The counters in the switching statistics should be reset to the values that were existing prior to the testing (see also SIPROTEC® System Description /1/).

Press the `ESC` key, several times if necessary, to return to the default display. The default display appears in the display (e.g. display of operation measured values).

Clear the LEDs on the front panel by pressing the `LED` key, so that they only show real events and states. In this context, also output relays probably memorized are reset. Pressing the `LED` key also serves as a test for the LEDs on the front panel because they should all light when the button is pushed. Any LEDs that are lit after the clearing attempt are displaying actual conditions.

The green ”RUN” LED must be on. The red ”ERROR” LED must not be lit.

Close the protective switches. If test switches are available, then these must be in the operating position.

The device is now ready for operation.

■

Technical Data

4

This chapter provides the technical data of SIPROTEC® 6MD66 device and its individual functions, including the limiting values that under no circumstances may be exceeded. The electrical and functional data for the maximum functional scope are followed by the mechanical specifications with dimensional diagrams.

4.1 General Device Data

4.1.1 Analogue inputs and outputs

Current inputs

Rated system frequency	f_{Nom}	50 Hz or 60 Hz	(adjustable)
Rated current	I_{Nom}	1 A or 5 A	
Burden per phase and ground path			
– at I_{Nom} = 1 A		Approx. 0.05 VA	
– at I_{Nom} = 5 A		Approx. 0.3 VA	
Current overload capability			
– Thermal (rms)		200 A for 1 s 15 A for 10 s 12 A continuous	
– Dynamic (peak value)		250 I_{Nom} (half-cycle)	
Precision		≤ 0.5 % of measured value at 50 % to 120 % $I_{Nom(under\ reference\ conditions)}$	

Voltage inputs

Secondary nominal voltage	80 V to 125 V
Measuring range	0 V to 170 V
Burden at 100 V	Approx. 0.3 VA
Voltage overload capacity	
– Thermal (rms)	230 V continuous
Precision	≤ 0.5 % of measured value at 50 % to 120 % $V_{Nom\ (under\ reference\ conditions)}$

Measuring transducer inputs

Input current	-20 mA DC to +20 mA DC
Overload capability	± 100 mA continuous
Input resistance	10 Ω
Power input	5.8 mW at 24 mA
Precision	< 1 % from rated value (under reference conditions)

Limit range behaviour, current

Overflow	Phase current > 1.2 x rated current The derived quantities P, Q, S, cosΦ, sinΦ and Φ also overflow as a result.

Limit range behaviour, voltage

Overflow	Secondary input voltage at the device > 120 V_{eff} The derived quantities P, Q, S, cosΦ, sinΦ and Φ also overflow as a result.

Limit range behaviour, power

Zero, invalid	A phase voltage < 0.1 x rated voltage or the nominal apparanet power S < 1 %
Overflow	A phase current or a phase-earth voltage in overflow

Limit range behaviour, cosΦ, sinΦ, Φ

Zero, invalid	A phase voltage < 0.1 x rated voltage or the nominal apparanet power S < 1 %
Overflow	A phase current or a phase-earth voltage in overflow

Limit range behaviour, frequency

Zero, invalid	Frequency < 45 Hz or secondary input voltage at device 10 V_{eff}
Overflow	Frequency > 65 Hz

4.1.2 Auxiliary voltage

DC voltage

Voltage supply via integrated AC/DC converter		
Rated auxiliary DC V_A–	24/48 V DC	60 V DC
Permissible voltage ranges	19 to 58 V DC	48 to 72 V DC
Rated auxiliary DC V_A–	110 V DC	220 to 250 V DC
Permissible voltage ranges	88 to 132 V DC	176 to 300 V DC
Superimposed AC ripple voltage, peak to peak, IEC 60 255-11	≤15 % of the auxiliary voltage	
Quiescent power consumption		Approx. 10.0 W
Power consumption plus energised relay		Approx. 0.27 W
Bridging time for failure/short circuit, IEC 60 255-11	≥ 50 ms at V ≥ 110 V DC	
	≥ 20 ms at V ≥ 24 V DC	

4.1.3 Binary inputs and outputs

Binary inputs

Variant	Number	
6MD663*–	50 (configurable)	
6MD664*–	65 (configurable)	
Rated voltage range	24 V DC to 250 V DC, bipolar	
Peak current at high level	80 mA (τ = 1.5 ms)	
Binary input	BI1....6; BI8....19; BI25....36	BI7; BI20....24; BI37
Current consumption, energised (independent of the control voltage)	Approx. 1.8 mA per BI	Approx. 1.8 mA
Pickup times	Approx. 9 ms	Approx. 4 ms

Switching thresholds	adjustable with jumpers	
for rated voltages	24/48/60 V DC	Vpu ≥ 19 V DC Vdo ≤ 14 V DC
for rated voltages	110 V DC	Vpu ≥ 88 V DC Vdo≤ 66 V DC
for rated voltages	220 to 250 V DC	Vpu ≥ 176 V DC Vdo≤ 132 V DC
Maximum permissible voltage	300 V DC	
Impulse filter on input	220 nF at 220 V with recovery time > 60 ms	

Output relays

Flag/command relay[1])	
Number and Information	According to the order variant (allocatable)
Order variant	
6MD663*–	35
6MD664*–	45
Contacts per relay	1 NO contact
Switching capability ON	1000 W/VA [1])
Switching capability OFF	30 VA 40 W resistive 25 W/VA at L/R ≤ 50ms
Switching voltage	250 V
Permissible current per contact / inrush peak	5 A continuous 30 A ≤ 0.5 s
Permissible current per contact On common path	5 A continuous 30 A for 0.5 s
Life contact	1 with 1 NO contact or 1 NC contact (switchable)
Switching capability ON	30 W/VA
Switching capability OFF	20 VA
Switching voltage	250 V
Permissible current	1 A continuous
[1])Maximum permissible number of simultaneously energised relays: 29	

4.1.4 Communications interfaces

Operator Interface

Connection	front side, non-isolated, RS 232, 9 pin DSUB port for connecting a personal computer
Operation	with DIGSI®
Transmission Speed	min. 4 800 Baud; max. 115 200 Baud; factory setting: 38 400 Baud; Parity: 8E1
Maximum Distance of Transmission	49 feet (15 m)

Service / modem interface

	Connection	isolated interface for data transfer
	Operation	with DIGSI®
	Transmission speed	min. 4,800 Baud; max. 115,200 Baud; Factory setting 38 400 Baud
RS232/RS485		RS232/RS485 according to the ordering variant
	Connection for flush-mounted case	Rear panel, slot "C", 9-pin subminiature socket
	Surface-mounting housing	At the housing mounted case on the case bottom; Shielded data cable
	Test voltage	500 V; 50 Hz
RS232	Channel distance	49.215 ft. (15 m)
RS485	Channel distance	3,281 ft. (1,000 m)
Fibre optic cable (FO)	Type of fibre optic cable	ST connector
	Connection for flush-mounted case	Rear panel, mounting location "D"
	For panel surface-mounted case	At the housing mounted case on the case bottom
	Optical wavelength	λ = 820 nm
	Laser Class 1 according to EN 60825–1/–2	Using glass fibre 50/125 μm or using glass fibre 62.5/125 μm
	Permissible link signal attenuation	max. 8 dB, with glass fibre 62.5/125 μm
	Channel distance	max. 0.93 mi. (1.5 km)
	Character idle state	Configurable; factory setting "Light off"

Inter relay communication interface

Transmission speed		
electrical	HDLC	125 KBaud, 250 KBaud, 1 MBaud, 1.25 MBaud
	UART	115 KBaud, 250 KBaud
optical	HDLC	125 KBaud
	UART	500 KBaud
Isolated interface for data transfer		
RS485	Connection for flush-mounted case	Rear panel, slot "C", 9-pin subminiature socket
	Surface-mounting case	At the housing mounted case on the case bottom; Shielded data cable
	Test voltage	500 V; 50 Hz
	Channel distance	3,281 ft. (1,000 m)

System interface

PROFIBUS FMS and PROFIBUS DP		
RS485	Connection for flush-mounted case	Rear panel, slot "E", 9-pin subminiature socket
	For panel surface-mounted case	At the housing mounted case on the case bottom
	Test voltage	500 V; 50 Hz
	Transmission speed	up to 1.5 MBd
	Channel distance	3,281 ft. (1,000 m) at ≤ 93.75 kBd 1,640.5 ft. (500 m) at ≤ 187.5 kBd 656.2 ft. (200 m) at ≤ 1.5 MBd
Fibre optic cable FO	Type of fibre optical connection	ST-connector single ring / double ring according to the order for FMS; for DP only double ring available
	Connection for flush-mounted case	Rear panel, mounting location "E"
	For panel surface-mounted case	In console housing on the case bottom, only RS485 [1)]
	Transmission speed	up to 1.5 MBd
	Recommended:	> 500 kBd with normal casing ≤ 57,600 Bd with detached operator panel
	Optical wavelength	λ = 820 nm
	Laser Class 1 according to EN 60825–1/–2	Using glass fibre 50/125 μm or using glass fibre 62.5/125 μm
	Permissible link signal attenuation	Max. 8 dB, with glass fibre 62.5/125 μm
	Maximum channel distance between two modules with redundant optical ring topology, baud rates ≥ 500 kB/s and glass fibre 62.5/125 μm	6562 ft. (2,000 m) for glass fibre 62.5/125 μm With plastic fibre: 6.562 ft. (2 m) At 500 kB/s, 5,249.6 ft. (1,600 m) At 1,500 kB/s, 1,738.93 ft. (530 m)
IEC 60 870–5–103		
RS485	Isolated interface for data transfer to a master terminal	
	Connection for flush-mounted case	Rear panel, slot "E", 9-pin subminiature socket
	For panel surface-mounted case	At the housing mounted case on the case bottom
	Test voltage	500 V; 50 Hz
	Transmission speed	min. 4,800 Baud; max. 38,400 Baud; Factory setting 38,400 Baud
	Channel distance	max. 0.621 mi. (1 km)

Fibre optic cable (FO)		
	Type of fibre optic cable	ST connector
	Connection for flush-mounted case	Rear panel, mounting location "E"
	For panel surface-mounted case	In console housing on the case bottom, only RS485 [1)]
	Optical wavelength	λ = 820 nm
	Laser Class 1 according to EN 60825–1/–2	When glass fibre used 50/12 μm or when 62.5/125 μm glass fibre is used
	Permissible path attenuation	Max. 8 dB, with glass fibre 62.5/125 μm
	Channel distance	0.93 mi. (1.5 km)
	Character idle state	Configurable; factory setting "Light off"

[1)] Common use of the OLM/G12 (OLM V3) with the optical PROFIBUS interfaces of the SIPROTEC® 4 devices may only use the OLM/G12 in compatibility mode (DIL switch S7 = ON)! The reason for this is the fact that the redundancy technology of the OLM V2 is implemented in the SIPROTEC® PROFIBUS interfaces, and this varies from OLM V3. An OLM V3 behaves in the same manner as an OLM V2 in compatibility mode. With an incorrect setting, secure data transmission cannot be guaranteed.

Time Synchronization Interface

Time Synchronization	DCF 77 / IRIG B–Signal
Connection for flush-mounted case	rear panel, mounting location "A"; 9-pole D-SUB miniature connector
for surface-mounting case	at the double-deck terminal on the case bottom
Signal Nominal Voltages	selectable 5 V, 12 V or 24 V
Signal Levels and Burdens:	

	Nominal Signal Voltage		
	5 V	12 V	24 V
V_{IHigh}	6.0 V	15.8 V	31 V
V_{ILow}	1.0 V at I_{ILow} = 0.25 mA	1.4 V at I_{ILow} = 0.25 mA	1.9 V at I_{ILow} = 0.25 mA
I_{IHigh}	4.5 mA to 9.4 mA	4.5 mA to 9.3 mA	4.5 mA to 8.7 mA
R_I	890 Ω at V_I = 4 V	1930 Ω at V_I = 8.7 V	3780 Ω at V_I = 17 V
	640 Ω at V_I = 6 V	1700 Ω at V_I = 15.8 V	3560 Ω at V_I = 31 V

4.1.5 Electrical Tests

Specifications

Standards:	IEC 60 255 (Product standards) ANSI/IEEE C37.90.0/.1/.2 UL 508 DIN 57 435 Part 303 - for more standards see also individual functions

Insulation Test

Standards:	IEC 60 255-5 and IEC 60 870-2-1
High Voltage Test (routine test) All circuits except power supply, Binary Inputs, Communication Interface and Time Synchronization Interfaces	2.5 kV (rms), 50 Hz
High voltage test (routine test) Auxiliary voltage and binary inputs	3.5 kV DC
High Voltage Test (routine test) Only Isolated Communication and Time Synchronization Interfaces	500 V (rms), 50 Hz
Impulse Voltage Test (type test) All Circuits Except Communication and Time Synchronization Interfaces, Class III	5 kV (peak): 1.2/50 μs: 0.5 Ws: 3 positive and 3 negative impulses in intervals of 5 s

EMC Tests for Immunity (Type Tests)

Standards:	IEC 60 255-6 and -22, (Product standards) EN 50 082-2 (Generic standard) DIN 57 435 Part 303
High Frequency Test IEC 60255-22-1, Class III and VDE 0435 Part 303, Class III	2.5 kV (Peak); 1 MHz; τ = 15 μs; 400 Surges per s; Test Duration 2 s; R_i = 200 Ω
Electrostatic Discharge IEC 60 255-22-2, Class IV and IEC 61 000-4-2, Class IV	8 kV contact discharge; 15 kV air discharge, both polarities; 150 pF; R_i = 330 Ω
Irradiation with HF field, non-modulated IEC 60 255-22-3 (Report), Class III	10 V/m; 27 MHz to 500 MHz
Irradiation with HF field, amplitude modulated IEC 61 000-4-3, Class III	10 V/m; 80 MHz to 1000 MHz; 80 % AM; 1 kHz
Irradiation with HF field, pulse modulated IEC 61 000-4-3/ENV 50 204, Class III	10 V/m; 900 MHz; repetition frequency 200 Hz; duty cycle of 50 %
Fast Transient Disturbance Variables / Burst IEC 60255-22-4 and IEC 61 000-4-4, Class IV	4 kV; 5/50 ns; 5 kHz; Burst length = 15 ms; repetition rate 300 ms; both polarities: R_i = 50 Ω; Test Duration 1 min
High Energy Surge Voltages (SURGE), IEC 61 000–4–5 Installation Class 3	Impulse: 1.2/50 μs
Power Supply Voltage	common mode: 2 kV; 12 Ω; 9 μF diff. mode:1 kV; 2 Ω; 18 μF
Measuring Inputs, Binary Inputs, Relay Outputs	common mode: 2 kV; 42 Ω; 0.5 μF diff. mode: 1 kV; 42 Ω; 0.5 μF
Line Conducted HF, amplitude module. IEC 61 000-4-6, Class III	10 V; 150 kHz to 80 MHz; 80 % AM; 1 kHz
Power System Frequency Magnetic Field IEC 61 000-4-8, Class IV IEC 60 255-6	30 A/m continuous; 300 A/m for 3 s; 50 Hz 0.5 mT; 50 Hz
Oscillatory Surge Withstand Capability ANSI/IEEE C37.90.1	2.5 to 3 kV (peak value); 1 to 1.5 MHz; damped oscillation; 50 surges per s; Test Duration 2 s; R_i = 150 Ω to 200 Ω
Fast Transient Surge Withstand Cap. ANSI/IEEE C37.90.1	4 kV to 5 kV; 10/150 ns; 50 pulses per s; both polarities; Test Duration 2 s; R_i = 80 Ω
Radiated Electromagnetic Interference ANSI/IEEE Std C37.90.2	35 V/m; 25 MHz to 1000 MHz
Damped Oscillations IEC 60,694, IEC 61 000–4–12	2.5 kV (Peak Value), polarity alternating 100 kHz, 1 MHz, 10 MHz and 50 MHz, R_i = 200 Ω

EMC Tests For Noise Emission (type test)

Standard:	EN 50 081–* (Product standards)
Radio Noise Voltage to Lines, Only Power Supply Voltage IEC–CISPR 22	150 kHz to 30 MH Limit Class B
Radio Noise Field Strength IEC–CISPR 22	30 MHz to 1000 MHz Limit Class B
Harmonic Currents on the Network Lead at 230 V AC IEC 61000–3–2	Device is to be assigned Class D; (applies only for devices with > 50 VA power consumption)
Voltage Variations and Flicker on the Network Lead at 230 V AC IEC 61000-3-3	Limits are observed

4.1.6 Mechanical Stress Tests

Vibration and Shock Stress During Operation

Standards:	IEC 60 255–21 and IEC 60 068
Vibration IEC 60255-21-1, Class 2 IEC 60068-2-6	Sinusoidal 10 Hz to 60 Hz: ± 0.075 mm Amplitude; 60 Hz to 150 Hz: 1g acceleration frequency sweep rate 1 Octave/min 20 cycles in 3 orthogonal axes.
Shock IEC 60 255-21-2, Class 1 IEC 60 068-2-27	Half-sine shaped Acceleration 5 g, duration 11 ms, 3 shocks in each direction of 3 orthogonal axes
Seismic Vibration IEC 60 255–21–3, Class 1 IEC 60 068–3–3	Sinusoidal 1 Hz to 8 Hz: ± 3.5 mm Amplitude (horizontal axis); 1 Hz to 8 Hz: ± 1.5 mm Amplitude (vertical axis); 8 Hz to 35 Hz: 1 g acceleration Amplitude (horizontal axis) 8 Hz to 35 Hz:0.5 g acceleration (vertical axis) Frequency Sweep Rate 1 Octave/min 1 cycle in 3 orthogonal axes

Vibration and Shock Stress During Transport

Standards:	IEC 60 255–21 and IEC 60 068
Vibration IEC 60255–21–1, Class 2 IEC 60068–2–6	sinussoidal 5 Hz to 8 Hz: ± 7.5 mm Amplitude; 8 Hz to 15 Hz: 2 g acceleration frequency sweep rate 1 Octave/min 20 cycles in 3 orthogonal axes.
Shock IEC 60 255–21–2, Class 1 IEC 60 068–2–27	Half-sine shaped acceleration 15 g, duration 11 ms, 3 shocks in each direction of 3 orthogonal axes
Continuous Shock IEC 60 255–21–2, Class 1 IEC 60 068–2–29	Half-sine shaped acceleration 10 g, duration 16 ms, 1000 shocks in each direction of 3 orthogonal axes

4.1.7 Climatic stress tests

Temperatures

Standards:	IEC 60255-6
Type tested (acc. IEC 60086-2-1 and -2, Test Bd, for 16 h)	–5 °C to +55 °C

Permissible temporary operating temperature (tested for 96 h)	–20 °C to +70 °C in quiescent state, i.e. no pickup and no indications (legibility of display may be restricted from +131 °F (+55 °C))
Recommended for permanent operation (according to IEC 60 255-6)	+23 °F to +131 °F (–5 °C to +55 °C)
Limiting temperatures for storage	–13 °F to +131 °F (–25 °C to +55 °C)
Limit temperatures during transport	–13 °F to +158 °F (–25 °C to +70 °C)
Storage and transport of the device with factory packaging!	
Limiting temperatures for normal operation (i.e. output relays not energized)	–4 °F to +158 °F (–20 °C to +70 °C)
Limiting temperatures with maximum load (max. cont. permissible input and output quantities)	–23 °F to +104 °F (–5 °C to +40 °C)

Humidity

Permissible humidity	Mean value per year ≤ 75 % relative humidity; on 56 days of the year up to 93 % relative humidity; condensation must be avoided!
Siemens recommends that all devices be installed such that they are not exposed to direct sunlight, nor subject to large fluctuations in temperature that may cause condensation to occur.	

4.1.8 Service Conditions

The protective device is designed for use in an industrial environment and an electrical utility environment. Proper installation procedures should be followed to ensure electromagnetic compatibility (EMC).

In addition, the following is recommended:

- All contacts and relays that operate in the same cubicle, cabinet, or relay panel as the numerical protective device should, as a rule, be equipped with suitable surge suppression components.
- For substations with operating voltages of 100 kV and above, all external cables should be shielded with a conductive shield grounded at both ends. For substations with lower operating voltages, no special measures are normally required.
- Do not withdraw or insert individual modules or boards while the protective device is energized. In withdrawn condition, some components are electrostatically endangered; during handling the EEC standards (standards for **E**lectrostatically **E**ndangered **C**omponents) must be observed. They are not endangered when inserted into the case.

4.1.9 Construction

Case	7XP20
Dimensions	See dimensional drawings, Section 4.8
Weight (maximum number of components) approx.	

6 MD663 in flush-mount case	23.1525 lb. (10.5 kg)
6 MD664 in flush-mount case	24.255 lb. (11 kg)
6 MD663 in case for detachted operator panel	27.5625 lb. (12.5 kg)
6 MD664 in case for detachted operator panel	28.665 lb. (13 kg)
Detached operator panel	5.5125 lb. (2.5 kg)
International protection under IEC 60 529	
For equipment of the flush-mount housing	
Front	IP 51
Rear	IP20
In flush-mount case and in model with detached operator panel	
Front	IP 51
Rear	IP 50
For personal protection	IP 2x with cover cap

4.2 Switchgear control

Number of controlled switchgear units	Depends on the number of binary inputs and outputs available
- 6MD663	2-pin command output: 8 switchgear units 1 $^1/_2$-pin command output: 10 switchgear units
- 6MD664	2-pin command output: 11 switchgear units 1 $^1/_2$-pin command output: 14 switchgear units
Interlocking	Freely programmable interlocking
Indications	Single point, double point, output, tagging and tap indications, bit patterns and counters
Commands	Single command / double command Pulse and continuous outputs
Switching command to circuit breaker	1-, 1$^1/_2$ - and 2-pin
Programmable logic controller	PLC logic, graphic input tool
Local control	Control via menu control, control keys Assignment of function keys
Remote control	Using communication interfaces Using substation automation system (e.g. SICAM) Using DIGSI® (e.g. via Modem)

4.3 Circuit breaker synchronisation

Operating modes	
Test programs	Synchronisation check, live bus / dead line live bus / dead line dead bus and dead line bypassing, or combination of them
Synchronisation	Closing the circuit breaker under synchronous and asynchronous power conditions possible (with circuit breaker operating time)
Voltages	
Maximum working voltage	20 V to 140 V (phase-to-phase) (1 V increments)
V< for dead status V> for live status	1 V to 60 V (phase-to-phase) (1 V increments) 20 V to 125 V (phase-to-phase) (1 V increments)
Tolerances Dropout	2 % of pickup value or 2 V Approx. 0.9 (V>) or 1.1 (V<); max. 1 V
Δ V measurements	
Quantity difference Tolerance	1 V to 40 V (phase-to-phase) (0.1 V increments) 1 V
Synchronous power conditions	
ΔΦ-measurement Tolerance	2 ° to 60 ° (1 ° increments) 2 °
Δf-measurement Tolerance	0.03 Hz to 2.00 Hz (0.01 Hz increments) 15 mHz The maximum permissible frequency difference depends on the circuit breaker operating time
Max. angle error	5 ° for Δf ≤ 2 Hz
Enable delay	0.00 s to 60.00 s (0.01 s increments)
Asynchronous power conditions	
Δf-measurement Tolerance	0.03 Hz to 2.00 Hz (0.01 Hz increments) 15 mHz The maximum permissible frequency difference depends on the circuit breaker operating time
Synchronous/asynchronous limits	0.01 Hz to 0.04 Hz (1 mHz increments)
Circuit breaker operating time	0.01 s to 0.60 s (0.01 s increments)
Times	
Minimum measuring time	Approx. 80 ms

Synchronisation function delay after start	250 ms
Maximum wait time (max. synchronisation duration	0.01 s to 600.00 s (0.01 s increments)
Tolerance of all times	1 % of setting value or 10 ms
Operating range	
Synchrocheck at rated frequency	50 Hz ± 2 Hz 60 Hz ± 2 Hz

4.4 User defined functions (CFC)

Function Modules and Possible Assignments to Task Levels

Function Module	Description	Run-Time Level			
		MW_BEARB (Measured Value Processing)	PLC1_BEARB (Slow PLC)	PLC_BEARB (Fast PLC)	SFS_BEARB (Interlocking)
ABSVALUE	Magnitude calculation	X	–	–	–
ADD	addition	X	X	X	X
AND	AND - Gate	X	X	X	X
BOOL_TO_CO	Boolean to Control (conversion)	–	X	X	–
BOOL_TO_DL	Boolean to Double Point (conversion)	–	X	X	X
BOOL_TO_IC	Bool to internal SI, conversion	–	X	X	X
BUILD_DI	Create Double Point annunciation	–	X	X	X
CMD_CHAIN	Switching sequence	–	X	X	–
CMD_INF	Command information	–	–	–	X
CONNECT	Connection	–	X	X	X
D_FF	D- Flipflop	–	X	X	X
D_FF_MEMO	status memory for restart	X	X	X	X
DI_TO_BOOL	Double Point to Boolean (conversion)	–	X	X	X
DIV	division	X	X	X	X
DM_DECODE	Decode double point	X	X	X	X
DYN_OR	dynamic or	X	X	X	X
LIVE_ZERO		X	–	–	–
LONG_TIMER	Timer (max.1193h)	X	X	X	X
LOOP	Feedback loop	X	X	X	X
LOWER_SETPOINT	Lower limit	X	–	–	–
MUL	multiplication	X	X	X	X
NAND	NAND - Gate	X	X	X	X
NEG	Negator	X	X	X	X
NOR	NOR - Gate	X	X	X	X
OR	OR - Gate	X	X	X	X
RS_FF	RS- Flipflop	–	X	X	X
SQUARE_ROOT	root extractor	X	X	X	X
SR_FF	SR- Flipflop	–	X	X	X
SUB	substraction	X	X	X	X
TIMER	Timer	–	X	X	–
UPPER_SETPOINT	Upper limit	X	–	–	–
X_OR	XOR - Gate	X	X	X	X
ZERO_POINT	Zero supression	X	–	–	–

General Limits

Designation	Limit[1)]	Comments
Maximum number of all CFC charts considering all task levels	32	
Maximum number of all CFC charts considering one task level	16	
Maximum number of all CFC inputs considering all charts	400	
Maximum number of inputs of one chart for each task level (number of unequal information items of the left border per task level)	400	here the number of elements of the left border per task level is counted. Since the same information is indicated at the border several times, only unequal information is to be counted.
Maximum number of switching sequences	20	
Maximum number of time modules	20	corresponds to 18 long timers or 9 universal timers. No test in DIGSI.
Maximum number of reset-resistant flipflops	50	

[1)] When the limit is exceeded, an error message is output by the device. Consequently, the device starts monitoring.

Device-specific limits

Code	Limits [1)]
Maximum number of synchronous changes of chart inputs per task level	50
Maximum number of chart outputs per task level	150

[1)] When the limit is exceeded, an error message is output by the device. Consequently, the device starts monitoring.

General Limits

<table>
<tr><th colspan="5">Additional limits [1)] for the following 4 CFC blocks:</th></tr>
<tr><th>Run-Time Level</th><th colspan="4">Maximum Number of Modules in the Task Levels</th></tr>
<tr><td></td><td>LONG_TIMER</td><td>TIMER</td><td>CMD_CHAIN</td><td>D_FF_MEMO</td></tr>
<tr><td>MW_BEARB (Measured Value Processing)</td><td rowspan="4">18</td><td></td><td></td><td rowspan="4">50</td></tr>
<tr><td>PLC1_BEARB (Slow PLC)</td><td rowspan="2">9</td><td rowspan="2">20</td></tr>
<tr><td>PLC_BEARB (Fast PLC)</td></tr>
<tr><td>SFS_BEARB (Interlocking)</td><td></td><td></td></tr>
</table>

[1)] When the limit is exceeded, an error message is output by the device. Consequently, the device starts monitoring.

Device-specific limits

Maximum number of TICKS [1] on the task levels	
Priority class	**Limit in TICKS**
MW_BEARB (Measured value processing)	3000
PLC1_BEARB (slow PLC processing)	5000
PLC_BEARB (fast PLC processing)	700
SFS_BEARB (interlocking)	3000

1) When the sum of TICKS of all blocks exceeds the limits before-mentioned, an error message is output by CFC.

Processing times in TICKS required by the individual elements

Element		Number of TICKS
Block, basic requirement		5
Each input more than 3 inputs for generic modules		1
Connection to an input signal		6
Connection to an output signal		7
Additional for each chart		1
	CMD_CHAIN	34
	D_FF_MEMO	6
	LOOP	8
	DM_DECODE	8
	DYN_OR	6
	ADD	26
	SUB	26
	MUL	26
	DIV	54
	SQUARE_ROOT	83

4.5 Operating measured values

Operational measured values for currents	I_{L1}; I_{L2}; I_{L3} in A (kA) primary and in A secondary or in % of I_{Nom}
Range	10 % to 120 % I_N
Tolerance	< 1 % of I_{Nom} at | f-f_{Nom} | < 5 Hz and at 10 % to 50 % I_{Nom} < 0.5 % of measured value at | f-f_{Nom} | < 5 Hz and at 10 % to 50 % I_{Nom}
Operational measured values for voltages	$V_{measured}$ in kV primary, in V secondary or in % of V_{Nom}
Range	10 % to 120 % of V_{Nom}
Tolerance	< 1 % of V_{Nom} at | f-f_{Nom} | < 5 Hz and at 10 % to 50 % V_N < 0.5 % of measured value at | f-f_{Nom} | < 5 Hz and at 50 % to 120 % U_{Nom}
Operational measured values for power	S, apparent power in kVAr (MVAr or GVAr) primary and in % of S_{Nom}
Range	50 % to 120 % S/S_{Nom}
Tolerance *)	< 0.5 % of measured value at | f-f_{Nom} | < 5 Hz for V/V_{Nom} and I/I_{Nom} = 50 to 120 %
	P, real power in kW (MW or GW) primary and in % P_{Nom}
Range	For | cos Φ | = 0.707 to 1.00
Tolerance *)	< 0.5 % of measured value at | f-f_{Nom} | < 5 Hz For V/V_{Nom} and I/I_{Nom} = 50 to 120 %
	Q, reactive power in kVAr (MVAr or GVAr) primary and in % of Q_{Nom}
Range	For | sin Φ | = 0.707 bis 1.00
Tolerance *)	< 0.5 % of measured value at | f-f_{Nom} | < 5 Hz For V/V_{Nom} and I/I_{Nom} = 50 to 120 %
Operating measured value for power factor	cos φ
Range	For | cos Φ | = 0.707 to 1.00
Tolerance	< 0.5 % of measured value at | f-f_{Nom} | < 5 Hz For V/V_{Nom} and I/I_{Nom} = 50 to 120 % and at | cos Φ | < 0.707 < ± 0.01 %
Operating measured value for power factor	cos φ
Range	For | cos Φ | = 0.707 to 1.00
Tolerance	< 0.5 % of measured value at | f-f_{Nom} | < 5 Hz For V/V_{Nom} and I/I_{Nom} = 50 to 120 % and at | cos Φ | < 0.707 < ± 0.01 %
Operating measured value for power factor	sin φ
Range	For | sin Φ | = 0.707 to 1.00

Tolerance	< 0.5 % of measured value at | f-f_{Nom} | < 5 Hz For V/V_{Nom} and I/I_{Nom} = 50 to 120 % and at | sin Φ | < 0.707 < ± 0.01 %
Operational measured values for angles	φ in °
Tolerance	< ± 0.5 °
Operational measured values for frequency	f in Hz
Range	± 20 mHz at V/V_{Nom} = 10 to 120 % and at f = f_{Nom} ± 5 Hz
Tolerance	20 mHz
Measuring transducer limit range behaviour	
Current, overflow range	Phase current > 1.2 I_{Nom} The derived quantities P, Q, C, sinφ, cos φ and φ are then invalid
Voltage, overflow range	Voltage > 1.2 I_{Nom} The derived phase-phase voltages and quantities P, Q, C, sinφ, cos φ and φ are then invalid
Power, zero range, are invalid	P, Q, S A phase voltage < 0.1V_{Nom} or the nominal apparanet power S < 1 %
Power, overflow range	A phase current or a phase-earth voltage in overflow
Phase angle, zero range, are invalid	sin φ, cos φ, and φ A phase voltage < 0.1V_{Nom} or the nominal apparanet power S < 1 %
Frequency, zero range, is invalid	f < 45 Hz or a phase voltage < 0.1V_{Nom}
Frequency, overflow range	f > 65 Hz
Measured values, technical data of the 20 mA inputs	
Rated input current	- 20 to 20 mA –
Measuring range	- 24 to 24 mA –
Input resistance	1 Ω ± 1 %
Active power input	5.76 W at I_{Nom} = 24 mA
Tolerance	1.0 %, relative to rated value of 20 mA
Metered values as binary pulses	
Max. metered frequency	50 Hz
Metered values calculated from current and voltage	
Precision	< 0.5 % of measured value at | f-f_{Nom} | < 5 Hz and at 50 % to 120 % V_{Nom} or at 50 % to 120 % I_{Nom}
*) Tolerance values apply to system frequency 50 Hz; with system frequency 60 Hz < 1%	

4.6 Inter relay communication

Number of users in the IRC combination	Max. 16
Number of information items which each IRC user can apply to the IRC bus	Max. 32
Minimum appearance duration for indications which are to be transferred via inter relay communication	20 ms (due to IRC cycle time)

4.7 Auxiliary functions

Time Stamping

Resolution for Event Log	1 ms
Maximum Time Deviation (Internal Clock)	0.01 %
Battery	Lithium battery 3 V/1 Ah, type CR 1/2 AA Message "Fail Battery" if battery changes is low

Commissioning aids

	Operational measured values Switching device test

Clock

Time Synchronization		DCF 77 / IRIG B-Signal Binary input Communication
Operating Modes for Time Tracking		
No.	Operating Mode	Explanations
1	Internal	Internal synchronization using RTC (presetting)
2	IEC 60870-5-103	External synchronization using system interface (IEC 60 870–5–103)
3	PROFIBUS FMS	External synchronization using PROFIBUS inter-face
4	Time signal IRIG B	External synchronisation via IRIG B (telegram format IRIG_B000)
5	Time signal DCF77	External synchronization using DCF 77
6	Time signal Sync. Box	External synchronization using SIMEAS Sync. Box
7	Pulse via binary input	External synchronization with pulse via binary input

4.8 Dimensions

4.8.1 Flush-mount and cabinet installation

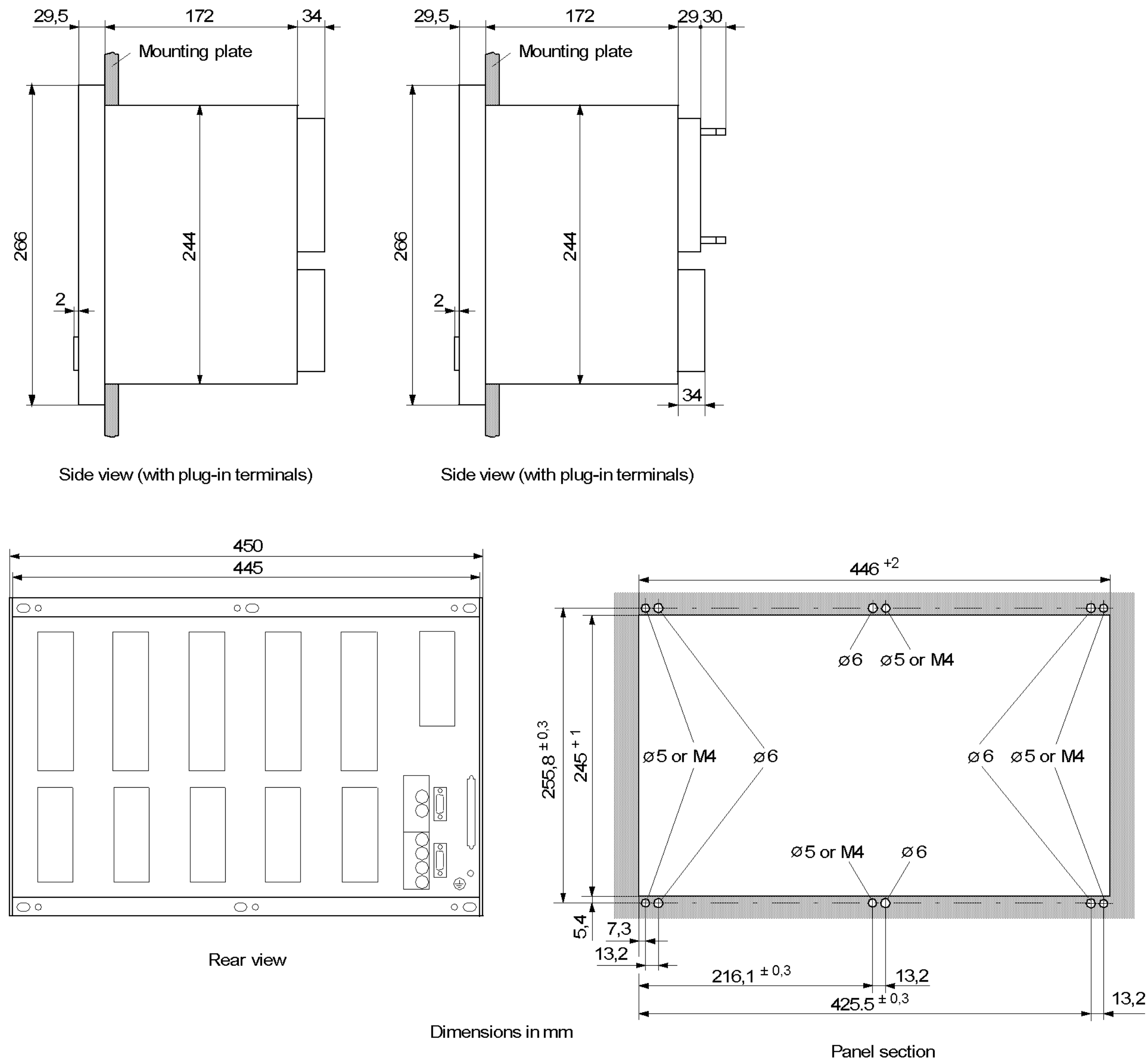


Figure 4-1 Dimensional drawing of a 6MD66 for panel surface and cabinet mounting

4.8.2 Mounting with detached operator panel or without operator panel

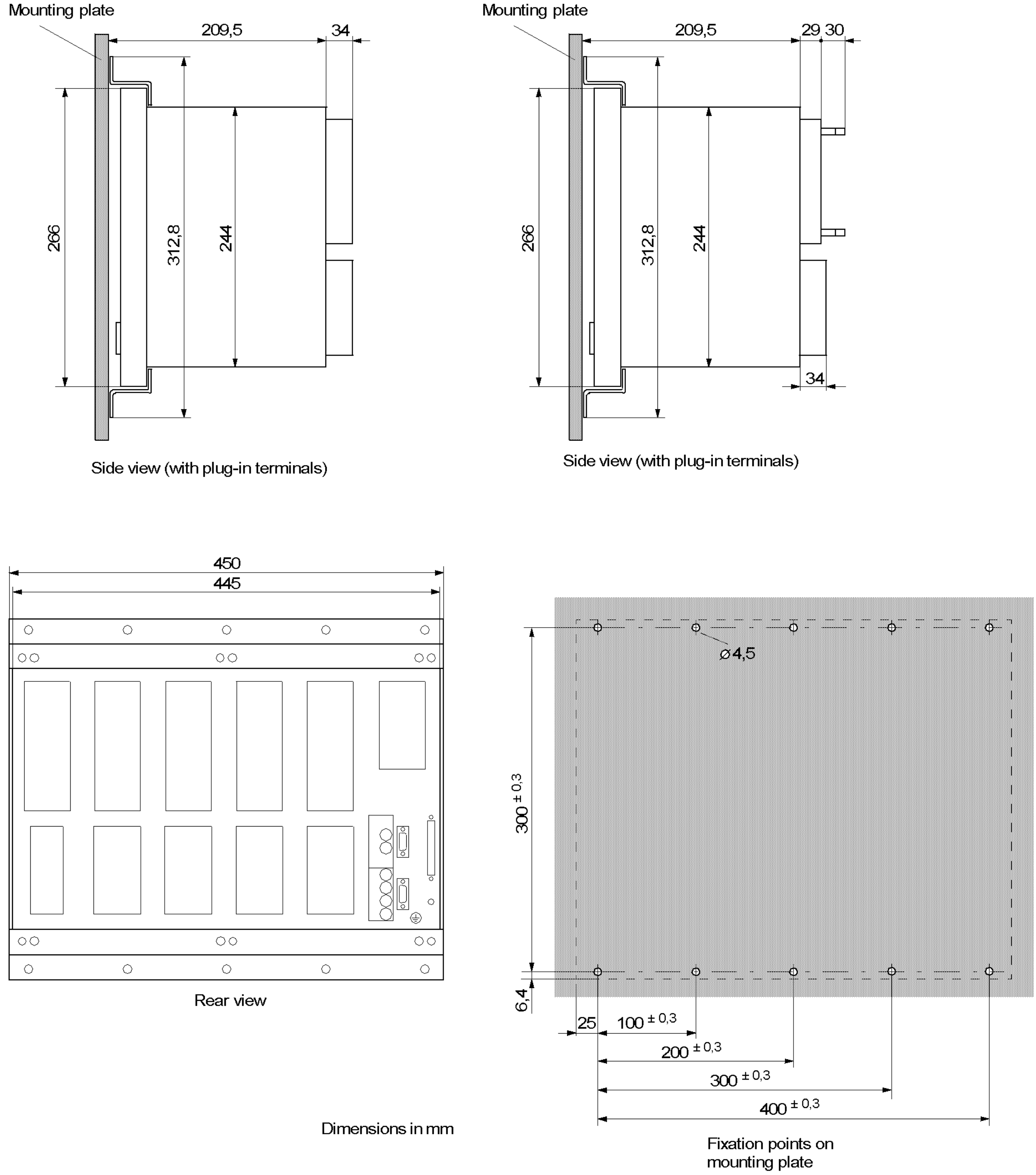


Figure 4-2 Dimensional drawing of a 6MD66 for surface mounting with/without operator control unit

4.8.3 Detached Operator Panel

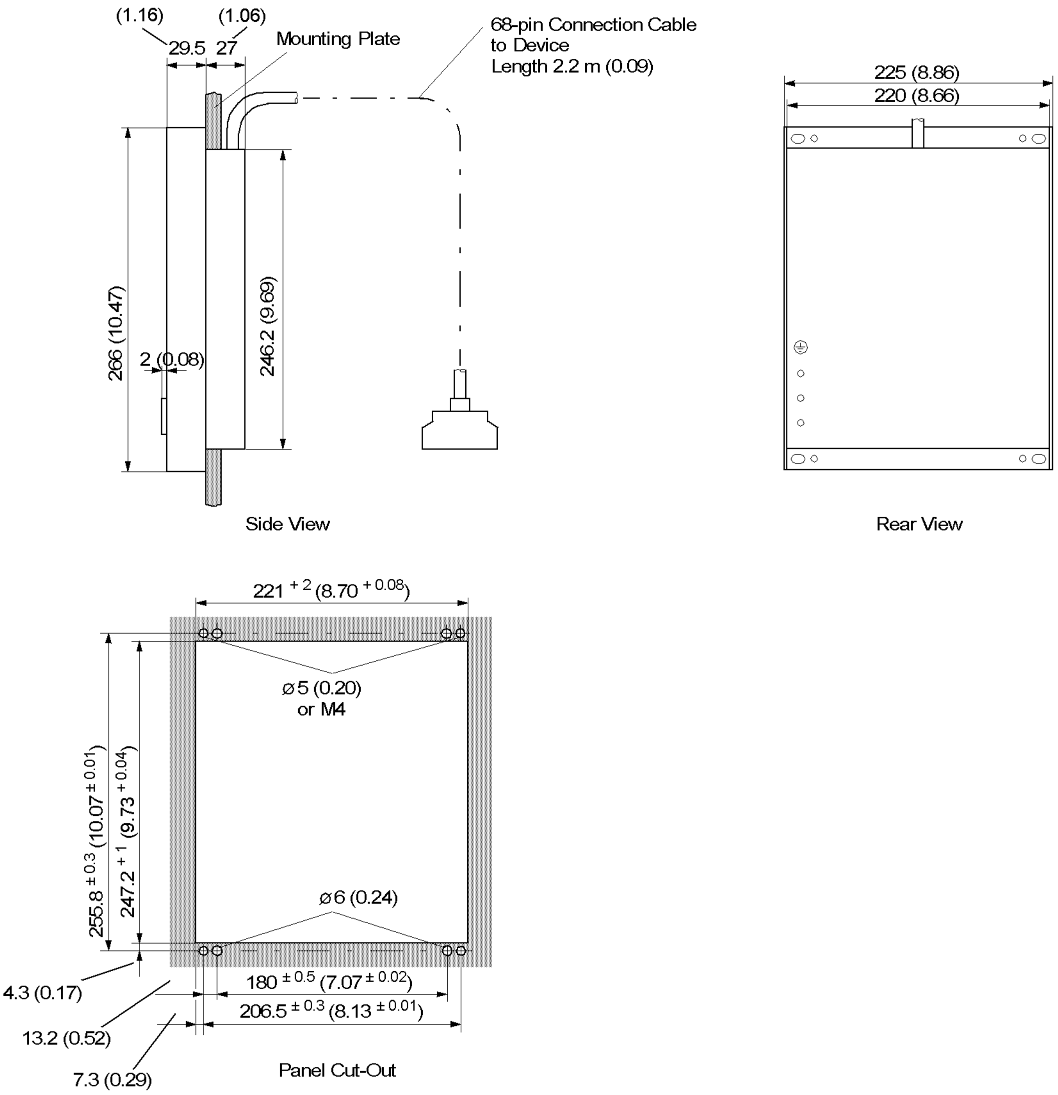


Figure 4-3 Dimensional drawing of a detached operator panel

4.8.4 D-SUB miniature Connector of Dongle Cable (Panel Flush or Cubicle Door Cutout)

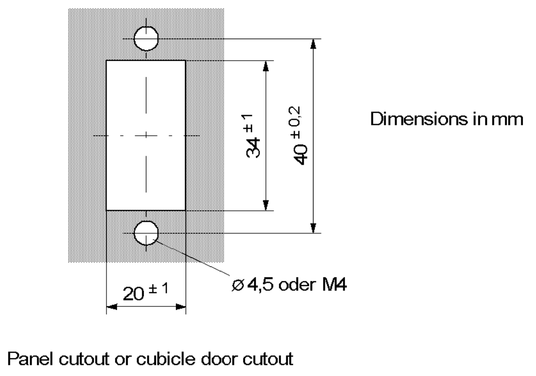


Figure 4-4 Dimensions of panel flush or cubicle door cutout of D-SUB miniature connector of dongle cable

■

Appendix A

This appendix is primarily a reference for the experienced user. This section provides ordering information for the models of this device. General diagrams indicating the terminal connections of the models of this device are included. Following the general diagrams are diagrams that show the proper connections of the devices to primary equipment in many typical power system configurations. Tables with all settings and all information available in this device equipped with all options are provided. Default settings are also given.

A.1 Ordering Information and Accessories

A.1.1 Ordering Information

A.1.1.1 6MD66 V 4.2

						6	7		8	9	10	11	12		13					17	18	19
High-voltage bay controller	6	M	D	6	6			-						-		A	A	0	+	L		

Equipment	Item 6
50 single point indications 32 one-pole single commands (can also be compiled with double-pole commands and double commands) Three current transformers, four voltage transformers, two measurement inputs 20 mA	3
65 single point indications 42 one-pole single commands (can also be compiled with double-pole commands and double commands) Three current transformers, four voltage transformers, two measurement inputs 20 mA	4

Rated current	Item 7
I_{Nom} = 1 A	1
I_{Nom} = 5 A	5

Power Supply, Binary Input Pickup Threshold Setting	Item 8
24 to 48 V DC, Binary Input Threshold 17 V [1)]	2
60 V DC, Binary Input Threshold 17 V [1)]	3
110 V DC, Binary Input Threshold 73 V [1)]	4
220 to 250 V DC, Binary Input Threshold 154 V [1)]	5

Construction	Item 9
Surface-mounting case, detached operator panel, installation in a low-voltage compartment Plug-in terminals (2/3 pin connectors)	A
Surface-mounting case, no operator panel, installation in a low-voltage compartment Plug-in terminals (2/3 pin connectors)	B
Surface-mounting case, detached operator panel, installation in a low-voltage compartment Screw-type terminals (direct connection / ring and spade lugs)	C
Flush mounted case with integrated local operation (graphic display, keyboard) Plug-in terminals (2/3 pin connectors)	D

Construction	Item 9
Flush mounted case with integrated local operation (graphic display, keyboard) Screw-type terminals (direct connection / ring and spade lugs)	E
Surface-mounting case, no operator panel, installation in a low-voltage compartment, screw-type terminals (direct connection / ring and spade lugs)	F

Region-specific Default / Language Settings and Function Versions	Item 10
Region DE, 50 Hz, IEC, Language German (Language can be changed)	A
Region World, 50/60 Hz, IEC/ANSI, Language English (Language can be changed)	B
Region US, 60 Hz, ANSI, Language American English (Language can be changed)	C

System Interface (Rear Side, Port B)	Item 11
IEC-Protocol, electrical RS485	2
IEC-Protocol, Optical, 820 nm, ST-Connector	3
PROFIBUS FMS Slave, electrical RS485	4
PROFIBUS FMS Slave, Optical, Single ring, ST-Connector	5
PROFIBUS FMS Slave, Optical, Double ring, ST-Connector	6
For further interface options see Additional Information L	9

Service/Function interface (back of device, interface C and D)	Item 12
No DIGSI interface at the back	0
DIGSI/Modem, electrical RS232, interface C:	1
DIGSI/Modem, electrical RS458, interface C:	2
DIGSI/Modem, Optical 820 nm, ST-Connector, interface D:	3
Inter relay communication, electrical RS458, interface C:	4
Inter relay communication, electrical RS458, interface C and DIGSI, optical 820 nm, ST-Connector, interface D:	5

Additional information L on further system interfaces (device rear) (only if item 11 = 9)	Item 17	Item 18	Item 19
PROFIBUS DP Slave, RS485	L	0	A
PROFIBUS DP Slave, 820 nm, Optical double ring, ST-Connector	L	0	B

[1] The thresholds can be changed between 17 V, 73 V and 154 V for each indication input

A.1.2 Accessories

Exchangeable interface modules

Name	Order No.
RS485	C73207-A322-D632-1
FO 820 nm	C73207-A322-D633-1
PROFIBUS FMS RS485	C73207-A322-D601-1
PROFIBUS FMS Double ring	C73207-A322-D602-1
PROFIBUS FMS Single ring	C73207-A322-D603-1

Optical Link Module (OLM)

Name	Order No.
Optical Link Module	6GK1502-3CB10
Power supply 24 V DC for OLM	7XV5810-0BA00

Cover caps

Covering cap for terminal block type	Order No.
18-pin voltage terminal, 12-pin current terminal	C73334-A1-C31-1
18-pin voltage terminal, 12-pin current terminal	C73334-A1-C32-1

Short-circuit links

Covering cap for terminal type	Order No.
18-pin/12-pin voltage terminal	C73334-A1-C34-1
12-pin/8-pin voltage terminal	C73334-A1-C33-1

Socket housing

Socket housing	Order No.
2-pin	C73334-A1-C35-1
3-pin	C73334-A1-C36-1

Mounting Rails for 19"-Racks

Name	Order No.
Angle Strip (Mounting Rail)	C73165-A63-C200-2

Battery

Lithium battery 3 V/1 Ah, type CR 1/2 AA	Order No.
VARTA	6127 501 501
SONNENSCHEIN	1110 150 301

Interface Cable

Interface cable between PC and SIPROTEC	Order No.
Cable with 9-pin male/female connections	7XV5100-4

Round cable assembly, 3-pin

Name	Order No.
Round cable assembly, 3-pin	C73195-A100-B65-1

DIGSI operating software

DIGSI protection operation and configuration software	Order No.
DIGSI, basic version with licenses for 10 computers	7XS5400-0AA00
DIGSI, complete version with all option packages	7XS5402-0AA00

Display Editor

Software for creating basic and mimic control pictures (option package of the complete version of DIGSI)	Order No.
Display Editor 4; Full version with license for 10 PCs	7XS5420-0AA0

Graphic Tools

Graphic Tools	Order No.
Full version with licenses for 10 computers	7XS5430-0AA0

DIGSI REMOTE 4

Software for remotely operating protective devices via a modem (and possibly a star connector) using DIGSI (option package of the complete version of DIGSI)	7XS5440-1AA0

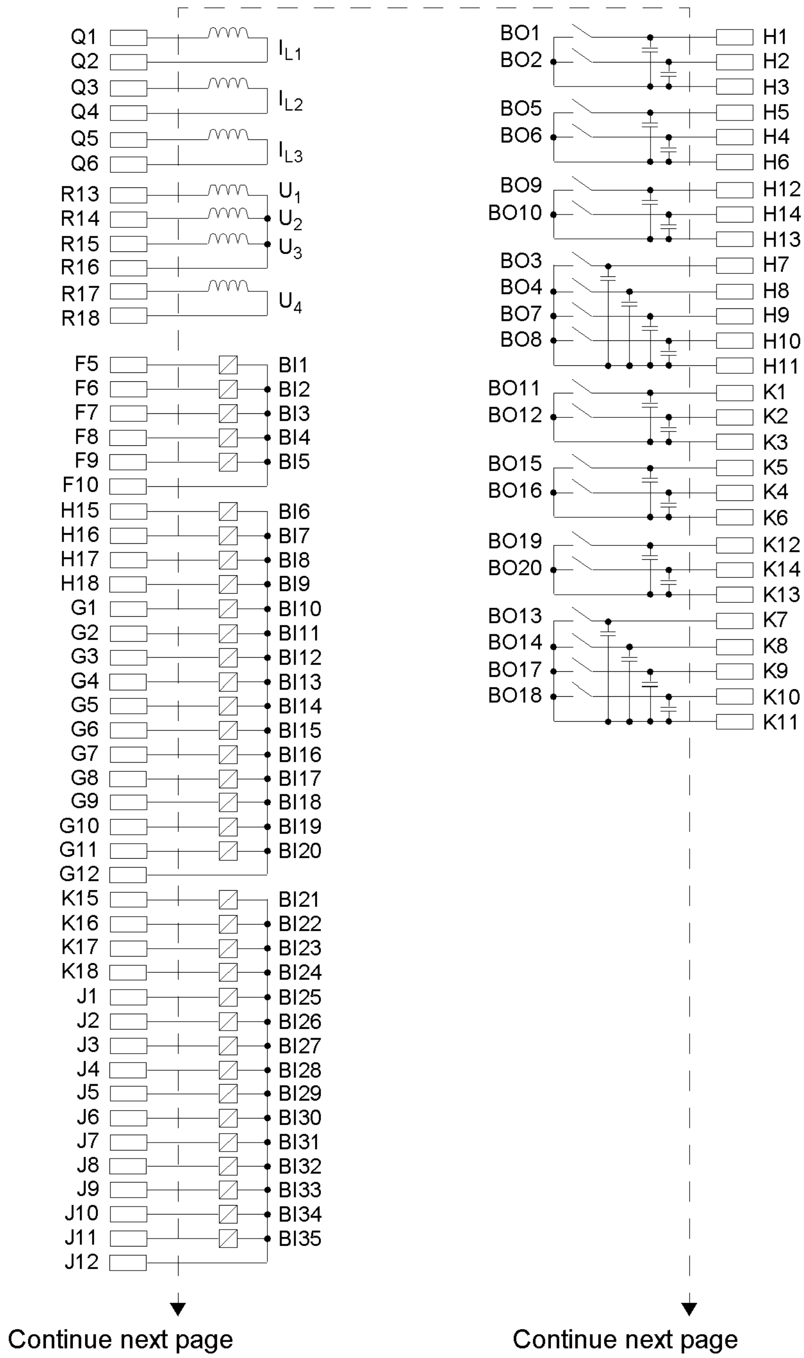
SIMATIC CFC 4

Graphical software for setting interlocking (latching) control conditions and creating additional functions (option package of the complete version of DIGSI)	7XS5450-0AA0

A.2 Terminal Assignments

A.2.1 Panel Flush Mounting or Cabinet Mounting

6MD663*-*D/E
(Page 1)



6MD663*-*D/E (Page 2)

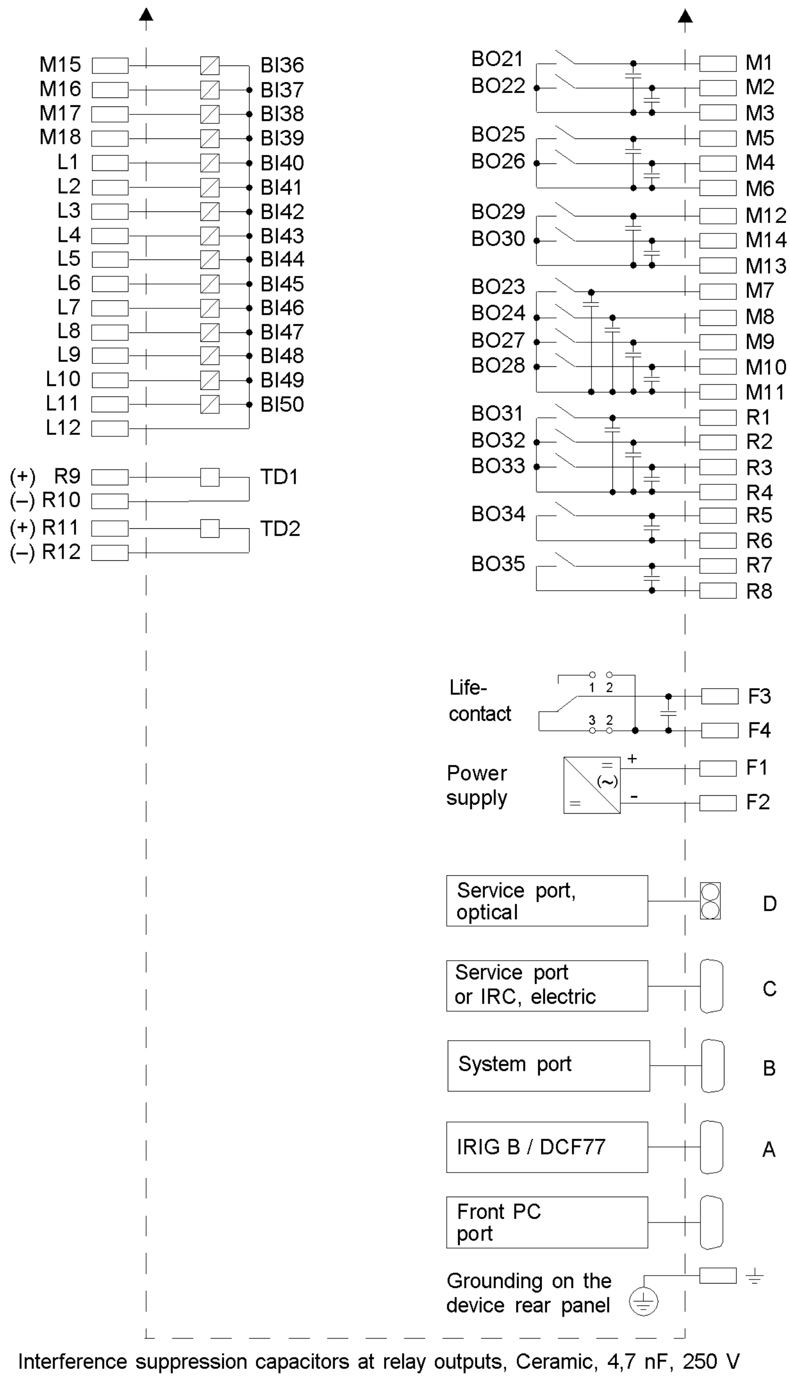
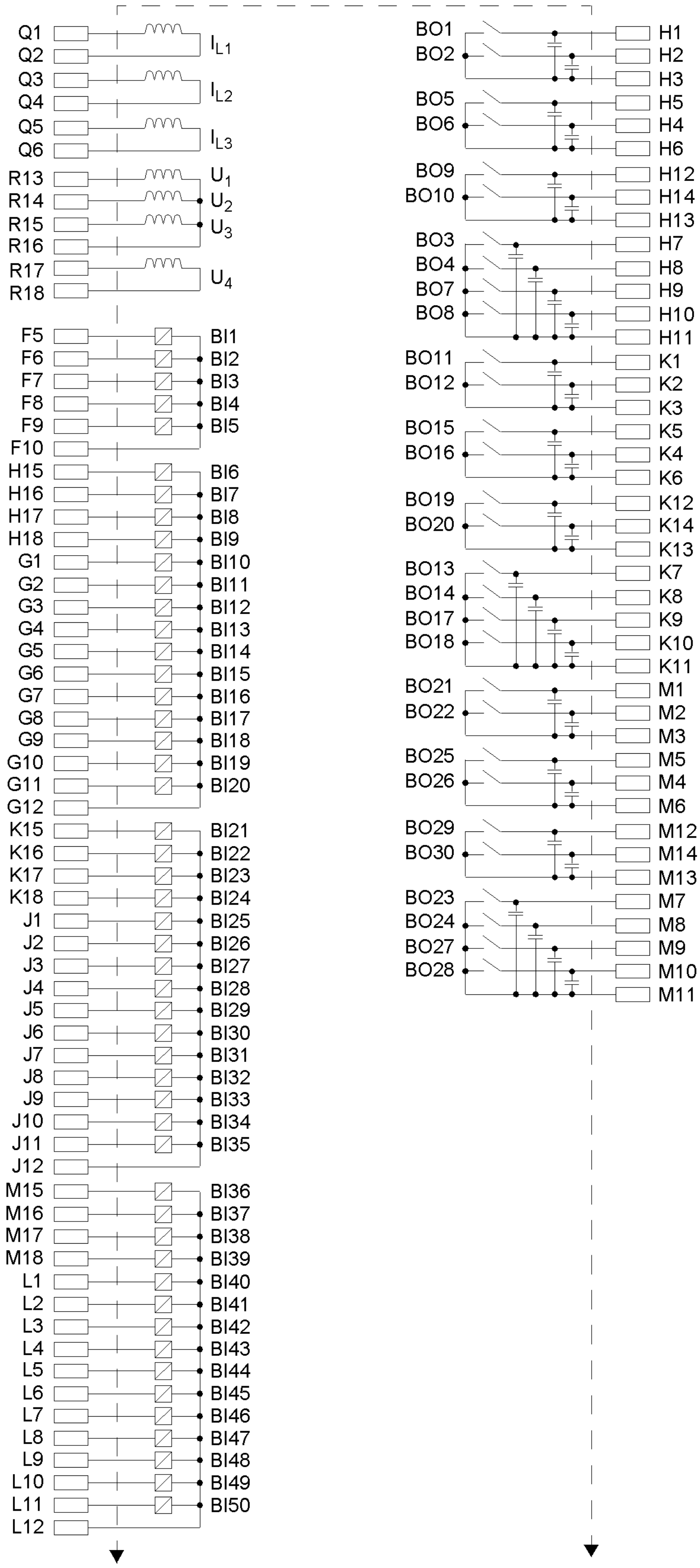


Figure A-1 General diagram 6 MD663*-*D/E (panel flush mounted or cabinet mounted)

6MD664*-*D/E (Page 1)



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6MD664*-*D/E
(Page 2)

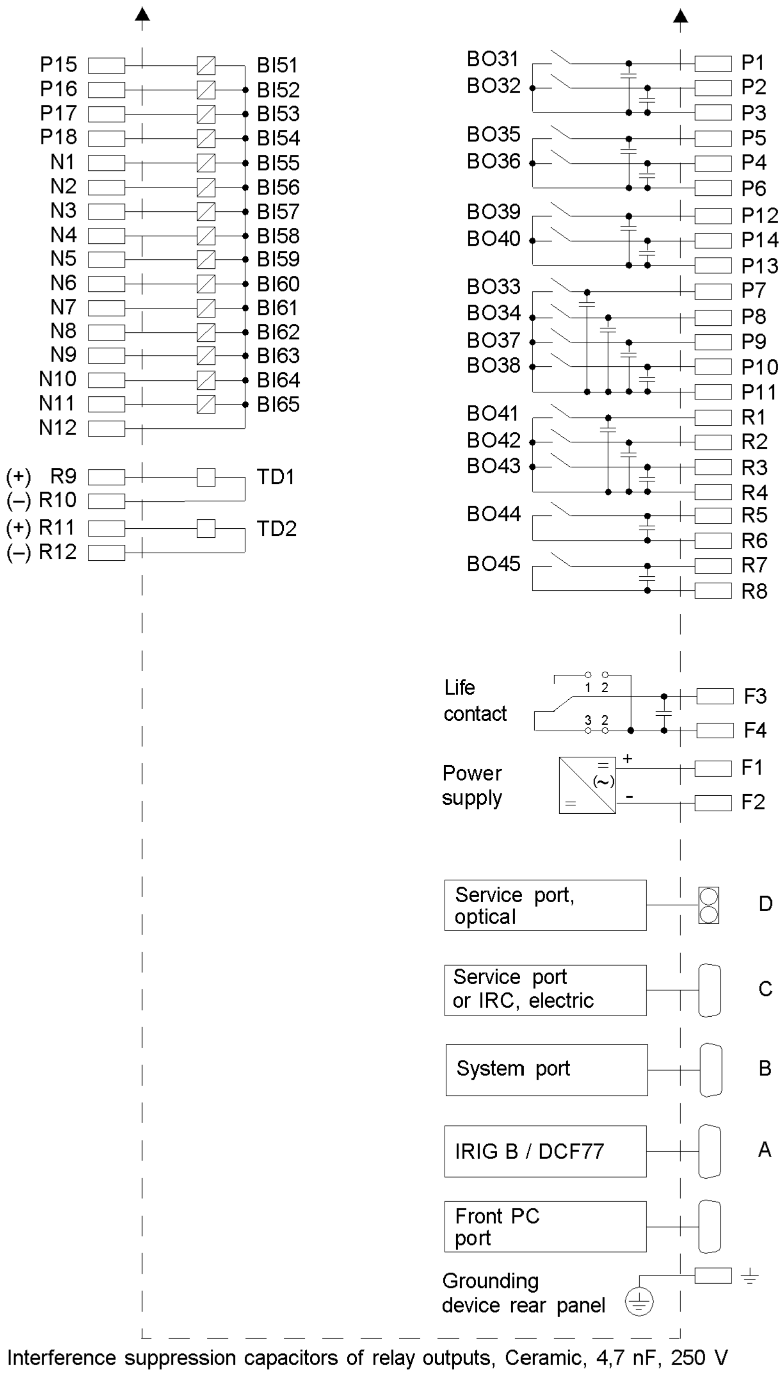
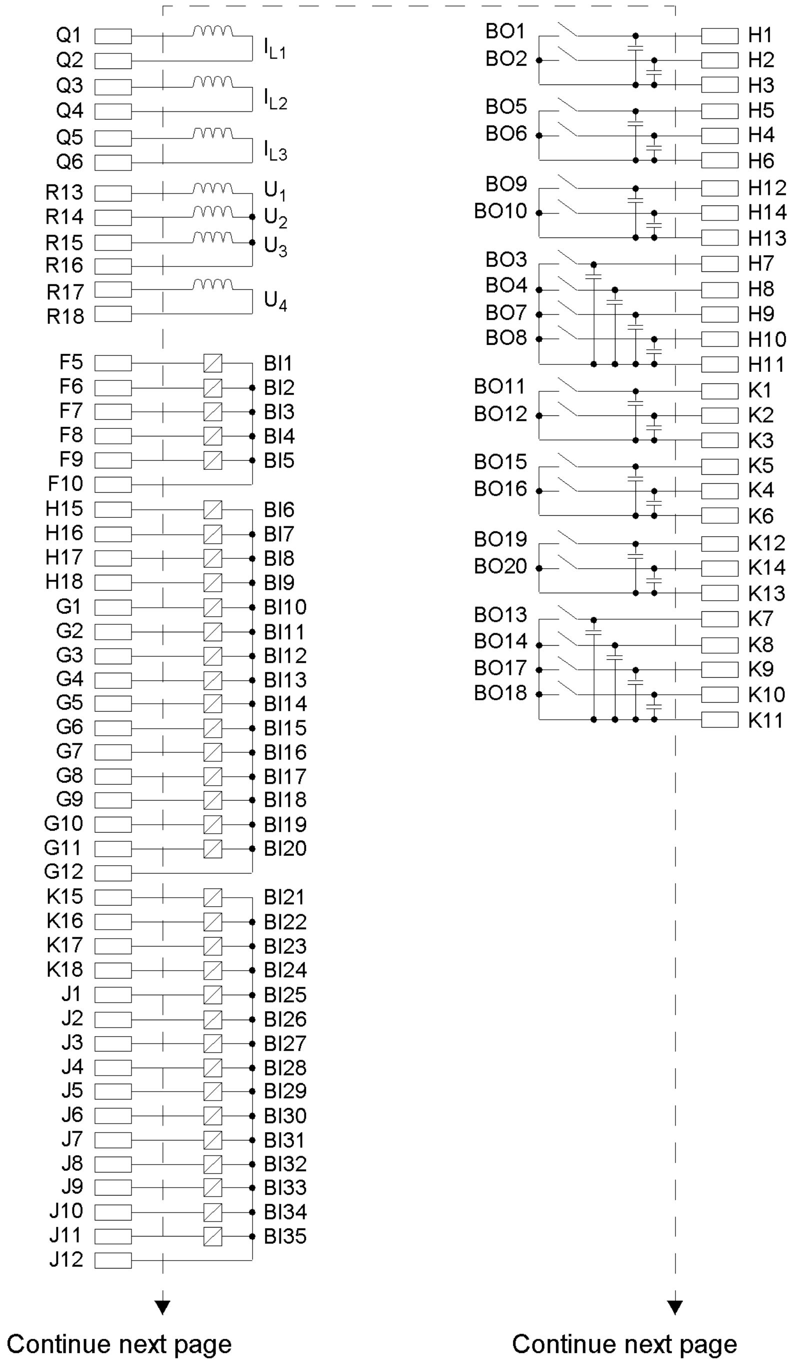


Figure A-2 General diagram 6 MD664*-*D/E (panel flush mounted or cabinet mounted)

A.2.2 Housing with Detached Operator Panel

6MD663*-*A/C (Page 1)



6MD663*-*A/C (Page 2)

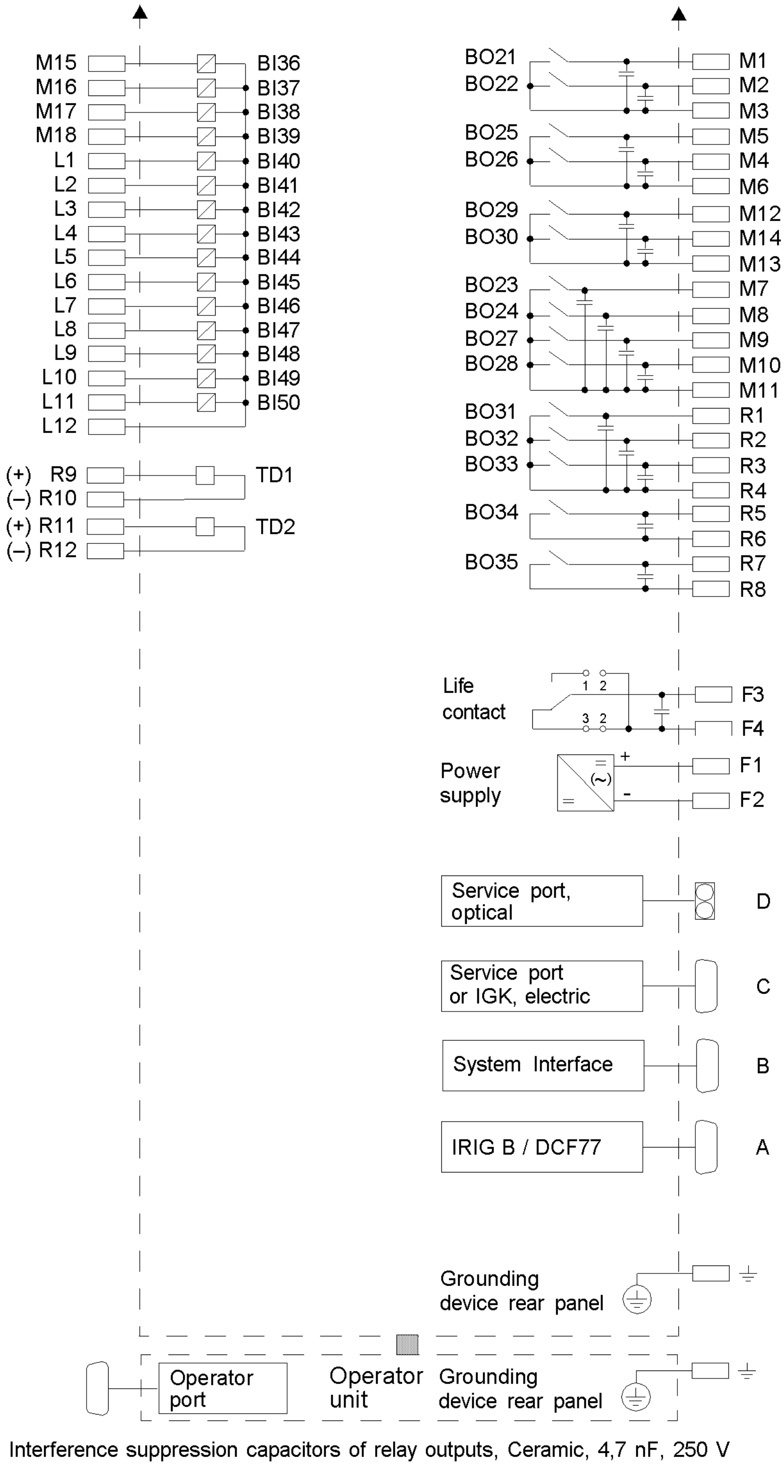
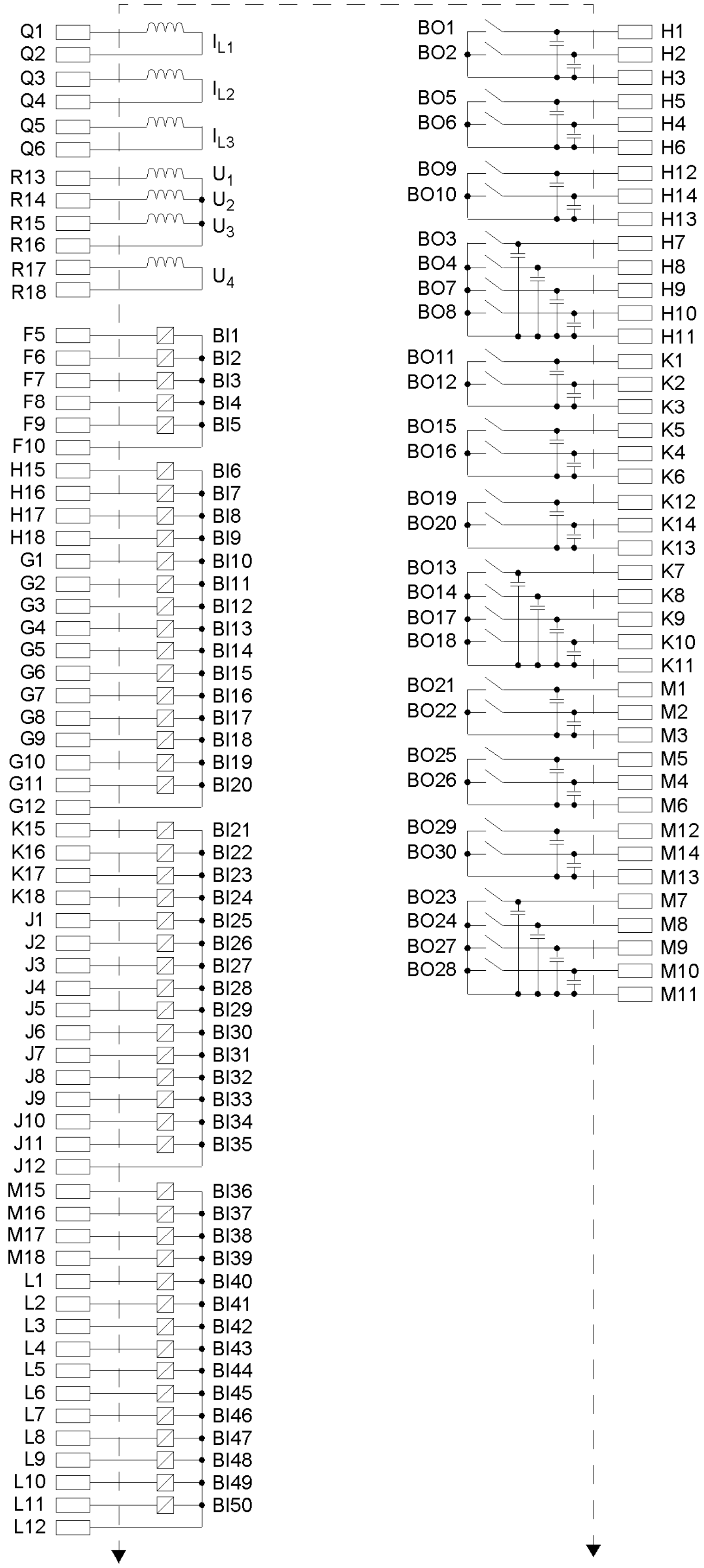


Figure A-3 General diagram 6 MD663*-*A/C (panel surface mounting with detached operator panel)

6MD664*-*A/C
(Page 1)



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6MD664*-*A/C (Page 2)

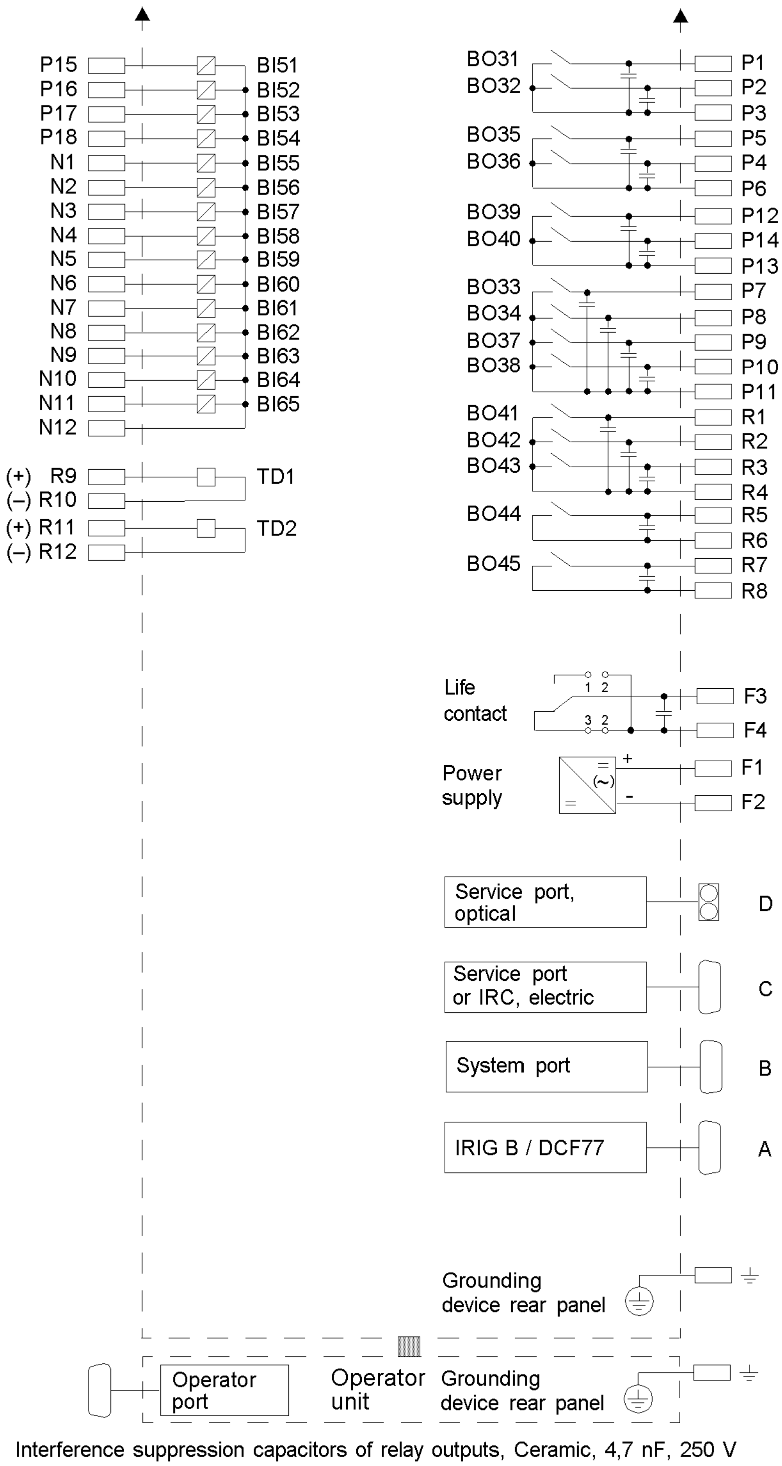
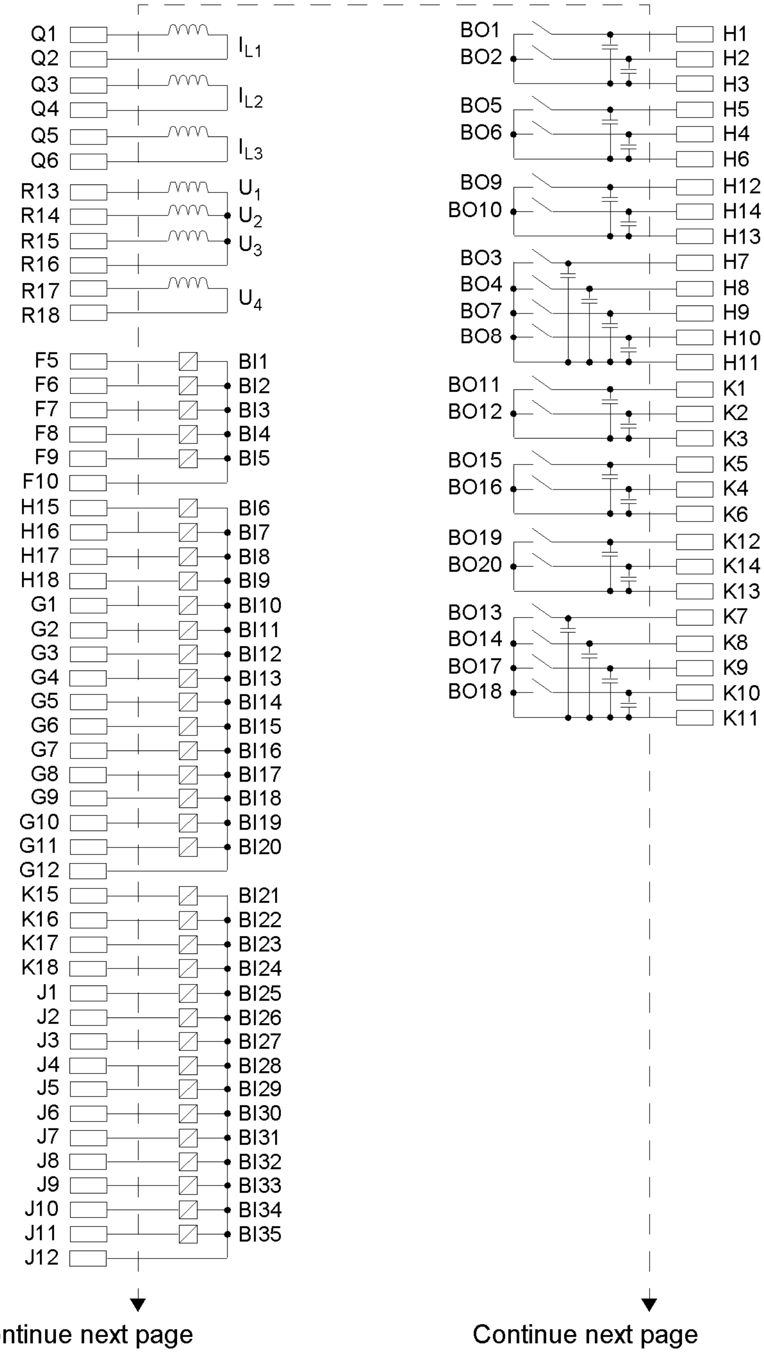


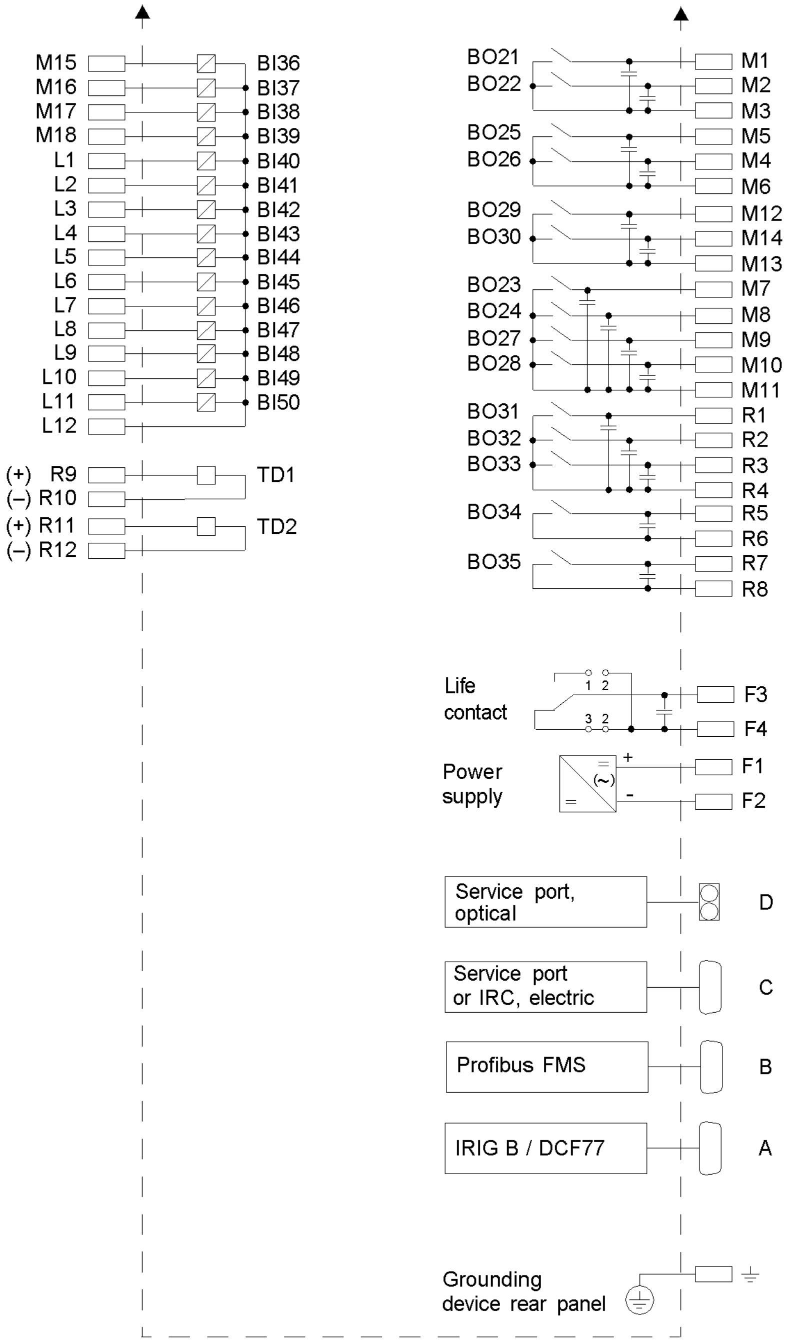
Figure A-4 General diagram 6 MD664*-*A/C (panel surface mounting with detached operator panel)

A.2.3 Housing for installation without operator panel

6MD663*-*B/F (Page 1)



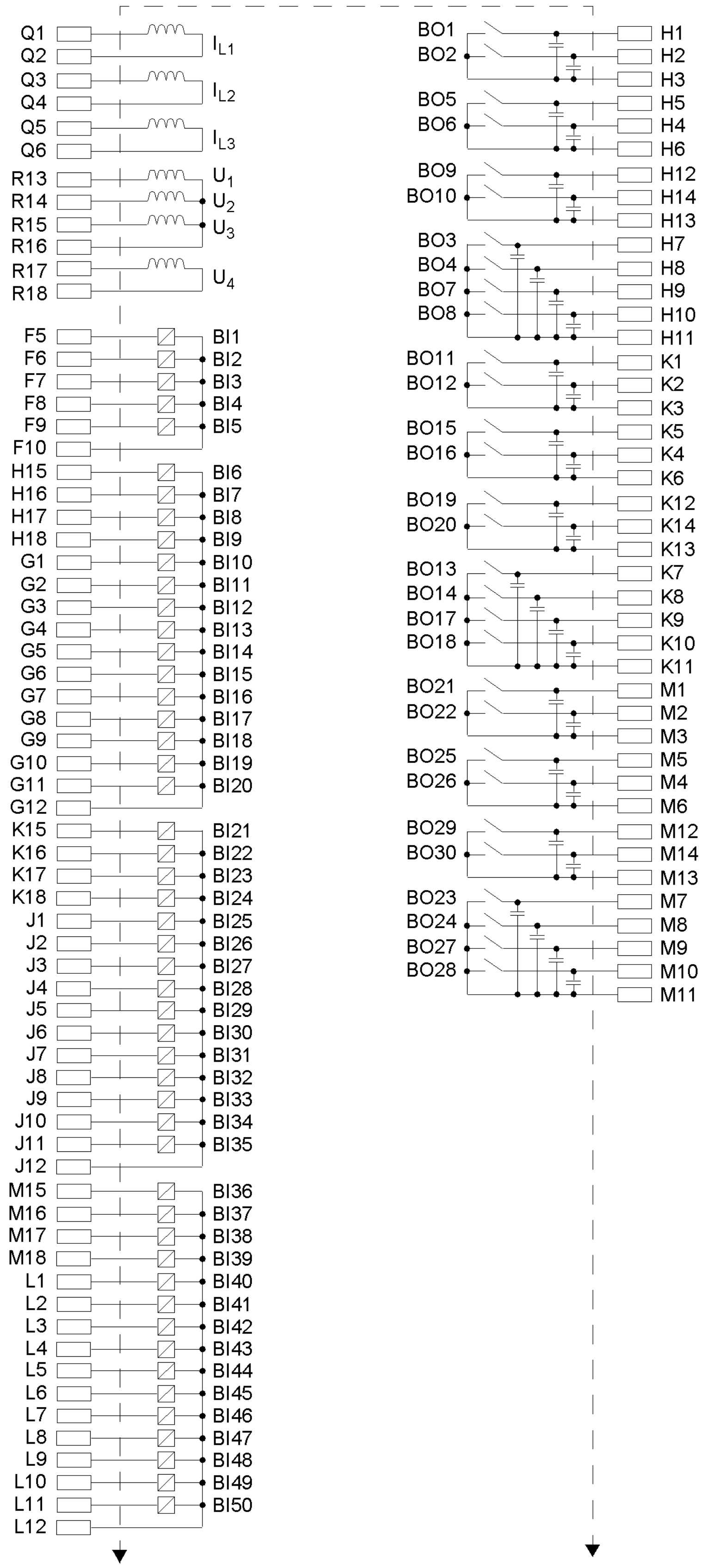
6MD663*-*B/F (Page 2)



Interference suppression capacitors of relay outputs, Ceramic, 4,7 nF, 250 V

Figure A-5 General diagram 6 MD663*-*B/F (devices for panel surface mounting without operator panel)

6MD664*-*B/F (Page 1)



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6MD664*-*B/F (Page 2)

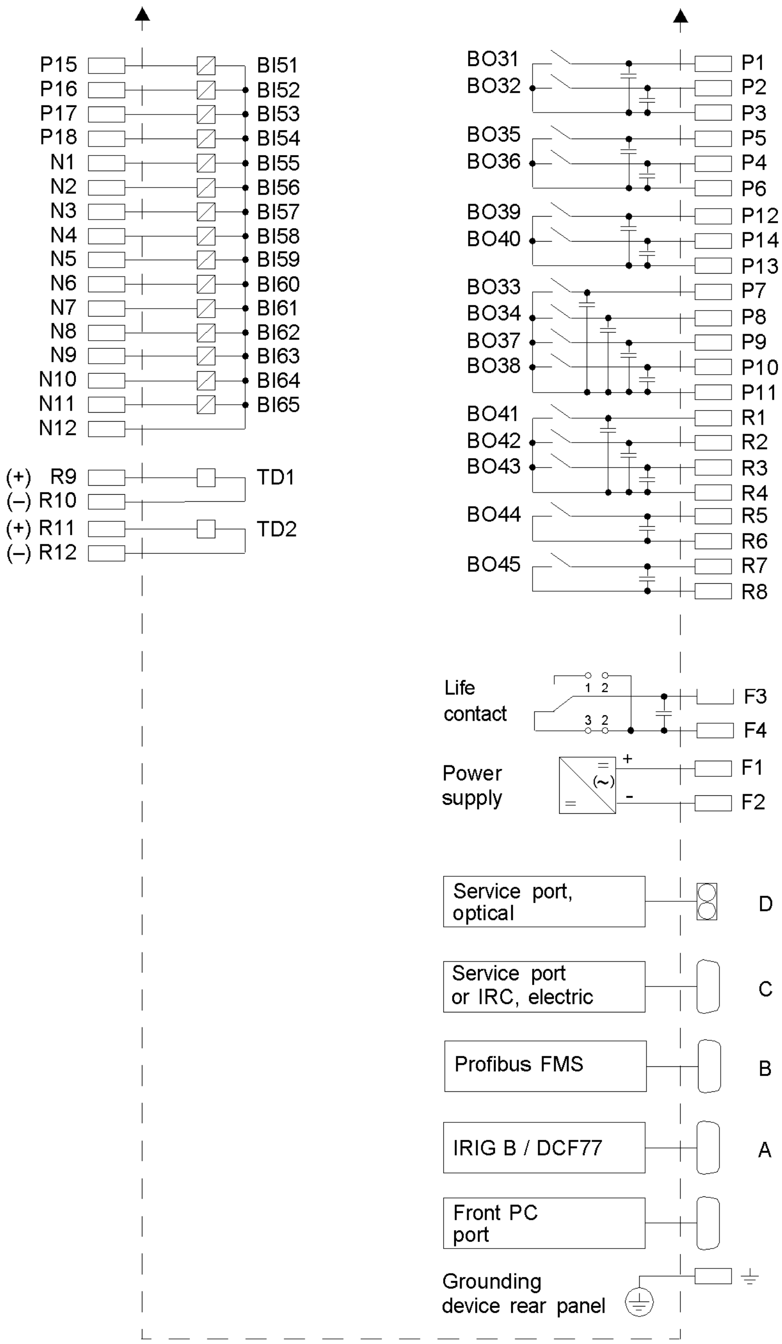

Figure A-6 General diagram 6 MD664*-*B/F (devices for panel surface mounting without operator panel)

A.3 Connection Examples

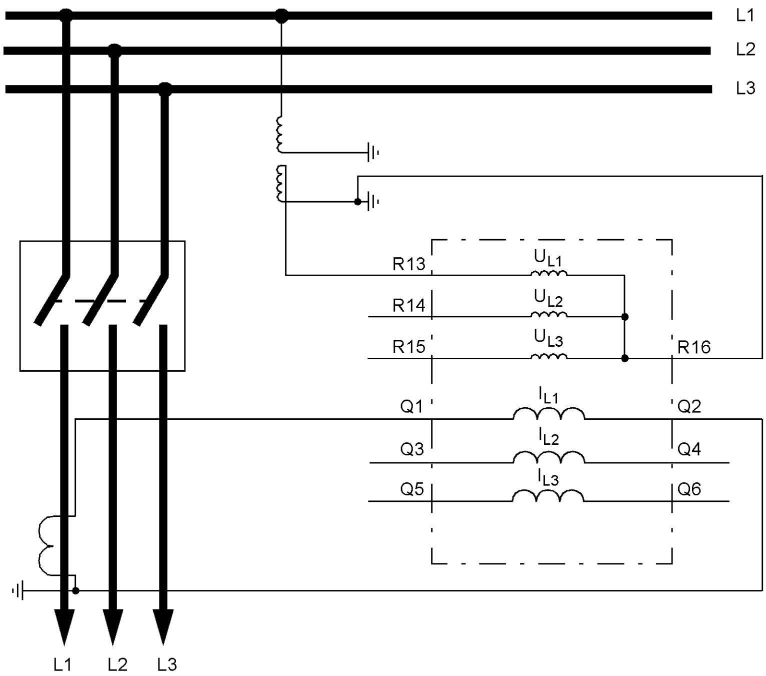

Figure A-7 Transformer connections to a current transformer and a voltage transformer (1-phase measuring transducer packet)

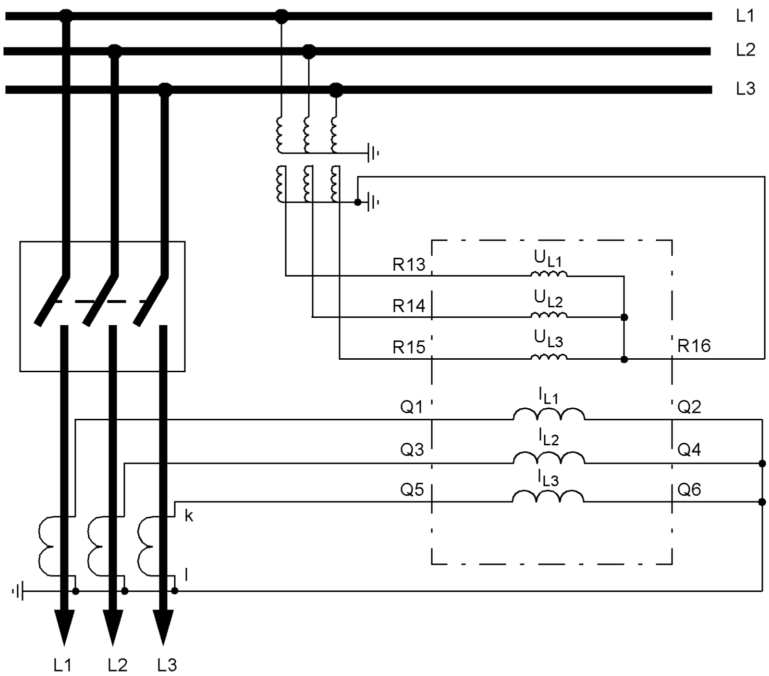

Figure A-8 Transformer connections to 3 current transformers and 3 voltage transformers (3-phase measuring transducer packet)

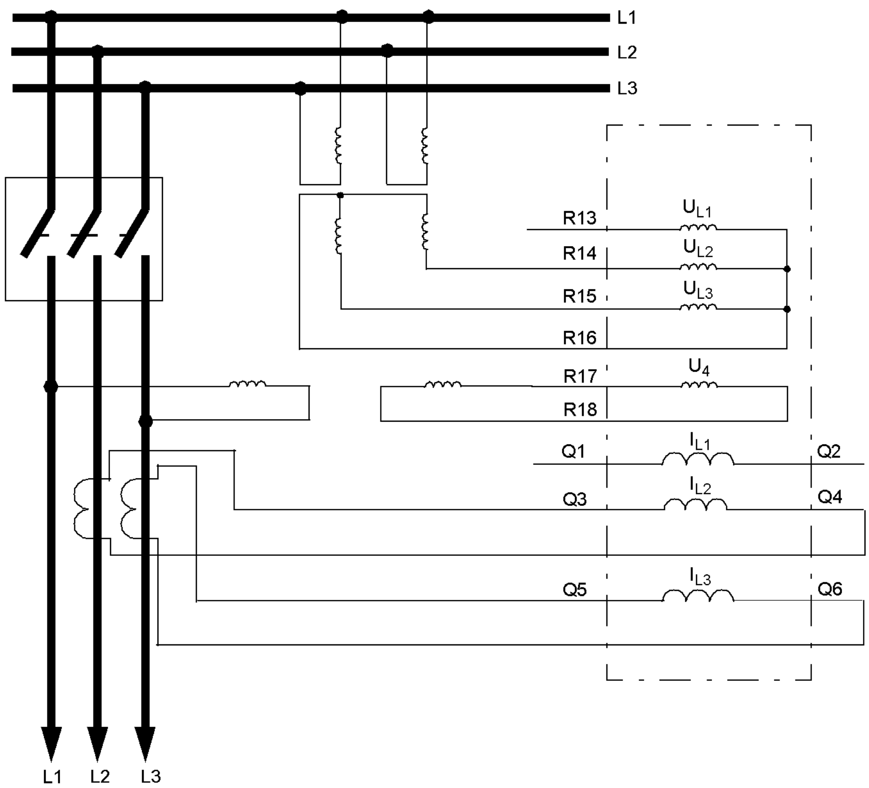

Figure A-9 Transformer connections to 2 current transformers and 2 voltage transformers for an Aron connection and circuit breaker synchronisation connection with V_{LL}

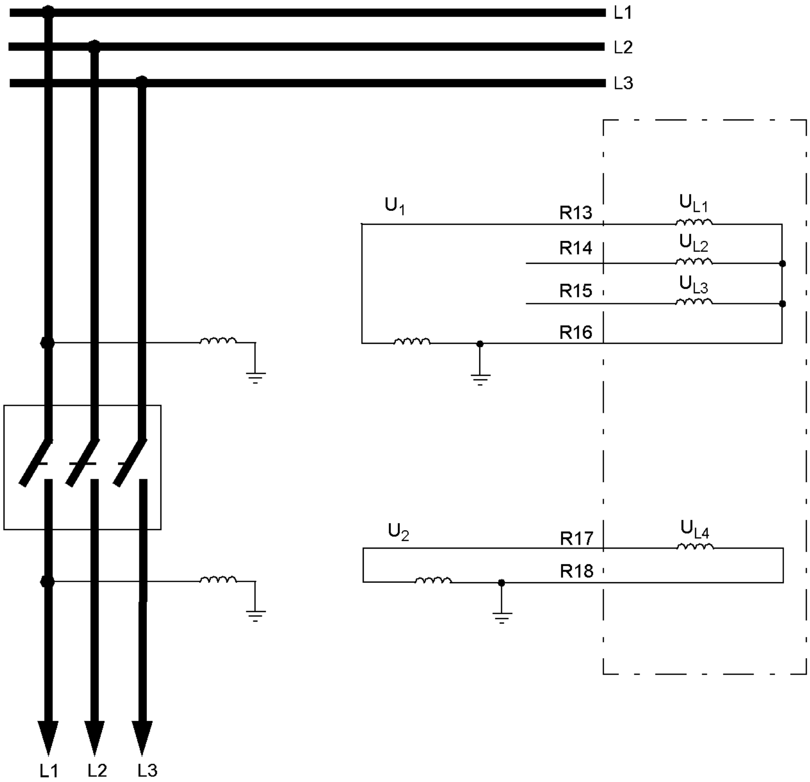

Figure A-10 Connection of measured values for the synchronisation blocks 1 to 5 (measurement transducer connection in accordance with connection examples 1 and 2)

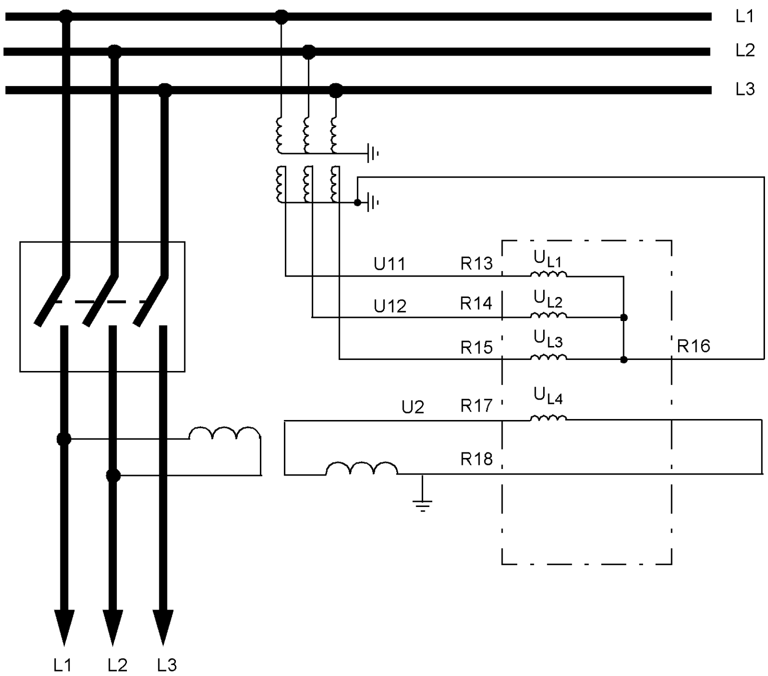

Figure A-11 Connection of measured values for the synchronisation blocks 6 to 8 (measurement transducer connection in accordance with connection examples 1 and 2)

A.4 Default Settings

When the device leaves the factory, a large number of LED indications, binary inputs and outputs as well as function keys are already preset. They are summarised in the following table.

A.4.1 LED

Table A-1 LED indication presettings

LED	Brief Text	Function No.	Remarks
LED	none		-

A.4.2 Binary Input

Table A-2 Binary input presettings for all devices and ordering variants

Binary Input	Brief Text	Function No.	Remarks
BI6	Q0		circuit breaker Q0
BI7	Q0		circuit breaker Q0
BI8	Q1		bus disconnector Q1
BI9	Q1		bus disconnector Q1
BI10	Q2		bus disconnector Q2
BI11	Q2		bus disconnector Q2
BI12	Q8		earthing isolator Q8
BI13	Q8		earthing isolator Q8
BI14	Q9		feeder disconnector Q9
BI15	Q9		feeder disconnector Q9

A.4.3 Binary Output

Table A-3 Output relay presettings for all devices and ordering variants

Binary Output	Brief Text	Function No.	Remarks
BO1	Q0 OPEN		circuit breaker Q0 -
BO2	Q0 CLOSED		circuit breaker Q0 -
BO3	Q1 OPEN		bus disconnector Q1 -
BO4	Q1 CLOSED		bus disconnector Q1 -

Binary Output	Brief Text	Function No.	Remarks
BO6	Q0 Common contact		circuit breaker Q0 -
BO7	Q2 OPEN		bus disconnector Q2 -
BO8	Q2 CLOSED		bus disconnector Q2 -
BO9	Q1 Common contact		bus disconnector Q1 -
BO10	Q2 Common contact		bus disconnector Q2 -
BO11	Q8 OPEN		earthing isolator Q8 -
BO12	Q8 CLOSED		earthing isolator Q8 -
BO15	Q9 OPEN		feeder disconnector Q9 -
BO16	Q9 CLOSED		feeder disconnector Q9 -
BO19	Q8 Common contact		earthing isolator Q8 -
BO20	Q9 Common contact		feeder disconnector Q9 -

A.4.4 Function Keys

Table A-4 Applies to all devices and ordered variants

Function Keys	Brief Text	Function No.	Remarks
F1	Display of operational indications		-
F2	Display of the primary operational measured values		-

A.4.5 Default display

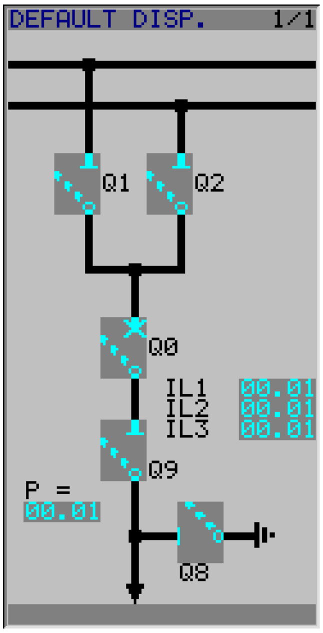

Figure A-12 Default display 6 MD 66

A.4.6 Pre-defined CFC-charts

A CFC chart is already installed when the SIPROTEC® 4 device is delivered.

Key switches

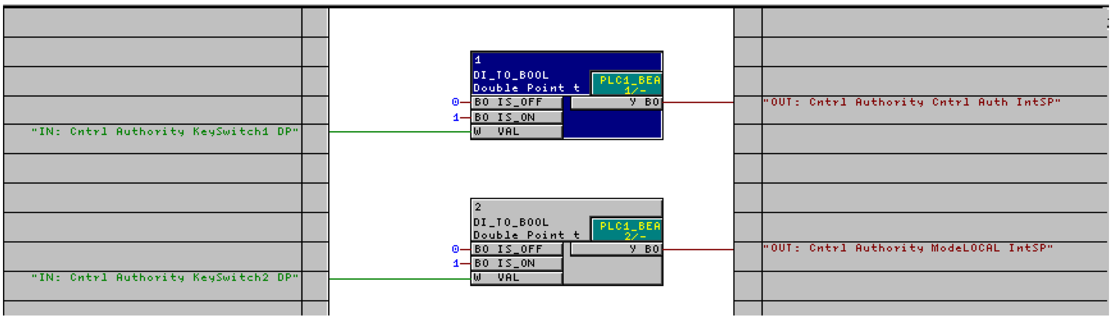

Figure A-13 CFC chart **KeySwitches**

By interconnecting both DI_TO_BOOL blocks, the **Switching Authority** function of both key switches of the device is implemented.

Interlocking

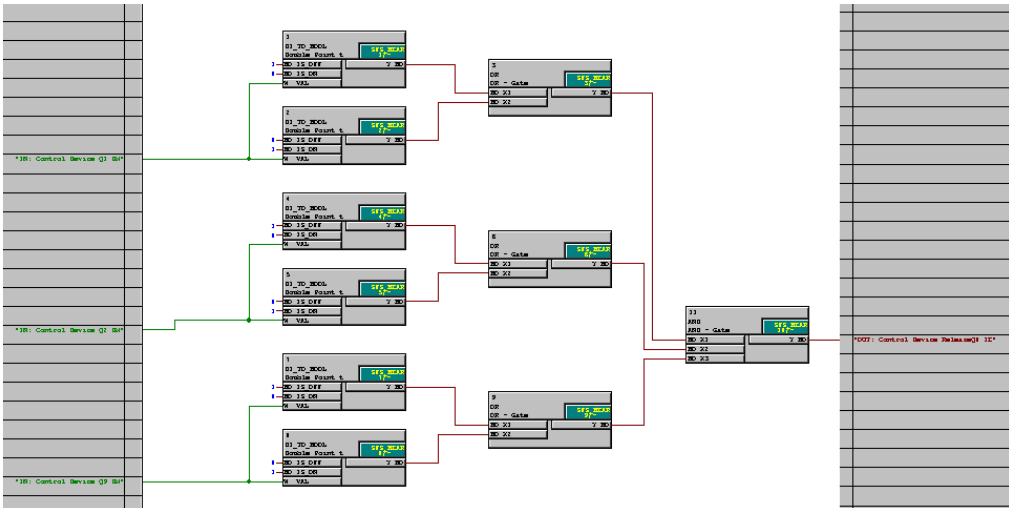

Figure A-14 CFC chart Interlocking

The CFC chart starts the interlocking check which is performed when switching operations of switching elements linked on the left side are executed.

A.5 Protocol-Dependent Functions

Interface → Function ↓	IEC 60870â5â103	PROFIBUS FMS	PROFIBUS DP	Inter relay communication (IRC, optional)
Operating Measured Values	Yes	Yes	Yes (without current message)	Yes
Metered values	Yes	Yes	Yes (without current message)	Yes
Indications	Yes	Yes	Yes (without time stamp)	Yes (setting taggings; without time stamp)
commands	According to VDEW (no system interlocking with local control)	Yes	Yes (without status information)	Yes (setting taggings; without time stamp)
Time Synchronization	Yes	Yes	Yes (not available with all control centres)	Yes
Commissioning Aids				
Indicate measured value blocking	Yes	Yes	No	No
Create test indications (DIGSIÂ®)	Yes	Yes	Yes	No
Physical properties				
Transmission mode	Cyclically/Event	Cyclically/Event	Cyclically	Cyclically
Baud rate	4800 to 38400	Up to 1.5 MBaud	Up to 1.5 MBaud (optical), up to 6 MBaud (electrical)	Up to 1.25 MBaud
Connection to device	Electrical: RS485 Optical: ST connector	Electrical: RS485 Optical: ST connector (single or double ring)	Electrical: RS485 Optical: ST connector (double ring)	Electrical: RS485 optical via external converter

A.6 Functional Overview

Addr.	Parameter	Setting Options	Default Setting	Description
0	**MU V_1**	Disabled Enabled	Disabled	Measurement V
0	**MU I_1**	Disabled Enabled	Disabled	Measurement I
0	**MU1P_1**	Disabled Enabled	Enabled	Measurement 1phase 1.packet
0	**MU1P_2**	Disabled Enabled	Disabled	Measurement 1phase 2.packet
0	**MU1P_3**	Disabled Enabled	Disabled	Measurement 1phase 3.packet
0	**MU3P_1**	Disabled Enabled	Enabled	Measurement 3phase 1.packet
0	**MUAron_1**	Disabled Enabled	Disabled	Measurement Aron 1.packet
0	**Synchronizing 1**	Disabled Enabled	Disabled	Synchronizing Function 1
0	**Synchronizing 2**	Disabled Enabled	Disabled	Synchronizing Function 2
0	**Synchronizing 3**	Disabled Enabled	Disabled	Synchronizing Function 3
0	**Synchronizing 4**	Disabled Enabled	Disabled	Synchronizing Function 4
0	**Synchronizing 5**	Disabled Enabled	Disabled	Synchronizing Function 5
0	**Synchronizing 6**	Disabled Enabled	Disabled	Synchronizing Function 6
0	**Synchronizing 7**	Disabled Enabled	Disabled	Synchronizing Function 7
0	**Synchronizing 8**	Disabled Enabled	Disabled	Synchronizing Function 8

A.7 Settings

Addr.	Parameter	Function	Setting Options	Default Setting	Description
0	SecVoltgNomVal	MU U_1 MU1P_1 MU1P_2 MU1P_3 MU3P_1 MUAron_1	0.00 .. 200.00 V; < > 0	100.00 V	Secondary Voltage Nominal Value
0	SecCurrNomVal	MU I_1 MU1P_1 MU1P_2 MU1P_3 MU3P_1 MUAron_1	0.00 .. 5.00 A; < > 0	1.00 A	Secondary Current Nominal Value
0	T-CB close	SYNC function 1 SYNC function 2 SYNC function 3 SYNC function 4 SYNC function 5 SYNC function 6 SYNC function 7 SYNC function 8	0.01 .. 0.60 sec	0.06 sec	Closing (operating) time of CB
0	T-SYN. DURATION	SYNC function 1 SYNC function 2 SYNC function 3 SYNC function 4 SYNC function 5 SYNC function 6 SYNC function 7 SYNC function 8	1.00 .. 600.00 sec	30.00 sec	Maximum duration of synchronism-check
0	fmin	SYNC function 1 SYNC function 2 SYNC function 3 SYNC function 4 SYNC function 5 SYNC function 6 SYNC function 7 SYNC function 8	95 .. 105 %	95 %	Minimum frequency
0	fmax	SYNC function 1 SYNC function 2 SYNC function 3 SYNC function 4 SYNC function 5 SYNC function 6 SYNC function 7 SYNC function 8	95 .. 105 %	105 %	Maximum frequency
0	SyncSD	SYNC function 1 SYNC function 2 SYNC function 3 SYNC function 4 SYNC function 5 SYNC function 6 SYNC function 7 SYNC function 8			synchronizable switching device
0	Balancing U1/U2	SYNC function 1 SYNC function 2 SYNC function 3 SYNC function 4 SYNC function 5 SYNC function 6 SYNC function 7 SYNC function 8	0.80 .. 1.20	1.00	Balancing Factor U1/U2
0	α Tr. U1-U2	SYNC function 1 SYNC function 2 SYNC function 3 SYNC function 4 SYNC function 5 SYNC function 6 SYNC function 7 SYNC function 8	0 .. 360 °	0 °	Angle adjustment U1-U2 (Trafo)

Addr.	Parameter	Function	Setting Options	Default Setting	Description
0	SecTransNomVal1	SYNC function 1 SYNC function 2 SYNC function 3 SYNC function 4 SYNC function 5 SYNC function 6 SYNC function 7 SYNC function 8	0 .. 170 V; < > 0	100 V	Secondary Transformer Nominal Value 1
0	SecTransNomVal2	SYNC function 1 SYNC function 2 SYNC function 3 SYNC function 4 SYNC function 5 SYNC function 6 SYNC function 7 SYNC function 8	0 .. 170 V; < > 0	100 V	Secondary Transformer Nominal Value 2
0	Umin	SYNC function 1 SYNC function 2 SYNC function 3 SYNC function 4 SYNC function 5 SYNC function 6 SYNC function 7 SYNC function 8	20 .. 125 V	90 V	Minimum Voltage for Synchronization
0	Umax	SYNC function 1 SYNC function 2 SYNC function 3 SYNC function 4 SYNC function 5 SYNC function 6 SYNC function 7 SYNC function 8	20 .. 140 V	110 V	Maximum Voltage for Synchronization
0	Udead	SYNC function 1 SYNC function 2 SYNC function 3 SYNC function 4 SYNC function 5 SYNC function 6 SYNC function 7 SYNC function 8	1 .. 60 V	5 V	Voltage Treshold for Dead Line/ Dead Bus
0	Sync.U1>U2<	SYNC function 1 SYNC function 2 SYNC function 3 SYNC function 4 SYNC function 5 SYNC function 6 SYNC function 7 SYNC function 8	YES NO	NO	Synchronize to U1> and U2<
0	Sync.U1<U2>	SYNC function 1 SYNC function 2 SYNC function 3 SYNC function 4 SYNC function 5 SYNC function 6 SYNC function 7 SYNC function 8	YES NO	NO	Synchronize to U1< and U2>
0	Sync.U1<U2<	SYNC function 1 SYNC function 2 SYNC function 3 SYNC function 4 SYNC function 5 SYNC function 6 SYNC function 7 SYNC function 8	YES NO	NO	Synchronize to U1< and U2<
0	UdiffSyn	SYNC function 1 SYNC function 2 SYNC function 3 SYNC function 4 SYNC function 5 SYNC function 6 SYNC function 7 SYNC function 8	0.5 .. 40.0 V	2.0 V	Maximum voltage difference, synchronous

Addr.	Parameter	Function	Setting Options	Default Setting	Description
0	fdiff	SYNC function 1 SYNC function 2 SYNC function 3 SYNC function 4 SYNC function 5 SYNC function 6 SYNC function 7 SYNC function 8	0.03 .. 2.00 Hz	0.10 Hz	Maximum frequency difference, syn.
0	αdiff	SYNC function 1 SYNC function 2 SYNC function 3 SYNC function 4 SYNC function 5 SYNC function 6 SYNC function 7 SYNC function 8	2 .. 60 °	10 °	Maximum angle difference, syn.
0	UdiffAsyn	SYNC function 1 SYNC function 2 SYNC function 3 SYNC function 4 SYNC function 5 SYNC function 6 SYNC function 7 SYNC function 8	0.5 .. 40.0 V	2.0 V	Maximum voltage differnece, asyn-chronous
0	f SYNCHRON	SYNC function 1 SYNC function 2 SYNC function 3 SYNC function 4 SYNC function 5 SYNC function 6 SYNC function 7 SYNC function 8	10 .. 40 mHz	10 mHz	Frequency diff. treshold Sync/ Async.
0	T SYNCHRON	SYNC function 1 SYNC function 2 SYNC function 3 SYNC function 4 SYNC function 5 SYNC function 6 SYNC function 7 SYNC function 8	0.00 .. 60.00 sec	0.05 sec	Switch Delay for synchronous systems
214	Rated Frequency	P.System Data 1	50 Hz 60 Hz	50 Hz	Rated Frequency
401	T Backlight on	Device, General	1 .. 60 min	10 min	Time Backlight on
402	DIGSI backplane	Device, General	Disabled Port C Port D	Disabled	Serviceport for DIGSI

A.8 Information Lists

Indications for IEC 60,870-5-103 are always reported ON / OFF if they are subject to general interrogation for IEC 60,870-5-103. If not, they are reported only as ON.

New user-defined indications or such newly allocated to IEC 60 870-5-103 are set to ON / OFF and subjected to general interrogation if the information type is not a spontaneous event (".._Ev").

In columns "Event Log”, "Trip Log” and "Ground Fault Log” the following applies:

UPPER CASE ON/OFF: definitely set, not allocatable

lower case on/off: preset, allocatable

*: not preset, allocatable

<blank>: neither preset nor allocatable

No.	Description	Function	Type of Infor-mation	Log Buffers				Configurable in Matrix					IEC 60870-5-103			
				Event Log ON/OFF	Trip (Fault) Log ON/OFF	Trip (Fault) Log ON/OFF	Marked in Oscill. Record	LED	Binary Input	Function Key	Binary Output	Chatter Blocking	Type	Information Number	Data Unit	General Interrogation
-	>Light on	Device, General (General functions)	SP	on off				LED	BI		BO					
-	DataStop	Device, General (General functions)	IntSP	on off				LED			BO		106	20	1	yes
-	Test mode	Device, General (General functions)	IntSP	on off				LED			BO		106	21	1	yes
-	HWTestMod	Device, General (General functions)	IntSP	on off				LED			BO					
-	SynchClock	Device, General (General functions)	IE_W					LED			BO					
-	Error FMS1	Device, General (General functions)	OUT	on off				LED			BO					
-	Error FMS2	Device, General (General functions)	OUT	on off				LED			BO					
-	KeySwitch1	Cntrl Authority (Command processing)	DM	on off				LED								
-	Cntrl Auth	Cntrl Authority (Command processing)	IntSP	ON OFF				LED					101	85	1	yes
-	KeySwitch2	Cntrl Authority (Command processing)	DM	on off				LED								
-	ModeLOCAL	Cntrl Authority (Command processing)	IntSP	ON OFF				LED					101	86	1	yes

No.	Description	Function	Type of Infor-mation	Log Buffers				Configurable in Matrix					IEC 60870-5-103			
				Event Log ON/OFF	Trip (Fault) Log ON/OFF	Trip (Fault) Log ON/OFF	Marked in Oscill. Record	LED	Binary Input	Function Key	Binary Output	Chatter Blocking	Type	Information Number	Data Unit	General Interrogation
-	ModeREMOTE	Cntrl Authority (Command processing)	IntSP	ON OFF				LED								
-	Q0	Control Device (Command processing)	BR_D2	on off							BO		240	160	20	
-	Q0	Control Device (Command processing)	DM	on off					BI			CB	240	160	1	yes
-	Q1	Control Device (Command processing)	BR_D2	on off							BO		240	161	20	
-	Q1	Control Device (Command processing)	DM	on off					BI			CB	240	161	1	yes
-	Q2	Control Device (Command processing)	BR_D2	on off							BO		240	162	20	
-	Q2	Control Device (Command processing)	DM	on off					BI			CB	240	162	1	yes
-	Q8	Control Device (Command processing)	BR_D2	on off							BO		240	164	20	
-	Q8	Control Device (Command processing)	DM	on off					BI			CB	240	164	1	yes
-	Q9	Control Device (Command processing)	BR_D2	on off							BO		240	163	20	
-	Q9	Control Device (Command processing)	DM	on off					BI			CB	240	163	1	yes
-	ReleaseQ0	Control Device (Command processing)	IntSP	on off				LED			BO					
-	ReleaseQ1	Control Device (Command processing)	IntSP	on off				LED			BO					
-	ReleaseQ2	Control Device (Command processing)	IntSP	on off				LED			BO					
-	ReleaseQ8	Control Device (Command processing)	IntSP	on off				LED			BO					
-	ReleaseQ9	Control Device (Command processing)	IntSP	on off				LED			BO					
-	ThreshVal1	Thresh.-Switch	IntSP	on off				LED	BI	FK	BO	CB				
-	SysIntErr.	Protocol (General functions)	IntSP	on off				LED			BO					

No.	Description	Function	Type of Infor-mation	Log Buffers				Configurable in Matrix					IEC 60870-5-103			
				Event Log ON/OFF	Trip (Fault) Log ON/OFF	Trip (Fault) Log ON/OFF	Marked in Oscill. Record	LED	Binary Input	Function Key	Binary Output	Chatter Blocking	Type	Information Number	Data Unit	General Interrogation
-	>Sy1 eff.	SYNC function 1 (Circuit breaker synchronisation)	SP	on off				LED	BI		BO					
-	>Sy1 block	SYNC function 1 (Circuit breaker synchronisation)	SP	on off				LED	BI		BO					
-	>Sy1 dirCO	SYNC function 1 (Circuit breaker synchronisation)	SP	on off				LED	BI		BO					
-	>Sy1 Meas	SYNC function 1 (Circuit breaker synchronisation)	SP	on off				LED	BI		BO					
-	>Sy1U1>U2<	SYNC function 1 (Circuit breaker synchronisation)	SP	on off				LED	BI		BO					
-	>Sy1U1<U2>	SYNC function 1 (Circuit breaker synchronisation)	SP	on off				LED	BI		BO					
-	>Sy1U1<U2<	SYNC function 1 (Circuit breaker synchronisation)	SP	on off				LED	BI		BO					
-	Sync. CloseRel	SYNC function 1 (Circuit breaker synchronisation)	OUT	on off				LED			BO		41	201	1	yes
-	Sync. Error	SYNC function 1 (Circuit breaker synchronisation)	OUT	on off				LED			BO		41	202	1	yes
-	Sync. block	SYNC function 1 (Circuit breaker synchronisation)	OUT	on off				LED			BO		41	204	1	yes
-	Sync.MonTimeExc	SYNC function 1 (Circuit breaker synchronisation)	OUT	on off				LED			BO		41	205	1	yes
-	Sync. synchron	SYNC function 1 (Circuit breaker synchronisation)	OUT	on off				LED			BO		41	206	1	yes
-	Sync. U1> U2<	SYNC function 1 (Circuit breaker synchronisation)	OUT	on off				LED			BO					
-	Sync. U1< U2>	SYNC function 1 (Circuit breaker synchronisation)	OUT	on off				LED			BO					
-	Sync. U1< U2<	SYNC function 1 (Circuit breaker synchronisation)	OUT	on off				LED			BO					
-	Sync. Vdiff>	SYNC function 1 (Circuit breaker synchronisation)	OUT	on off				LED			BO		41	207	1	yes
-	Sync. fdiff>	SYNC function 1 (Circuit breaker synchronisation)	OUT	on off				LED			BO		41	208	1	yes

No.	Description	Function	Type of Infor-mation	Log Buffers				Configurable in Matrix					IEC 60870-5-103			
				Event Log ON/OFF	Trip (Fault) Log ON/OFF	Trip (Fault) Log ON/OFF	Marked in Oscill. Record	LED	Binary Input	Function Key	Binary Output	Chatter Blocking	Type	Information Number	Data Unit	General Interrogation
-	Sync. α diff>	SYNC function 1 (Circuit breaker synchronisation)	OUT	on off				LED			BO		41	209	1	yes
-	Sync. f1>>	SYNC function 1 (Circuit breaker synchronisation)	OUT	on off				LED			BO					
-	Sync. f1<<	SYNC function 1 (Circuit breaker synchronisation)	OUT	on off				LED			BO					
-	Sync. f2>>	SYNC function 1 (Circuit breaker synchronisation)	OUT	on off				LED			BO					
-	Sync. f2<<	SYNC function 1 (Circuit breaker synchronisation)	OUT	on off				LED			BO					
-	Sync. U1>>	SYNC function 1 (Circuit breaker synchronisation)	OUT	on off				LED			BO					
-	Sync. U1<<	SYNC function 1 (Circuit breaker synchronisation)	OUT	on off				LED			BO					
-	Sync. U2>>	SYNC function 1 (Circuit breaker synchronisation)	OUT	on off				LED			BO					
-	Sync. U2<<	SYNC function 1 (Circuit breaker synchronisation)	OUT	on off				LED			BO					
-	>Sy2 eff.	SYNC function 2	SP	on off				LED	BI		BO					
-	>Sy2 block	SYNC function 2	SP	on off				LED	BI		BO					
-	>Sy2 dirCO	SYNC function 2	SP	on off				LED	BI		BO					
-	>Sy2 Meas	SYNC function 2	SP	on off				LED	BI		BO					
-	>Sy2U1>U2<	SYNC function 2	SP	on off				LED	BI		BO					
-	>Sy2U1<U2>	SYNC function 2	SP	on off				LED	BI		BO					
-	>Sy2U1<U2<	SYNC function 2	SP	on off				LED	BI		BO					
-	Sync. CloseRel	SYNC function 2	OUT	on off				LED			BO					
-	Sync. Error	SYNC function 2	OUT	on off				LED			BO					
-	Sync. block	SYNC function 2	OUT	on off				LED			BO					
-	Sync.MonTimeExc	SYNC function 2	OUT	on off				LED			BO					

No.	Description	Function	Type of Infor-mation	Log Buffers				Configurable in Matrix					IEC 60870-5-103			
				Event Log ON/OFF	Trip (Fault) Log ON/OFF	Trip (Fault) Log ON/OFF	Marked in Oscill. Record	LED	Binary Input	Function Key	Binary Output	Chatter Blocking	Type	Information Number	Data Unit	General Interrogation
-	Sync. synchron	SYNC function 2	OUT	on off				LED			BO					
-	Sync. U1> U2<	SYNC function 2	OUT	on off				LED			BO					
-	Sync. U1< U2>	SYNC function 2	OUT	on off				LED			BO					
-	Sync. U1< U2<	SYNC function 2	OUT	on off				LED			BO					
-	Sync. Vdiff>	SYNC function 2	OUT	on off				LED			BO					
-	Sync. fdiff>	SYNC function 2	OUT	on off				LED			BO					
-	Sync. α diff>	SYNC function 2	OUT	on off				LED			BO					
-	Sync. f1>>	SYNC function 2	OUT	on off				LED			BO					
-	Sync. f1<<	SYNC function 2	OUT	on off				LED			BO					
-	Sync. f2>>	SYNC function 2	OUT	on off				LED			BO					
-	Sync. f2<<	SYNC function 2	OUT	on off				LED			BO					
-	Sync. U1>>	SYNC function 2	OUT	on off				LED			BO					
-	Sync. U1<<	SYNC function 2	OUT	on off				LED			BO					
-	Sync. U2>>	SYNC function 2	OUT	on off				LED			BO					
-	Sync. U2<<	SYNC function 2	OUT	on off				LED			BO					
-	>Sy3 eff.	SYNC function 3	SP	on off				LED	BI		BO					
-	>Sy3 block	SYNC function 3	SP	on off				LED	BI		BO					
-	>Sy3 dirCO	SYNC function 3	SP	on off				LED	BI		BO					
-	>Sy3 Meas	SYNC function 3	SP	on off				LED	BI		BO					
-	>Sy3U1>U2<	SYNC function 3	SP	on off				LED	BI		BO					
-	>Sy3U1<U2>	SYNC function 3	SP	on off				LED	BI		BO					
-	>Sy3U1<U2<	SYNC function 3	SP	on off				LED	BI		BO					
-	Sync. CloseRel	SYNC function 3	OUT	on off				LED			BO					

No.	Description	Function	Type of Infor-mation	Log Buffers				Configurable in Matrix					IEC 60870-5-103			
				Event Log ON/OFF	Trip (Fault) Log ON/OFF	Trip (Fault) Log ON/OFF	Marked in Oscill. Record	LED	Binary Input	Function Key	Binary Output	Chatter Blocking	Type	Information Number	Data Unit	General Interrogation
-	Sync. Error	SYNC function 3	OUT	on off				LED			BO					
-	Sync. block	SYNC function 3	OUT	on off				LED			BO					
-	Sync.MonTimeExc	SYNC function 3	OUT	on off				LED			BO					
-	Sync. synchron	SYNC function 3	OUT	on off				LED			BO					
-	Sync. U1> U2<	SYNC function 3	OUT	on off				LED			BO					
-	Sync. U1< U2>	SYNC function 3	OUT	on off				LED			BO					
-	Sync. U1< U2<	SYNC function 3	OUT	on off				LED			BO					
-	Sync. Vdiff>	SYNC function 3	OUT	on off				LED			BO					
-	Sync. fdiff>	SYNC function 3	OUT	on off				LED			BO					
-	Sync. α diff>	SYNC function 3	OUT	on off				LED			BO					
-	Sync. f1>>	SYNC function 3	OUT	on off				LED			BO					
-	Sync. f1<<	SYNC function 3	OUT	on off				LED			BO					
-	Sync. f2>>	SYNC function 3	OUT	on off				LED			BO					
-	Sync. f2<<	SYNC function 3	OUT	on off				LED			BO					
-	Sync. U1>>	SYNC function 3	OUT	on off				LED			BO					
-	Sync. U1<<	SYNC function 3	OUT	on off				LED			BO					
-	Sync. U2>>	SYNC function 3	OUT	on off				LED			BO					
-	Sync. U2<<	SYNC function 3	OUT	on off				LED			BO					
-	>Sy4 eff.	SYNC function 4	SP	on off				LED	BI		BO					
-	>Sy4 block	SYNC function 4	SP	on off				LED	BI		BO					
-	>Sy4 dirCO	SYNC function 4	SP	on off				LED	BI		BO					
-	>Sy4 Meas	SYNC function 4	SP	on off				LED	BI		BO					
-	>Sy4U1>U2<	SYNC function 4	SP	on off				LED	BI		BO					

No.	Description	Function	Type of Infor-mation	Log Buffers				Configurable in Matrix					IEC 60870-5-103			
				Event Log ON/OFF	Trip (Fault) Log ON/OFF	Trip (Fault) Log ON/OFF	Marked in Oscill. Record	LED	Binary Input	Function Key	Binary Output	Chatter Blocking	Type	Information Number	Data Unit	General Interrogation
-	>Sy4U1<U2>	SYNC function 4	SP	on off				LED	BI		BO					
-	>Sy4U1<U2<	SYNC function 4	SP	on off				LED	BI		BO					
-	Sync. CloseRel	SYNC function 4	OUT	on off				LED			BO					
-	Sync. Error	SYNC function 4	OUT	on off				LED			BO					
-	Sync. block	SYNC function 4	OUT	on off				LED			BO					
-	Sync.MonTimeExc	SYNC function 4	OUT	on off				LED			BO					
-	Sync. synchron	SYNC function 4	OUT	on off				LED			BO					
-	Sync. U1> U2<	SYNC function 4	OUT	on off				LED			BO					
-	Sync. U1< U2>	SYNC function 4	OUT	on off				LED			BO					
-	Sync. U1< U2<	SYNC function 4	OUT	on off				LED			BO					
-	Sync. Vdiff>	SYNC function 4	OUT	on off				LED			BO					
-	Sync. fdiff>	SYNC function 4	OUT	on off				LED			BO					
-	Sync. α diff>	SYNC function 4	OUT	on off				LED			BO					
-	Sync. f1>>	SYNC function 4	OUT	on off				LED			BO					
-	Sync. f1<<	SYNC function 4	OUT	on off				LED			BO					
-	Sync. f2>>	SYNC function 4	OUT	on off				LED			BO					
-	Sync. f2<<	SYNC function 4	OUT	on off				LED			BO					
-	Sync. U1>>	SYNC function 4	OUT	on off				LED			BO					
-	Sync. U1<<	SYNC function 4	OUT	on off				LED			BO					
-	Sync. U2>>	SYNC function 4	OUT	on off				LED			BO					
-	Sync. U2<<	SYNC function 4	OUT	on off				LED			BO					
-	>Sy5 eff.	SYNC function 5	SP	on off				LED	BI		BO					
-	>Sy5 block	SYNC function 5	SP	on off				LED	BI		BO					

No.	Description	Function	Type of Information	Log Buffers				Configurable in Matrix					IEC 60870-5-103			
				Event Log ON/OFF	Trip (Fault) Log ON/OFF	Trip (Fault) Log ON/OFF	Marked in Oscill. Record	LED	Binary Input	Function Key	Binary Output	Chatter Blocking	Type	Information Number	Data Unit	General Interrogation
-	>Sy5 dirCO	SYNC function 5	SP	on off				LED	BI		BO					
-	>Sy5 Meas	SYNC function 5	SP	on off				LED	BI		BO					
-	>Sy5U1>U2<	SYNC function 5	SP	on off				LED	BI		BO					
-	>Sy5U1<U2>	SYNC function 5	SP	on off				LED	BI		BO					
-	>Sy5U1<U2<	SYNC function 5	SP	on off				LED	BI		BO					
-	Sync. CloseRel	SYNC function 5	OUT	on off				LED			BO					
-	Sync. Error	SYNC function 5	OUT	on off				LED			BO					
-	Sync. block	SYNC function 5	OUT	on off				LED			BO					
-	Sync.MonTimeExc	SYNC function 5	OUT	on off				LED			BO					
-	Sync. synchron	SYNC function 5	OUT	on off				LED			BO					
-	Sync. U1> U2<	SYNC function 5	OUT	on off				LED			BO					
-	Sync. U1< U2>	SYNC function 5	OUT	on off				LED			BO					
-	Sync. U1< U2<	SYNC function 5	OUT	on off				LED			BO					
-	Sync. Vdiff>	SYNC function 5	OUT	on off				LED			BO					
-	Sync. fdiff>	SYNC function 5	OUT	on off				LED			BO					
-	Sync. α diff>	SYNC function 5	OUT	on off				LED			BO					
-	Sync. f1>>	SYNC function 5	OUT	on off				LED			BO					
-	Sync. f1<<	SYNC function 5	OUT	on off				LED			BO					
-	Sync. f2>>	SYNC function 5	OUT	on off				LED			BO					
-	Sync. f2<<	SYNC function 5	OUT	on off				LED			BO					
-	Sync. U1>>	SYNC function 5	OUT	on off				LED			BO					
-	Sync. U1<<	SYNC function 5	OUT	on off				LED			BO					
-	Sync. U2>>	SYNC function 5	OUT	on off				LED			BO					

No.	Description	Function	Type of Infor-mation	Log Buffers				Configurable in Matrix					IEC 60870-5-103			
				Event Log ON/OFF	Trip (Fault) Log ON/OFF	Trip (Fault) Log ON/OFF	Marked in Oscill. Record	LED	Binary Input	Function Key	Binary Output	Chatter Blocking	Type	Information Number	Data Unit	General Interrogation
-	Sync. U2<<	SYNC function 5	OUT	on off				LED			BO					
-	>Sy6 eff.	SYNC function 6	SP	on off				LED	BI		BO					
-	>Sy6 block	SYNC function 6	SP	on off				LED	BI		BO					
-	>Sy6 dirCO	SYNC function 6	SP	on off				LED	BI		BO					
-	>Sy6 Meas	SYNC function 6	SP	on off				LED	BI		BO					
-	>Sy6U1>U2<	SYNC function 6	SP	on off				LED	BI		BO					
-	>Sy6U1<U2>	SYNC function 6	SP	on off				LED	BI		BO					
-	>Sy6U1<U2<	SYNC function 6	SP	on off				LED	BI		BO					
-	Sync. CloseRel	SYNC function 6	OUT	on off				LED			BO					
-	Sync. Error	SYNC function 6	OUT	on off				LED			BO					
-	Sync. block	SYNC function 6	OUT	on off				LED			BO					
-	Sync.MonTimeExc	SYNC function 6	OUT	on off				LED			BO					
-	Sync. synchron	SYNC function 6	OUT	on off				LED			BO					
-	Sync. U1> U2<	SYNC function 6	OUT	on off				LED			BO					
-	Sync. U1< U2>	SYNC function 6	OUT	on off				LED			BO					
-	Sync. U1< U2<	SYNC function 6	OUT	on off				LED			BO					
-	Sync. Vdiff>	SYNC function 6	OUT	on off				LED			BO					
-	Sync. fdiff>	SYNC function 6	OUT	on off				LED			BO					
-	Sync. α diff>	SYNC function 6	OUT	on off				LED			BO					
-	Sync. f1>>	SYNC function 6	OUT	on off				LED			BO					
-	Sync. f1<<	SYNC function 6	OUT	on off				LED			BO					
-	Sync. f2>>	SYNC function 6	OUT	on off				LED			BO					
-	Sync. f2<<	SYNC function 6	OUT	on off				LED			BO					

No.	Description	Function	Type of Infor-mation	Log Buffers				Configurable in Matrix					IEC 60870-5-103			
				Event Log ON/OFF	Trip (Fault) Log ON/OFF	Trip (Fault) Log ON/OFF	Marked in Oscill. Record	LED	Binary Input	Function Key	Binary Output	Chatter Blocking	Type	Information Number	Data Unit	General Interrogation
-	Sync. U1>>	SYNC function 6	OUT	on off				LED			BO					
-	Sync. U1<<	SYNC function 6	OUT	on off				LED			BO					
-	Sync. U2>>	SYNC function 6	OUT	on off				LED			BO					
-	Sync. U2<<	SYNC function 6	OUT	on off				LED			BO					
-	>Sy7 eff.	SYNC function 7	SP	on off				LED	BI		BO					
-	>Sy7 block	SYNC function 7	SP	on off				LED	BI		BO					
-	>Sy7 dirCO	SYNC function 7	SP	on off				LED	BI		BO					
-	>Sy7 Meas	SYNC function 7	SP	on off				LED	BI		BO					
-	>Sy7U1>U2<	SYNC function 7	SP	on off				LED	BI		BO					
-	>Sy7U1<U2>	SYNC function 7	SP	on off				LED	BI		BO					
-	>Sy7U1<U2<	SYNC function 7	SP	on off				LED	BI		BO					
-	Sync. CloseRel	SYNC function 7	OUT	on off				LED			BO					
-	Sync. Error	SYNC function 7	OUT	on off				LED			BO					
-	Sync. block	SYNC function 7	OUT	on off				LED			BO					
-	Sync.MonTimeExc	SYNC function 7	OUT	on off				LED			BO					
-	Sync. synchron	SYNC function 7	OUT	on off				LED			BO					
-	Sync. U1> U2<	SYNC function 7	OUT	on off				LED			BO					
-	Sync. U1< U2>	SYNC function 7	OUT	on off				LED			BO					
-	Sync. U1< U2<	SYNC function 7	OUT	on off				LED			BO					
-	Sync. Vdiff>	SYNC function 7	OUT	on off				LED			BO					
-	Sync. fdiff>	SYNC function 7	OUT	on off				LED			BO					
-	Sync. α diff>	SYNC function 7	OUT	on off				LED			BO					
-	Sync. f1>>	SYNC function 7	OUT	on off				LED			BO					

No.	Description	Function	Type of Information	Log Buffers				Configurable in Matrix					IEC 60870-5-103			
				Event Log ON/OFF	Trip (Fault) Log ON/OFF	Trip (Fault) Log ON/OFF	Marked in Oscill. Record	LED	Binary Input	Function Key	Binary Output	Chatter Blocking	Type	Information Number	Data Unit	General Interrogation
-	Sync. f1<<	SYNC function 7	OUT	on off				LED			BO					
-	Sync. f2>>	SYNC function 7	OUT	on off				LED			BO					
-	Sync. f2<<	SYNC function 7	OUT	on off				LED			BO					
-	Sync. U1>>	SYNC function 7	OUT	on off				LED			BO					
-	Sync. U1<<	SYNC function 7	OUT	on off				LED			BO					
-	Sync. U2>>	SYNC function 7	OUT	on off				LED			BO					
-	Sync. U2<<	SYNC function 7	OUT	on off				LED			BO					
-	>Sy8 eff.	SYNC function 8	SP	on off				LED	BI		BO					
-	>Sy8 block	SYNC function 8	SP	on off				LED	BI		BO					
-	>Sy8 dirCO	SYNC function 8	SP	on off				LED	BI		BO					
-	>Sy8 Meas	SYNC function 8	SP	on off				LED	BI		BO					
-	>Sy8U1>U2<	SYNC function 8	SP	on off				LED	BI		BO					
-	>Sy8U1<U2>	SYNC function 8	SP	on off				LED	BI		BO					
-	>Sy8U1<U2<	SYNC function 8	SP	on off				LED	BI		BO					
-	Sync. CloseRel	SYNC function 8	OUT	on off				LED			BO					
-	Sync. Error	SYNC function 8	OUT	on off				LED			BO					
-	Sync. block	SYNC function 8	OUT	on off				LED			BO					
-	Sync.MonTimeExc	SYNC function 8	OUT	on off				LED			BO					
-	Sync. synchron	SYNC function 8	OUT	on off				LED			BO					
-	Sync. U1> U2<	SYNC function 8	OUT	on off				LED			BO					
-	Sync. U1< U2>	SYNC function 8	OUT	on off				LED			BO					
-	Sync. U1< U2<	SYNC function 8	OUT	on off				LED			BO					
-	Sync. Vdiff>	SYNC function 8	OUT	on off				LED			BO					

No.	Description	Function	Type of Infor-mation	Log Buffers				Configurable in Matrix					IEC 60870-5-103			
				Event Log ON/OFF	Trip (Fault) Log ON/OFF	Trip (Fault) Log ON/OFF	Marked in Oscill. Record	LED	Binary Input	Function Key	Binary Output	Chatter Blocking	Type	Information Number	Data Unit	General Interrogation
-	Sync. fdiff>	SYNC function 8	OUT	on off				LED			BO					
-	Sync. α diff>	SYNC function 8	OUT	on off				LED			BO					
-	Sync. f1>>	SYNC function 8	OUT	on off				LED			BO					
-	Sync. f1<<	SYNC function 8	OUT	on off				LED			BO					
-	Sync. f2>>	SYNC function 8	OUT	on off				LED			BO					
-	Sync. f2<<	SYNC function 8	OUT	on off				LED			BO					
-	Sync. U1>>	SYNC function 8	OUT	on off				LED			BO					
-	Sync. U1<<	SYNC function 8	OUT	on off				LED			BO					
-	Sync. U2>>	SYNC function 8	OUT	on off				LED			BO					
-	Sync. U2<<	SYNC function 8	OUT	on off				LED			BO					
3	>Time Synch	Device, General (General func-tions)	EM_W					LED	BI	FK	BO		135	48	1	
16	>DataStop	Device, General (General func-tions)	SP					LED	BI		BO		135	54	1	yes
51	Device OK	Device, General (General func-tions)	OUT	on off				LED			BO		135	81	1	yes
55	Reset Device	Device, General (General func-tions)	OUT	on				LED			BO					
56	Initial Start	Device, General (General func-tions)	OUT	on				LED			BO		106	5	1	
60	Reset LED	Device, General (General func-tions)	OUT_Ev	on				LED			BO		106	19	1	
67	Resume	Device, General (General func-tions)	OUT	on				LED			BO					
68	Clock SyncError	Device, General (General func-tions)	IntSP	on off				LED			BO					
69	DayLightSavTime	Device, General (General func-tions)	OUT	on off				LED			BO					
70	Settings Calc.	Device, General (General func-tions)	OUT	on off				LED			BO		105	22	1	yes

No.	Description	Function	Type of Information	Log Buffers: Event Log ON/OFF	Trip (Fault) Log ON/OFF	Trip (Fault) Log ON/OFF	Marked in Oscill. Record	Configurable in Matrix: LED	Binary Input	Function Key	Binary Output	Chatter Blocking	IEC 60870-5-103: Type	Information Number	Data Unit	General Interrogation
71	Settings Check	Device, General (General functions)	OUT					LED			BO					
72	Level-2 change	Device, General (General functions)	OUT	on off				LED			BO					
73	Local change	Device, General (General functions)	OUT					LED			BO					
110	Event Lost	Device, General (General functions)	OUT_Ev										135	130	1	
125	Chatter ON	Device, General (General functions)	OUT	on off				LED			BO		135	145	1	yes
147	Error PwrSupply	Device, General (General functions)	OUT	on off				LED			BO					
177	Fail Battery	Device, General (General functions)	OUT	on off				LED			BO					
183	Error Board 1	Device, General (General functions)	OUT	on off				LED			BO					
184	Error Board 2	Device, General (General functions)	OUT	on off				LED			BO					
185	Error Board 3	Device, General (General functions)	OUT	on off				LED			BO					
186	Error Board 4	Device, General (General functions)	OUT	on off				LED			BO					
187	Error Board 5	Device, General (General functions)	OUT	on off				LED			BO					
188	Error Board 6	Device, General (General functions)	OUT	on off				LED			BO					
189	Error Board 7	Device, General (General functions)	OUT	on off				LED			BO					

A.9 Group Alarms

No.	Description	No.	Description

A.10 Measured Values

No.	Description	Function	IEC 60870-5-103					Configurable in Matrix		
			Type	Information Number	Compatibility	Data Unit	Position	CFC	Control Display	Default Display
-	Control DIGSI	Cntrl Authority (Command processing)	-	-	-	-	-	CFC	CD	DD
-	Voltage or Current Input U/I	MU U_1 (Measured value processing)	-	-	-	-	-			
-	Voltage U	MU U_1 (Measured value processing)	-	-	-	-	-	CFC	CD	DD
-	frequency	MU U_1 (Measured value processing)	-	-	-	-	-	CFC	CD	DD
-	Current Input I	MU I_1 (Measured value processing)	-	-	-	-	-			
-	Current I	MU I_1 (Measured value processing)	-	-	-	-	-	CFC	CD	DD
-	frequency	MU I_1 (Measured value processing)	-	-	-	-	-	CFC	CD	DD
-	1P1 Voltage Input U	MU1P_1 (Measured value processing)	-	-	-	-	-			
-	1P1 Current Input I	MU1P_1 (Measured value processing)	-	-	-	-	-			
-	1P1 Voltage U	MU1P_1 (Measured value processing)	106	146	no	3	2	CFC	CD	DD
			134	152	no	9	1			
-	1P1 Current I	MU1P_1 (Measured value processing)	106	146	no	3	1	CFC	CD	DD
			134	152	no	9	2			
-	1P1 Active Power P	MU1P_1 (Measured value processing)	106	146	no	3	3	CFC	CD	DD
			134	152	no	9	3			
-	1P1 Reactive Power Q	MU1P_1 (Measured value processing)	106	146	no	3	4	CFC	CD	DD
			134	152	no	9	4			
-	1P1 Apparent Power S	MU1P_1 (Measured value processing)	134	152	no	9	5	CFC	CD	DD
-	1P1 Phase Angle Phi	MU1P_1 (Measured value processing)	134	152	no	9	6	CFC	CD	DD
-	1P1 Active Power Factor Cosine Phi	MU1P_1 (Measured value processing)	134	152	no	9	7	CFC	CD	DD
-	1P1 Reactive Power Factor Sine Phi	MU1P_1 (Measured value processing)	134	152	no	9	8	CFC	CD	DD

No.	Description	Function	IEC 60870-5-103					Configurable in Matrix		
			Type	Information Number	Compatibility	Data Unit	Position	CFC	Control Display	Default Display
-	1P1 Frequency of U	MU1P_1 (Measured value processing)	134	152	no	9	9	CFC	CD	DD
-	1P2 Voltage Input U	MU1P_2	-	-	-	-	-			
-	1P2 Current Input	MU1P_2	-	-	-	-	-			
-	1P2 Voltage U	MU1P_2	134	153	no	9	1	CFC	CD	DD
-	1P2 Current I	MU1P_2	134	153	no	9	2	CFC	CD	DD
-	1P2 Active Power P	MU1P_2	134	153	no	9	3	CFC	CD	DD
-	1P2 Reactive Power Q	MU1P_2	134	153	no	9	4	CFC	CD	DD
-	1P2 Apparent Power S	MU1P_2	134	153	no	9	5	CFC	CD	DD
-	1P2 Phase Angle Phi	MU1P_2	134	153	no	9	6	CFC	CD	DD
-	1P2 Active Power Factor Cosine Phi	MU1P_2	134	153	no	9	7	CFC	CD	DD
-	1P2 Reactive Power Factor Sine Phi	MU1P_2	134	153	no	9	8	CFC	CD	DD
-	1P2 Frequency of U	MU1P_2	134	153	no	9	9	CFC	CD	DD
-	1P3 Voltage Input U	MU1P_3	-	-	-	-	-			
-	1P3 Current Input I	MU1P_3	-	-	-	-	-			
-	1P3 Voltage U	MU1P_3	134	154	no	9	1	CFC	CD	DD
-	1P3 Current I	MU1P_3	134	154	no	9	2	CFC	CD	DD
-	1P3 Active Power P	MU1P_3	134	154	no	9	3	CFC	CD	DD
-	1P3 Reactive Power Q	MU1P_3	134	154	no	9	4	CFC	CD	DD
-	1P3 Apparent Power S	MU1P_3	134	154	no	9	5	CFC	CD	DD
-	1P3 Phase Angle Phi	MU1P_3	134	154	no	9	6	CFC	CD	DD
-	1P3 Active Power Factor Cosine Phi	MU1P_3	134	154	no	9	7	CFC	CD	DD
-	1P3 Reactive Power Factor Sine Phi	MU1P_3	134	154	no	9	8	CFC	CD	DD
-	1P3 Frequency of U	MU1P_3	134	154	no	9	9	CFC	CD	DD
-	3P1 Voltage Input U1	MU3P_1 (Measured value processing)	-	-	-	-	-			
-	3P1 Voltage Input U2	MU3P_1 (Measured value processing)	-	-	-	-	-			
-	3P1 Voltage Input U3	MU3P_1 (Measured value processing)	-	-	-	-	-			
-	3P1 Current Input I1	MU3P_1 (Measured value processing)	-	-	-	-	-			
-	3P1 Current Input I2	MU3P_1 (Measured value processing)	-	-	-	-	-			
-	3P1 Current Input I3	MU3P_1 (Measured value processing)	-	-	-	-	-			
-	3P1 Zero Sequence Voltage	MU3P_1 (Measured value processing)	134	151	no	9	1	CFC	CD	DD
-	3P1 Phase to Earth Voltage U1	MU3P_1 (Measured value processing)	106	148	no	9	4	CFC	CD	DD
			134	151	no	9	2			
-	3P1 Phase to Earth Voltage U2	MU3P_1 (Measured value processing)	106	148	no	9	5	CFC	CD	DD
			134	151	no	9	3			

No.	Description	Function	IEC 60870-5-103					Configurable in Matrix		
			Type	Information Number	Compatibility	Data Unit	Position	CFC	Control Display	Default Display
-	3P1 Phase to Earth Voltage U3	MU3P_1 (Measured value processing)	106	148	no	9	6	CFC	CD	DD
			134	151	no	9	4			
-	3P1 Phase to Phase Voltage U12	MU3P_1 (Measured value processing)	134	151	no	9	5	CFC	CD	DD
-	3P1 Phase to Phase Voltage U23	MU3P_1 (Measured value processing)	134	151	no	9	6	CFC	CD	DD
-	3P1 Phase to Phase Voltage U31	MU3P_1 (Measured value processing)	134	151	no	9	7	CFC	CD	DD
-	3P1 Zero Sequence Current	MU3P_1 (Measured value processing)	134	151	no	9	8	CFC	CD	DD
-	3P1 Phase Current I1	MU3P_1 (Measured value processing)	106	148	no	9	1	CFC	CD	DD
			134	151	no	9	9			
-	3P1 Phase Current I2	MU3P_1 (Measured value processing)	106	148	no	9	2	CFC	CD	DD
			134	151	no	9	10			
-	3P1 Phase Current I3	MU3P_1 (Measured value processing)	106	148	no	9	3	CFC	CD	DD
			134	151	no	9	11			
-	3P1 Active Power Three Phase	MU3P_1 (Measured value processing)	106	148	no	9	7	CFC	CD	DD
			134	151	no	9	12			
-	3P1 Reactive Power Three Phase	MU3P_1 (Measured value processing)	106	148	no	9	8	CFC	CD	DD
			134	151	no	9	13			
-	3P1 Apparent Power Three Phase	MU3P_1 (Measured value processing)	134	151	no	9	14	CFC	CD	DD
-	3P1 Phase Angle Three Phase	MU3P_1 (Measured value processing)	-	-	-	-	-	CFC	CD	DD
-	3P1 Active Power Factor Three Phase	MU3P_1 (Measured value processing)	134	151	no	9	15	CFC	CD	DD
-	3P1 Reactive Power Factor Three Phase	MU3P_1 (Measured value processing)	-	-	-	-	-	CFC	CD	DD
-	3P1 Frequency	MU3P_1 (Measured value processing)	106	148	no	9	9	CFC	CD	DD
			134	151	no	9	16			
-	A1 Voltage Input U1	MUAron_1 (Measured value processing)	-	-	-	-	-			
-	A1 Voltage Input U2	MUAron_1 (Measured value processing)	-	-	-	-	-			

No.	Description	Function	IEC 60870-5-103					Configurable in Matrix		
			Type	Information Number	Compatibility	Data Unit	Position	CFC	Control Display	Default Display
-	A1 Current Input I1	MUAron_1 (Measured value processing)	-	-	-	-	-			
-	A1 Voltage Input I2	MUAron_1 (Measured value processing)	-	-	-	-	-			
-	A1 Phase to Phase Voltage U12	MUAron_1 (Measured value processing)	134	155	no	9	1	CFC	CD	DD
-	A1 Phase to Phase Voltage U13	MUAron_1 (Measured value processing)	134	155	no	9	2	CFC	CD	DD
-	A1 Phase Current I2	MUAron_1 (Measured value processing)	134	155	no	9	3	CFC	CD	DD
-	A1 Phase Current I3	MUAron_1 (Measured value processing)	134	155	no	9	4	CFC	CD	DD
-	A1 Active Power P	MUAron_1 (Measured value processing)	134	155	no	9	5	CFC	CD	DD
-	A1 Reactive Power Q	MUAron_1 (Measured value processing)	134	155	no	9	6	CFC	CD	DD
-	A1 Apparent Power S	MUAron_1 (Measured value processing)	134	155	no	9	7	CFC	CD	DD
-	A1 Phase Angle Phi	MUAron_1 (Measured value processing)	134	155	no	9	8	CFC	CD	DD
-	A1 Active Power Factor Cosine Phi	MUAron_1 (Measured value processing)	134	155	no	9	9	CFC	CD	DD
-	A1 Reactive Power Factor Sine Phi	MUAron_1 (Measured value processing)	134	155	no	9	10	CFC	CD	DD
-	A1 Frequency	MUAron_1 (Measured value processing)	134	155	no	9	11	CFC	CD	DD
-	Sync1, Voltage input U1	SYNC function 1 (Circuit breaker synchronisation)	-	-	-	-	-			
-	Sync1, Voltage input U2	SYNC function 1 (Circuit breaker synchronisation)	-	-	-	-	-			
-	Sync. voltage U1	SYNC function 1 (Circuit breaker synchronisation)	130	1	no	9	1	CFC	CD	DD

No.	Description	Function	IEC 60870-5-103					Configurable in Matrix		
			Type	Information Number	Compatibility	Data Unit	Position	CFC	Control Display	Default Display
-	Sync. voltage U2	SYNC function 1 (Circuit breaker syn-chronisation)	130	1	no	9	3	CFC	CD	DD
-	Sync. voltage difference U1,U2	SYNC function 1 (Circuit breaker syn-chronisation)	130	1	no	9	2	CFC	CD	DD
-	Sync. angle between U1,U2	SYNC function 1 (Circuit breaker syn-chronisation)	130	1	no	9	6	CFC	CD	DD
-	Sync. frequency f1	SYNC function 1 (Circuit breaker syn-chronisation)	130	1	no	9	4	CFC	CD	DD
-	Sync. frequency f2	SYNC function 1 (Circuit breaker syn-chronisation)	130	1	no	9	7	CFC	CD	DD
-	Sync. frequency difference f1, f2	SYNC function 1 (Circuit breaker syn-chronisation)	130	1	no	9	5	CFC	CD	DD
-	Sync2, Voltage input U1	SYNC function 2	-	-	-	-	-			
-	Sync2, Voltage input U2	SYNC function 2	-	-	-	-	-			
-	Sync. voltage U1	SYNC function 2	130	2	no	9	1	CFC	CD	DD
-	Sync. voltage U2	SYNC function 2	130	2	no	9	3	CFC	CD	DD
-	Sync. voltage difference U1,U2	SYNC function 2	130	2	no	9	2	CFC	CD	DD
-	Sync. angle between U1,U2	SYNC function 2	130	2	no	9	6	CFC	CD	DD
-	Sync. frequency f1	SYNC function 2	130	2	no	9	4	CFC	CD	DD
-	Sync. frequency f2	SYNC function 2	130	2	no	9	7	CFC	CD	DD
-	Sync. frequency difference f1, f2	SYNC function 2	130	2	no	9	5	CFC	CD	DD
-	Sync3, Voltage input U1	SYNC function 3	-	-	-	-	-			
-	Sync3, Voltage input U2	SYNC function 3	-	-	-	-	-			
-	Sync. voltage U1	SYNC function 3	130	3	no	9	1	CFC	CD	DD
-	Sync. voltage U2	SYNC function 3	130	3	no	9	3	CFC	CD	DD
-	Sync. voltage difference U1,U2	SYNC function 3	130	3	no	9	2	CFC	CD	DD
-	Sync. angle between U1,U2	SYNC function 3	130	3	no	9	6	CFC	CD	DD
-	Sync. frequency f1	SYNC function 3	130	3	no	9	4	CFC	CD	DD
-	Sync. frequency f2	SYNC function 3	130	3	no	9	7	CFC	CD	DD
-	Sync. frequency difference f1, f2	SYNC function 3	130	3	no	9	5	CFC	CD	DD

No.	Description	Function	IEC 60870-5-103					Configurable in Matrix		
			Type	Information Number	Compatibility	Data Unit	Position	CFC	Control Display	Default Display
-	Sync4, Voltage input U1	SYNC function 4	-	-	-	-	-			
-	Sync4, Voltage input U2	SYNC function 4	-	-	-	-	-			
-	Sync. voltage U1	SYNC function 4	130	4	no	9	1	CFC	CD	DD
-	Sync. voltage U2	SYNC function 4	130	4	no	9	3	CFC	CD	DD
-	Sync. voltage difference U1,U2	SYNC function 4	130	4	no	9	2	CFC	CD	DD
-	Sync. angle between U1,U2	SYNC function 4	130	4	no	9	6	CFC	CD	DD
-	Sync. frequency f1	SYNC function 4	130	4	no	9	4	CFC	CD	DD
-	Sync. frequency f2	SYNC function 4	130	4	no	9	7	CFC	CD	DD
-	Sync. frequency difference f1, f2	SYNC function 4	130	4	no	9	5	CFC	CD	DD
-	Sync5, Voltage input U1	SYNC function 5	-	-	-	-	-			
-	Sync5, Voltage input U2	SYNC function 5	-	-	-	-	-			
-	Sync. voltage U1	SYNC function 5	130	5	no	9	1	CFC	CD	DD
-	Sync. voltage U2	SYNC function 5	130	5	no	9	3	CFC	CD	DD
-	Sync. voltage difference U1,U2	SYNC function 5	130	5	no	9	2	CFC	CD	DD
-	Sync. angle between U1,U2	SYNC function 5	130	5	no	9	6	CFC	CD	DD
-	Sync. frequency f1	SYNC function 5	130	5	no	9	4	CFC	CD	DD
-	Sync. frequency f2	SYNC function 5	130	5	no	9	7	CFC	CD	DD
-	Sync. frequency difference f1, f2	SYNC function 5	130	5	no	9	5	CFC	CD	DD
-	Sync6, Voltage input U1, 1.PE	SYNC function 6	-	-	-	-	-			
-	Sync6, Voltage input U1, 2.PE	SYNC function 6	-	-	-	-	-			
-	Sync6, Voltage input U2	SYNC function 6	-	-	-	-	-			
-	Sync. voltage U1	SYNC function 6	130	6	no	9	1	CFC	CD	DD
-	Sync. voltage U2	SYNC function 6	130	6	no	9	3	CFC	CD	DD
-	Sync. voltage difference U1,U2	SYNC function 6	130	6	no	9	2	CFC	CD	DD
-	Sync. angle between U1,U2	SYNC function 6	130	6	no	9	6	CFC	CD	DD
-	Sync. frequency f1	SYNC function 6	130	6	no	9	4	CFC	CD	DD
-	Sync. frequency f2	SYNC function 6	130	6	no	9	7	CFC	CD	DD
-	Sync. frequency difference f1, f2	SYNC function 6	130	6	no	9	5	CFC	CD	DD
-	Sync7, Voltage input U1, 1.PE	SYNC function 7	-	-	-	-	-			

No.	Description	Function	IEC 60870-5-103					Configurable in Matrix		
			Type	Information Number	Compatibility	Data Unit	Position	CFC	Control Display	Default Display
-	Sync7, Voltage input U1, 2.PE	SYNC function 7	-	-	-	-	-			
-	Sync7, Voltage input U2	SYNC function 7	-	-	-	-	-			
-	Sync. voltage U1	SYNC function 7	130	7	no	9	1	CFC	CD	DD
-	Sync. voltage U2	SYNC function 7	130	7	no	9	3	CFC	CD	DD
-	Sync. voltage difference U1,U2	SYNC function 7	130	7	no	9	2	CFC	CD	DD
-	Sync. angle between U1,U2	SYNC function 7	130	7	no	9	6	CFC	CD	DD
-	Sync. frequency f1	SYNC function 7	130	7	no	9	4	CFC	CD	DD
-	Sync. frequency f2	SYNC function 7	130	7	no	9	7	CFC	CD	DD
-	Sync. frequency difference f1, f2	SYNC function 7	130	7	no	9	5	CFC	CD	DD
-	Sync8, Voltage input U1, 1.PE	SYNC function 8	-	-	-	-	-			
-	Sync8, Voltage input U1, 2.PE	SYNC function 8	-	-	-	-	-			
-	Sync8, Voltage input U2	SYNC function 8	-	-	-	-	-			
-	Sync. voltage U1	SYNC function 8	130	8	no	9	1	CFC	CD	DD
-	Sync. voltage U2	SYNC function 8	130	8	no	9	3	CFC	CD	DD
-	Sync. voltage difference U1,U2	SYNC function 8	130	8	no	9	2	CFC	CD	DD
-	Sync. angle between U1,U2	SYNC function 8	130	8	no	9	6	CFC	CD	DD
-	Sync. frequency f1	SYNC function 8	130	8	no	9	4	CFC	CD	DD
-	Sync. frequency f2	SYNC function 8	130	8	no	9	7	CFC	CD	DD
-	Sync. frequency difference f1, f2	SYNC function 8	130	8	no	9	5	CFC	CD	DD
-	Wp Forward	Energy	133	51	no	205	-		CD	DD
-	Wq Forward	Energy	133	52	no	205	-		CD	DD
-	Wp Reverse	Energy	133	53	no	205	-		CD	DD
-	Wq Reverse	Energy	133	54	no	205	-		CD	DD
-	Pulsed Energy Wp (active)	Energy	133	55	no	205	-		CD	DD
-	Pulsed Energy Wq (reactive)	Energy	133	56	no	205	-		CD	DD
996	Transducer 1	Measurement (Measured value process-ing)	134	136	no	9	1	CFC	CD	DD
997	Transducer 2	Measurement (Measured value process-ing)	134	136	no	9	2	CFC	CD	DD

■

Glossary

Control display	The display which is displayed on devices with a large (graphic) display after you have pressed the control key is called the control display. It contains the switchgear that can be controlled in the feeder with status display. It is used to perform switching operations. Defining this diagram is part of the configuration.
OUT	Output indication
OI_F	Output indication fleeting → Transient information
C_xx	Command without feedback
CF_xx	Command with feedback
Tree view	The left pane of the project window displays the names and symbols of all containers of a project in the form of a folder tree. This area is called the tree view.
Container	If an object can contain other objects, it is called a container. The object Folder is an example of such a container.
Bit pattern indication	Bit pattern indication is a processing function by means of which items of digital process information applying across several inputs can be detected together in parallel and processed further. The bit pattern length can be specified as 1, 2, 3 or 4 bytes.
BP_xx	→ Bit pattern indication (Bitstring Of x Bit), x designates the length in bits (8, 16, 24 or 32 bits).
CFC	Continuous Function Chart. CFC is a graphics editor with which a program can be created and configured by using ready-made blocks.
CFC blocks	Blocks are parts of the user program delimited by their function, their structure or their purpose.
COMTRADE	Common Format for Transient Data Exchange, format for fault records.
DCF77	The extremely precise official time is determined in Germany by the "Physikalisch-Technischen-Bundesanstalt PTB" in Braunschweig. The atomic clock unit of the PTB transmits this time via the long-wave time-signal transmitter in Mainflingen near Frankfurt/Main. The emitted time signal can be received within a radius of approx. 1,500 km from Frankfurt/Main.

Data pane → The right-hand area of the project window displays the contents of the area selected in the → navigation window, for example indications, measured values, etc. of the information lists or the function selection for the device configuration.

DP → Double-point indication

DP_I → Double point indication, intermediate position 00

Double command Double commands are process outputs which indicate 4 process states at 2 outputs: 2 defined (for example ON/OFF) and 2 undefined states (for example intermediate positions)

Double-point indication Double-point indications are items of process information which indicate 4 process states at 2 inputs: 2 defined (for example ON/OFF) and 2 undefined states (for example intermediate positions).

Drag-and-drop Copying, moving and linking function, used at graphics user interfaces. Objects are selected with the mouse, held and moved from one data area to another.

ESD protection ESD protection is the total of all the means and measures used to protect electrostatic sensitive devices.

Single command Single commands are process outputs which indicate 2 process states (for example, ON/OFF) at one output.

Single point indication Single indications are items of process information which indicate 2 process states (for example, ON/OFF) at one output.

Electromagnetic compatibility Electromagnetic compatibility (EMC) is the ability of an electrical apparatus to function fault-free in a specified environment without influencing the environment unduly.

SI → Single point indication

SI_F → Single-point indication fleeting → Transient information, → Single point indication

EMC → Electromagnetic compatibility

Earth The conductive earth whose electric potential can be set equal to zero at every point. In the area of ground electrodes the earth can have a potential deviating from zero. The term "Ground reference plane" is often used for this state.

Earthing Earthing means that a conductive part is to connect via an earthing system to the → earth.

Floating → Without electrical connection to the → Earth.

Earthing Earthing is the total of all means and measured used for earthing.

ExC External command without feedback via an ETHERNET connection, device-specific

ExCF External command with feedback via an ETHERNET connection, device-specific

ExBPxx External bit pattern indication via an ETHERNET connection, device-specific → Bit pattern indication

ExDP External double point indication via an ETHERNET connection, device-specific → Double-point indication

ExDP_I External double point indication via an ETHERNET connection, intermediate position 00, device-specific → Double-point indication

ExSI External single point indication via an ETHERNET connection, device-specific → Single point indication

ExSI_F External single point indication via an ETHERNET connection, device-specific → Transient information, → Single point indication

ExMV External metered value via an ETHERNET connection, device-specific

Field devices Generic term for all devices assigned to the field level: Protection devices, combination devices, bay controllers.

Bay controllers Bay controllers are devices with control and monitoring functions without protective functions.

Chatter blocking A rapidly intermittent input (for example, due to a relay contact fault) is switched off after a configurable monitoring time and can thus not generate any further signal changes. The function prevents overloading of the system when a fault arises.

FMS communication branch Within an FMS communication branch the users communicate on the basis of the PROFIBUS FMS protocol via a PROFIBUS FMS network.

General interrogation (GI) During the system start-up the state of all the process inputs, of the status and of the fault image is sampled. This information is used to update the system-end process image. The current process state can also be sampled after a data loss by means of a GI.

Device container In the Component View, all SIPROTEC 4 devices are assigned to an object of type Device container. This object is a special object of DIGSI Manager. However, since there is no component view in DIGSI Manager, this object only becomes visible in conjunction with STEP 7.

GPS Global Positioning System. Satellites with atomic clocks on board orbit the earth twice a day in different parts in approx. 20,000 km. They transmit signals which also contain the GPS universal time. The GPS receiver determines its own position from the signals received. From its position it can derive the running time of a satellite and thus correct the transmitted GPS universal time.

LV	Limit value
LVU	Limit value, user-defined
Hierarchy level	Within a structure with higher-level and lower-level objects a hierarchy level is a container of equivalent objects.
HV field description	The HV project description file contains details of fields which exist in a ModPara-project. The actual field information of each field is memorized in a HV field description file. Within the HV project description file, each field is allocated such a HV field description file by a reference to the file name.
HV project description	All the data is exported once the configuration and parameterisation of PCUs and submodules using ModPara has been completed. This data is split up into several files. One file contains details about the fundamental project structure. This also includes, for example, information detailing which fields exist in this project. This file is called a HV project description file.
ID	Internal double point indication → Double-point indication
ID_S	Internal double point indication intermediate position 00, → Double-point indication
IS	Internal single point indication → Single point indication
IS_F	Single-point indication fleeting → Transient information, → Single point indication
IEC	International Electrotechnical Commission
IEC Address	Within an IEC bus a unique IEC address has to be assigned to each SIPROTEC 4 device. A total of 254 IEC addresses are available for each IEC bus.
IEC communication branch	Within an IEC communication branch the users communicate on the basis of the IEC60-870-5-103 protocol via an IEC bus.
IRC combination	Inter Relay Communication, IRC, is used for directly exchanging process information between SIPROTEC 4 devices. You require an object of type IRC combination to configure an Inter Relay Communication. Each user of the combination and all the necessary communication parameters are defined in this object. The type and scope of the information exchanged among the users is also stored in this object.
Inter relay communication	→ IRC combination
Initialization string	An initialization string comprises a range of modem-specific commands. These are transmitted to the modem within the framework of modem initialization. The commands can, for example, force specific settings for the modem.
PMV	Pulse metered value

IRIG-B	Time signal code of the Inter-Range Instrumentation Group
ISO 9001	The ISO 9000 ff range of standards defines measures used to ensure the quality of a product from the development stage to the manufacturing stage.
Combination devices	Combination devices are bay devices with protection functions and a control display.
Communication reference CR	The communication reference describes the type and version of a station in communication by PROFIBUS.
Communication branch	A communications branch corresponds to the configuration of 1 to n users which communicate by means of a common bus.
Component view	In addition to a topological view, SIMATIC Manager offers you a component view. The component view does not offer any overview of the hierarchy of a project. It does, however, provide an overview of all the SIPROTEC 4 devices within a project.
Link address	The link address gives the address of a V3/V2 device.
List view	The right pane of the project window displays the names and icons of objects which represent the contents of a container selected in the tree view. Because they are displayed in the form of a list, this area is called the list view.
Master	Masters may send data to other users and request data from other users. DIGSI operates as a master.
MLFB Number	MLFB is the abbreviation for "MaschinenLesbare FabrikateBezeichnung" (machine-readable product designation). This is the equivalent of an order number. The type and version of a SIPROTEC 4 device are coded in the order number.
Modem profile	A modem profile consists of the name of the profile, a modem driver and may also comprise several initialization commands and a user address. You can create several modem profiles for one physical modem. To do so you need to link various initialization commands or user addresses to a modem driver and its properties and save them under different names.
Modems	Modem profiles for a modem connection are saved in this object type.
Modem connection	This object type contains information on both partners of a modem connection, the local modem and the remote modem.
MV	Measured value
MVU	Measured value, user-defined
MVT	Measured value with time

MVMV	Metered value which is formed from the measured value
Navigation pane	The left pane of the project window displays the names and symbols of all containers of a project in the form of a folder tree.
Object	Each element of a project structure is called an object in DIGSI.
Object properties	Each object has properties. These might be general properties that are common to several objects. An object can also have specific properties.
Off-line	In Off-line mode a link with the SIPROTEC 4 device is not necessary. You work with data which are stored in files.
On-line	When working in On-line mode, there is a physical link to a SIPROTEC 4 device which can be implemented in various ways. This link can be implemented as a direct connection, as a modem connection or as a PROFIBUS FMS connection.
Folder	This object type is used to create the hierarchical structure of a project.
Setting parameters	General term for all adjustments made to the device. Parameterization jobs are executed by means of DIGSI or, in some cases, directly on the device.
Parameter set	The parameter set is the set of all parameters that can be set for a SIPROTEC 4 device.
PROFIBUS	PROcess FIeld BUS, the German process and field bus standard, as specified in the standard EN 50170, Volume 2, PROFIBUS. It defines the functional, electrical, and mechanical properties for a bit-serial field bus.
PROFIBUS Address	Within a PROFIBUS network a unique PROFIBUS address has to be assigned to each SIPROTEC 4 device. A total of 254 PROFIBUS addresses are available for each PROFIBUS network.
Project	Content-wise, a project is the image of a real power supply system. Graphically, a project is represented by a number of objects which are integrated in a hierarchical structure. Physically, a project consists of a series of folders and files containing project data.
Process bus	Devices with a process bus interface allow direct communication with SICAM HV modules. The process bus interface is equipped with an Ethernet module.
Battery	The buffer battery ensures that specified data areas, flags, timers and counters are retained retentively.
Reorganizing	Frequent addition and deletion of objects gives rise to memory areas that can no longer be used. By cleaning up projects, you can release these memory areas again. However, a clean up also reassigns the VD addresses. The consequence of that is that all SIPROTEC 4 devices have to be reinitialised.

RIO file	Relay data Interchange format by Omicron.
RSxxx-interface	Serial interfaces RS232, RS422/485
Protection devices	All devices with a protective function and no control display.
Service port	Rear serial interface on the devices for connecting DIGSI (for example, via modem).
SICAM SAS	Modularly structured station control system, based on the substation controller → SICAM SC and the SICAM WinCC operator control and monitoring system.
SICAM SC	Substation Controller. Modularly structured substation control system, based on the SIMATIC M7 automation system.
SICAM WinCC	The SICAM WinCC operator control and monitoring system displays the state of your network graphically, visualizes alarms, interrupts and indications, archives the network data, offers the possibility of intervening manually in the process and manages the system rights of the individual employee.
SIPROTEC	The registered trademark SIPROTEC is used for devices implemented on system base V4.
SIPROTEC 4 device	This object type represents a real SIPROTEC 4 device with all the setting values and process data it contains.
SIPROTEC 4 variant	This object type represents a variant of an object of type SIPROTEC 4 device. The device data of this variant may well differ from the device data of the source object. However, all variants derived from the source object have the same VD address as the source object. For this reason they always correspond to the same real SIPROTEC 4 device as the source object. Objects of type SIPROTEC 4 variant have a variety of uses, such as documenting different operating states when entering parameter settings of a SIPROTEC 4 device.
Slave	A slave may only exchange data with a master after being prompted to do so by the master. SIPROTEC 4 devices operate as slaves.
SCADA Interface	Rear serial interface on the devices for connecting to a control system via IEC or PROFIBUS.
Users	Up to 16 compatible SIPROTEC 4 devices can communicate with one another in an Inter Relay Communication combination. The individual participating devices are called users.
User address	A user address comprises the name of the station, the national code, the area code and the user-specific phone number.
Phone book	User addresses for a modem connection are saved in this object type.

TxTap → Transformer Tap Indication

Topological view DIGSI Manager always displays a project in the topological view. This shows the hierarchical structure of a project with all available objects.

Transformer Tap Indication Transformer tap indication is a processing function on the DI by means of which the steps of the transformer adjustment can be detected together in parallel and processed further.

VD A VD (Virtual Device) includes all communication objects and their properties and states that are used by a communication user through services. A VD can be a physical device, a module of a device or a software module.

VD address The VD address is assigned automatically by DIGSI Manager. It exists only once in the entire project and thus serves to identify unambiguously a real SIPROTEC 4 device. The VD address assigned by DIGSI Manager must be transferred to the SIPROTEC 4 device in order to allow communication with DIGSI Device Editor.

Combination matrix Up to 16 compatible SIPROTEC 4 devices can communicate with one another in an Inter Relay Communication combination (IRC combination). Which device exchanges which information is defined with the help of the combination matrix.

VFD A VFD (Virtual Field Device) includes all communication objects and their properties and states that are used by a communication user through services.

Transient information A transient information is a brief transient → single-point indication at which only the coming of the process signal is detected and processed immediately.

Metered value Metered values are a processing function with which the total number of discrete similar events (counting pulses) is determined for a period, usually as an integrated value. In power supply companies the electrical work is usually recorded as a metered value (energy purchase/supply, energy transportation).

Time stamp Time stamp is the assignment of the real time to a process event.

Literature

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