SIPROTEC 4 6MD66
High-Voltage Bay Control Unit

Fig. 12/10 SIPROTEC 4
6MD66 high-voltage bay control unit

Description

The 6MD66 high-voltage bay control unit is the control unit for high voltage bays from the SIPROTEC 4 relay series. Because of its integrated functions, it is an optimum, low-cost solution for high-voltage switchbays.

The 6MD66 high-voltage bay control unit also has the same design (look and feel) as the other protection and combined units of the SIPROTEC 4 relay series. Configuration is performed in a standardized way with the easy-to-use DIGSI 4 configuration tool.

For operation, a large graphic display with a keyboard is available. The important operating actions are performed in a simple and intuitive way, e.g. alarm list display or switchgear control. The operator panel can be mounted separately from the unit, if required. Thus, flexibility with regard to the mounting position of the unit is ensured. Integrated key-operated switches control the switching authority and authorization for switching without interlocking. High-accuracy measurement (± 0.5 %) for voltage, current and calculated values *P* and *Q* are another feature of the unit.

Function overview

Application

- Integrated synchro-check for synchronized closing of the circuit-breaker
- Breaker-related protection functions (Breaker Failure 50BF, Autoreclosure 79)
- Automation can be configured easily by graphic means with CFC
- Flexible, powerful measured-value processing
- Connection for 4 voltage transformers, 3 current transformers, two 20 mA transducers
- Volume of signals for high voltage
- Up to 14 1 ½-pole circuit-breakers can be operated
- Up to 11 2-pole switching devices can be operated
- Up to 65 indication inputs, up to 45 command relays
- Can be supplied with 3 volumes of signals as 6MD662 (35 indications, 25 commands), 6MD663 (50 indications, 35 commands) or 6MD664 (65 indications, 45 commands); number of measured values is the same
- Switchgear interlocking
- Inter-relay communication with other devices of the 6MD66 series, even without a master station interface with higher level control and protection
- Suitable for redundant master station
- Display of operational measured values *V*, *I*, *P*, *Q*, *S*, *f*, cos φ (power factor) (single and three-phase measurement)
- Limit values for measured values
- Can be supplied in a standard housing for cubicle mounting or with a separate display for free location of the operator elements
- 4 freely assignable function keys to speed up frequently recurring operator actions

Communication interfaces

- System interface
  - IEC 61850 Ethernet
  - IEC 60870-5-103 protocol
  - PROFIBUS-FMS/-DP
  - Service interface for DIGSI 4 (modem)
  - Front interface for DIGSI 4
  - Time synchronization via IRIG B/DCF 77

Functions

Communication

With regard to communication between components, particular emphasis is placed on the SIPROTEC 4 functions required for energy automation.

- Every data item is time-stamped at its source, i.e. where it originates.
- Information is marked according to where it originates from (e.g. if a command originates "local" or "remote")
- The feedback to switching processes is allocated to the commands.
- Communication processes the transfer of large data blocks, e.g. file transfers, independently.
- For the reliable execution of a command, the relevant signal is first acknowledged in the unit executing the command. A check-back indication is issued after the command has been enabled (i.e. interlocking check, target = actual check) and executed.

In addition to the communication interfaces on the rear of the unit, which are equipped to suit the customer's requirements, the front includes an RS232 interface for connection of DIGSI. This is used for quick diagnostics as well as for the loading of parameters. DIGSI 4 can read out and represent the entire status of the unit online, thus making diagnostics and documentation more convenient.

Control

The bay control units of the 6MD66 series have command outputs and indication inputs that are particularly suited to the requirements of high-voltage technology. As an example, the 2-pole control of a switching device is illustrated (see Fig. 12/11). In this example, two poles of the circuit-breaker are closed and 1 pole is open. All other switching devices (disconnectors, earthing switches) are closed and open in 1½-pole control. A maximum of 14 switching devices can be controlled in this manner.

A complete 2-pole control of all switching devices (see Fig. 12/12) is likewise possible. However more contacts are required for this. A maximum of 11 switching devices can be controlled in this manner.

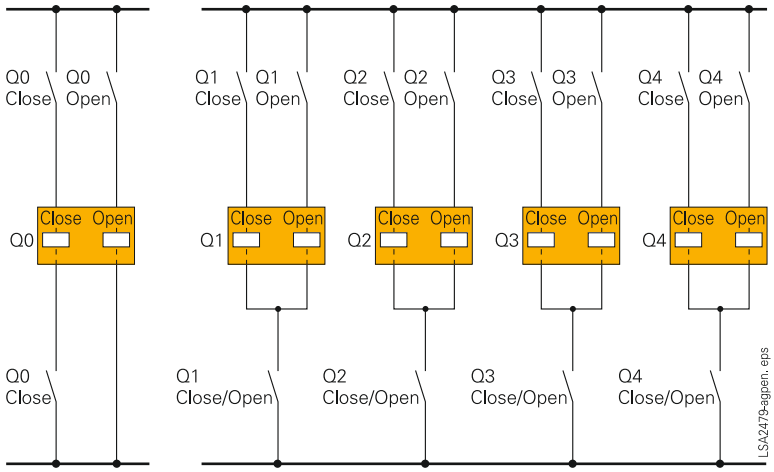

Fig. 12/11 Connection diagram of the switching devices (circuit-breaker 2 poles closed, 1 pole open; disconnector/earthing switch 1½ pole)

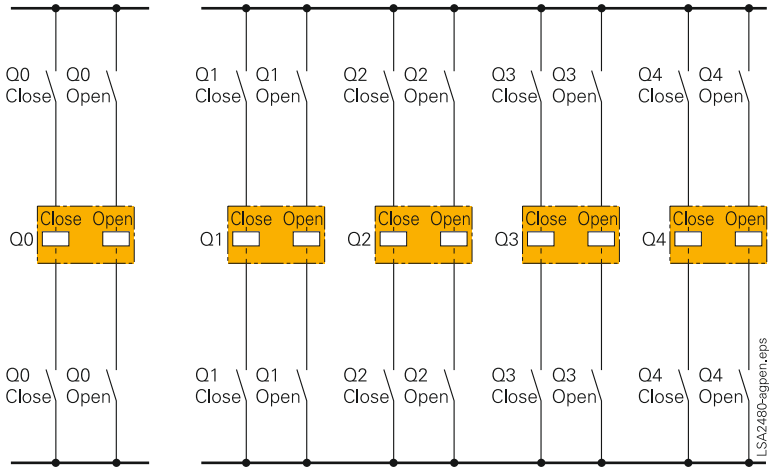

Fig. 12/12 2-pole connection diagram of circuit-breakers and disconnectors

A possible method to connect the switching devices to the bay control unit 6MD66 is shown in Fig. 12/13. There it is shown how three switching devices Q0, Q1, and Q2 are connected using 1½ pole control.

Functions

Switchgear interlockings

Using the CFC (Continuous Function Chart) available in all SIPROTEC 4 units, the bay interlock conditions can, among other things, be conveniently configured graphically in the 6MD66 bay control unit. The inter-bay interlock conditions can be checked via the “inter-relay communication” (see next section) to other 6MD66 devices. With the introduction of IEC 61850 communication, the exchange of information for interlocking purposes is also possible via Ethernet. This is handled via the GOOSE message method. Possible partners are all other bay devices or protection devices which support IEC 61850-GOOSE message.

In the tests prior to command output, the positions of both key-operated switches are also taken into consideration. The upper key-operated switch corresponds to the S5 function (local/remote switch), which is already familiar from the 8TK switchgear interlock system. The lower key-operated switch effects the changeover to non-interlocked command output (S1 function). In the position ”Interlocking Off” the key cannot be withdrawn, with the result that non-operation of the configured interlocks is immediately evident.

The precise action of the key-operated switch can be set using the parameter “switching authority”.

With the integrated function ”switchgear interlocking” there is no need for an external switchgear interlock device.

Furthermore, the following tests are implemented (parameterizable) before the output of a command:

- Target = Actual, i.e. is the switching device already in the desired position?
- Double command lockout, i.e. is another command already running?
- Individual commands, e.g. earthing control can additionally be secured using a code.

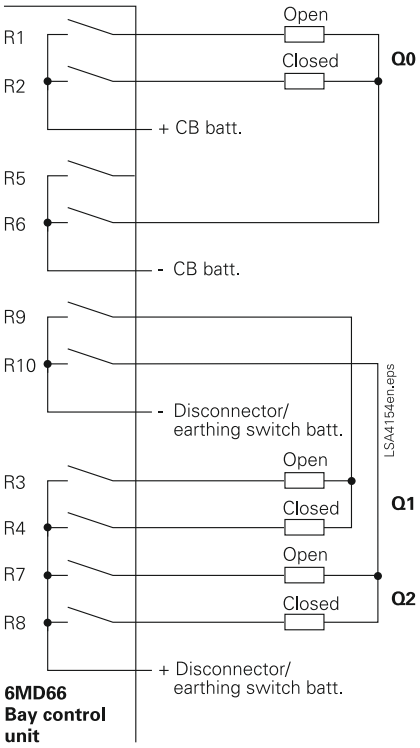

Fig. 12/13
Typical connection for 1½-pole control

Functions

Synchronization

The bay control unit can, upon closing of the circuit-breaker, check whether the synchronization conditions of both partial networks are met (synchro-check). Thus an additional, external synchronization device is not required. The synchronization conditions can be easily specified using the configuration system DIGSI 4. The unit differentiates between synchronous and asynchronous networks and reacts differently upon connection:

In synchronous networks there are minor differences with regard to phase angle and voltage moduli and so the circuit-breaker response time does not need to be taken into consideration. For asynchronous networks however, the differences are larger and the range of the connection window is traversed at a faster rate. Therefore it is wise here to take the circuit-breaker response time into consideration. The command is automatically dated in advance of this time so that the circuit-breaker contacts close at precisely the right time.
Fig. 12/14 illustrates the connection of the voltages.

As is evident from Fig. 12/14, the synchronization conditions are tested for one phase. The important parameters for synchronization are:

$|U_{min}| < |U| < |U_{max}|$
(Voltage modulus)

$\Delta\varphi < \Delta\varphi_{max}$
(Angle difference)

$\Delta f < \Delta f_{max}$
(Frequency difference)

Using the automation functions available in the bay control unit, it is possible to connect various reference voltages depending on the setting of a disconnector. Thus in the case of a double busbar system, the reference voltage of the active busbar can be automatically used for synchronization (see Fig. 12/15).

Alternatively the selection of the reference voltage can also take place via relay switching, if the measurement inputs are already being used for other purposes.

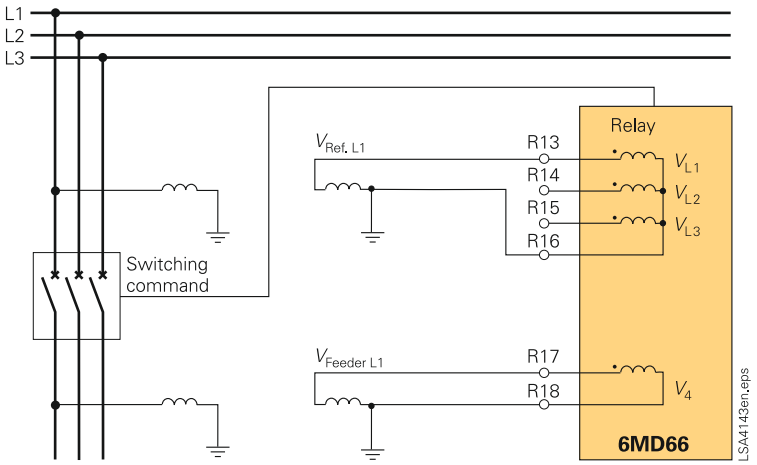

Fig. 12/14
Connection of the measured values for synchronization

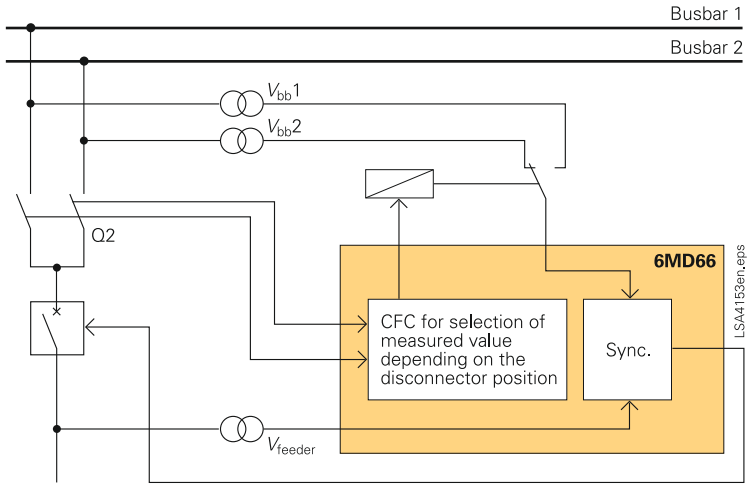

Fig. 12/15
Voltage selection for synchronization with duplicate busbar system

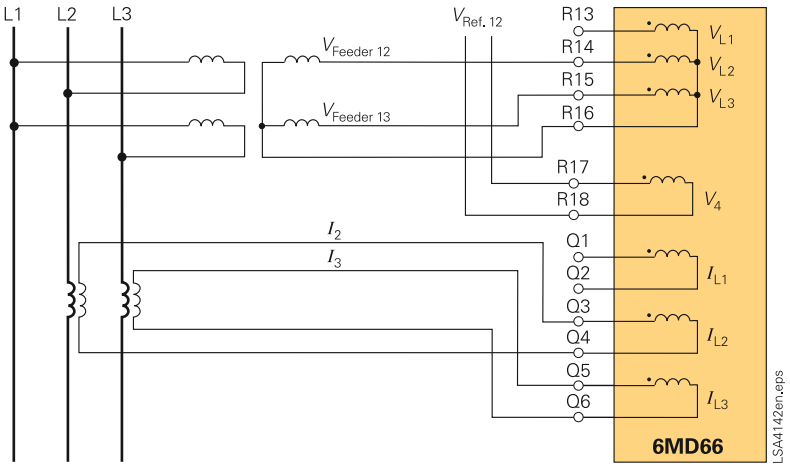

Fig. 12/16
Simultaneous connection of measured values according to a two-wattmeter circuit and synchronization

Functions

Synchronization

The bay control unit offers the option of storing various parameter sets (up to eight) for the synchronization function and of selecting one of these for operation. Thus the different properties of several circuit-breakers can be taken into consideration. These are then used at the appropriate time. This is relevant if several circuit-breakers with e.g. different response times are to be served by one bay control unit.

The measured values can be connected to the bay control unit in accordance with Fig. 12/14 (single-phase system) or Fig. 12/16 (two-wattmeter circuit).

The synchronization function can be parameterized via four tabs in DIGSI.

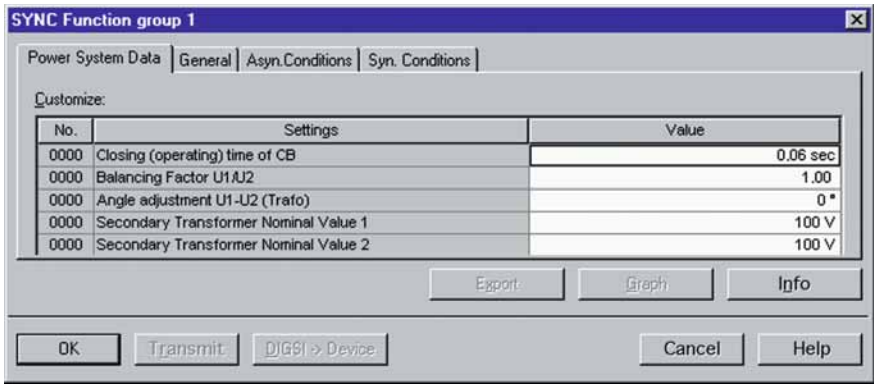

Fig. 12/17
"Power System Data", sheet for parameters of the synchronization function

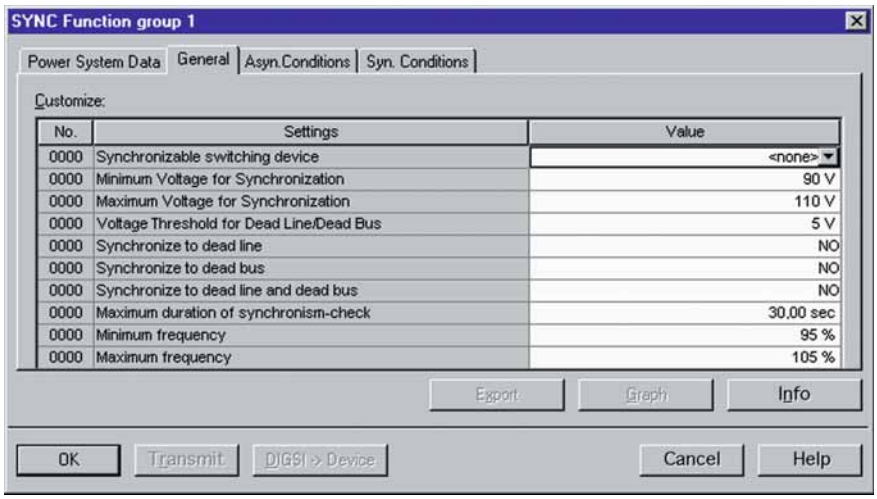

Fig. 12/18
General parameters of the synchronization function

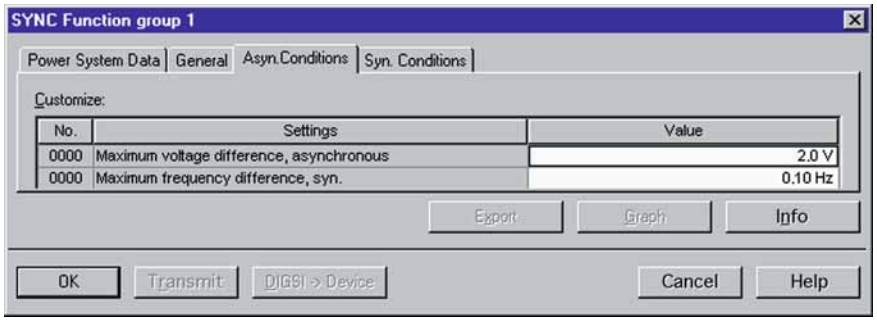

Fig. 12/19
Parameter page for asynchronous networks

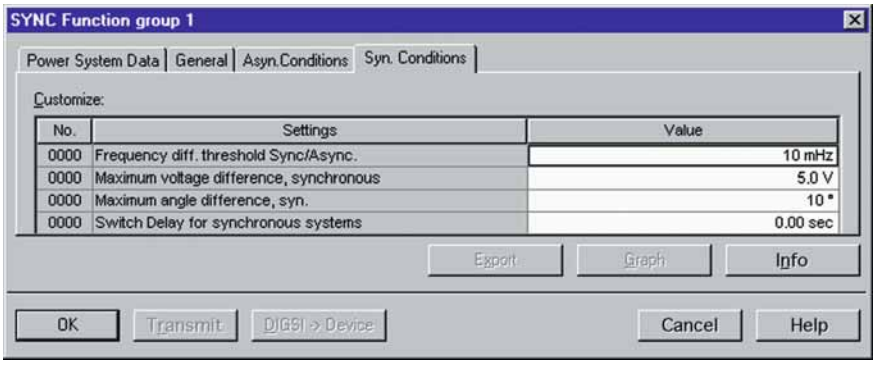

Fig. 12/20
Parameter page for asynchronous networks

Communication

Communication

The device is not only able to communicate to the substation control level via standard protocol like IEC 61850, IEC 60870-5-103 or others. It is also possible to communicate with other bay devices or protection devices. Two possibilities are available.

Inter-relay-communication

The function "inter-relay-communication" enables the exchange of information directly between 6MD66 bay controller devices. The communication is realized via Port "C" of the devices, so it is independent from the substation communication port "B". Port "C" is equipped with a RS485 interface. For communication over longer distances, an external converter to fiber-optic cable can be used.

An application example for inter-relay-communication is shown in Fig. 12/22. Three 6MD66 devices are used for control of a 1½ circuit-breaker bay. One device is assigned to each of the three circuit-breakers. By this means, the redundancy of the primary equipment is also available on the secondary side. Even if one circuit-breaker fails, both feeders can be supplied. Control over the entire bay is retained, even if one bay control unit fails. The three bay control units use the inter-relay-communication for interchange of switchgear interlocking conditions. So the interlocking is working completely independent from the substation control level.

IEC 61850-GOOSE

With the communication standard IEC 61850, a similar function like inter-relay-communication is provided with the "GOOSE" communication to other IEC 61850-devices. Since the standard IEC 61850 is used by nearly all SIPROTEC devices and many devices from other suppliers, the number of possible communication partners is large.

The applications for IEC 61850-GOOSE are quite the same as for inter-relay-communication. The most used application is the interchange of switchgear interlocking information between bay devices. GOOSE uses the IEC 61850 substation Ethernet, so no separate communication port is needed. The configuration is shown in Fig. 12/23. The SIPROTEC devices are connected via optical Ethernet and grouped by voltage levels (110 kV and 20 kV). The devices in the same voltage level can interchange the substation-wide interlocking information. GOOSE uses the substation Ethernet.

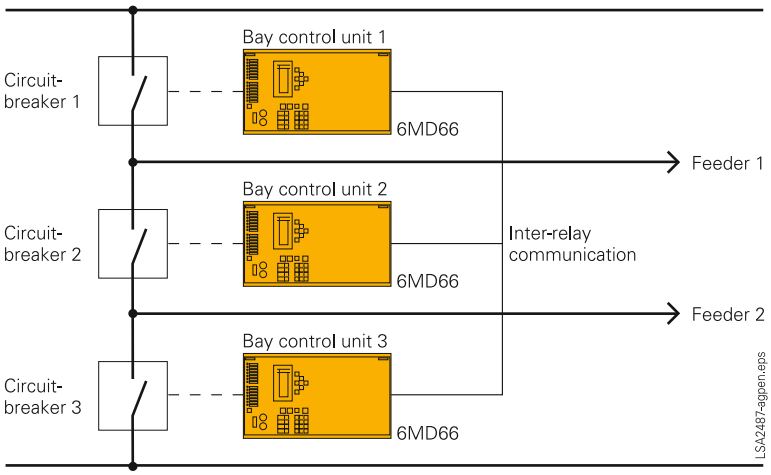

Fig. 12/21 Typical application: 1½ circuit-breaker method (disconnector and earthing switch not shown)

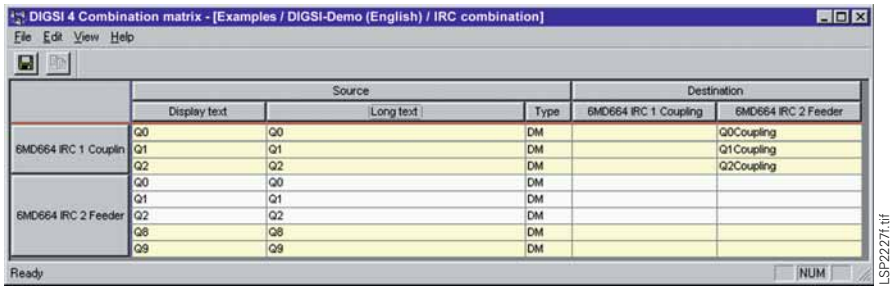

Fig. 12/22 Connection matrix of inter-relay communication in DIGSI 4

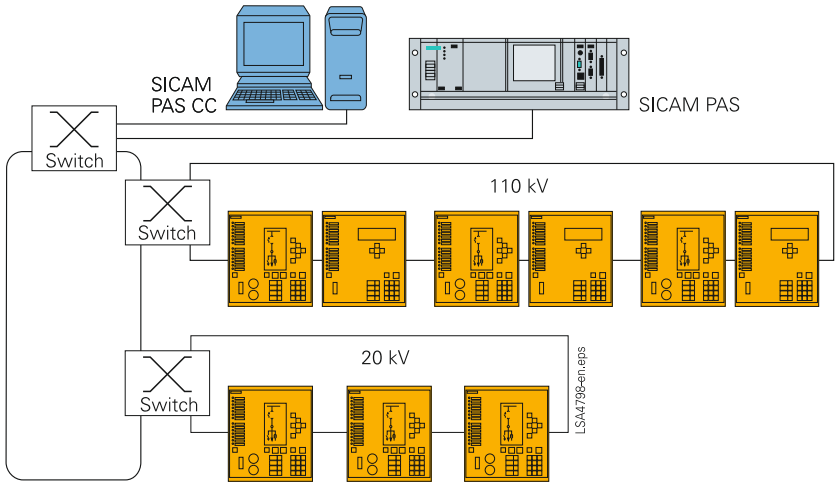

Fig. 12/23 Connection for IEC 61850-GOOSE communication

Like inter-relay-communication, GOOSE also supplies a status information for supervision of the communication. In case of interruption, the respective information is marked as "invalid". Therefore, non-affected information still can be used for interlocking, and a maximum functional availability is guaranteed.

Functions

Measured-value processing

Measured-value processing is implemented by predefined function modules, which are likewise configured using DIGSI 4.

The transducer modules are assigned in the DIGSI 4 assignment matrix to current and voltage channels of the bay control unit. From these input variables, they form various computation variables (see Table 12/1).

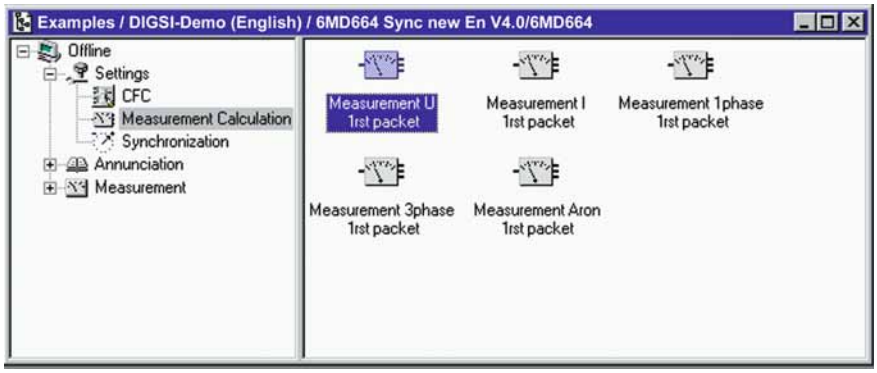

Fig. 12/24
DIGSI 4 Parameter view – transducer packets

The individual transducer modules can be activated in the functional scope of the unit and will then appear in the DIGSI 4 assignment matrix with the input channels and output variables from Table 1. The output variables can then be assigned to the system interface or represented in the measured value window in the display.

Name of the transducer module	Max. availability of transducers on the unit (can be set via the functional scope)	Required input channels	Calculated variables (= output variables)
Transducer *V*	x 1	*V*	*V*, *f*
Transducer *I*	x 1	*I*	*I*, *f*
Transducer packet 1 phase	x 3	*V*, *I*	*V*, *I*, *P*, *Q*, *S*, φ, cos φ (PF), sin φ, *f*
Transducer packet 3 phase	x 1	*V*1, *V*2, *V*3, *I*1, *I*2, *I*3	*V*0, *V*1, *V*2, *V*3, *V*12, *V*23, *V*31, *I*0, *I*1, *I*2, *I*3, *P*, *Q*, *S*, φ, cos φ (PF), sin φ, *f*
Transducer packet two-wattmeter circuit	x 1	*V*1, *V*2, *I*1, *I*2	*V*12, *V*13, *I*2, *I*3, *P*, *Q*, *S*, φ, cos φ (PF), sin φ, *f*

Table 12/1
Properties of measured-value processing

Sample presentation of the measured value display.

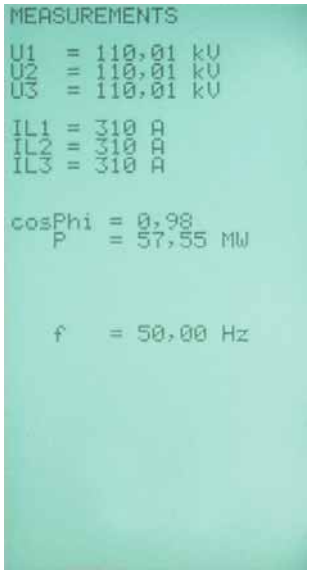

Fig. 12/25

Functions

The connection of the input channels can be chosen without restriction. For the two-wattmeter circuit, the interface connection should be selected in accordance with Fig. 12/26. The two-wattmeter circuit enables the complete calculation of a three-phase system with only two voltage and two current transformers.

Metered values

For internal metering, the unit can calculate an energy metered value from the measured current and voltage values. If an external meter with a metering pulse output is available, the bay control unit can obtain and process metering pulses via an indication input.

The metered values can be displayed and passed on to a master unit. A distinction is made between forward, reverse, active and reactive power (± kWh, ± kvarh).

Automation

With integrated logic, the user can set, via a graphic interface (CFC, Continuous Function Chart), specific functions for the automation of switchgear or substation. Functions are activated via function keys, binary input or via communication interface. Processing of internal indications or measured values is also possible.

Switching authorization/ Key-operated switch

The switching authorization (control authorization) (interlocked/non-interlocked, corresponds to key-operated S1 in the 8TK interlock system) and the switching authority (local/remote, corresponds to key-operated S5 for 8TK) can be preset for the SIPROTEC 4 bay control unit using key-operated switches. The position of both keys is automatically evaluated by command processing. The key for operation without interlocks cannot be removed when in the position "non-interlocked", such that this mode of operation is immediately recognizable (see also page 12/15, Section "Switchgear interlockings").

Every change in the key-operated switch positions is logged.

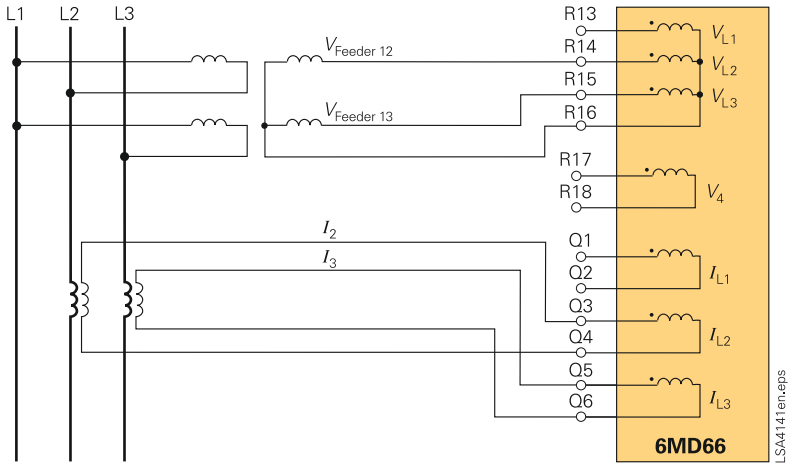

Fig. 12/26
Two-wattmeter circuit (connection to bay control unit)

Chatter blocking

Chatter blocking feature evaluates whether, in a configured period of time, the number of status changes of indication input exceeds a specified figure. If exceeded, the indication input is blocked for a certain period, so that the communication line to the master unit will not be overloaded by disturbed inputs.

For every binary input, it is possible to set separately whether the chatter blocking should be active or not. The parameters (number of status changes, test time, etc.) can be set once per unit.

Indication / measured value blocking

To avoid the transmission of information to the master unit during works on the bay, a transmission blocking can be activated.

Indication filtering

Indications can be filtered and delayed.

Filtering serves to suppress brief changes in potential at the indication input. The indication is passed on only if the indication voltage is still present after a set period of time.
The filter time can be set from 0 to 24 hours in 1 ms steps. It is also possible to set the filter time so that it can, if desired, be retriggered.

Furthermore, the hardware filter time can be taken into consideration in the time stamp; i.e. the time stamp of a message that is detected as arriving will be predated by the known, constant hardware filter time. This can be set individually for every binary input in a 6MD66 bay control unit.

Functions

Auto-Reclosure (ANSI 79)

The 6MD66 is equipped with an auto-reclosure function (AR). The function includes several operating modes:

- Interaction with an external device for auto-reclosure via binary inputs and binary outputs; also possible with interaction via IEC 61850-GOOSE
- Control of the internal AR function by external protection
- 3-pole auto-reclosure for all types of faults; different dead times are available depending on the type of the fault
- 1-pole auto-reclosure for 1-phase faults, no reclosing for multi-phase faults
- 1-pole auto-reclosure for 1-phase faults and 2-phase faults, no reclosing for multi-phase faults.
- 1-pole auto-reclosure for 1-phase and 3-pole auto-reclosure for multi-phase faults
- 1-pole auto-reclosure for 1-phase faults and 2-phase faults and 3-phase auto-reclosure for multi-phase faults
- Multiple-shot auto-reclosure
- Interaction with the internal synchro-check
- Monitoring of the circuit-breaker auxiliary contacts

In addition to the above-mentioned operating modes, several other operating principles can be employed by means of the integrated programmable logic (CFC). Integration of auto-reclosure in the feeder protection allows the line-side voltages to be evaluated. A number of voltage-dependent supplementary functions are thus available:

- DLC
  By means of dead-line-check (DLC), reclosure is effected only when the line is deenergized (prevention of asynchronous breaker closure)
- ADT
  The adaptive dead time (ADT) is employed only if auto-reclosure at the remote station was successful (reduction of stress on equipment).

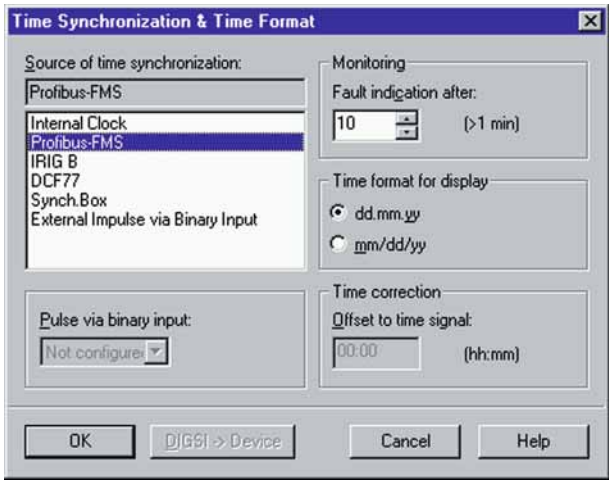

Fig. 12/27
Parameterization of time management

- RDT
  Reduced dead time (RDT) is employed in conjunction with auto-reclosure where no teleprotection method is employed: When faults within the zone extension but external to the protected line of a distance protection are switched off for rapid auto-reclosure (RAR), the RDT function decides on the basis of measurement of the return voltage from the remote station which has not tripped whether or not to reduce the dead time.

Breaker failure protection (ANSI 50BF)

The 6MD66 incorporates a two-stage circuit-breaker failure protection to detect failures of tripping command execution, for example, due to a defective circuit breaker. The current detection logic is phase-selective and can therefore also be used in single-pole tripping schemes. If the fault current is not interrupted after a settable time delay has expired, a retrip command or a busbar trip command will be generated. The breaker failure protection can be initiated by external devices via binary input signals or IEC 61850 GOOSE messages.

Time management

The 6MD66 bay control units can, like the other units in the SIPROTEC 4 range, be provided with the current time by a number of different methods:

- Via the interface to the higher-level system control (PROFIBUS FMS or IEC 61850)
- Via the external time synchronization interface on the rear of the unit (various protocols such as IRIG B and DCF77 are possible)
- Via external minute impulse, assigned to a binary input
- From another bay control unit by means of inter-relay communication
- Via the internal unit clock.

Fig. 12/27 illustrates the settings that are possible on the DIGSI interface.

DIGSI 4 Configuration tool

The PC program DIGSI 4 is used for the convenient configuration of all SIPROTEC 4 units. Data exchange with the configuration tool SICAM PAS of the energy automation system is possible, such that the bay level information needs only be entered once. Thus errors that could arise as a result of duplicated entries are excluded.

DIGSI 4 offers the user a modern and intuitive Windows interface, with which the units can be set and also read out.

DIGSI 4 configuration matrix

The DIGSI 4 configuration matrix allows the user to see the overall view of the unit configuration at a glance (see Part 3, Fig. 3/2). For example, all allocations of the binary inputs, the output relays and the LEDs are shown at a glance. And with one click of the button, connections can be switched. Also the measuring and metering values are contained in this matrix.

Commissioning

Special attention has been paid to commissioning. All binary inputs and outputs can be read and set directly. This can simplify the wire checking process significantly for the user.

CFC: Reduced time and planning for programming logic

With the help of the CFC (Continuous Function Chart), you can configure interlocks and switching sequences simply by drawing the logic sequences; no special knowledge of software is required. Logical elements, such as AND, OR and time elements, measured limit values, etc. are available.

Display editor

A convenient display editor is available to design the display on SIPROTEC 4 units. The predefined symbol sets can be expanded to suit the user. Drawing a single-line diagram is extremely simple. Operational measured values (analog values) in the unit can be placed where required.

In order to also display the comprehensive plant of the high-voltage switchgear and controlgear, the feeder control display of the 6MD66 bay control unit can have a number of pages.

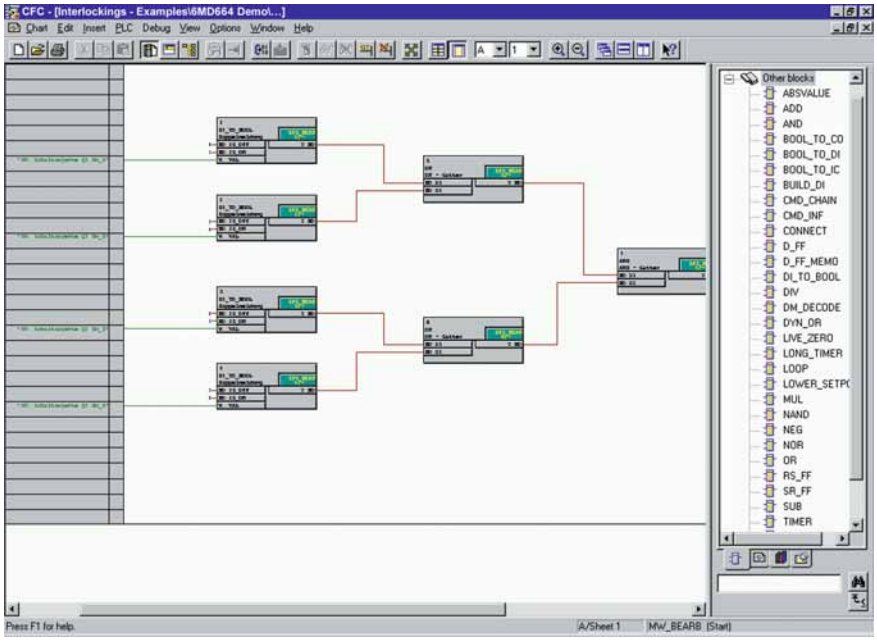

Fig. 12/28
CFC plan for interlocking logic (example)

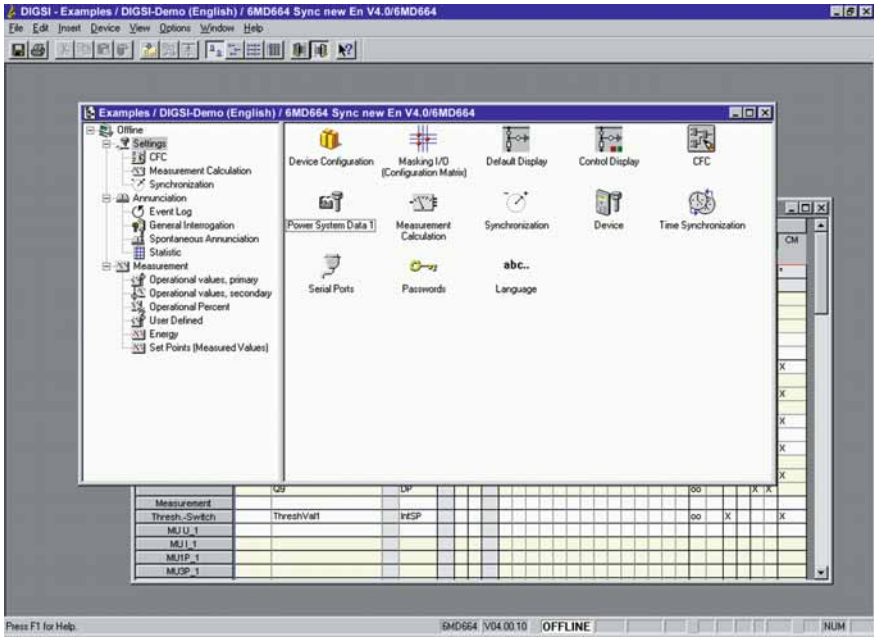

Fig. 12/29
General configuration view of the bay control unit

In this process, several pages of a control display can be configured under one another, and the user can switch between them using the cursor. The number of pages, including the basic display and the feeder control display, should not exceed 10, as otherwise the memory in the unit will be completely occupied.

Fig. 12/29 illustrates the general view of the 6MD66 bay control unit on the DIGSI 4 configuration interface.

As is the case with the SIPROTEC 4 protection units, there is an icon called "Functional Scope". It enables the configuration of measured-value processing and the synchronization function and the protection functions (auto-reclosure and breaker failure protection).

Technical data

General unit data

Analog inputs

Rated frequency	50 or 60 Hz (adjustable, depending on the order number)
Rated current I_N	1 or 5 A (can be changed via plug-in jumper)
Rated voltage V_N	100 V, 110 V, 125 V, 100 V/$\sqrt{3}$, 110 V/$\sqrt{3}$ can be adjusted using parameters
Power consumption	
at I_N = 1A	< 0.1 VA
at I_N = 5A	< 0.5 VA
Voltage inputs	< 0.3 VA with 100 V
Measurement range current I	Up to 1.2 times the rated current
Thermal loading capacity	12 A continuous, 15 A for 10 s, 200 A for 1 s
Measurement range voltage V	Up to 170 V (rms value)
Max. permitted voltage	170 V (rms value) continuous
Transducer inputs	
Measurement range	± 24 mA DC
Max. permitted continuous current	± 250 mA DC
Input resistance,	10 Ω ± 1 %
recorded power loss at 24 mA	5.76 mW

Power supply

Rated auxiliary voltages	24 to 48 V DC, 60 to 125 V DC, 110 to 250 V DC
Permitted tolerance	-20 % to +20 %
Permitted ripple of the rated auxiliary voltage	15 %
Power consumption	
Max. at 60 to 250 V DC	20 W
Max. at 24 to 48 V DC	21.5 W
Typical at 60 to 250 V DC	17.5 W
Typical at 24 to 48 V DC (typical = 5 relays picked up + live contact active + LCD display illuminated + 2 interface cards plugged in)	18.5 W
Bridging time	
at 24 and 60 V DC	≥ 20 ms
at 48 and ≥ 110 V DC	≥ 50 ms

Binary inputs

Number	
6MD662	35
6MD663	50
6MD664	65
Rated voltage range	24 to 250 V DC (selectable)
Pick-up value (range can be set using jumpers for every binary input)	17, 73 or 154 V DC
Function (allocation)	Can be assigned freely
Minimum voltage threshold (presetting)	
for rated voltage 24, 48, 60 V	17 V DC
for rated voltage 110 V	73 V DC
for rated voltage 220, 250 V	154 V DC
Maximum permitted voltage	300 V DC

Binary inputs (cont'd)

Current consumption, excited	approx. 1.5 mA
for 3 ms	approx. 50 mA to increase pickup time
Permitted capacitive coupling of the indication inputs	220 nF
Minimum impulse duration for message	4.3 ms

Output relay

Live contact	1 NC/NO (can be set via jumper: Factory setting is "Break contact", i.e. the contact is normally open but then closes in the event of an error)
Number of command relays, single pole	
6MD662	25, grouping in 2 groups of 4, 1 group of 3, 6 groups of 2 and two ungrouped relays
6MD663	35, grouping in 3 groups of 4, 1 group of 3, 9 groups of 2 and two ungrouped relays
6MD664	45, grouping 4 groups of 4, 1 group of 3, 12 groups of 2 plus two ungrouped relays
Switching capacity, command relay	
Make	max. 1000 W/ VA
Break	max. 30 VA
Break (at L/R ≤ 50 ms)	25 VA
Max. switching voltage	250 V
Max. contact continuous current	5 A
Max. (short-duration) current for 4 s	15 A
Switching capacity,	
live contact ON and OFF	20 W/VA
Max. switching voltage	250 V
Max. contact continuous current	1 A
Max. make-time	8 ms
Max. chatter time	2.5 ms
Max. break time	2 ms

LED

Number	
RUN (green)	1
ERROR (red)	1
Display (red), function can be allocated	14

Unit design

Housing 7XP20	For dimensions drawings, see part 15
Type of protection acc. to EN60529	
in the surface-mounting housing	IP20
in the flush-mounting housing	
front	IP51
rear	IP20
Weight	
Flush-mounting housing, integrated local control	
6MD663	approx. 10.5 kg
6MD664	approx. 11 kg
Surface-mounting housing, without local control, with assembly angle	
6MD663	approx. 12.5 kg
6MD664	approx. 13 kg
Detached local control	approx. 2.5 kg

Technical data

Serial interfaces

System interfaces

PROFIBUS FMS, Hardware version depending on Order No.:	
PROFIBUS fiber optic cable	ST connector
Baud rate	max 1.5 Mbaud
Optical wave length	820 nm
Permissible path attenuation	max. 8 dB for glassfiber 62.5/125 µm
Distance, bridgeable	max. 1.5 km
PROFIBUS RS485	9-pin SUB-D connector
Baud rate	max. 12 Mbaud
Distance, bridgeable	max. 1000 m at 93.75 kBaud max. 100 m at 12 Mbaud
PROFIBUS RS232	9-pin SUB-D connector
Baud rate	4800 to 115200 baud
Distance, bridgeable	max. 15 m

Time synchronization DCF77/IRIG B signal

Connection		9-pin SUB-D connector
Input voltage level		either 5 V, 12 V or 24 V
Connection allocation	Pin 1	24 V input for minute impulse
	Pin 2	5 V input for minute impulse
	Pin 3	Return conductor for minute impulse
	Pin 4	Return conductor for time message
	Pin 7	5 V input for minute impulse
	Pin 8	24 V input for time message
	Pin 5, 9	Screen
	Pin 6	Not allocated
Message type (IRIG B, DCF, etc.)		Can be adjusted using parameters

Control interface for RS232 DIGSI 4

Connection	Front side, non-isolated, 9-pin SUB-D connector

DIGSI 4 interface (rear of unit)

Fiber optic	ST connector
Baud rate	max. 1.5 Mbaud
Optical wave length	820 nm
Permissible path attenuation	max. 8 dB for glass fiber of 62.5/125 µm
Distance, bridgeable	max. 1.5 km
RS485	9-pin SUB-D connector
Baud rate	max. 12 Mbaud
Distance, bridgeable	max. 1000 m at 93.75 kBaud max. 100 m at 12 MBaud
RS232	9-pin SUB-D connector
Baud rate	4800 to 115200 Baud
Distance, bridgeable	max. 15m

Interface for inter-unit communication

RS485	9-pin SUB-D connector
Baud rate	max. 12 Mbaud
Distance, bridgeable	max. 1000 m at 93.75 kBaud max. 100 m at 12 Mbaud

Ethernet interface

IEC 61850 protocol

Isolated interface for data transfer: to a control center with DIGSI between SIPROTEC 4 relays	Port B, 100 Base T acc. to IEEE 802.3
Transmission rate	1000 MBit
Ethernet, electrical	
Connection for flush-mounting housing/ surface-mounting housing with detached operator panel	Two RJ45 connectors, mounting location “B”
Distance	Max. 20 m/65.6 ft
Test voltage	500 V AC against earth
Ethernet, optical	
Connection for flush-mounting housing/ surface-mounting housing with detached operator panel	Integrated LC connector for FO connection, mounting location “B”
Optical wavelength	1300 nmm
Distance	1.5 km/0.9 miles

Electrical tests

Specifications

Standards	IEC 60255 (product standards) ANSI/IEEE C37.90.0/.1/.2 DIN 57435 Part 303 For further standards see specific tests

Insulation tests

Standards	IEC 60255-5 and IEC 60870-2-1
Voltage test (100 % test) All circuits except for auxiliary supply, binary inputs, communication and time synchronization interfaces	2.5 kV (rms), 50 Hz
Voltage test (100 % test) Auxiliary voltage and binary inputs	3.5 kV DC
Voltage test (100 % test) only isolated communication and time synchronization interfaces	500 V (rms value), 50 Hz
Surge voltage test (type test) All circuits except for communication and time synchronization interfaces, class III	5 kV (peak); 1.2/50 µs; 0.5 J; 3 positive and 3 negative surges at intervals of 5 s

EMC tests for noise immunity; type test

Standards	IEC 60255-6, IEC 60255-22 (product standards) EN 50082-2 (generic standard) DIN 57 435 Part 303
High frequency test IEC 60255-22-1, class III and DIN 57435 part 303, class III	2.5 kV (peak value), 1 MHz; τ = 15 ms 400 pulses per s; duration 2 s
Discharge of static electricity IEC 60255-22-2 class IV EN 61000-4-2, class IV	8 kV contact discharge; 15 kV air discharge; both polarities; 150 pF; R_i = 330 Ω
Exposure to RF field, non-modulated IEC 60255-22-3 (report), class III	10 V/m; 27 to 500 MHz
Exposure to RF field, amplitude-modulated IEC 61000-4-3, class III	10 V/m; 80 to 1000 MHz; 80 % AM; 1 kHz
Exposure to RF field, pulse-modulated IEC 61000-4-3/ ENV 50204, class III	10 V/m; 900 MHz; repetition frequency 200 Hz; duty cycle 50 %
Fast transient interference bursts IEC 60255-22-4, IEC 61000-4-4, class IV	4 kV; 5/50 ns; 5 kHz; burst length = 15 ms; repetition frequency 300 ms; both polarities; R_i = 50 Ω; test duration 1 min

Technical data

EMC tests for noise immunity; type test (cont'd)

High-energy surge voltages (SURGE), IEC 61000-4-5 installation class III	Impulse: 1.2/50 µs
Auxiliary supply	common mode: 2 kV; 12 Ω, 9 µF differential mode:1 kV; 2 Ω, 18 µF
Measurement inputs, binary inputs and relay outputs	common mode: 2 kV; 42 Ω, 0.5 µF differential mode: 1 kV; 42 Ω, 0.5 µF
Conducted RF, amplitude-modulated IEC 61000-4-6, class III	10 V; 150 kHz to 80 MHz; 80 % AM; 1 kHz
Magnetic field with power frequency IEC 61000-4-8, class IV; IEC 60255-6	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); 1 to 1.5 MHz damped wave; 50 surges per second; duration 2 s; R_i = 150 to 200 Ω
Fast transient surge withstand capability ANSI/IEEE C37.90.1	4 to 5 kV; 10/150 ns; 50 impulses per second; both polarities; duration 2 s ; R_i = 80 Ω
Radiated electromagnetic interference ANSI/IEEE C37.90.2	35 V/m; 25 to 1000 MHz
Damped oscillations IEC 60894, IEC 61000-4-12	2.5 kV (peak value), 100 kHz polarity alternating, 1 MHz, 10 and 50 MHz, R_i = 200 Ω

EMC tests for interference emission; type tests

Standard	EN 50081-1 (Basic specification)
Radio interference voltage on lines only auxiliary supply IEC-CISPR 22	150 kHz to 30 MHz class B
Interference field strength IEC-CISPR 22	30 to 1000 MHz class B

Mechanical dynamic tests

Vibration, shock stress and seismic vibration

During operation

Standards	IEC 60255-21 and IEC 60068-2
Vibration IEC 60255-21-1, class 2 IEC 60068-2-6	Sinusoidal 10 to 60 Hz: ±0.075 mm amplitude; 60 to 150 Hz: 1 *g* acceleration Frequency sweep 1 octave/min 20 cycles in 3 orthogonal axes
Shock IEC 60255-21-2, class 1 IEC 60068-2-27	Half-sinusoidal Acceleration 5 *g*, duration 11 ms, 3 shocks each in both directions of the 3 axes
Vibration during earthquake IEC 60255-21-2, class 1 IEC 60068-3-3	Sinusoidal 1 to 8 Hz: ± 4 mm amplitude (horizontal axis) 1 to 8 Hz: ± 2 mm amplitude (vertical axis) 8 to 35 Hz: 1 *g* acceleration (horizontal axis) 8 to 35 Hz: 0,5 *g* acceleration (vertical axis) Frequency sweep 1 octave/min 1 cycle in 3 orthogonal axes

During transport

Standards	IEC 60255-21 and IEC 60068-2
Vibration IEC 60255-21-1, class 2 IEC 60068-2-6	Sinusoidal 5 to 8 Hz: ±7.5 mm amplitude; 8 to 150 Hz: 2 *g* acceleration Frequency sweep 1 octave/min 20 cycles in 3 orthogonal axes
Shock IEC 60255-21-2, class 1 IEC 60068-2-27	Half-sinusoidal Acceleration 15 *g*, duration 11 ms, 3 shocks each in both directions 3 axes
Continuous shock IEC 60255-21-2, class 1 IEC 60068-2-29	Half-sinusoidal Acceleration 10 *g*, duration 16 ms, 1000 shocks in both directions of the 3 axes

Climatic stress tests

Temperatures

Standards	IEC 60255-6	
Recommended temperature during operation	–5 to +55 °C	25 to 131 °F
Temporary permissible temperature limit during operation (The legibility of the display may be impaired above 55 °C/131 °F)	–20 to +70 °C	-4 to 158 °F
Limit temperature during storage	–25 to +55 °C	-13 to 131 °F
Limit temperature during transport Storage and transport with standard factory packaging	–25 to +70 °C	-13 to 158 °F

Humidity

Permissible humidity stress We recommend arranging the units in such a way that they are not exposed to direct sunlight or pronounced temperature changes that could cause condensation	Annual average ≤ 75 % relative humidity; on 56 days a year up to 93 % relative humidity; condensation during operation is not permitted

CE conformity

The product meets the stipulations of the guideline of the council of the European Communities for harmonization of the legal requirements of the member states on electro-magnetic compatibility (EMC directive 89/336/EEC) and product use within certain voltage limits (low-voltage directive 73/23/EEC).
The product conforms with the international standard of the IEC 60255 series and the German national standard DIN VDE 57 435,Part 303. The unit has been developed and manufactured for use in industrial areas in accordance with the EMC standard.

Further applicable standards: ANSI/IEEE C37.90.0 and C37.90.1

This conformity is the result of a test that was performed by Siemens AG in accordance with Article 10 of the directive in conformance with generic standards EN 50081-2 and EN 50082-2 for the EMC directive and EN 60255-6 for the low-voltage directive.

Selection and ordering data

Description	Order No.	Order code
6MD66 high-voltage bay control unit	6MD662□ – □□□□□ – 0□□□	□□□
Processor module with power supply, input/output modules with a total of:		
Number of inputs and outputs		
35 single-point indications, 22 1-pole single commands, 3 single commands to common potential, 1 live contact, 3 x current 4 x voltage via direct CT inputs, 2 measuring transducer inputs		
Current transformer I_N		
1 A	1	
1 A / 150 % I_N	2	
1 A / 200 % I_N	3	
5 A	5	
5 A / 150 % I_N	6	
5 A / 200 % I_N	7	
Rated auxiliary voltage (power supply, indication voltage)		
24 to 48 V DC, threshold binary input 19 V[2)]	2	
60 V DC, threshold binary input 19 V[2)]	3	
110 V DC, threshold binary input 88 V[2)]	4	
220 to 250 V DC, threshold binary input 176 V[2)]	5	
Unit design		
For panel flush mounting, with integr. local operation, HMI, plug-in terminal (2/3-pole AMP socket)	D	
For panel flush mounting, with integr. local operation, graphic display, keyboard, screw-type terminals (direct connec./ring-type cable lugs)	E	
Region-specific default settings/function and language presettings		
Region DE, 50 Hz, language: German, changeable	A	
Region World, 50/60 Hz, language: English (GB), changeable	B	
Region US, ANSI, language: English (US), changeable	C	
Region World, 50/60 Hz, language: French, changeable	D	
Region World, 50/60 Hz, language: Spanish, changeable	E	
System interface (on rear of unit, port B)		
No system interface	0	
IEC 60870-5-103 protocol, electrical RS485	2	
IEC 60870-5-103 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	
PROFIBUS-DP Slave, electrical RS485	9	L 0 A
PROFIBUS-DP Slave, 820 nm fiber, double ring, ST plugs	9	L 0 B
PROFIBUS-DP Slave, double electrical RS485 (second module on port D)	9	L 1 A
IEC 61850, 100 Mbit Ethernet, electrical, double, RJ45 connector	9	L 0 R
IEC 61850, 100 Mbit Ethernet, optical, double, LC connector	9	L 0 S
Function interface (on rear of unit, port C and D)		
No function interface	0	
DIGSI 4, electrical RS232, port C	1	
DIGSI 4, electrical RS485, port C	2	
DIGSI 4, optical 820 nm, ST connector, port D	3	
With RS485 interface for inter-relay communication, port C and DIGSI 4	4	
With RS485 interface for inter-relay communication, port C and DIGSI 4, with optical 820 nm, ST connector, port D	5	

see next page

2) The binary input thresholds can be selected in two stages by means of jumpers.

Selection and ordering data

Description	Order No.	Order code
6MD66 high-voltage bay control unit	*6MD662□ – □□□□□ – 0□□□*	*□□□*
Measured-value processing		
Full measured-value processing and display		*A*
No measured-value processing and no display		*F*
Synchronization		
With synchronization		*A*
Without synchronization		*F*
Protection function		
Without protection functions		*0*
With auto-reclosure (AR)		*1*
With circuit-breaker failure protection		*2*
With auto-reclosure and circuit-breaker failure protection		*3*
With fault recording		*4*

Selection and ordering data

Description	Order No.	Order code
6MD66 high-voltage bay control unit	6MD66☐☐ – ☐☐☐☐☐ – 0☐☐☐	☐☐☐
Processor module with power supply, input/output modules with a total of:		
Number of inputs and outputs		
50 single-point indications, 32 1-pole single commands, 3 single commands to common potential, 1 live contact, 3 x current, 4 x voltage via direct CT inputs, 2 measuring transducer inputs	3	
65 single-point indications, 42 1-pole single commands, 3 single commands to common potential, 1 live contact, 3 x current, 4 x voltage via direct CT inputs, 2 measuring transducer inputs	4	
Current transformer I_N		
1 A	1	
1 A / 150 % I_N	2	
1 A / 200 % I_N	3	
5 A	5	
5 A / 150 % I_N	6	
5 A / 200 % I_N (for 6MD664)	7	
Rated auxiliary voltage (power supply, indication voltage)		
24 to 48 V DC, threshold binary input 19 V[1)]	2	
60 V DC, threshold binary input 19 V[1)]	3	
110 V DC, threshold binary input 88 V[1)]	4	
220 to 250 V DC, threshold binary input 176 V[1)]	5	
Unit design		
For panel surface mounting, detached operator panel, f. mount. in l.-v. case, screw-type terminals (direct connec./ring-type cable lugs)	C	
For panel flush mounting, with integr. local operation, graphic display, keyboard, screw-type terminals (direct connec./ring-type cable lugs)	E	
For panel surface mounting, w /o operator unit, f. mount. in l.-v. case, screw-type terminals (direct connec./ring-type cable lugs)	F	
Region-specific default settings/function and language presettings		
Region DE, 50 Hz, language: German, changeable	A	
Region World, 50/60 Hz, language: English (GB), changeable	B	
Region US, ANSI, language: English (US), changeable	C	
Region World, 50/60 Hz, language: French, changeable	D	
Region World, 50/60 Hz, language: Spanish, changeable	E	
System interface (on rear of unit, port B)		
No system interface	0	
IEC 60870-5-103 protocol, electrical RS485	2	
IEC 60870-5-103 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	
PROFIBUS-DP Slave, electrical RS485	9	L 0 A
PROFIBUS-DP Slave, optical 820 nm, double ring, ST connector	9	L 0 B
PROFIBUS-DP Slave, double electrical RS485 (second module on port D)	9	L 1 A
PROFIBUS-DP Slave, double optical double ring ST (second module on port D)	9	L 1 B
IEC 61850, 100 Mbit Ethernet, electrical, double, RJ45 connector	9	L 0 R
IEC 61850, 100 Mbit Ethernet, optical, double, LC connector	9	L 0 S

see next page

1) The binary input thresholds can be selected by means of jumpers.

Selection and ordering data

Description	Order No.
6MD66 high-voltage bay control unit	*6MD66*☐☐ – ☐☐☐☐☐ – *0*☐☐☐
Function interface (on rear of unit, port C and D)	
No function interface	*0*
DIGSI 4, electrical RS232, port C	*1*
DIGSI 4, electrical RS485, port C	*2*
DIGSI 4, optical 820 nm, ST connector, port D [1]	*3*
With RS485 interface for inter-relay communication, port C and DIGSI 4	*4*
With RS485 interface for inter-relay communication, port C and DIGSI 4, with optical 820 nm, ST connector, port D [1]	*5*
Measured-value processing	
Full measured-value processing and display	*A*
No measured-value processing and no display [2]	*F*
Synchronization	
With synchronization	*A*
Without synchronization	*F*
Protection function	
Without protection functions	*0*
With auto-reclosure (AR) incl. fault recording	*1*
With circuit-breaker failure protection (BF) incl. fault recording	*2*
With auto-reclosure (AR) and circuit-breaker failure protection (BF) incl. fault recording	*3*
Fault recording	*4*

1) Not for double PROFIBUS-DP (position 11 = *9-L1A* or *9-L1B*).

2) Only for position 16 = *0* (without protection functions).

Connection diagrams

Bay unit 6MD662

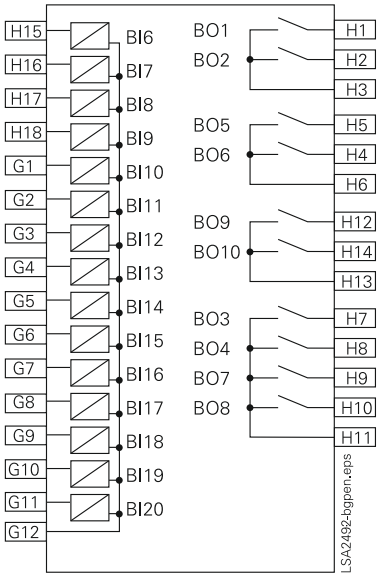

Fig. 12/30
Module 1, indications, commands

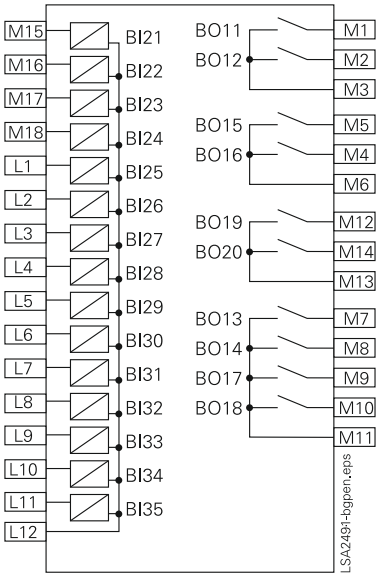

Fig. 12/31
Module 2, indications, commands

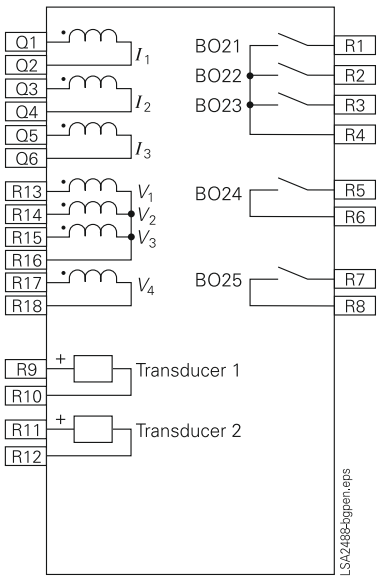

Fig. 12/32
Module 4, measuring values commands

Connection diagrams

Bay unit 6MD662

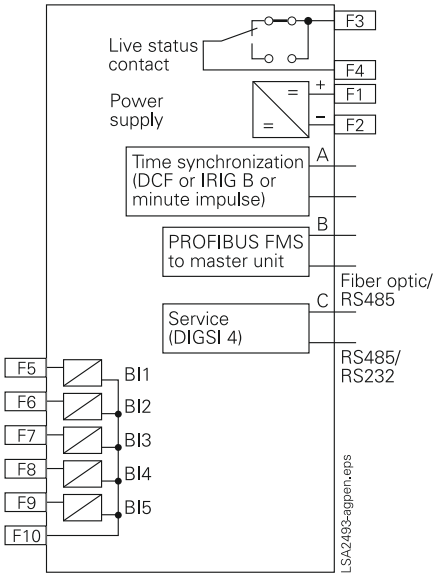

Fig. 12/33
CPU, C-CPU 2
For unit 6MD662*-****1-0AA0
and 6MD662*-****2-0AA0
(DIGSI interface, electrical, system interface
optical or electrical)

or

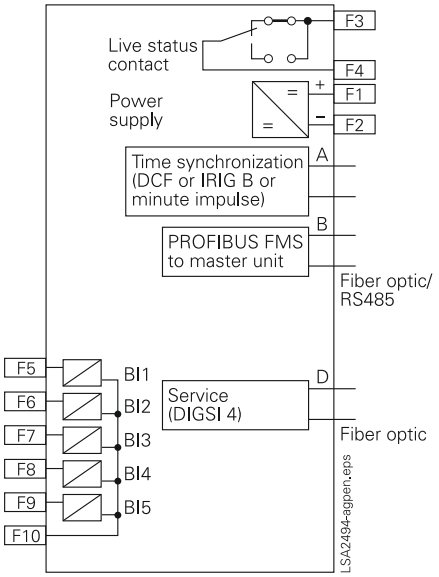

Fig. 12/34
CPU, C-CPU 2
For unit 6MD662*-****3-0AA0
(DIGSI interface, optical, system interface
optical or electrical)

or

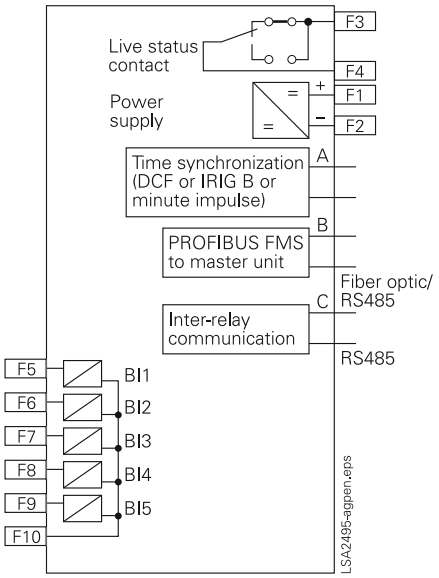

Fig. 12/35
CPU, C-CPU 2
For unit 6MD662*-****4-0AA0
(Inter-relay communication
interface electrical, system interface
optical or electrical)

or

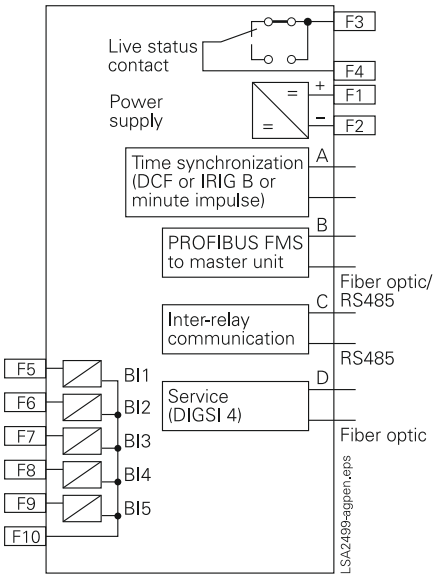

Fig. 12/36
CPU, C-CPU 2
For unit 6MD662*-****5-0AA0
(DIGSI interface, optical,
Inter-relay communication
interface electrical, system interface
optical or electrical)

Connection diagrams

Bay unit 6MD664

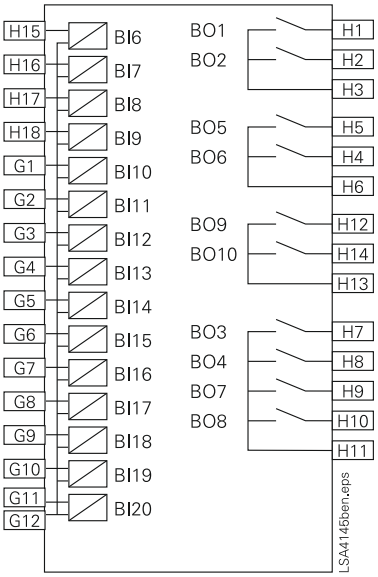

Fig. 12/37
Module 1, indications commands

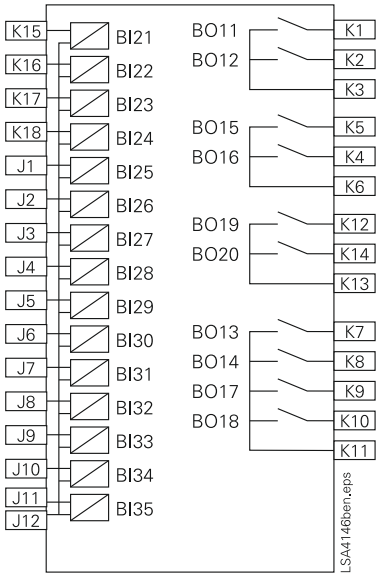

Fig. 12/38
Module 2, indications commands

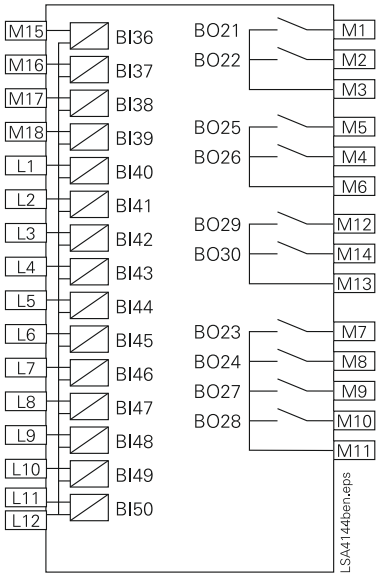

Fig. 12/39
Module 3, indications, commands

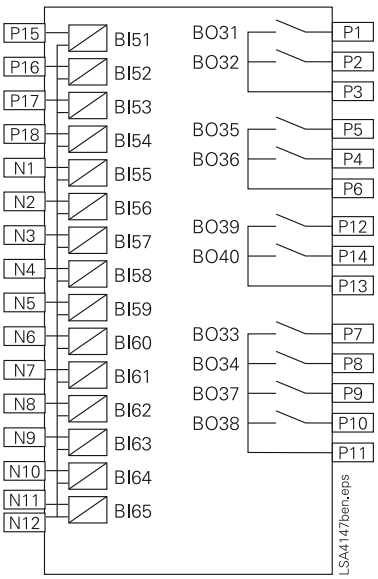

Fig. 12/40
Module 4, indications, commands

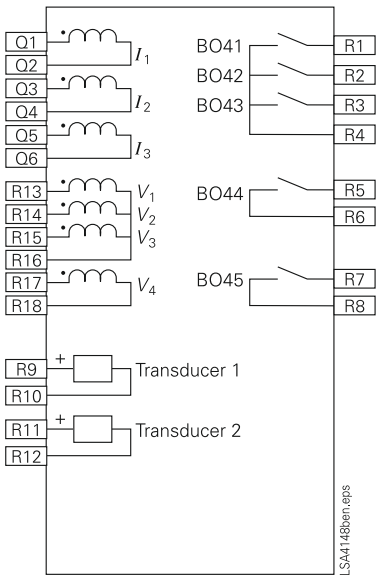

Fig. 12/41
Module 5, measuring values, commands

Connection diagrams

Bay unit 6MD664

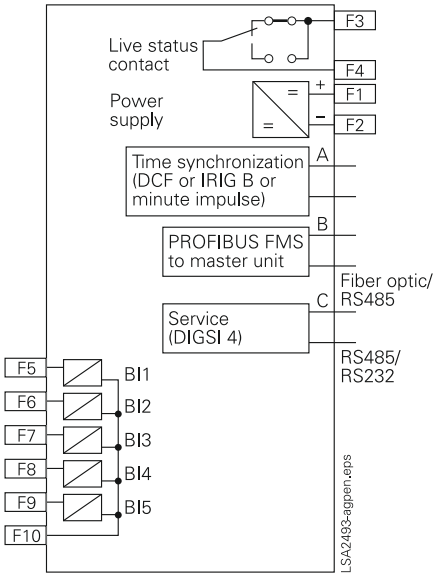

Fig. 12/42
CPU, C-CPU 2
For unit 6MD664*-****1-0AA0
and 6MD664*-****2-0AA0
(DIGSI interface electric, system interface optical optical or electric)

or

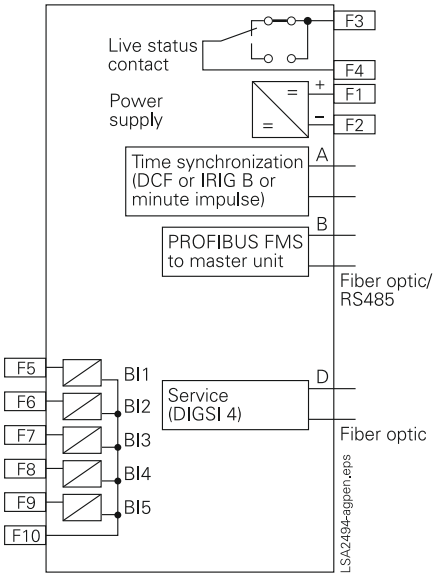

Fig. 12/43
CPU, C-CPU 2
For unit 6MD664*-****3-0AA0
(DIGSI interface optical,
system interface optical
optical or electric)

or

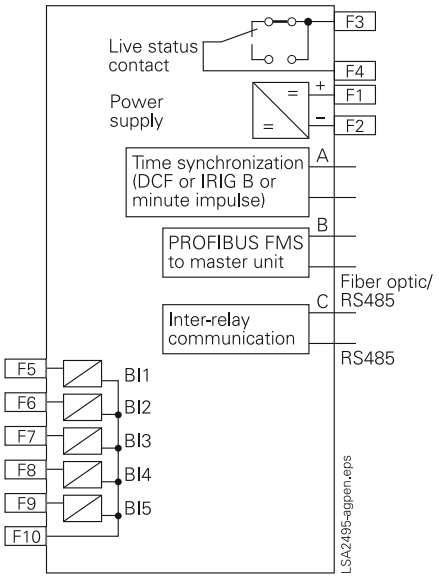

Fig. 12/44
CPU, C-CPU 2
For unit 6MD664*-****4-0AA0
(Inter-relay communication
interface electric, system
interface optical or electric)

or

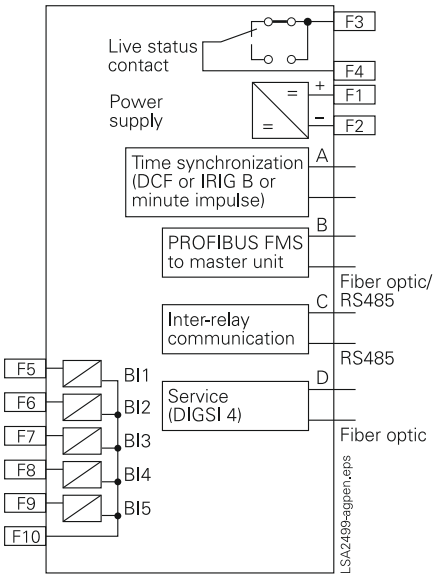

Fig. 12/45
CPU, C-CPU 2
For unit 6MD664*-****5-0AA0
(DIGSI interface optical,
(Inter-relay communication
electric, system
interface optical or electric)