SIPROTEC 4 7SJ61 multifunction protection relay

Fig. 5/56 SIPROTEC 4 7SJ61 multifunction protection relay with text (left) and graphic display

Description

The SIPROTEC 4 7SJ61 relays can be used for line protection of high and medium voltage networks with earthed (grounded), low-resistance grounded, isolated or compensated neutral point. When protecting motors, the SIPROTEC 4 7SJ61 is suitable for asynchronous machines of all sizes. The relay performs all functions of backup protection supplementary to transformer differential protection.

The relay provides control of the circuit-breaker, further switching devices and automation functions. The integrated programmable logic (CFC) allows the user to implement their own functions, e. g. for the automation of switchgear (interlocking). The user is also allowed to generate user-defined indications.

The flexible communication interfaces are open for modern communication architectures with control systems.

Function overview

Protection functions

- Overcurrent protection (definite-time/inverse-time/user-def.)
- Sensitive ground-fault detection
- Intermittent ground-fault protection
- High-impedance restricted ground fault
- Inrush-current detection
- Motor protection
  - Undercurrent monitoring
  - Starting time supervision
  - Restart inhibit
  - Locked rotor
  - Load jam protection
- Overload protection
- Temperature monitoring
- Breaker failure protection
- Negative-sequence protection
- Auto-reclosure
- Lockout

Control functions/programmable logic

- Commands for control of a circuit-breaker and of isolators
- Position of switching elements is shown on the graphic display
- Control via keyboard, binary inputs, DIGSI 4 or SCADA system
- User-defined logic with CFC (e.g. interlocking)

Monitoring functions

- Operational measured values I
- Circuit-breaker wear monitoring
- Slave pointer
- Time metering of operating hours
- Trip circuit supervision
- 8 oscillographic fault records
- Motor statistics

Communication interfaces

- System interface
  - IEC 60870-5-103, IEC 61850
  - PROFIBUS-FMS/-DP
  - DNP 3.0/ DNP3 TCP/MODBUS RTU
- Service interface for DIGSI 4 (modem)
- Front interface for DIGSI 4
- Time synchronization via IRIG B/DCF77

Hardware

- 4 current transformers
- 3/8/11 binary inputs
- 4/8/6 output relays

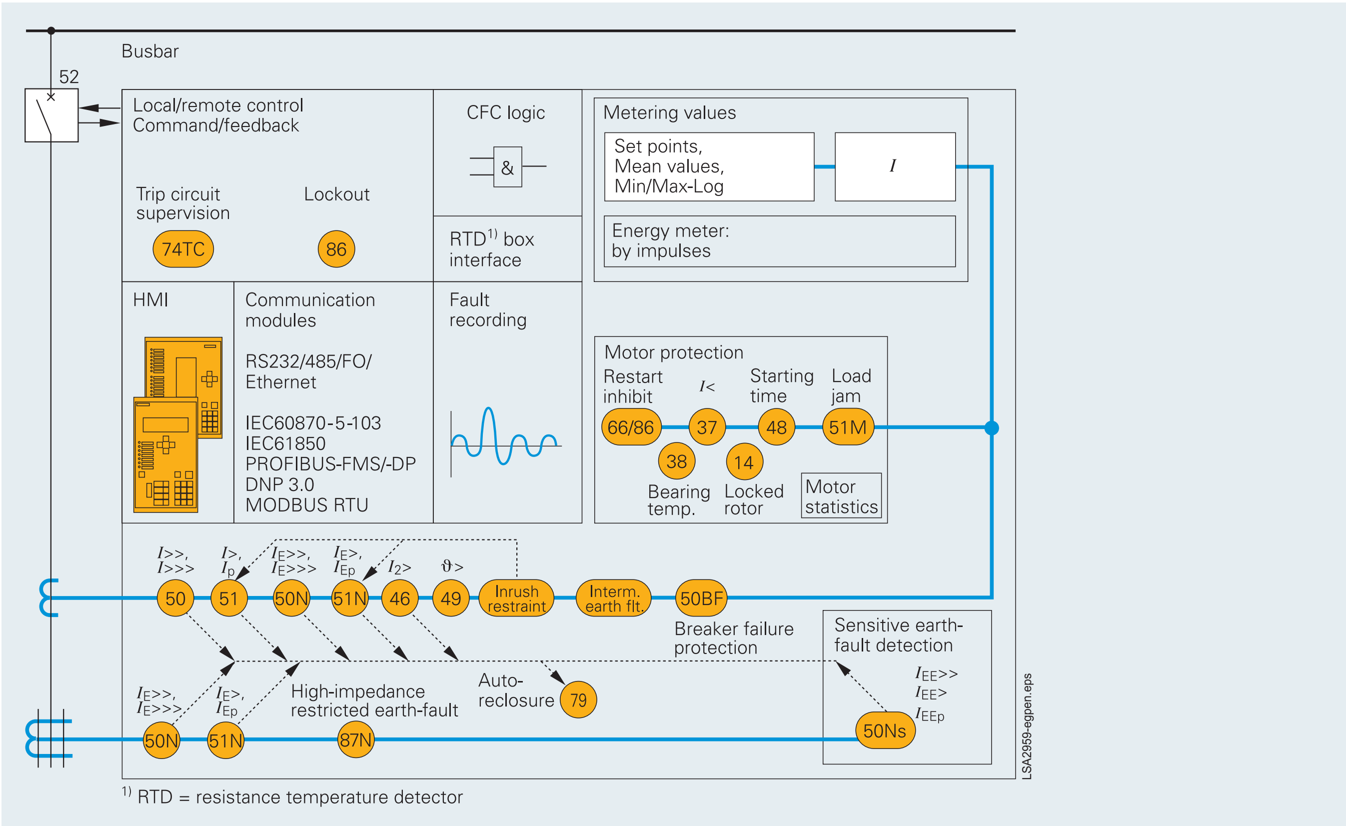


Fig. 5/57 Function diagram

Application

The SIPROTEC 4 7SJ61 unit is a numerical protection relay that also performs control and monitoring functions and therefore supports the user in cost-effective power system management, and ensures reliable supply of electric power to the customers. Local operation has been designed according to ergonomic criteria. A large, easy-to-read display was a major design aim.

Control

The integrated control function permits control of disconnect devices, grounding switches or circuit-breakers via the integrated operator panel, binary inputs, DIGSI 4 or the control and protection system (e.g. SICAM). The present status (or position) of the primary equipment can be displayed, in case of devices with graphic display. A full range of command processing functions is provided.

Programmable logic

The integrated logic characteristics (CFC) allow the user to implement their own functions for automation of switchgear (interlocking) or a substation via a graphic user interface. The user can also generate user-defined indications.

Line protection

The relay is a non-directional overcurrent relay which can be used for line protection of high and medium-voltage networks with earthed (grounded), low-resistance grounded, isolated or compensated neutral point.

Motor protection

When protecting motors, the 7SJ61 relay is suitable for asynchronous machines of all sizes.

Transformer protection

The relay performs all functions of backup protection supplementary to transformer differential protection. The inrush suppression effectively prevents tripping by inrush currents.

The high-impedance restricted ground-fault protection detects short-circuits and insulation faults on the transformer.

Backup protection

The 7SJ61can be used universally for backup protection.

Flexible protection functions

By configuring a connection between a standard protection logic and any measured or derived quantity, the functional scope of the relays can be easily expanded by up to 20 protection stages or protection functions.

Metering values

Extensive measured values, limit values and metered values permit improved system management.

ANSI	IEC	Protection functions
50, 50N	$I>$, $I>>$, $I>>>$ $I_E>$, $I_E>>$	Definite-time overcurrent protection (phase/neutral)
50, 51N	I_p, I_{Ep}	Inverse-time overcurrent protection (phase/neutral)
50Ns, 51Ns	$I_{EE}>$, $I_{EE}>>$, I_{EEp}	Sensitive ground-fault protection
–		Cold load pick-up (dynamic setting change)
–	$I_E>$	Intermittent ground fault
87N		High-impedance restricted ground-fault protection
50BF		Breaker failure protection
79		Auto-reclosure
46	$I_2>$	Phase-balance current protection (negative-sequence protection)
49	$\vartheta>$	Thermal overload protection
48		Starting time supervision
51M		Load jam protection
14		Locked rotor protection
66/86		Restart inhibit
37	$I<$	Undercurrent monitoring
38		Temperature monitoring via external device (RTD-box), e.g. bearing temperature monitoring

Construction

Connection techniques and housing with many advantages

⅓-rack size (text display variants) and ½-rack size (graphic display variants) are the available housing widths of the 7SJ61 relays referred to a 19" module frame system. This means that previous models can always be replaced. The height is a uniform 244 mm for flush-mounting housings and 266 mm for surface-mounting housing. All cables can be connected with or without ring lugs.

In the case of surface mounting on a panel, the connection terminals are located above and below in the form of screw-type terminals. The communication interfaces are located in a sloped case at the top and bottom of the housing.

Fig. 5/58 Rear view with screw-type, ⅓-rack size

Protection functions

Overcurrent protection (ANSI 50, 50N, 51, 51N)

This function is based on the phase-selective measurement of the three phase currents and the ground current (four transformers). Three definite-time overcurrent protection elements (DMT) exist both for the phases and for the ground. The current threshold and the delay time can be set within a wide range. In addition, inverse-time overcurrent protection characteristics (IDMTL) can be activated.

Reset characteristics

For easier time coordination with electromechanical relays, reset characteristics according to ANSI C37.112 and IEC 60255-3 / BS 142 standards are applied.
When using the reset characteristic (disk emulation), a reset process is initiated after the fault current has disappeared. This reset process corresponds to the reverse movement of the Ferraris disk of an electromechanical relay (thus: disk emulation).

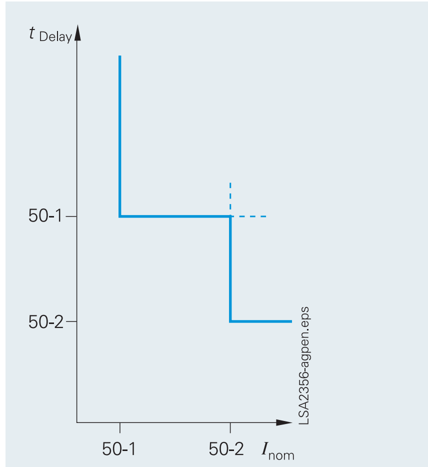


Fig. 5/59 Definite-time overcurrent characteristic

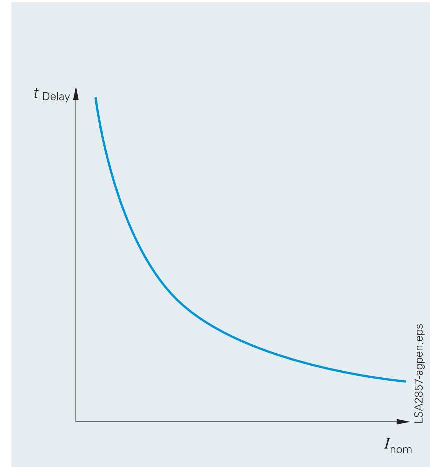


Fig. 5/60 Inverse-time overcurrent characteristic

Available inverse-time characteristics		
Characteristics acc. to	*ANSI/IEEE*	*IEC 60255-3*
Inverse	•	•
Short inverse	•	
Long inverse	•	•
Moderately inverse	•	
Very inverse	•	•
Extremely inverse	•	•

User-definable characteristics

Instead of the predefined time characteristics according to ANSI, tripping characteristics can be defined by the user for phase and ground units separately. Up to 20 current/ time value pairs may be programmed. They are set as pairs of numbers or graphically in DIGSI 4.

Inrush restraint

The relay features second harmonic restraint. If the second harmonic is detected during transformer energization, pickup of non-directional normal elements (I>, I_p) are blocked.

Cold load pickup/dynamic setting change

For overcurrent protection functions the initiation thresholds and tripping times can be switched via binary inputs or by time control.

Flexible protection functions

The 7SJ61 units enable the user to easily add on up to 20 protective functions. To this end, parameter definitions are used to link a standard protection logic with any chosen characteristic quantity (measured or derived quantity). The standard logic consists of the usual protection elements such as the pickup message, the parameter- definable delay time, the TRIP command, a blocking possibility, etc. The mode of operation for current quantities can be three-phase or single-phase. The quantities can be operated as greater than or less than stages. All stages operate with protection priority. Protection stages/functions attainable on the basis of the available characteristic quantities:

Function	*ANSI No.*
I>, I_E>	50, 50N
$3I_0$>, I_1>, I_2>, I_2/I_1>	50N, 46
Binary input	

(Sensitive) ground-fault detection (ANSI 50Ns, 51Ns/50N, 51N)

For high-resistance grounded networks, a sensitive input transformer is connected to a phase-balance neutral current transformer (also called core-balance CT).

The function can also be operated in the insensitive mode as an additional short-circuit protection.

Intermittent ground-fault protection

Intermittent (re-striking) faults occur due to insulation weaknesses in cables or as a result of water penetrating cable joints. Such faults either simply cease at some stage or develop into lasting short-circuits. During intermittent activity, however, star-point resistors in networks that are impedance-grounded may undergo thermal overloading. The normal ground-fault protection cannot reliably detect and interrupt the current pulses, some of which can be very brief.
The selectivity required with intermittent ground faults is achieved by summating the duration of the individual pulses and by triggering when a (settable) summed time is reached. The response threshold I_{IE}> evaluates the r.m.s. value, referred to one systems period.

Breaker failure protection (ANSI 50BF)

If a faulted portion of the electrical circuit is not disconnected upon issuance of a trip command, another command can be initiated using the breaker failure protection which operates the circuit-breaker, e.g. of an upstream (higher-level) protection relay. Breaker failure is detected if after a trip command, current is still flowing in the faulted circuit. As an option it is possible to make use of the circuit-breaker position indication.

Phase-balance current protection (ANSI 46) (Negative-sequence protection)

In line protection, the two-element phase-balance current/negative-sequence protection permits detection on the high side of high-resistance phase-to-phase faults and phase-to-ground faults that are on the low side of a transformer (e.g. with the switch group Dy 5). This provides backup protection for high-resistance faults beyond the transformer.

Settable dropout delay times

If the devices are used in parallel with electromechanical relays in networks with intermittent faults, the long dropout times of the electromechanical devices (several hundred milliseconds) can lead to problems in terms of time grading. Clean time grading is only possible if the dropout time is approximately the same. This is why the parameter of dropout times can be defined for certain functions such as overcurrent protection, ground short-circuit and phase-balance current protection.

Auto-reclosure (ANSI 79)

Multiple reclosures can be defined by the user and lockout will occur if a fault is present after the last reclosure. The following functions are possible:

- 3-pole ARC for all types of faults
- Separate settings for phase and ground faults
- Multiple ARC, one rapid auto-reclosure (RAR) and up to nine delayed auto-reclosures (DAR)
- Starting of the ARC depends on the trip command selection (e.g. 46, 50, 51)
- Blocking option of the ARC via binary inputs
- ARC can be initiated externally or via CFC
- The overcurrent elements can either be blocked or operated non-delayed depending on the auto-reclosure cycle
- Dynamic setting change of the overcurrent elements can be activated depending on the ready AR

Thermal overload protection (ANSI 49)

For protecting cables and transformers, an overload protection with an integrated pre-warning element for temperature and current can be applied. The temperature is calculated using a thermal homogeneous-body model (according to IEC 60255-8), which takes account both of the energy entering the equipment and the energy losses. The calculated temperature is constantly adjusted accordingly. Thus, account is taken of the previous load and the load fluctuations.

For thermal protection of motors (especially the stator) a further time constant can be set so that the thermal ratios can be detected correctly while the motor is rotating and when it is stopped. The ambient temperature or the temperature of the coolant can be detected serially via an external temperature monitoring box (resistance-temperature detector box, also called RTD-box). The thermal replica of the overload function is automatically adapted to the ambient conditions. If there is no RTD-box it is assumed that the ambient temperatures are constant.

High-impedance restricted ground-fault protection (ANSI 87N)

The high-impedance measurement principle is an uncomplicated and sensitive method for detecting ground faults, especially on transformers. It can also be applied to motors, generators and reactors when these are operated on an grounded network.

When the high-impedance measurement principle is applied, all current transformers in the protected area are connected in parallel and operated on one common resistor of relatively high R whose voltage is measured (see Fig. 5/61). In the case of 7SJ6 units, the voltage is measured by detecting the current through the (external) resistor R at the sensitive current measurement input I_{EE}. The varistor V serves to limit the voltage in the event of an internal fault. It cuts off the high momentary voltage spikes occurring at transformer saturation. At the same time, this results in smoothing of the voltage without any noteworthy reduction of the average value. If no faults have occurred and in the event of external faults, the system is at equilibrium, and the voltage through the resistor is approximately zero. In the event of internal faults, an imbalance occurs which leads to a voltage and a current flow through the resistor R.

The current transformers must be of the same type and must at least offer a separate core for the high-impedance restricted ground-fault protection. They must in particular have the same transformation ratio and an approximately identical knee-point voltage. They should also demonstrate only minimal measuring errors.

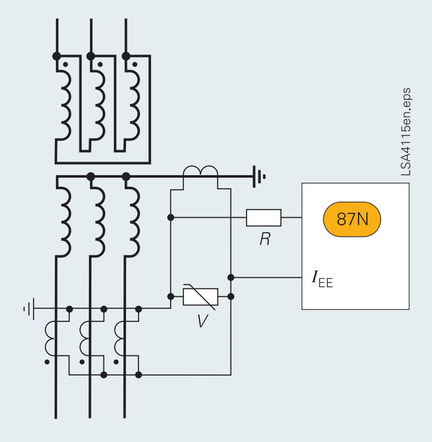


Fig. 5/61 High-impedance restricted ground-fault protection

Motor protection

Starting time supervision (ANSI 48)

Starting time supervision protects the motor against long unwanted start-ups that might occur when excessive load torque occurs, excessive voltage drops occur within the motor or if the rotor is locked. Rotor temperature is calculated from measured stator current. The tripping time is calculated according to the following equation:

for $I > I_{\text{MOTOR START}}$

$$t = \left(\frac{I_A}{I}\right)^2 \cdot T_A$$

I = Actual current flowing

$I_{\text{MOTOR START}}$ = Pickup current to detect a motor start

t = Tripping time

I_A = Rated motor starting current

T_A = Tripping time at rated motor starting current (2 times, for warm and cold motor)

The characteristic (equation) can be adapted optimally to the state of the motor by applying different tripping times T_A in dependence of either cold or warm motor state. For differentiation of the motor state the thermal model of the rotor is applied.

If the trip time is rated according to the above formula, even a prolonged start-up and reduced voltage (and reduced start-up current) will be evaluated correctly. The tripping time is inverse (current dependent).

A binary signal is set by a speed sensor to detect a blocked rotor. An instantaneous tripping is effected.

Temperature monitoring (ANSI 38)

Up to 2 temperature monitoring boxes with a total of 12 measuring sensors can be used for temperature monitoring and detection by the protection relay. The thermal status of motors, generators and transformers can be monitored with this device. Additionally, the temperature of the bearings of rotating machines are monitored for limit value violation. The temperatures are being measured with the help of temperature detectors at various locations of the device to be protected. This data is transmitted to the protection relay via one or two temperature monitoring boxes (see "Accessories", page 5/78).

Load jam protection (ANSI 51M)

Sudden high loads can cause slowing down and blocking of the motor and mechanical damages. The rise of current due to a load jam is being monitored by this function (alarm and tripping). The overload protection function is too slow and therefore not suitable under these circumstances.

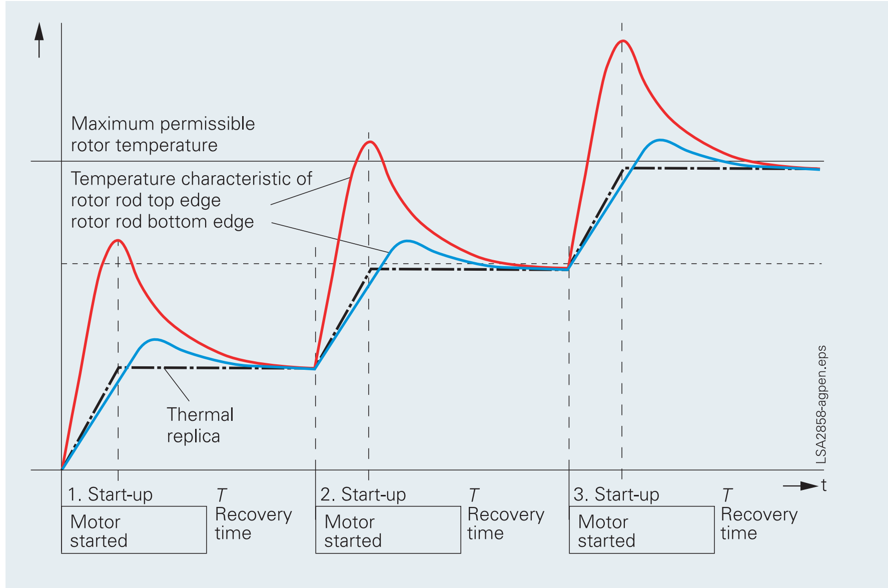


Fig. 5/62

Phase-balance current protection (ANSI 46) (Negative-sequence protection)

The negative-sequence / phase-balance current protection detects a phase failure or load unbalance due to network asymmetry and protects the rotor from impermissible temperature rise.

Restart inhibit (ANSI 66/86)

If a motor is started up too many times in succession, the rotor can be subject to thermal overload, especially the upper edges of the bars. The rotor temperature is calculated from the stator current. The reclosing lockout only permits start-up of the motor if the rotor has sufficient thermal reserves for a complete start-up (see Fig. 5/62).

Emergency start-up

This function disables the reclosing lockout via a binary input by storing the state of the thermal replica as long as the binary input is active. It is also possible to reset the thermal replica to zero.

Undercurrent monitoring (ANSI 37)

With this function, a sudden drop in current, that can occur due to a reduced motor load, is detected. This may be due to shaft breakage, no-load operation of pumps or fan failure.

Motor statistics

Essential information on start-up of the motor (duration, current, voltage) and general information on number of starts, total operating time, total down time, etc. are saved as statistics in the device.

Circuit-breaker wear monitoring

Methods for determining circuit-breaker contact wear or the remaining service life of a circuit-breaker (CB) allow CB maintenance intervals to be aligned to their actual degree of wear. The benefit lies in reduced maintenance costs.

There is no mathematically exact method of calculating the wear or the remaining service life of circuit-breakers that takes into account the arc-chamber's physical conditions when the CB opens.

This is why various methods of determining CB wear have evolved which reflect the different operator philosophies. To do justice to these, the devices offer several methods:

- ΣI
- ΣI^x, with x = 1… 3
- $\Sigma i^2 t$

The devices additionally offer a new method for determining the remaining service life:

- Two-point method

The CB manufacturers double-logarithmic switching cycle diagram (see Fig. 5/63) and the breaking current at the time of contact opening serve as the basis for this method. After CB opening, the two-point method calculates the number of still possible switching cycles. To this end, the two points P1 and P2 only have to be set on the device. These are specified in the CB's technical data.

All of these methods are phase-selective and a limit value can be set in order to obtain an alarm if the actual value falls below or exceeds the limit value during determination of the remaining service life.

Commissioning

Commissioning could hardly be easier and is fully supported by DIGSI 4. The status of the binary inputs can be read individually and the state of the binary outputs can be set individually. The operation of switching elements (circuit-breakers, disconnect devices) can be checked using the switching functions of the bay controller. The analog measured values are represented as wide-ranging operational measured values.

To prevent transmission of information to the control center during maintenance, the bay controller communications can be disabled to prevent unnecessary data from being transmitted. During commissioning, all indications with test marking for test purposes can be connected to a control and protection system.

Test operation

During commissioning, all indications can be passed to an automatic control system for test purposes.

■ Control and automatic functions

Control

In addition to the protection functions, the SIPROTEC 4 units also support all control and monitoring functions that are required for operating medium-voltage or high-voltage substations.

The main application is reliable control of switching and other processes.

The status of primary equipment or auxiliary devices can be obtained from auxiliary contacts and communicated to the 7SJ61 via binary inputs. Therefore it is possible to detect and indicate both the OPEN and CLOSED position or a fault or intermediate circuit-breaker or auxiliary contact position.

The switchgear or circuit-breaker can be controlled via:

– integrated operator panel
– binary inputs
– substation control and protection system
– DIGSI 4

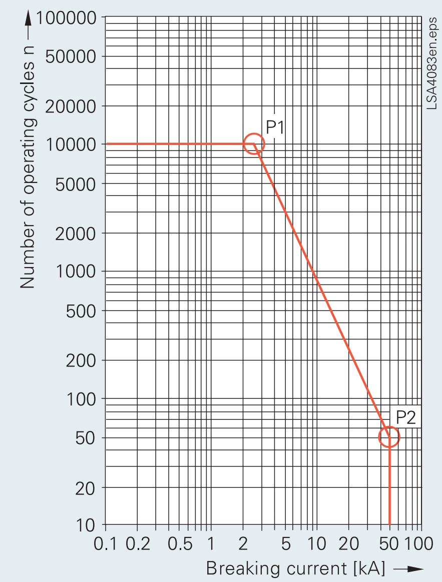


Fig. 5/63 CB switching cycle diagram

Automation / user-defined logic

With integrated logic, the user can set, via a graphic interface (CFC), specific functions for the automation of switchgear or substation. Functions are activated via function keys, binary input or via communication interface.

Switching authority

Switching authority is determined according to parameters and communication.

If a source is set to “LOCAL”, only local switching operations are possible. The following sequence of switching authority is laid down: “LOCAL”; DIGSI PC program, “REMOTE”.

Command processing

All the functionality of command processing is offered. This includes the processing of single and double commands with or without feedback, sophisticated monitoring of the control hardware and software, checking of the external process, control actions using functions such as runtime monitoring and automatic command termination after output. Here are some typical applications:

- Single and double commands using 1, 1 plus 1 common or 2 trip contacts
- User-definable bay interlocks
- Operating sequences combining several switching operations such as control of circuit-breakers, disconnectors and grounding switches
- Triggering of switching operations, indications or alarm by combination with existing information

Functions

Assignment of feedback to command

The positions of the circuit-breaker or switching devices and transformer taps are acquired by feedback. These indication inputs are logically assigned to the corresponding command outputs. The unit can therefore distinguish whether the indication change is a consequence of switching operation or whether it is a spontaneous change of state.

Chatter disable

Chatter disable 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 event list will not record excessive operations.

Indication filtering and delay

Binary indications can be filtered or 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. In the event of indication delay, there is a wait for a preset time. The information is passed on only if the indication voltage is still present after this time.

Indication derivation

A further indication (or a command) can be derived from an existing indication. Group indications can also be formed. The volume of information to the system interface can thus be reduced and restricted to the most important signals.

Measured values

The r.m.s. values are calculated from the acquired current. The following functions are available for measured value processing:

- Currents I_{L1}, I_{L2}, I_{L3}, I_E, I_{EE} (50Ns)
- Symmetrical components I_1, I_2, $3I_0$
- Mean as well as minimum and maximum current values
- Operating hours counter
- Mean operating temperature of overload function
- Limit value monitoring
  Limit values are monitored using programmable logic in the CFC. Commands can be derived from this limit value indication.
- Zero suppression
  In a certain range of very low measured values, the value is set to zero to suppress interference.

Fig. 5/64 NXAIR panel (air-insulated)

Metered values

If an external meter with a metering pulse output is available, the SIPROTEC 4 unit can obtain and process metering pulses via an indication input.

The metered values can be displayed and passed on to a control center as an accumulation with reset.

Switchgear cubicles for high/medium voltage

All units are designed specifically to meet the requirements of high/medium-voltage applications.

In general, no separate measuring instruments or additional control components are necessary.

Communication

In terms of communication, the units offer substantial flexibility in the context of connection to industrial and power automation standards. Communication can be extended or added on thanks to modules for retrofitting on which the common protocols run. Therefore, also in the future it will be possible to optimally integrate units into the changing communication infrastructure, for example in Ethernet networks (which will also be used increasingly in the power supply sector in the years to come).

Serial front interface

There is a serial RS232 interface on the front of all the units. All of the unit's functions can be set on a PC by means of the DIGSI 4 protection operation program. Commissioning tools and fault analysis are also built into the program and are available through this interface.

Rear-mounted interfaces[1)]

A number of communication modules suitable for various applications can be fitted in the rear of the flush-mounting housing. In the flush-mounting housing, the modules can be easily replaced by the user.

The interface modules support the following applications:

- Time synchronization interface
  All units feature a permanently integrated electrical time synchronization interface. It can be used to feed timing telegrams in IRIG-B or DCF77 format into the units via time synchronization receivers.
- System interface
  Communication with a central control system takes place through this interface. Radial or ring type station bus topologies can be configured depending on the chosen interface. Furthermore, the units can exchange data through this interface via Ethernet and IEC 61850 protocol and can also be operated by DIGSI.
- Service interface
  The service interface was conceived for remote access to a number of protection units via DIGSI. On all units, it can be an electrical RS232/RS485 or an optical interface. For special applications, a maximum of two temperature monitoring boxes (RTD-box) can be connected to this interface as an alternative.

System interface protocols (retrofittable)

IEC 61850 protocol

The Ethernet-based IEC 61850 protocol is the worldwide standard for protection and control systems used by power supply corporations. Siemens was the first manufacturer to support this standard. By means of this protocol, information can also be exchanged directly between bay units so as to set up simple masterless systems for bay and system interlocking. Access to the units via the Ethernet bus is also possible with DIGSI.

IEC 60870-5-103 protocol

The IEC 60870-5-103 protocol is an international standard for the transmission of protective data and fault recordings. All messages from the unit and also control commands can be transferred by means of published, Siemens-specific extensions to the protocol.

Redundant solutions are also possible. Optionally it is possible to read out and alter individual parameters (only possible with the redundant module).

PROFIBUS-DP protocol

PROFIBUS-DP is the most widespread protocol in industrial automation. Via PROFIBUS-DP, SIPROTEC units make their information available to a SIMATIC controller or, in the control direction, receive commands from a central SIMATIC. Measured values can also be transferred.

MODBUS RTU protocol

This uncomplicated, serial protocol is mainly used in industry and by power supply corporations, and is supported by a number of unit manufacturers. SIPROTEC units function as MODBUS slaves, making their information available to a master or receiving information from it.
A time-stamped event list is available.

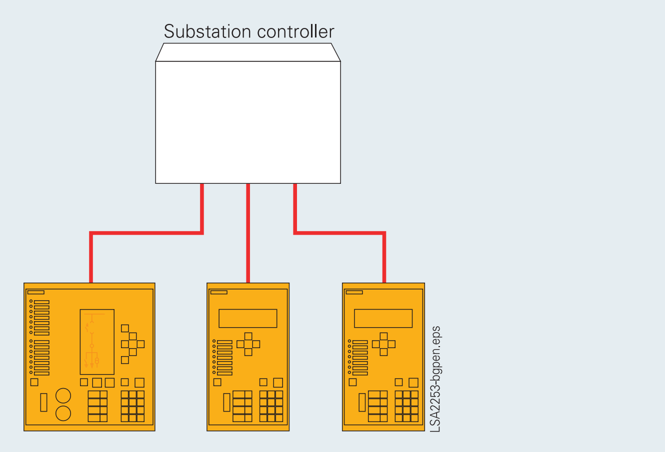


Fig. 5/65 IEC 60870-5-103: Radial fiber-optic connection

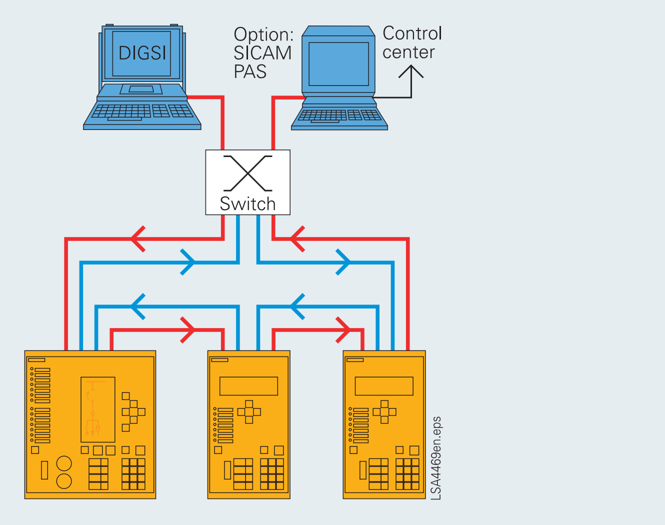


Fig. 5/66 Bus structure for station bus with Ethernet and IEC 61850, fiber-optic ring

1) For units in panel surface-mounting housings please refer to note on page 5/77.

Communication

PROFINET

PROFINET is the ethernet-based successor of Profibus DP and is supported in the variant PROFINET IO. The protocol which is used in industry together with the SIMATIC systems control is realized on the optical and electrical Plus ethernet modules which are delivered since November 2012. All network redundancy procedures which are available for the ethernet modules, such as RSTP, PRP or HSR, are also available for PROFINET. The time synchronization is made via SNTP. The network monitoring is possible via SNMP V2 where special MIB files exist for PROFINET. The LLDP protocol of the device also supports the monitoring of the network topology. Single-point indications, double-point indications, measured and metered values can be transmitted cyclically in the monitoring direction via the protocol and can be selected by the user with DIGSI 4. Important events are also transmitted spontaneously via configurable process alarms. Switching commands can be executed by the system control via the device in the controlling direction. The PROFINET implementation is certifi ed. The device also supports the IEC 61850 protocol as a server on the same ethernet module in addition to the PROFINET protocol. Client server connections are possible for the intercommunication between devices, e.g. for transmitting fault records and GOOSE messages.

DNP 3.0

Power utilities use the serial DNP 3.0 (Distributed Network Protocol) for the station and network control levels. SIPROTEC units function as DNP slaves, supplying their information to a master system or receiving information from it.

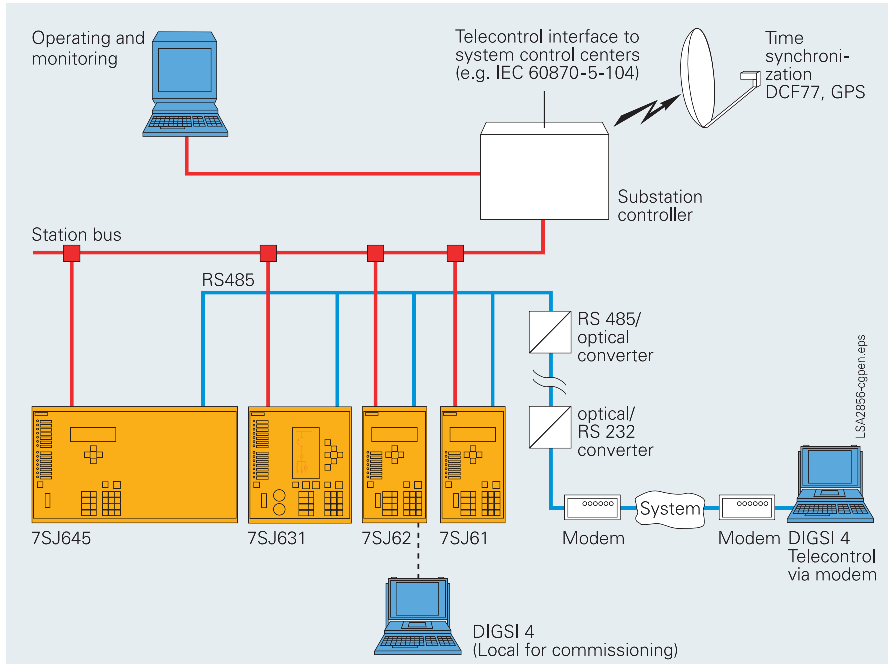


Fig. 5/67 System solution/communication

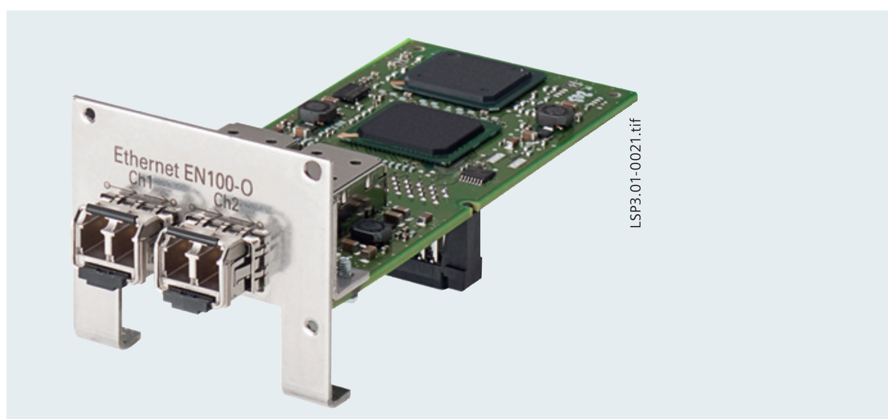


Fig. 5/68 Optical Ethernet communication module for IEC 61850 with integrated Ethernet-switch

DNP3 TCP

The ethernet-based TCP variant of the DNP3 protocol is supported with the electrical and optical ethernet module. Two DNP3 TCP clients are supported. Redundant ring structures can be realized for DNP3 TCP with the help of the integrated switch in the module. For instance, a redundant optical ethernet ring can be constructed. Single-point indications, double-point indications, measured and metered values can be configured with DIGSI 4 and are transmitted to the DNP3 TCP client. Switching commands can be executed in the controlling direction. Fault records of the device are stored in the binary Comtrade format and can be retrieved via the DNP3 file transfer. The time synchronization is performed via the DNP3 TCP client or SNTP. The device can also be integrated into a network monitoring system via the SNMP V2 protocol. Parallel to the DNP3 TCP protocol the IEC 61850 protocol (the device works as a server) and the GOOSE messages of the IEC 61850 are available for the intercommunication between devices.

System solutions for protection and station control

Together with the SICAM power automation system, SIPROTEC 4 can be used with PROFIBUS-FMS. Over the low-cost electrical RS485 bus, or interference-free via the optical double ring, the units exchange information with the control system.

Units featuring IEC 60870-5-103 interfaces can be connected to SICAM in parallel via the RS485 bus or radially by fiber-optic link. Through this interface, the system is open for the connection of units of other manufacturers (see Fig. 5/65).

Because of the standardized interfaces, SIPROTEC units can also be integrated into systems of other manufacturers or in SIMATIC. Electrical RS485 or optical interfaces are available. The optimum physical data transfer medium can be chosen thanks to opto-electrical converters. Thus, the RS485 bus allows low-cost wiring in the cubicles and an interference-free optical connection to the master can be established.

For IEC 61850, an interoperable system solution is offered with SICAM PAS. Via the 100 Mbits/s Ethernet bus, the units are linked with PAS electrically or optically to the station PC. The interface is standardized, thus also enabling direct connection of units of other manufacturers to the Ethernet bus. With IEC 61850, however, the units can also be used in other manufacturers' systems (see Fig. 5/66).

Typical connections

■ Connection of current and voltage transformers

Standard connection

For grounded networks, the ground current is obtained from the phase currents by the residual current circuit.

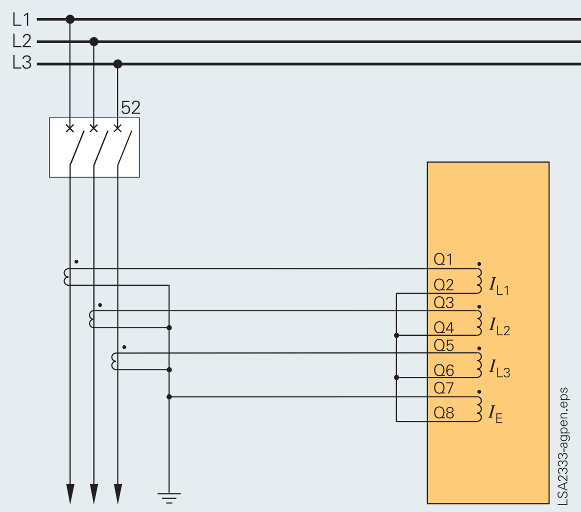


Fig. 5/69 Residual current circuit

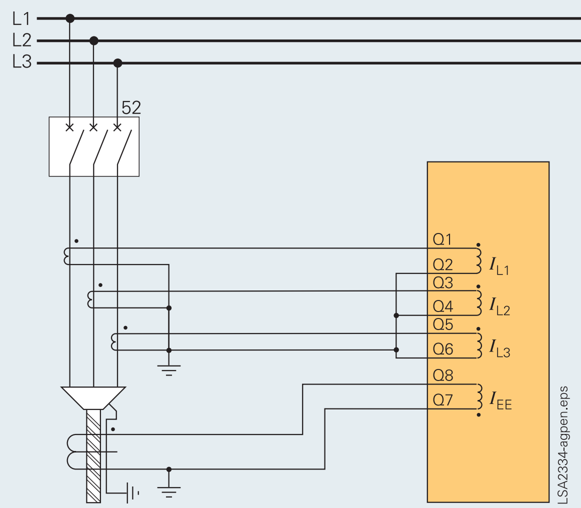


Fig. 5/70 Sensitive ground current detection

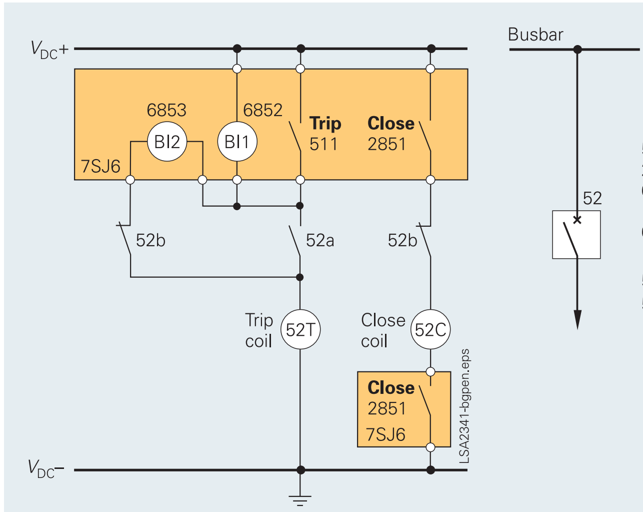
Typical applications

Overview of connection types		
Type of network	*Function*	*Current connection*
(Low-resistance) grounded network	Overcurrent protection hase/ground non-directional	Residual circuit, with 3 phase-current transformers required, phase-balance neutral current transformer possible
(Low-resistance) grounded networks	Sensitive ground-fault protection	Phase-balance neutral current transformers required
Isolated or compensated networks	Overcurrent protection phases non-directional	Residual circuit, with 3 or 2 phase current transformers possible
Isolated networks	Sensitive ground-fault protection	Phase-balance neutral current transformers required
Compensated networks	Sensitive ground-fault protection	Phase-balance neutral current transformers required

Typical applications

Trip circuit supervision (ANSI 74TC)

One or two binary inputs can be used for monitoring the circuit-breaker trip coil including its incoming cables. An alarm signal occurs whenever the circuit is interrupted.



TRIP contact	Breaker	BI1	BI2
open	closed	H	L
open	open	H	H
closed	closed	L	L
closed	open	L	H

Fig. 5/71 Trip circuit supervision with 2 binary inputs

General unit data	
Measuring circuits	
System frequency	50 / 60 Hz (settable)
Current transformer	
Rated current I_{nom}	1 or 5 A (settable)
Option: sensitive ground-fault CT	I_{EE} < 1.6 A
Power consumption at I_{nom} = 1 A at I_{nom} = 5 A for sensitive ground-fault CT at 1 A	 Approx. 0.05 VA per phase Approx. 0.3 VA per phase Approx. 0.05 VA
Overload capability Thermal (effective)	 500 A for 1 s 150 A for 10 s 20 A continuous
Dynamic (impulse current)	250 x I_{nom} (half cycle)
Overload capability if equipped with sensitive ground-fault CT Thermal (effective)	 300 A for 1 s 100 A for 10 s 15 A continuous
Dynamic (impulse current)	750 A (half cycle)

Auxiliary voltage (via integrated converter)				
Rated auxiliary voltage V_{aux}	DC 24/48 V AC	60/125 V	110/250 V 115/230 V	
Permissible tolerance	DC 19-58 V AC	48-150 V	88-330 V 92-138 V	 184-265 V
Ripple voltage, peak-to-peak	≤ 12 %			
Power consumption Quiescent Energized	 Approx. 3 W Approx. 7 W			
Backup time during loss/short-circuit of auxiliary voltage	≥ 50 ms at V ≥ DC 110 V ≥ 20 ms at V ≥ DC 24 V ≥ 200 ms at AC 115 V/230 V			

Binary inputs/indication inputs			
Type	7SJ610	7SJ611, 7SJ613	7SJ612, 7SJ614
Number	3	8	11
Voltage range	DC 24–250 V		
Pickup threshold	Modifiable by plug-in jumpers		
Pickup threshold	DC 19 V		88 V
For rated control voltage	DC 24/48/60/110/125 V		110/220/250 V
Response time/ drop-out time	Approx. 3.5 ms		
Power consumption energized	1.8 mA (independent of operating voltage)		

Binary outputs/command outputs				
Type		7SJ610,	7SJ611, 7SJ612,	7SJ613 7SJ614
Number command/indication relay		4	8	6
Contacts per command/ indication relay		1 NO / form A (2 contacts changeable to NC / form B, via jumpers)		
Live status contact		1 NO / NC (jumper) / form A / B		
Switching capacity	Make	1000 W/VA		
	Break	30 W/VA / 40 $W_{resistive}$ / 25 W at L/R ≤ 50 ms		
Switching voltage	≤ DC 250 V			
Permissible current	5 A continuous, 30 A for 0.5 s making current, 2000 switching cycles			

Electrical tests	
Specification	
Standards	IEC 60255 ANSI C37.90, C37.90.1, C37.90.2, UL508
Insulation tests	
Standards	IEC 60255-5; ANSI/IEEE C37.90.0
Voltage test (100 % test) all circuits except for auxiliary voltage and RS485/RS232 and time synchronization	2.5 kV (r.m.s. value), 50/60 Hz
Auxiliary voltage	DC 3.5 kV
Communication ports and time synchronization	AC 500 V
Impulse voltage test (type test) all circuits, except communication ports and time synchronization, class III	5 kV (peak value); 1.2/50 µs; 0.5 J 3 positive and 3 negative impulses at intervals of 5 s
EMC tests for interference immunity; type tests	
Standards	IEC 60255-6; IEC 60255-22 (product standard) EN 50082-2 (generic specification) DIN 57435 Part 303
High-frequency test IEC 60255-22-1, class III and VDE 0435 Part 303, class III	2.5 kV (peak value); 1 MHz; τ =15 ms; 400 surges per s; test duration 2 s
Electrostatic discharge IEC 60255-22-2 class IV and EN 61000-4-2, class IV	8 kV contact discharge; 15 kV air gap discharge; both polarities; 150 pF; R_i = 330 Ω
Irradiation with radio-frequency field, non-modulated IEC 60255-22-3 (Report) class III	10 V/m; 27 to 500 MHz
Irradiation with radio-frequency field, amplitude-modulated IEC 61000-4-3; class III	10 V/m, 80 to 1000 MHz; AM 80 %; 1 kHz
Irradiation with radio-frequency field, pulse-modulated IEC 61000-4-3/ENV 50204; class III	10 V/m, 900 MHz; repetition rate 200 Hz, on duration 50 %
Fast transient interference/burst IEC 60255-22-4 and IEC 61000-4-4, 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 61000-4-5; class III Auxiliary voltage	 From circuit to circuit: 2 kV; 12 Ω; 9 µF across contacts: 1 kV; 2 Ω ;18 µF
Binary inputs/outputs	From circuit to circuit: 2 kV; 42 Ω; 0.5 µF across contacts: 1 kV; 42 Ω; 0.5 µF
Line-conducted HF, amplitude-modulated IEC 61000-4-6, class III	10 V; 150 kHz to 80 MHz; AM 80 %; 1 kHz
Power frequency magnetic field IEC 61000-4-8, class IV IEC 60255-6	30 A/m; 50 Hz, continuous 300 A/m; 50 Hz, 3 s 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 wave; 50 surges per s; duration 2 s, R_i = 150 to 200 Ω

EMC tests for interference immunity; type tests (cont'd)	
Fast transient surge withstand capability ANSI/IEEE C37.90.1	4 to 5 kV; 10/150 ns; 50 surges per s both polarities; duration 2 s, R_i = 80 Ω
Radiated electromagnetic interference ANSI/IEEE C37.90.2	35 V/m; 25 to 1000 MHz; amplitude and pulse-modulated
Damped wave IEC 60694 / IEC 61000-4-12	2.5 kV (peak value, polarity alternating) 100 kHz, 1 MHz, 10 and 50 MHz, R_i = 200 Ω
EMC tests for interference emission; type tests	
Standard	EN 50081-* (generic specification)
Conducted interferences only auxiliary voltage IEC/CISPR 22	150 kHz to 30 MHz Limit class B
Radio interference field strength IEC/CISPR 11	30 to 1000 MHz Limit class B
Units with a detached operator panel must be installed in a metal cubicle to maintain limit class B	

5

Mechanical stress 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 perpendicular axes
Shock IEC 60255-21-2, class 1 IEC 60068-2-27	Semi-sinusoidal Acceleration 5 *g*, duration 11 ms; 3 shocks in both directions of 3 axes
Seismic vibration IEC 60255-21-3, class 1 IEC 60068-3-3	Sinusoidal 1 to 8 Hz: ± 3.5 mm amplitude (horizontal axis) 1 to 8 Hz: ± 1.5 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 perpendicular axes
During transportation	
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 perpendicular axes
Shock IEC 60255-21-2, Class 1 IEC 60068-2-27	Semi-sinusoidal Acceleration 15 *g*, duration 11 ms 3 shocks in both directions of 3 axes
Continuous shock IEC 60255-21-2, class 1 IEC 60068-2-29	Semi-sinusoidal Acceleration 10 *g*, duration 16 ms 1000 shocks in both directions of 3 axes

Climatic stress tests	
Temperatures	
Type-tested acc. to IEC 60068-2-1 and -2, test Bd, for 16 h	-25 °C to +85 °C /-13 °F to +185 °F
Temporarily permissible operating temperature, tested for 96 h	-20 °C to +70 °C /-4 °F to -158 °F
Recommended permanent operating temperature acc. to IEC 60255-6 (Legibility of display may be impaired above +55 °C /+131 °F)	-5 °C to +55 °C /+25 °F to +131 °F
– Limiting temperature during permanent storage	-25 °C to +55 °C /-13 °F to +131 °F
– Limiting temperature during transport	-25 °C to +70 °C /-13 °F to +158 °F
Humidity	
Permissible humidity It is recommended to arrange 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 95 % relative humidity; condensation not permissible!
Unit design	
Housing	7XP20
Dimensions	See dimension drawings, part 14
Weight	
1/3 19", surface-mounting housing	4.5 kg
1/3 19", flush-mounting housing	4.0 kg
1/2 19", surface-mounting housing	7.5 kg
1/2 19", flush-mounting housing	6.5 kg
Degree of protection acc. to EN 60529	
Surface-mounting housing	IP 51
Flush-mounting housing	Front: IP 51, rear: IP 20;
Operator safety	IP 2x with cover

Serial interfaces	
Operating interface (front of unit)	
Connection	Non-isolated, RS232; front panel, 9-pin subminiature connector
Transmission rate	Factory setting 115200 baud, min. 4800 baud, max. 115200 baud
Service/modem interface (rear of unit)	
Isolated interface for data transfer	Port C: DIGSI / modem / RTD-box
Transmission rate	Factory setting 38400 baud, min. 4800 baud, max. 115200 baud
RS232/RS485	
Connection	
For flush-mounting housing/ surface-mounting housing with detached operator panel	9-pin subminiature connector, mounting location "C"
For surface-mounting housing with two-tier terminal at the top/bottom part	At the bottom part of the housing: shielded data cable
Distance RS232	15 m / 49.2 ft
Distance RS485	Max. 1 km / 3300 ft
Test voltage	AC 500 V against ground

System interface (rear of unit)	
IEC 60870-5-103 protocol	
Isolated interface for data transfer to a control center	Port B
Transmission rate	Factory setting 9600 baud, min. 1200 baud, max. 115200 baud
RS232/RS485	
Connection	
For flush-mounting housing/ surface-mounting housing with detached operator panel	Mounting location "B"
For surface-mounting housing with two-tier terminal on the top/bottom part	At the bottom part of the housing: shielded data cable
Distance RS232	Max. 15 m / 49 ft
Distance RS485	Max. 1 km / 3300 ft
Test voltage	AC 500 V against ground
Fiber optic	
Connection fiber-optic cable	Integrated ST connector for fiber-optic connection
For flush-mounting housing/ surface-mounting housing with detached operator panel	Mounting location "B"
For surface-mounting housing with two-tier terminal on the top/bottom part	At the bottom part of the housing
Optical wavelength	820 nm
Permissible path attenuation	Max. 8 dB, for glass fiber 62.5/125 µm
Distance	Max. 1.5 km / 0.9 miles
IEC 60870-5-103 protocol, redundant	
RS485	
Connection	
For flush-mounting housing/ surface-mounting housing with detached operator panel	Mounting location "B"
For surface-mounting housing with two-tier terminal on the top/bottom part	(not available)
Distance RS485	Max. 1 km / 3300 ft
Test voltage	AC 500 V against ground
Ethernet (EN 100) for DIGSI, IEC 61850, DNP3 TCP, PROFINET	
Isolated interface for data transfer: - to a control center - with DIGSI - between SIPROTEC 4 relays	Port B, 100 Base T acc. to IEEE802.3
Transmission rate	100 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	AC 500 V against ground
Ethernet, optical	
Connection For flush-mounting housing/ surface-mounting housing with detached operator panel	Integr. LC connector for FO connection Mounting location "B"
Optical wavelength	1300 nm
Distance	1.5 km / 0.9 miles

PROFIBUS-FMS/DP	
Isolated interface for data transfer to a control center	Port B
Transmission rate	Up to 1.5 Mbaud
RS485	
Connection	
For flush-mounting housing/ surface-mounting housing with detached operator panel	9-pin subminiature connector, mounting location "B"
For surface-mounting housing with two-tier terminal on the top/bottom part	At the bottom part of the housing: shielded data cable
Distance	1000 m / 3300 ft ≤ 93.75 kbaud; 500 m / 1500 ft ≤ 187.5 kbaud; 200 m / 600 ft ≤ 1.5 Mbaud; 100 m / 300 ft ≤ 12 Mbaud
Test voltage	AC 500 V against ground
Fiber optic	
Connection fiber-optic cable For flush-mounting housing/ surface-mounting housing with detached operator panel	Integr. ST connector for FO connection Mounting location "B"
For surface-mounting housing with two-tier terminal on the top/bottom part	At the bottom part of the housing Important: Please refer to footnotes 1) and 2) on page 5/99
Optical wavelength	820 nm
Permissible path attenuation	Max. 8 dB, for glass fiber 62.5/125 µm
Distance	500 kB/s 1.6 km / 0.99 miles 1500 kB/s 530 m / 0.33 miles
MODBUS RTU, ASCII, DNP 3.0	
Isolated interface for data transfer to a control center	Port B
Transmission rate	Up to 19200 baud
RS485	
Connection	
For flush-mounting housing/ surface-mounting housing with detached operator panel	9-pin subminiature connector, mounting location "B"
For surface-mounting housing with two-tier terminal at the top/bottom part	At bottom part of the housing: shielded data cable
Distance	Max. 1 km / 3300 ft max. 32 units recommended
Test voltage	AC 500 V against ground
Fiber optic	
Connection fiber-optic cable	Integrated ST connector for fiber-optic connection
For flush-mounting housing/ surface-mounting housing with detached operator panel	Mounting location "B"
For surface-mounting housing with two-tier terminal at the top/bottom part	At the bottom part of the housing Important: Please refer to footnotes 1) and 2) on page 5/77
Optical wavelength	820 nm
Permissible path attenuaion	Max. 8 dB, for glass fiber 62.5/125 µm
Distance	Max. 1.5 km/0.9 miles

Technical data

Time synchronization DCF77 / IRIG-B signal (Format IRIG-B000)	
Connection	9-pin subminiature connector (SUB-D) (terminal with surface-mounting housing)
Voltage levels	5 V, 12 V or 24 V (optional)

Functions	
Definite-time overcurrent protection (ANSI 50, 50N)	
Operating mode phase protection (ANSI 50)	3-phase (standard) or 2-phase (L1 and L3)
Number of elements (stages)	I>, I>>, I>>> (phases) I_E>, I_E>>, I_E>>> (ground)
Setting ranges	
Pickup phase elements Pickup ground elements	0.5 to 175 A or ∞1) (in steps of 0.01 A) 0.25 to 175 A or ∞1) (in steps of 0.01 A)
Delay times T Dropout delay time T_{DO}	0 to 60 s or ∞ (in steps of 0.01 s) 0 to 60 s (in steps of 0.01 s)
Times Pickup times (without inrush restraint, with inrush restraint + 10 ms)	
With twice the setting value With five times the setting value	pprox. 30 ms Approx. 20 ms
Dropout times	Approx. 40 ms
Dropout ratio	Approx. 0.95 for $I/I_{nom} \geq 0.3$
Tolerances Pickup Delay times T, T_{DO}	 2 % of setting value or 50 mA[1)] 1 % or 10 ms
Inverse-time overcurrent protection (ANSI 51, 51N)	
Operating mode phase protection (ANSI 51)	3-phase (standard) or 2-phase (L1 and L3)
Setting ranges	
Pickup phase element I_P Pickup ground element I_{EP} Time multiplier T (IEC characteristics) Time multiplier D (ANSI characteristics)	0.5 to 20 A or ∞ [1)] (in steps of 0.01 A) 0.25 to 20 A or ∞ [1)] (in steps of 0.01 A) 0.05 to 3.2 s or ∞ (in steps of 0.01 s) 0.05 to 15 s or ∞ (in steps of 0.01 s)
Trip characteristics	
IEC	Normal inverse, very inverse, extremely inverse, long inverse
ANSI	Inverse, short inverse, long inverse moderately inverse, very inverse, extremely inverse, definite inverse
User-defined characteristic	Defined by a maximum of 20 value pairs of current and time delay
Dropout setting Without disk emulation	 Approx. 1.05 · setting value I_p for $I_p/I_{nom} \geq 0.3$, corresponds to approx. 0.95 · pickup threshold
With disk emulation	Approx. 0.90 · setting value I_p
Tolerances Pickup/dropout thresholds I_p, I_{Ep} Pickup time for $2 \leq I/I_p \leq 20$	 2 % of setting value or 50 mA[1)] 5 % of reference (calculated) value + 2 % current tolerance, respectively 30 ms
Dropout ratio for $0.05 \leq I/I_p \leq 0.9$	5 % of reference (calculated) value + 2 % current tolerance, respectively 30 ms

1) For I_{nom} = 1 A, all limits divided by 5.

Inrush blocking	
Influenced functions	Time-overcurrent elements, I>, I_E>, I_p, I_{Ep}
Lower function limit phases	At least one phase current (50 Hz and 100 Hz) ≥ 125 mA [1)]
Lower function limit ground	Ground current (50 Hz and 100 Hz) ≥ 125 mA [1)]
Upper function limit (setting range)	1.5 to 125 A [1)] (in steps of 0.01 A)
Setting range I_{2f} /I	10 to 45 % (in steps of 1 %)
Crossblock (I_{L1}, I_{L2}, I_{L3})	ON/OFF
Dynamic setting change	
Controllable function	Pickup, tripping time
Start criteria	Current criteria, CB position via aux. contacts, binary input, auto-reclosure ready
Time control	3 timers
Current criteria	Current threshold (reset on dropping below threshold; monitoring with timer)
(Sensitive) ground-fault detection (ANSI 50 Ns, 51Ns)	
Ground-fault pickup for all types of ground faults	
Definite-time characteristic (ANSI 50Ns)	
Setting ranges Pickup threshold I_{EE}>, I_{EE}>> For sensitive input For normal input Delay times T for I_{EE}>, I_{EE}>> Dropout delay time T_{DO}	 0.001 to 1.5 A (in steps of 0.001 A) 0.25 to 175 A[1)] (in steps of 0.01 A) 0 to 320 s or ∞ (in steps of 0.01 s) 0 to 60 s (in steps of 0.01 s)
Times Pickup times	 Approx. 50 ms
Dropout ratio	Approx. 0.95
Tolerances Pickup threshold I_{EE}>, I_{EE}>> Delay times	 2 % of setting value or 1 mA 1 % of setting value or 20 ms
Ground-fault pickup for all types of ground faults	
Inverse-time characteristic (ANSI 51Ns)	
<u>User-defined characteristic</u>	Defined by a maximum of 20 pairs of current and delay time values
Setting ranges Pickup threshold I_{EEp} For sensitive input For normal input	 0.001 A to 1.4 A (in steps of 0.001 A) 0.25 to 20 A[1)] (in steps of 0.01 A)
User defined Time multiplier T	 0.1 to 4 s or ∞ (in steps of 0.01 s)
Times Pickup times	 Approx. 50 ms
Pickup threshold	Approx. 1.1 · I_{EEp}
Dropout ratio	Approx. 1.05 · I_{EEp}
Tolerances Pickup threshold For sensitive input For normal input Dropout times in linear range	 2 % of setting value or 1 mA 2 % of setting value or 50 mA[1)] 7 % of reference value for $2 \leq I/I_{EEp} \leq 20$ + 2 % current tolerance, or 70 ms
<u>Logarithmic inverse</u> <u>Logarithmic inverse with knee point</u>	Refer to the manual Refer to the manual

High-impedance restricted ground-fault protection (ANSI 87N) / single-phase overcurrent protection	
Setting ranges	
Pickup thresholds $I>$, $I>>$	
For sensitive input	0.003 to 1.5 A or ∞ (in steps of 0.001 A)
For normal input	0.25 to 175 A[1)] or ∞ (in steps of 0.01 A)
Delay times $T_{I>}$, $T_{I>>}$	0 to 60 s or ∞ (in steps of 0.01 s)
Times	
Pickup times	
Minimum	Approx. 20 ms
Typical	Approx. 30 ms
Dropout times	Approx. 30 ms
Dropout ratio	Approx. 0.95 for $I/I_{nom} \geq 0.5$
Tolerances	
Pickup thresholds	3 % of setting value or 1 % rated current at I_{nom} = 1 or 5 A; 5 % of setting value or 3 % rated current at Inom = 0.1 A
Delay times	1 % of setting value or 10 ms

Intermittent ground-fault protection	
Setting ranges	
Pickup threshold	
For I_E $I_{IE}>$	0.25 to 175 A[1)] (in steps of 0.01 A)
For $3I_0$ $I_{IE}>$	0.25 to 175 A[1)] (in steps of 0.01 A)
For I_{EE} $I_{IE}>$	0.005 to 1.5 A (in steps of 0.001 A)
Pickup prolongation time T_V	0 to 10 s (in steps of 0.01 s)
Ground-fault accumulation time T_{sum}	0 to 100 s (in steps of 0.01 s)
Reset time for accumulation T_{res}	1 to 600 s (in steps of 1 s)
Number of pickups for intermittent ground fault	2 to 10 (in steps of 1)
Times	
Pickup times	
Current = 1.25 · pickup value	Approx. 30 ms
Current ≥ 2 · pickup value	Approx. 22 ms
Dropout time	Approx. 22 ms
Tolerances	
Pickup threshold $I_{IE}>$	3 % of setting value, or 50 mA[1)]
Times T_V, T_{sum}, T_{res}	1 % of setting value or 10 ms

Thermal overload protection (ANSI 49)	
Setting ranges	
Factor k	0.1 to 4 (in steps of 0.01)
Time constant	1 to 999.9 min (in steps of 0.1 min)
Warning overtemperature $\Theta_{alarm}/\Theta_{trip}$	50 to 100 % with reference to the tripping overtemperature (in steps of 1 %)
Current warning stage I_{alarm}	0.5 to 20 A (in steps of 0.01 A)
Extension factor when stopped k_t factor	1 to 10 with reference to the time constant with the machine running (in steps of 0.1)
Rated overtemperature (for I_{nom})	40 to 200 °C (in steps of 1 °C)

1) For I_{nom} = 1 A, all limits divided by 5.

Tripping characteristic For $(I/k \cdot I_{nom}) \leq 8$	$t = t_{th} \cdot \ln \frac{(I/k \cdot I_{nom})^2 - (I_{pre}/k \cdot I_{nom})^2}{(I/k \cdot I_{nom})^2 - 1}$
	t = Tripping time τ_{th} = Temperature rise time constant I = Load current I_{pre} = Preload current k = Setting factor acc. to VDE 0435 Part 3011 and IEC 60255-8 I_{nom} = Rated (nominal) current of the protection relay
Dropout ratios	
Θ/Θ_{Trip}	Drops out with Θ_{Alarm}
Θ/Θ_{Alarm}	Approx. 0.99
I/I_{Alarm}	Approx. 0.97
Tolerances	
With reference to $k \cdot I_{nom}$	Class 5 acc. to IEC 60255-8
With reference to tripping time	5 % ± 2 s acc. to IEC 60255-8

Auto-reclosure (ANSI 79)	
Number of reclosures	0 to 9 Shot 1 to 4 individually adjustable
Program for phase fault Start-up by	Time-overcurrent elements, negative sequence, binary input
Program for ground fault Start-up by	Time-overcurrent elements, sensitive ground-fault protection, binary input
Blocking of ARC	Pickup of protection functions, three-phase fault detected by a protective element, binary input, last TRIP command after the reclosing cycle is complete (unsuccessful reclosing), TRIP command by the breaker failure protection (50BF), opening the CB without ARC initiation, external CLOSE command
Setting ranges	
Dead time (separate for phase and ground and individual for shots 1 to 4)	0.01 to 320 s (in steps of 0.01 s)
Blocking duration for manual-CLOSE detection	0.5 s to 320 s or 0 (in steps of 0.01 s)
Blocking duration after reclosure	0.5 s to 320 s (in steps of 0.01 s)
Blocking duration after dynamic blocking	0.01 to 320 s (in steps of 0.01 s)
Start-signal monitoring time	0.01 to 320 s or ∞ (in steps of 0.01 s)
Circuit-breaker supervision time	0.1 to 320 s (in steps of 0.01 s)
Max. delay of dead-time start	0 to 1800 s or ∞ (in steps of 0.1 s)
Maximum dead time extension	0.5 to 320 s or ∞(in steps of 0.01 s)
Action time	0.01 to 320 s or ∞ (in steps of 0.01 s)

The delay times of the following protection function can be altered individually by the ARC for shots 1 to 4 (setting value $T = T$, non-delayed $T = 0$, blocking $T = \infty$):
$I>>>$, $I>>$, $I>$, I_p,
$I_E>>>$, $I_E>>$, $I_E>$, I_{Ep}

Technical data

Auto-reclosure (ANSI 79) (cont'd)	
Additional functions	Lockout (final trip), delay of dead-time start via binary input (monitored), dead-time extension via binary input (monitored), co-ordination with other protection relays, circuit-breaker monitoring, evaluation of the CB contacts
Breaker failure protection (ANSI 50 BF)	
Setting ranges	
Pickup thresholds	0.2 to 5 A[1)] (in steps of 0.01 A)
Delay time	0.06 to 60 s or ∞ (in steps of 0.01 s)
Times	
Pickup times	
with internal start	is contained in the delay time
with external start	is contained in the delay time
Dropout times	Approx. 25 ms
Tolerances	
Pickup value	2 % of setting value (50 mA)[1)]
Delay time	1 % or 20 ms
Flexible protection functions (ANSI 47, 50, 50N)	
Operating modes/measuring quantities	
3-phase	I, I_1, I_2, I_2/I_1, $3I_0$
1-phase	I, I_E, $I_{E\ sens.}$
Without fixed phase relation	Binary input
Pickup when	Exceeding or falling below threshold value
Setting ranges	
Current I, I_1, I_2, $3I_0$, I_E	0.15 to 200 A[1)] (in steps of 0.01 A)
Current ratio I_2 / I_1	15 to 100 % (in steps of 1 %)
Sensitive ground current $I_{E\ sens.}$	0.001 to 1.5 A (in steps of 0.001 A)
Dropout ratio >- stage	1.01 to 3 (in steps of 0.01)
Dropout ratio <- stage	0.7 to 0.99 (in steps of 0.01)
Pickup delay time	0 to 60 s (in steps of 0.01 s)
Trip delay time	0 to 3600 s (in steps of 0.01 s)
Dropout delay time	0 to 60 s (in steps of 0.01 s)
Times	
Pickup times, phase quantities	
With 2 times the setting value	Approx. 30 ms
With 10 times the setting value	Approx. 20 ms
Pickup times, symmetrical components	
With 2 times the setting value	Approx. 40 ms
With 10 times the setting value	Approx. 30 ms
Binary input	Approx. 20 ms
Dropout times	
Phase quantities	< 20 ms
Symmetrical components	< 30 ms
Binary input	< 10 ms
Tolerances	
Pickup threshold	
Phase quantities	1 % of setting value or 50 mA[1)]
Symmetrical components	2 % of setting value or 100 mA[1)]
Times	1 % of setting value or 10 ms
Negative-sequence current detection (ANSI 46)	
Definite-time characteristic (ANSI 46-1 and 46-2)	
Setting ranges	
Pickup current $I_2>$, $I_2>>$	0.5 to 15 A or ∞ (in steps of 0.01 A)
Delay times	0 to 60 s or ∞ (in steps of 0.01 s)
Dropout delay time T_{DO}	0 to 60 s (in steps of 0.01 s)
Functional limit	All phase currents ≤ 50 A[1)]

Times	
Pickup times	Approx. 35 ms
Dropout times	Approx. 35 ms
Dropout ratio	Approx. 0.95 for $I_2/I_{nom} > 0.3$
Tolerances	
Pickup thresholds	3 % of the setting value or 50 mA[1)]
Delay times	1 % or 10 ms
Inverse-time characteristic (ANSI 46-TOC)	
Setting ranges	
Pickup current	0.5 to 10 A[1)] (in steps of 0.01 A)
Time multiplier T (IEC characteristics)	0.05 to 3.2 s or ∞ (in steps of 0.01 s)
Time multiplier D (ANSI characteristics)	0.5 to 15 s or ∞ (in steps of 0.01 s)
Functional limit	All phase currents ≤ 50 A[1)]
Trip characteristics	
IEC	Normal inverse, very inverse, extremely inverse
ANSI	Inverse, moderately inverse, very inverse, extremely inverse
Pickup threshold	Approx. 1.1 · I_{2p} setting value
Dropout	
IEC and ANSI (without disk emulation)	Approx. 1.05 · I_{2p} setting value, which is approx. 0.95 · pickup threshold
ANSI with disk emulation	Approx. 0.90 · I_{2p} setting value
Tolerances	
Pickup threshold	3 % of the setting value or 50 mA[1)]
Time for 2 ≤ M ≤ 20	5 % of setpoint (calculated) +2 % current tolerance, at least 30 ms
Starting time monitoring for motors (ANSI 48)	
Setting ranges	
Motor starting current $I_{STARTUP}$	2.5 to 80 A[1)] (in steps of 0.01)
Pickup threshold $I_{MOTOR\ START}$	2 to 50 A[1)] (in steps of 0.01)
Permissible starting time $T_{STARTUP}$, cold motor	1 to 180 s (in steps of 0.1 s)
Permissible starting time $T_{STARTUP}$, warm motor	0.5 to 180 s (in steps of 0.1 s)
Temperature threshold cold motor	0 to 80 % (in steps of 1 %)
Permissible blocked rotor time $T_{LOCKED\text{-}ROTOR}$	0.5 to 120 s or ∞ (in steps of 0.1 s)
Tripping time characteristic	
For $I > I_{MOTOR\ START}$	$t = \left(\frac{I_{STARTUP}}{I}\right)^2 \cdot T_{STRATUP}$ $I_{STARTUP}$ = Rated motor starting current I = Actual current flowing $T_{STARTUP}$ = Tripping time for rated motor starting current t = Tripping time in seconds
Dropout ratio $I_{MOTOR\ START}$	Approx. 0.95
Tolerances	
Pickup threshold	2 % of setting value or 50 mA[1)]
Delay time	5 % or 30 ms
Load jam protection for motors (ANSI 51M)	
Setting ranges	
Current threshold for alarm and trip	0.25 to 60 A[1)] (in steps of 0.01 A)
Delay times	0 to 600 s (in steps of 0.01 s)
Blocking duration after close signal detection	0 to 600 s (in steps of 0.01 s)
Tolerances	
Pickup threshold	2 % of setting value or 50 mA[1)]
Delay time	1 % of setting value or 10 ms

1) For I_{nom} = 1 A, all limits divided by 5.

Restart inhibit for motors (ANSI 66)	
Setting ranges	
Motor starting current relative to rated motor current $I_{MOTOR\ START}/I_{Motor\ Nom}$	1.1 to 10 (in steps of 0.1)
Rated motor current $I_{Motor\ Nom}$	1 to 6 A[1)] (in steps of 0.01 A)
Max. permissible starting time $T_{Start\ Max}$	1 to 320 s (in steps of 1 s)
Equilibrium time T_{Equal}	0 min to 320 min (in steps of 0.1 min)
Minimum inhibit time $T_{MIN.\ INHIBIT\ TIME}$	0.2 min to 120 min (in steps of 0.1 min)
Max. permissible number of warm starts	1 to 4 (in steps of 1)
Difference between cold and warm starts	1 to 2 (in steps of 1)
Extension k-factor for cooling simulations of rotor at zero speed $k_{t\ at\ STOP}$	0.2 to 100 (in steps of 0.1)
Extension factor for cooling time constant with motor running $k_{t\ RUNNING}$	0.2 to 100 (in steps of 0.1)
Restarting limit	$\Theta_{restart} = \Theta_{rot\ max\ perm} \cdot \frac{n_c - 1}{n_c}$
	$\Theta_{restart}$ = Temperature limit below which restarting is possible
	$\Theta_{rot\ max\ perm}$ = Maximum permissible rotor overtemperature (= 100 % in operational measured value $\Theta_{rot}/\Theta_{rot\ trip}$)
	n_c = Number of permissible start-ups from cold state
Undercurrent monitoring (ANSI 37)	
Signal from the operational measured values	Predefined with programmable logic
Temperature monitoring box (ANSI 38)	
Temperature detectors	
Connectable boxes	1 or 2
Number of temperature detectors per box	Max. 6
Type of measuring	Pt 100 Ω or Ni 100 Ω or Ni 120 Ω
Mounting identification	“Oil” or “Environment” or “Stator” or “Bearing” or “Other”
Thresholds for indications	
For each measuring detector Stage 1	-50 °C to 250 °C (in steps of 1 °C) -58 °F to 482 °F (in steps of 1 °F) or ∞ (no indication)
Stage 2	-50 °C to 250 °C (in steps of 1 °C) -58 °F to 482 °F (in steps of 1 °F) or ∞ (no indication)

1) At rated frequency.

Additional functions	
Operational measured values	
Currents I_{L1}, I_{L2}, I_{L3} Positive-sequence component I_1 Negative-sequence component I_2 I_E or $3I_0$	In A (kA) primary, in A secondary or in % I_{nom}
Range	10 to 200 % I_{nom}
Tolerance[1)]	1 % of measured value or 0.5 % I_{nom}
Temperature overload protection Θ/ΘTrip	In %
Range	0 to 400 %
Tolerance[1)]	5 % class accuracy per IEC 60255-8
Temperature restart inhibit Θ_L/Θ_L Trip	In %
Range	0 to 400 %
Tolerance[1)]	5 % class accuracy per IEC 60255-8
Restart threshold $\Theta_{Restart}/\Theta_{L\ Trip}$	In %
Reclose time $T_{Reclose}$	In min
Current of sensitive ground fault detection I_{EE}	In A (kA) primary and in mA secondary
Range	0 mA to 1600 mA
Tolerance[1)]	2 % of measured value or 1 mA
RTD-box	See section "Temperature monitoring box"
Long-term averages	
Time window	5, 15, 30 or 60 minutes
Frequency of updates	Adjustable
Long-term averages of currents	$I_{L1dmd}, I_{L2dmd}, I_{L3dmd}, I_{1dmd}$ in A (kA)
Max. / Min. report	
Report of measured values	With date and time
Reset, automatic	Time of day adjustable (in minutes, 0 to 1439 min) Time frame and starting time adjustable (in days, 1 to 365 days, and ∞)
Reset, manual	Using binary input, using keypad, via communication
Min./Max. values for current	I_{L1}, I_{L2}, I_{L3} I_1 (positive-sequence component)
Min./Max. values for overload protection	Θ/Θ_{Trip}
Min./Max. values for mean values	$I_{L1dmd}, I_{L2dmd}, I_{L3dmd}$ I_1 (positive-sequence component)
Local measured values monitoring	
Current asymmetry	I_{max}/I_{min} > balance factor, for $I>I_{balance\ limit}$
Current phase sequence	Clockwise (ABC) / counter-clockwise (ACB)
Limit value monitoring	Predefined limit values, user-defined expansions via CFC
Fault recording	
Recording of indications of the last 8 power system faults	
Recording of indications of the last 3 power system ground faults	

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Time stamping	
Resolution for event log (operational annunciations)	1 ms
Resolution for trip log (fault annunciations)	1 ms
Maximum time deviation (internal clock)	0.01 %
Battery	Lithium battery 3 V/1 Ah, type CR 1/2 AA, message "Battery Fault" for insufficient battery charge

Oscillographic fault recording	
Maximum 8 fault records saved, memory maintained by buffer battery in case of loss of power supply	
Recording time	Total 20 s Pre-trigger and post-fault recording and memory time adjustable
Sampling rate for 50 Hz Sampling rate for 60 Hz	1 sample/1.25 ms (16 samples/cycle) 1 sample/1.04 ms (16 samples/cycle)

Statistics	
Saved number of trips	Up to 9 digits
Number of automatic reclosing commands (segregated according to 1st and ≥ 2nd cycle)	Up to 9 digits

Circuit-breaker wear	
Methods	• ΣI^x with x = 1 .. 3 • 2-point method (remaining service life) • $\Sigma i^2 t$
Operation	Phase-selective accumulation of measured values on TRIP command, up to 8 digits, phase-selective limit values, monitoring indication

Motor statistics		
Total number of motor start-ups	0 to 9999	(resolution 1)
Total operating time	0 to 99999 h	(resolution 1 h)
Total down-time	0 to 99999 h	(resolution 1 h)
Ratio operating time/down-time	0 to 100 %	(resolution 0.1 %)
Motor start-up data:	of the last 5 start-ups	
– start-up time	0.30 s to 9999.99 s	(resolution 10 ms)
– start-up current (primary)	0 A to 1000 kA	(resolution 1 A)

Operating hours counter	
Display range	Up to 7 digits
Criterion	Overshoot of an adjustable current threshold (BkrClosed IMIN)

Trip circuit monitoring	
With one or two binary inputs	

Commissioning aids	
Phase rotation field check, operational measured values, circuit-breaker/switching device test, creation of a test measurement report	

Clock	
Time synchronization	DCF77/IRIG-B signal (telegram format IRIG-B000), binary input, communication

Setting group switchover of the function parameters	
Number of available setting groups	4 (parameter group A, B, C and D)
Switchover performed	Via keypad, DIGSI, system (SCADA) interface or binary input

Control	
Number of switching units	Depends on the binary inputs and outputs
Interlocking	Programmable
Circuit-breaker signals	Feedback, close, open, intermediate position
Control commands	Single command / double command 1, 1 plus 1 common or 2 trip contacts
Programmable controller	CFC logic, graphic input tool
Local control	Control via menu, assignment of a function key
Remote control	Via communication interfaces, using a substation automation and control system (e.g. SICAM), DIGSI 4 (e.g. via modem)

CE conformity

This product is in conformity with the Directives of the European Communities on the harmonization of the laws of the Member States relating to electromagnetic compatibility (EMC Council Directive 2004/108/EG previous 89/336/EEC) and electrical equipment designed for use within certain voltage limits (Council Directive 2006/95/EG previous 73/23/EEC).

This unit conforms to the international standard IEC 60255, and the German standard DIN 57435/Part 303 (corresponding to VDE 0435/ Part 303).

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

The unit conforms to the international standard IEC 60255, and the German standard DIN 57435/Part 303 (corresponding to VDE 0435/ Part 303).

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

C UL US LISTED

Description	Order No.
7SJ61multifunction protection relay	7SJ61□□-□□□□□-□
Housing, binary inputs (BI) and outputs (BO)	
Housing ⅓19", 4 line text display, 3 BI, 4 BO, 1 live status contact	0
Housing ⅓19", 4 line text display, 8 BI, 8 BO, 1 live status contact	1
Housing ⅓19", 4 line text display, 11 BI, 6 BO, 1 live status contact	2
Housing ½19", graphic display, 8 BI, 8 BO, 1 live status contact [7)]	3
Housing ½19", graphic display, 11 BI, 6 BO, 1 live status contact [7)]	4
Measuring inputs (4 x I)	
I_{ph} =1A[1)], I_e =1A[1)] (min. = 0.05 A) Position 15 only with **A**	1
I_{ph} =1A[1)], I_e = sensitive (min. = 0.001 A) Position 15 only with **B**	2
I_{ph} =5A[1)], I_e =5A[1)] (min. = 0.25 A) Position 15 only with **A**	5
I_{ph} =5A[1)], I_e = sensitive (min. = 0.001 A) Position 15 only with **B**	6
I_{ph} =5A[1)], I_e =1A[1)] (min. = 0.05 A) Position 15 only with **A**	7
Rated auxiliary voltage (power supply, indication voltage)	
DC 24 to 48 V, threshold binary input DC 19 V [3)]	2
DC 60 to 125 V [2)], threshold binary input DC 19 V [3)]	4
DC 110 to 250 V [2)], AC 115 to 230 V[4)] , threshold binary input DC 88 V [3)]	5
DC 110 to 250 V [2)], AC 115 to 230 V[4)] , threshold binary input DC 176 V [3)]	6
Unit version	
For panel surface mounting, 2 tier terminal top/bottom	B
For panel flush mounting, plug-in terminal (2/3 pin connector)	D
For panel flush mounting, screw-type terminal (direct connection/ring-type cable lugs)	E
Region-specific default settings/function versions and language settings	
Region DE, 50 Hz, IEC, language: German, selectable	A
Region World, 50/60 Hz, IEC/ANSI, language: English (GB), selectable	B
Region US, 60 Hz, ANSI, language: English (US), selectable	C
Region FR, 50/60 Hz, IEC/ANSI, language: French, selectable	D
Region World, 50/60 Hz, IEC/ANSI, language: Spanish, selectable	E
Region IT, 50/60 Hz, IEC/ANSI, language: Italian, selectable	F
System interface (Port B): Refer to page 5/77	
No system interface	0
Protocols see page 5/77	
Service interface (Port C)	
No interface at rear side	0
DIGSI 4/modem, electrical RS232	1
DIGSI 4/modem/RTD-box[5)], electrical RS485	2
DIGSI 4/modem/RTD-box[5)6)], optical 820 nm wavelength, ST connector	3
Measuring/fault recording	
Fault recording	1
Slave pointer,mean values, min/max values, fault recording	3

1) Rated current can be selected by means of jumpers.

2) Transition between the two auxiliary voltage ranges can be selected by means of jumpers.

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

4) AC 230 V, starting from device version .../EE.

5) Temperature monitoring box 7XV5662-□AD10, refer to "Accessories".

6) When using the temperature monitoring box at an optical interface, the additional RS485 fiber-optic converter 7XV5650-0□A00 is required.

7) starting from device version .../GG and FW-Version V4.82

Selection and ordering data

Description			Order No.	Order code
7SJ61multifunction protection relay			7SJ61□□-□□□□□-□□□□	
Designation	ANSI No.	Description		
Basic version		Control		
	50/51	Overcurrent protection $I>$, $I>>$, $I>>>$, I_p		
	50N/51N	Ground-fault protection $I_E>$, $I_E>>$, $I_E>>>$, I_{Ep}		
	50N/51N	Ground-fault protection via insensitive IEE function: $I_{EE}>$, $I_{EE}>>$, I_{EEp} 1)		
	50/50N	Flexible protection functions (index quantities derived from current): Additional time-overcurrent protection stages $I_2>$, $I>>>>$, $I_E>>>>$		
	49	Overload protection (with 2 time constants)		
	46	Phase balance current protection (negative-sequence protection)		
	50BF	Breaker failure protection		
	37	Undercurrent monitoring		
	74TC	Trip circuit supervision		
		4 setting groups, cold-load pickup		
		Inrush blocking		
	86	Lockout		F A
■ IEF		Intermittent ground fault		P A
■	50Ns/51Ns	Sensitive ground-fault detection (non-directional)		
	87N	High-impedance restricted ground fault		F B 2)
■ IEF	50Ns/51Ns	Sensitive ground-fault detection (non-directional)		
	87N	High-impedance restricted ground fault		
		Intermittent ground fault		P B 2)
■ Motor IEF	50Ns/51Ns	Sensitive ground-fault detection (non-directional)		
	87N	High-impedance restricted ground fault		
		Intermittent ground fault		
	48/14	Starting time supervision, locked rotor		
	66/86	Restart inhibit		
	51M	Load jam protection, motor statistics		R B 2)
■ Motor	50Ns/51Ns	Sensitive ground-fault detection (non-directional)		
	87N	High-impedance restricted ground fault		
	48/14	Starting time supervision, locked rotor		
	66/86	Restart inhibit		
	51M	Load jam protection, motor statistics		H B 2)
■ Motor	48/14	Starting time supervision, locked rotor		
	66/86	Restart inhibit		
	51M	Load jam protection, motor statistics		H A
ARC		Without		0
	79	With auto-reclosure		1

■ Basic version included

IEF = Intermittent ground fault

1) 50N/51N only with insensitive ground-current transformer when position 7 = **1**, **5**, **7**.

2) Sensitive ground-current transformer only when position 7 = **2**, **6**.

Description	Order No.	Order code
7SJ61multifunction protection relay	7SJ61□□-□□□□□-□□□□-□□□	
System interface (on rear of unit, Port B)		
No system interface	0	
IEC 60870-5-103 protocol, RS232	1	
IEC 60870-5-103 protocol, RS485	2	
IEC 60870-5-103 protocol, 820 nm fiber, ST connector	3	
PROFIBUS-FMS Slave, RS485	4	
PROFIBUS-FMS Slave, 820 nm wavelength, single ring, ST connector 1)	5	
PROFIBUS-FMS Slave, 820 nm wavelength, double ring, ST connector 1)	6	
PROFIBUS-DP Slave, RS485	9	L 0 A
PROFIBUS-DP Slave, 820 nm wavelength, double ring, ST connector 1)	9	L 0 B
MODBUS, RS485	9	L 0 D
MODBUS, 820 nm wavelength, ST connector 2)	9	L 0 E
DNP 3.0, RS485	9	L 0 G
DNP 3.0, 820 nm wavelength, ST connector 2)	9	L 0 H
IEC 60870-5-103 protocol, redundant, RS485, RJ45 connector 2)	9	L 0 P
IEC 61850, 100 Mbit Ethernet, electrical, double, RSJ45 connector (EN 100)	9	L 0 R
IEC 61850, 100 Mbit Ethernet, optical, double, ST connector (EN 100) 2)	9	L 0 S
DNP3 TCP + IEC 61850, 100Mbit Eth, electrical, double, RJ45 connector 3)	9	L 2 R
DNP3 TCP + IEC 61850, 100Mbit Eth, optical, double, LC connector 3)	9	L 2 S
PROFINET + IEC 61850, 100Mbit Eth, electrical, double, RJ45 connector 3)	9	L 3 R
PROFINET + IEC 61850, 100Mbit Eth, optical, double, RJ45 connector 3)	9	L 3 S

1) Not with position 9 = "**B**"; if 9 = "**B**", please order 7SJ6 unit with RS485 port and separate fiber-optic converters.
For single ring, please order converter 6GK1502-3AB10, not available with position 9 = "**B**".
For double ring, please order converter 6GK1502-4AB10, not available with position 9 = "**B**".
The converter requires a AC 24 V power supply (e.g. power supply 7XV5810-0BA00).

2) Not available with position 9 = "**B**".

3) Available with V4.9

Sample order

Position		Order No. + Order code
		7SJ612 5 - 5 E C 9 1 - 3 F A 1 + L 0 G
6	I/O's: 11 BI/6 BO, 1 live status contact	2
7	Current transformer: 5 A	5
8	Power supply: DC 110 to 250 V, AC 115 V to AC 230 V	5
9	Unit version: Flush-mounting housing, screw-type terminals	E
10	Region: US, English language (US); 60 Hz, ANSI	C
11	Communication: System interface: DNP 3.0, RS485	9 L 0 G
12	Communication: DIGSI 4, electric RS232	1
13	Measuring/fault recording: Extended measuring and fault records	3
14/15	Protection function package: Basic version	F A
16	With auto-reclosure	1

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Selection and ordering data

Accessories	Description	Order No.
	DIGSI 4	
	Software for configuration and operation of Siemens protection units running under MS Windows 2000/XP Professional Edition	
	Basis Full version with license for 10 computers, on CD-ROM (authorization by serial number)	**7XS5400-0AA00**
	Professional DIGSI 4 Basis and additionally SIGRA (fault record analysis), CFC Editor (logic editor), Display Editor (editor for default and control displays) and DIGSI 4 Remote (remote operation)	**7XS5402-0AA00**
	Professional + IEC 61850 Complete version: DIGSI 4 Basis and additionally SIGRA (fault record analysis), CFC Editor (logic editor), Display Editor (editor for control displays), DIGSI 4 Remote (remote operation) + IEC 61850 system configurator	**7XS5403-0AA00**
	IEC 61850 System configurator	
	Software for configuration of stations with IEC 61850 communication under DIGSI, running under MS Windows 2000 or XP Professional Edition Optional package for DIGSI 4 Basis or Professional License for 10 PCs. Authorization by serial number. On CD-ROM	**7XS5460-0AA00**
	SIGRA 4	
	Software for graphic visualization, analysis and evaluation of fault records. Can also be used for fault records of devices of other manufacturers (Comtrade format). Running under MS Windows 2000 or XP Professional Edition (generally contained in DIGSI Professional, but can be ordered additionally) Authorization by serial number. On CD-ROM.	**7XS5410-0AA00**
	Temperature monitoring box	
	AC/DC 24 to 60 V	**7XV5662-2AD10**
	AC/DC 90 to 240 V	**7XV5662-5AD10**
	Varistor / Voltage Arrester	
	Voltage arrester for high-impedance REF protection 125 Vrms; 600 A; 1S/S 256	**C53207-A401-D76-1**
	240 Vrms; 600 A; 1S/S 1088	**C53207-A401-D77-1**
	Connecting cable	
	Cable between PC/notebook (9-pin con.) and protection unit (9-pin connector) (contained in DIGSI 4, but can be ordered additionally)	**7XV5100-4**
	Cable between temperature monitoring box and SIPROTEC 4 unit - length 5 m / 16.4 ft	**7XV5103-7AA05**
	- length 25 m / 82 ft	**7XV5103-7AA25**
	- length 50 m / 164 ft	**7XV5103-7AA50**
	Manual for 7SJ61	
	English/German	**C53000-G1140-C210-x** 1)

1) x = please inquire for latest edition (exact Order No.).

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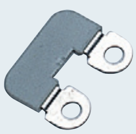
Accessories	Description	Order No.	Size of package	Supplier
 LSP2289-afp.eps	Terminal safety cover			
	Voltage/current terminal 18-pole/12-pole	**C73334-A1-C31-1**	1	Siemens
	Voltage/current terminal 12-pole/8-pole	**C73334-A1-C32-1**	1	Siemens
Mounting rail	Connector 2-pin	**C73334-A1-C35-1**	1	Siemens
	Connector 3-pin	**C73334-A1-C36-1**	1	Siemens
 LSP2090-afp.eps  LSP2091-afp.eps	Crimp connector CI2 0.5 to 1 mm^2	**0-827039-1**	4000 taped on reel	AMP [1]
	Crimp connector CI2 0.5 to 1 mm^2	**0-827396-1**	1	AMP [1]
	Crimp connector: Type III+ 0.75 to 1.5 mm^2	**0-163084-2**	1	AMP [1]
	Crimp connector: Type III+ 0.75 to 1.5 mm^2	**0-163083-7**	4000 taped on reel	AMP [1]
2-pin connector / 3-pin connector	Crimping tool for Type III+	**0-539635-1**	1	AMP [1]
	and matching female	**0-539668-2**	1	AMP [1]
	Crimping tool for CI2	**0-734372-1**	1	AMP [1]
	and matching female	**1-734387-1**	1	AMP [1]
 LSP2093-afp.eps  LSP2092-afp.eps	Short-circuit links			
	for current terminals	**C73334-A1-C33-1**	1	Siemens
	for other terminals	**C73334-A1-C34-1**	1	Siemens
Short-circuit links for current terminals / Short-circuit links for current terminals	Mounting rail for 19" rack	**C73165-A63-D200-1**	1	Siemens

1) Your local Siemens representative can inform you on local suppliers.

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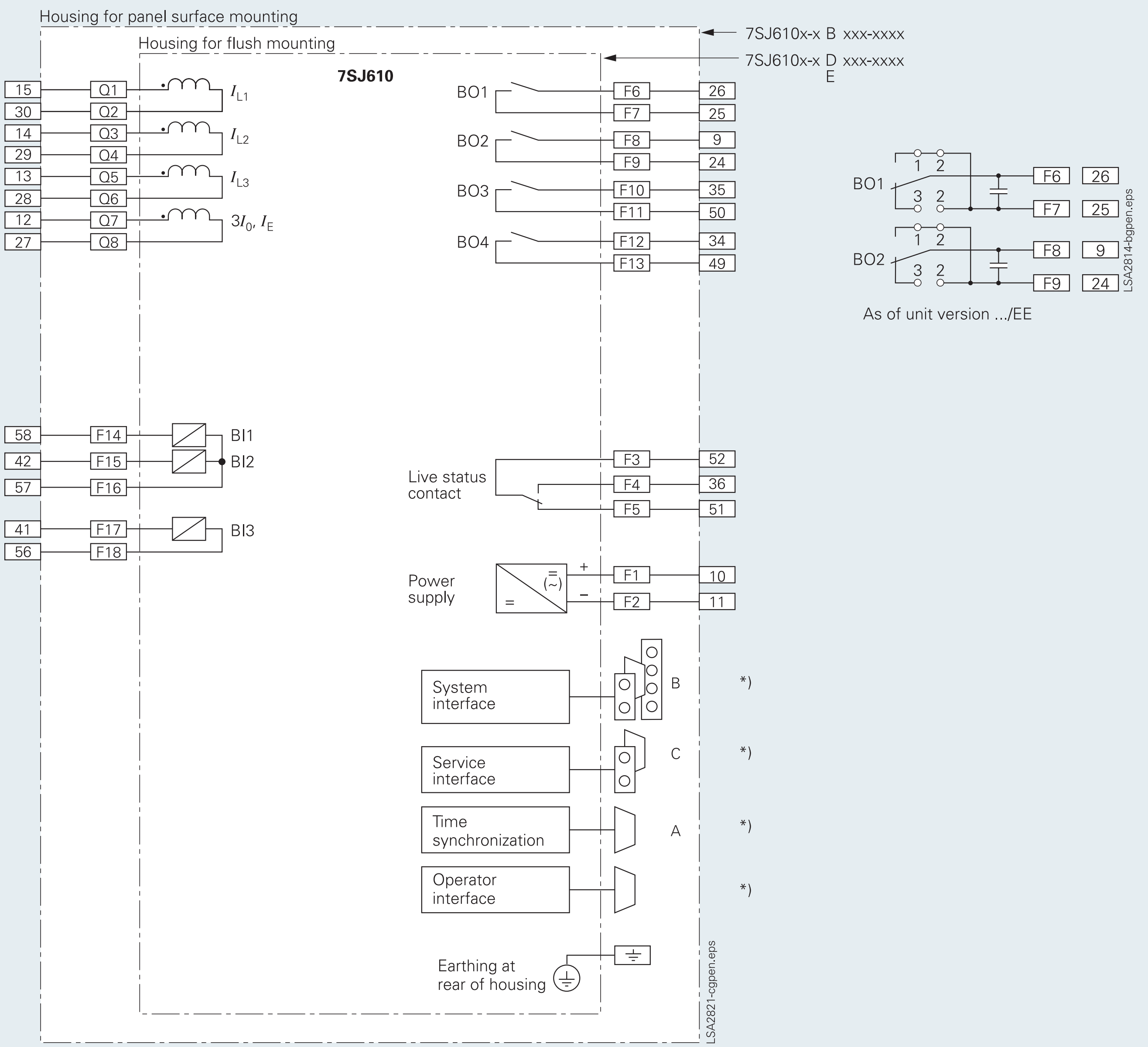
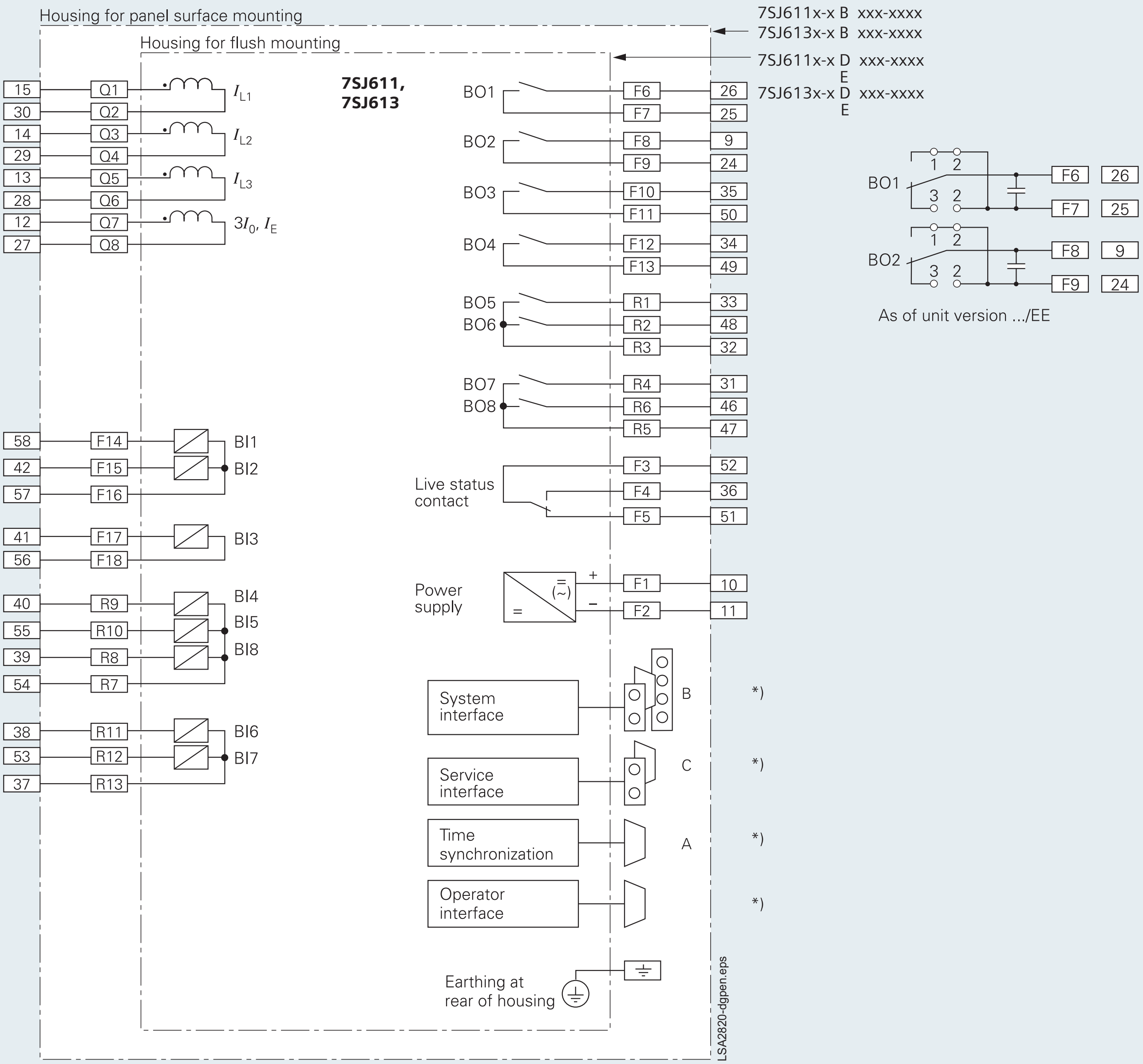
Connection diagram



*) For pinout of communication ports see part 14 of this catalog.
For the allocation of the terminals of the panel surface-mounting version refer to the manual (http://www.siemens.com/siprotec).

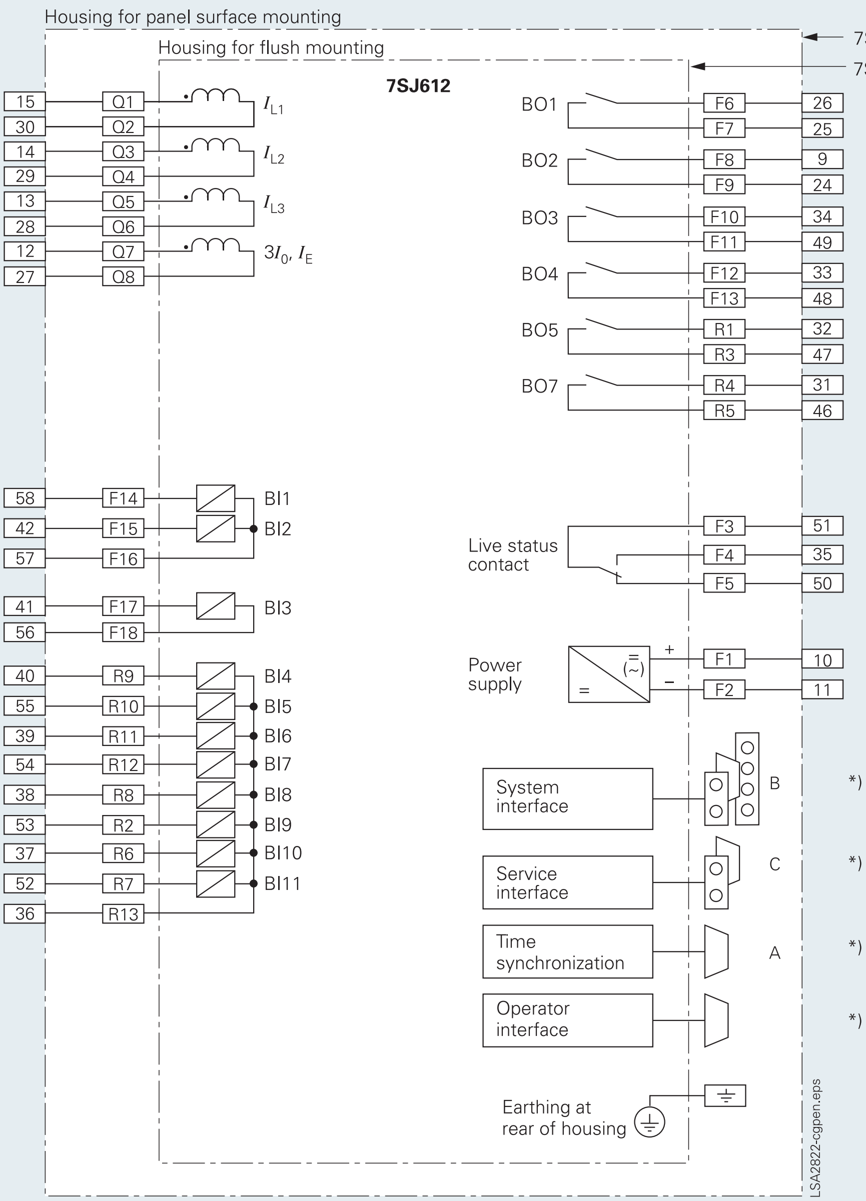
Fig. 5/72 7SJ610 connection diagram

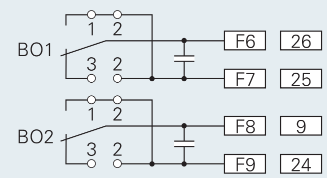


*) For pinout of communication ports see part 14 of this catalog.
For the allocation of the terminals of the panel surface-mounting version refer to the manual (http://www.siemens.com/siprotec).

Fig. 5/73 7SJ611, 7SJ613 connection diagram

Connection diagram





As of unit version .../EE

*) For pinout of communication ports see part 14 of this catalog.
For the allocation of the terminals of the panel surface-mounting version refer to the manual (http://www.siemens.com/siprotec).

Fig. 5/74 7SJ612, 7SJ614 connection diagram