SIPROTEC 4 7SD61
Differential Protection Relay for Two Line Ends

Fig. 7/10
SIPROTEC 4 7SD61
differential protection relay

Description

The 7SD610 relay is a differential protection relay suitable for all types of applications and incorporating all those functions required for differential protection of lines, cables and transformers. Transformers and compensation coils within the differential protection zone are protected by means of integrated functions, which were previously to be found only in transformer differential protection. It is also well-suited for complex applications such as series and parallel compensation of lines and cables.

It is designed to provide differential and directional back-up protection for all voltage levels and types of networks. The relay features high speed and phase-selective short-circuit measurement. The unit is thus suitable for single-phase and three-phase fault clearance.

Digital data communication for differential current measurement is effected via fiber-optic cables, networks or pilot wires connections, so that the line ends can be quite far apart. The serial protection data interface (R2R interface) of the relay can flexibly be adapted to the requirements of all existing communication media. If the communication method is changed, flexible retrofitting of communication modules to the existing configuration is possible.

Apart from the main protection function, i.e. the differential protection, the 7SD610 has a full range of configurable emergency and / or back-up protection functions such as phase and earth overcurrent protection with directional elements if voltage transformers are connected. Overload, under- and over-voltage/frequency and breaker-failure protection round off the functional scope of the 7SD610.

Function overview

Protection functions

- Differential protection for universal use with power lines and cables on all voltage levels with phase-segregated measurement (87L)
- Two line ends capability
- Suitable for transformers in protected zones (87T)
- Restricted earth-fault protection (87N) if a transformer is within the protection zone
- Well-suited for serial compensated lines
- Two independent differential stages: one stage for sensitive measuring for high-resistance faults and one stage for high-current faults and fast fault clearance
- Breaker-failure protection (50BF)
- Phase and earth overcurrent protection with directional element (50, 50N, 51, 51N, 67, 67N)
- Phase-selective intertripping (85)
- Overload protection (49)
- Over/undervoltage protection (59/27)
- Over/underfrequency protection (81O/U)
- Auto-reclosure single/three-pole (79)

Control functions

- Command and inputs for ctrl. of CB and disconnectors (isolators)

Monitoring functions

- Self-supervision of the relay
- Trip circuit supervision (74TC)
- 8 oscillographic fault records
- CT-secondary current supervision
- Event logging / fault logging
- Switching statistics

Front design

- User-friendly local operation
- PC front port for convenient relay setting
- Function keys and 8 LEDs f. local alarm

Communication interfaces

- 1 serial protection data (R2R) interface
- Front interface for PC connection
- System interface
  - IEC 61850 Ethernet
  - IEC 60870-5-103 protocol
  - PROFIBUS-DP, DNP 3.0 and MODBUS
- Service / modem interface (rear)
- Time synchronization via IRIG-B, DCF77 or system interface

Features

- Browser-based commissioning tool
- Direct connection to digital communication networks

Application

The 7SD610 relay is a differential protection relay suitable for all types of applications and incorporating all those functions required for differential protection of lines, cables and transformers.
Transformers and compensation coils within the differential protection zone are protected by means of integrated functions, which were previously to be found only in transformer differential protection. It is also well-suited for complex applications such as series and parallel compensation of lines and cables.

It is designed to provide protection for all voltage levels and types of networks; two line ends may lie within the protection zone. The relay features very high-speed and phase-selective short-circuit measurement. The unit is thus suitable for single and three-phase fault clearance. The necessary restraint current for secure operation is calculated from the current transformer data by the differential protection unit itself.

Digital data communication for differential current measurement is effected via fiber-optic cables, digital communication networks or pilot wires, so that the line ends can be quite far apart. Thanks to special product characteristics, the relay is particularly suitable for use in conjunction with digital communication networks.

The units measure the delay time in the communication network and adaptively match their measurements accordingly. The units can be operated through pilot wires or twisted telephone pairs at typical distances of 15 km by means of special converters.

The serial communication interfaces for data transmission between the ends are replaceable by virtue of plug-in modules and can easily be adapted to multi-mode and mono-mode fiber-optic cables and to leased lines within the communication networks. Secure, selective and sensitive protection of two-end lines can now be provided by means of these relays.

ANSI	
87L	ΔI for lines/cables
87T	ΔI for lines / cables with transformers
87N	Restricted earth-fault protection
85	Phase-selective intertrip, remote trip
86	Lockout function
50 50N 51 51N 67 67N	Three-stage overcurrent protection with directional elements
50HS	Instantaneous high-current tripping (switch-onto-fault)
79	Single or three-pole auto-reclosure with new adaptive technology
49	Overload protection
50BF	Breaker failure protection
59 27	Over/undervoltage protection
81O/U	Over/underfrequency protection
74TC	Trip circuit supervision

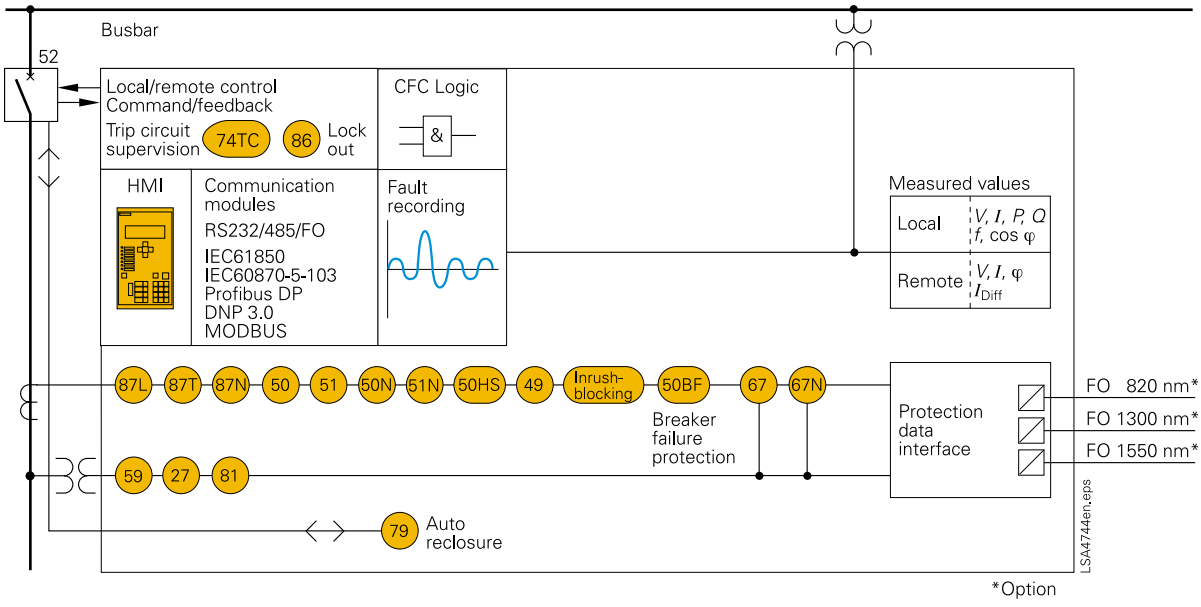


Fig. 7/11

Application

Typical applications employing fiber-optic cables or communication networks

Four applications are shown in Fig. 7/12. The 7SD610 differential protection relay is connected to the current transformers and to the voltage transformers at one end of the cable, although only the currents are required for the differential protection function. The voltage connection improves, among other things, the frequency measurement and allows the measured values and the fault records to be extended. Direct connection to the other units is effected via mono-mode fiber-optic cables and is thus immune to interference.

Five different modules are available. In the case of direct connection via fiber-optic cables, data communication is effected at 512 kbit/s and the command time of the protection unit is reduced to 15 ms. Parallel compensation (for the load currents) is provided within the protection zone of the cable. By means of the integrated inrush restraint, the differential protection relay can tolerate the surge on switching-on of the cable and the compensation reactors, and thus allows sensitive settings to be used under load conditions.

7SD610 offers many features to reliably and safely handle data exchange via communication networks.

Depending on the bandwidth available a communication converter for G703-64 kbit/s or X21-64/128/512 kbit/s can be selected. For higher communication speed a communication converter with G703-E1 (2,048 kbit/s) or G703-T1 (1,554 kbit/s) is available.

The connection to the communication converter is effected via a cost-effective 820 nm interface with multi-mode fiber. This communication converter converts the optical input to electrical signals in accordance to the specified telecommunication interface.

The fourth example shows the relays being connected via a twisted pilot pair. Data exchange and transmission is effected via pilot wires of a typical length of 15 km. Here a transformer is in the protected zone. In this application, 7SD610 is set like a transformer differential relay. Vector group matching and inrush restraint is provided by the relay.

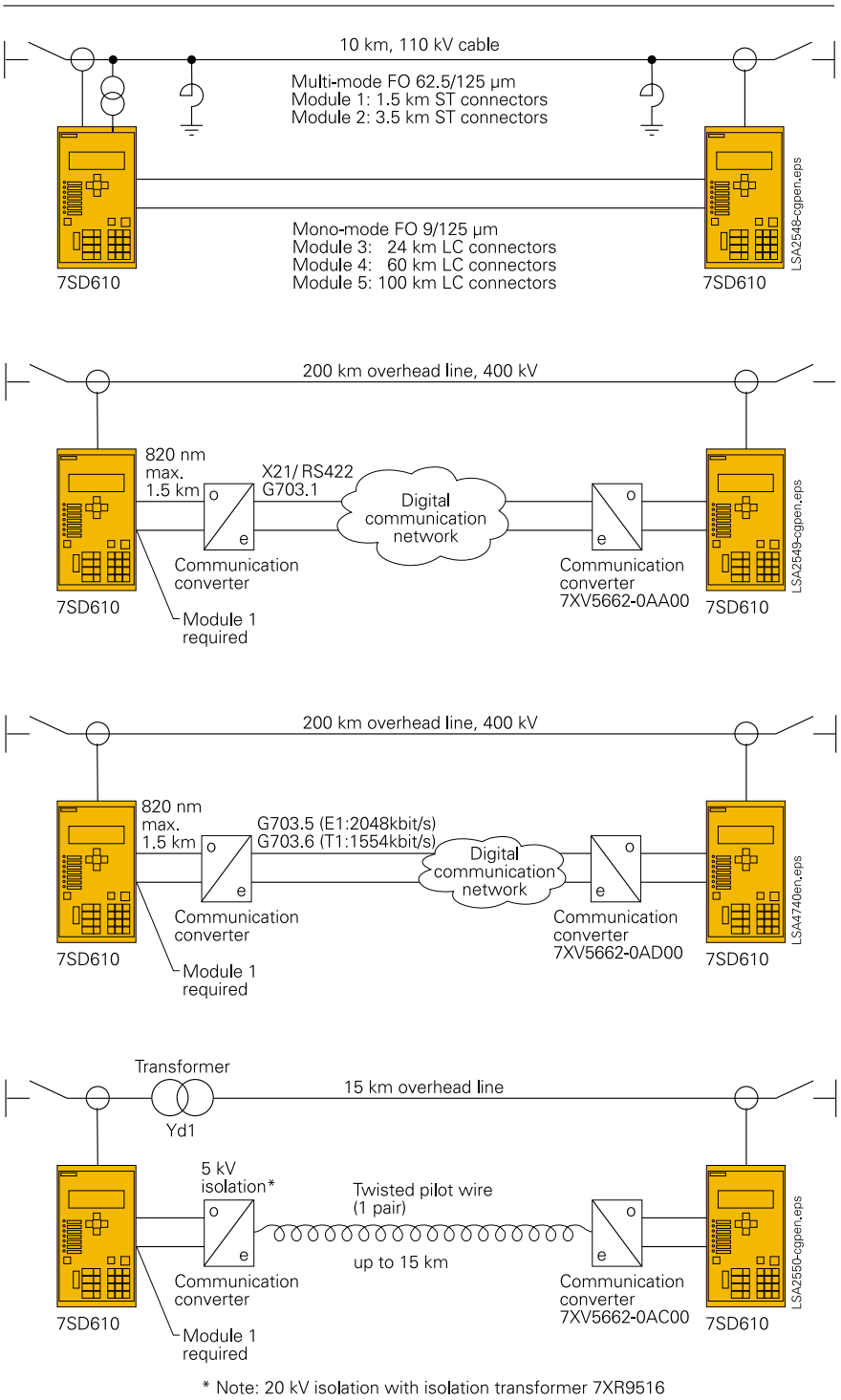


Fig. 7/12
Typical applications

Construction

The 7SD610 is available in a housing width of 1/3, referred to a 19" module frame system. The height is a uniform 245 mm for flush-mounting housings and 266 mm for surface-mounting housings.

All cables can be connected with or without cable ring lugs. Plug-in terminals are available as an option, it is thus possible to employ prefabricated cable harnesses. 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 on the same sides of the housing. For dimensions, please refer to "Dimension drawings".

Fig. 7/13

Protection functions

Differential protection (ANSI 87L, 87T, 87N)

The differential protection function has the following features:

- Measurements are performed separately for each phase; thus the trip sensitivity is independent of the fault type.
- An adaptive measurement method with high sensitivity for differential fault currents below the rated current offers the detection of highly resistive faults. This trip element uses special filters, which offer high security even with high level DC components in the short-circuit current. The trip time of this stage is about 35 ms, the pickup value is about 10 % of the rated current.
- A high-set differential trip stage which clears differential fault currents higher than the rated current within 15 ms offers fast tripping time and high-speed fault clearance time. A high-speed charging comparison method is employed for this function.
- When a long line or cable is switched on at one end, transient peaks of the charge current load the line. To avoid a higher setting of the sensitive differential trip stage, this setpoint may be increased for a settable time. This offers greater sensitivity under normal load conditions.
- A special feature of the unit is parameterization of the current transformer data. The unit automatically calculates the necessary restraint current by means of the previously entered current transformer error. The unit thus adaptively matches the working point on the tripping characteristic so that it is no longer necessary for the user to enter characteristic settings.
- Different current-transformer ratios may be employed at the ends of the line. A mismatch of 1:8 is permissible.
- Differential protection tripping can be guarded with overcurrent pickup. In this case, pickup of the protection relay is initiated only on simultaneous presence of differential current and overcurrent.
- Easy to set tripping characteristic. Because the relay works adaptively, only the setpoint $I_{Diff}>$ (sensitive stage) and $I_{Diff}>>$ (high-set current differential stage) must be set according to the charge current of the line/cable.
- Differential and restraint current are monitored continuously during normal operation and are displayed as operational measured values.
- High stability during external faults even with different current transformers saturation level. For an external fault, only 5 ms of saturation-free time are necessary to guarantee the stability of the differential protection.
- Single-phase short-circuits within the protection zone can be cleared using a time delay, whereas multi-phase faults are cleared instantaneously. Because of this function, the unit is optimally suited for applications in inductively compensated networks, where differential current can occur as a result of charge transfer phenomena on occurrence of a single-phase earth fault within the protection zone, thus resulting in undesired tripping by the differential protection relay. Undesired tripping of the differential protection can be suppressed by making use of the provision for introduction of a time delay on occurrence of single-phase faults.
- With transformers or compensation coils in the protection zone, the sensitive response threshold $I_{Diff}>$ can be blocked by an inrush detection function. Like in transformer differential protection, it works with the second harmonic of the measured current compared with the fundamental component. Blocking is cancelled when an adjustable threshold value of the short-circuit current is reached, so that very high current faults are switched off instantaneously.
- In the case of transformers within the protection zone, vector group adaptation and matching of different current transformer ratios is carried out within the unit. The interference zero current, which flows through the earthed winding, is eliminated from the differential current measurement. The 7SD610 thus behaves like a transformer differential relay whose ends, however, can be quite far apart.
- A more sensitive protection for transformers within the protection zone is given by measurement of the star-point current on an earthed winding. Therefore the I_E current measurement input has to be used.

Protection functions

If the sum of the phase currents of a winding is compared with the measured star-point current, a sensitive earth-current differential protection (REF) can be implemented. This function is substantially more sensitive than the differential protection during faults to earth in a winding, detecting fault currents as small as 10 % of the transformer rated current.

Characteristics of differential protection communciation through the remote relay interfaces

The 7SD610 is ideally adapted for application in communication networks.

The data required for measurement of differential currents and numerous other variables are exchanged between the protection units in the form of synchronous serial telegrams employing the full duplex mode. The telegrams are secured using 32-bit checksums so that transmission errors in a communication network are detected immediately. Moreover, each telegram carries a time stamp accurate to a microsecond, thus allowing measurement and monitoring of the continuous transmission delay times.

- Data communication is immune to electromagnetic interference, since fiber-optic cables are employed in the critical region, e.g. in the relay house or relay room.
- Monitoring of each individual incoming telegram and of overall communication between the units, no need of supplementary equipment. The check sum (correctness of the telegram contents), the address of the neighboring unit and the transmission delay time of the telegram are monitored.
- Unambiguous identification of each unit is ensured by assignment of a settable communication address within a differential protection topology. Only those units mutually known to each other can cooperate. Incorrect interconnection of the communication links results in blocking of the protection system.
- Detection of telegrams, which are reflected back to the transmitting unit within the communication network.
- Detection of path switching in a communication network. Automatic restraint of the protection function until measurement of the parameters of the new communication link has been completed.
- Continuous measurement of the transmission delay time to the remote line end. Taking into account the delay time in differential current measurement and compensation thereof, including monitoring of a settable maximum permissible delay time of 30 ms.
- Generation of alarm signals on disturbed communication links. Statistical values for the percentage availability of the communication links per minute and per hour are available as operational measured values.
- With a GPS high-precision 1-s pulse from a GPS receiver the relays can be syncronized with an absolute, exact time at each line end. In this way, the delay in the receive and transmit path can be measured exactly. With this optional feature the relay can used in communication networks where this delay times are quite different.

Phase-selective intertrip and remote trip/indications

Normally the differential current is calculated for each line end nearly at the same time. This leads to fast and uniform tripping times. Under weak infeed conditions, especially when the differential function is combined with an overcurrent pickup, a phase-selective intertrip offers a tripping of both line ends.

- 7SD610 has 4 intertrip signals which are transmitted in high-speed mode (20 ms) to the other terminals. These intertrip signals can also be initiated and transmitted by an external relay via binary inputs. In cases where these signals are not employed for breaker intertripping, other alternative information can be rapidly transmitted to the remote end of the line.
- In addition, four high-speed remote commands are available, which can be introduced either via a binary input or by means of an internal event and then rapidly communicated to the other end.
- Provided that the circuit-breaker auxiliary contacts are wired to binary inputs at the line ends, the switching status of the circuit-breakers is indicated and evaluated at the remote ends of the line. Otherwise the switching status is derived from the measured current.

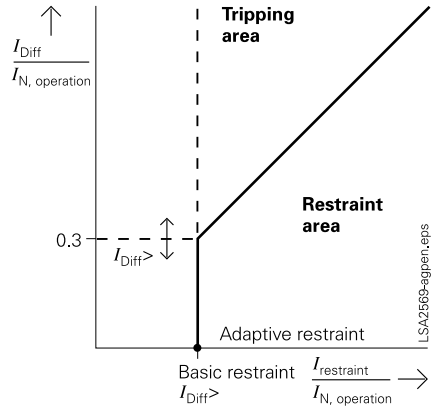


Fig. 7/14
Tripping characteristic

Possible modes of operation of the differential protection section

Special modes of operation such as the "Commissioning mode" and "Test operation" are advantageous for commissioning and servicing the units.

- In general, an alarm indication is generated on interruption of the communication links and an attempt is made to re-establish the communication link. The units operate in the emergency mode, provided that these have been parameterized.
- The complete configuration can also be used in a testing mode. The local end is in an operating mode, which, for example, allows the pickup values to be tested. The current values received from the remote end of the line are set to zero, so as to achieve defined test conditions. The remote-end unit ignores the differential currents, which occur as a result of testing, and blocks differential protection and breaker intertripping. It may optionally operate in the backup protection mode.
- Differential protection is activated in the commissioning mode. However, test currents injected at one end of the line and which generate a differential current do not lead to output of a TRIP command by the differential protection or to breaker intertripping. All those indications that would actually occur in conjunction with a genuine short-circuit are generated and displayed. TRIP commands can be issued by the backup protection.

Protection functions

Thermal overload protection (ANSI 49)

A built-in overload protection with a current and thermal alarm stage is provided for thermal protection of cables and transformers.

The trip time characteristics are exponential functions according to IEC 60255-8. The preload is considered in the trip times for overloads.

An adjustable alarm stage can initiate an alarm before tripping is initiated.

Overcurrent protection (ANSI 50, 50N, 51, 51N, 67, 67N)

The 7SD610 provides a three-stage overcurrent protection. Two definite-time stages and one inverse-time stage (IDMT) are available, separately for phase currents and for the earth current. Two operating modes (backup, emergency) are selectable. Two stages e.g. can run in backup mode, whereas the third stage is configured for emergency operation, e.g. during interruption of the protection communication and/or failure of the voltage in the VT secondary circuit. The secondary voltage failure can be detected by the integrated fuse failure monitor or via a binary input from a VT miniature cicuit-breaker (VT m.c.b. trip).

The following ANSI/IEC inverse-time characteristics are available:

- Inverse
- Short inverse
- Long inverse
- Moderately inverse
- Very inverse
- Extremely inverse
- Definite inverse

If VTs are connected, separate stages with directional measurement are available, two definite-time and two inverse-time stages (each for phase and earth). Using the forward pickup indication as a signal to the remote end, a 100 % protection coverage of the line can be operated in parallel to the differential protection.

Instantaneous high-speed switch-onto-fault overcurrent protection (ANSI 50HS)

Instantaneous tripping is possible when energizing a faulty line. On large fault currents, the high-speed switch-onto-fault overcurrent stage can initiate very fast three-pole tripping.

Circuit-breaker closure onto a faulty line is also possible provided that the circuit-breaker auxiliary contacts of the remote end are connected and monitored. If an overcurrent arises on closing of the circuit-breaker at one end of a line (while the other end is energized) the measured current can only be due to a short-circuit. In this case, the energizing line end is tripped instantaneously.

In the case of circuit-breaker closure, the auto-reclosure is blocked at both ends of the line to prevent a further unsuccessful closure onto a short-circuit.
If circuit-breaker intertripping to the remote end is activated, intertripping is also blocked.

Auto-reclosure (ANSI 79)

The 7SD610 relay is equipped with an auto-reclose function (AR). The function includes several operating modes:

- 3-pole auto-reclosure for all types of faults; different dead times are available depending the type of fault
- 1-pole auto-reclosure for 1-phase faults, no reclosing for multi-phase faults
- 1-pole auto-reclosure for 1-phase faults and for 2-phase faults without earth, no reclosing for multi-phase faults
- 1-pole auto-reclosure for 1-phase and 3-pole auto-reclosing for multi-phase faults
- 1-pole auto-reclosure for 1-phase faults and 2-phase faults without earth and 3-pole auto-reclosure for other faults
- Multiple-shot auto-reclosure
- Interaction with an external device for auto-reclosure via binary inputs and outputs
- Control of the integrated AR function by external protection
- Adaptive auto-reclosure. Only one line end is closed after the dead time. If the fault persists this line end is switched off. Otherwise the other line ends are closed via a command over the communication links. This avoids stress when heavy fault currents are fed from all line ends again.
- Interaction with an external synchro-check

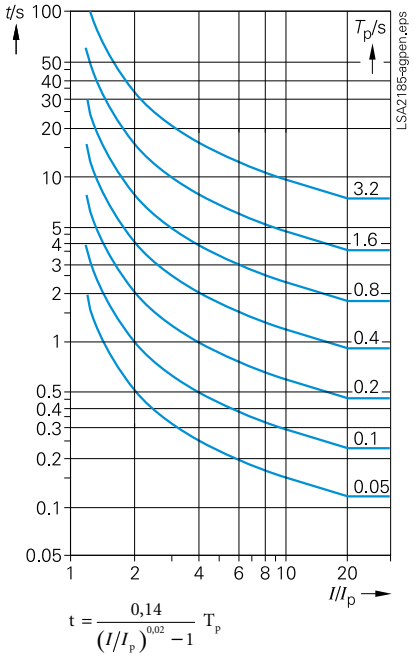


Fig. 7/15 Inverse

- 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 evaluation of the line-side voltages. A number of voltage-dependent supplementary functions are thus available:

- DLC
  By means of dead-line check, reclosure is effected only when the line is deenergized (prevention of asynchronous breaker closure).
- ADT
  The adaptive dead time is employed only if auto-reclosure at the remote station was successful (reduction of stress on equipment).
- RDT
  Reduced dead time is employed in conjunction with auto-reclosure where no tele-protection method is employed:
  When faults within the zone extension, but external to the protected line, 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.

Protection functions

Breaker failure protection (ANSI 50BF)

The 7SD610 relay incorporates a two-stage breaker failure protection to detect the failure of tripping command execution, for example, due to a defective circuit-breaker. The current detection logic is phase-segregated 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 is generated. The breaker failure protection can be initiated by all integrated protection functions as well as by external devices via binary input signals.

Overvoltage protection, undervoltage protection (ANSI 59, 27)

A voltage rise can occur on long lines that are operating at no-load or are only lightly loaded. The 7SD610 contains a number of overvoltage measuring elements. Each measuring element is of two-stage design. The following measuring elements are available:

- Phase-to-earth overvoltage
- Phase-to-phase overvoltage
- Zero-sequence overvoltage
  The zero-sequence voltage can be connected to the 4th voltage input or be derived from the phase voltages.
- Positive-sequence overvoltage of the local end or calculated for the remote end of the line (compounding).
- Negative-sequence overvoltage

Tripping by the overvoltage measuring elements can be effected either at the local circuit-breaker or at the remote station by means of a transmitted signal.

The 7SD610 is fitted, in addition, with three two-stage undervoltage measuring elements:

- Phase-to-earth undervoltage
- Phase-to-phase undervoltage
- Positive-sequence undervoltage

The undervoltage measuring elements can be blocked by means of a minimum current criterion and by means of binary inputs.

Frequency protection (ANSI 81O/U)

Frequency protection can be used for overfrequency and underfrequency protection. Unwanted frequency changes in the network can be detected and the load can be removed at a specified frequency setting. Frequency protection can be used over a wide frequency range (45 to 55, 55 to 65 Hz). There are four elements (selectable as overfrequency or underfrequency) and each element can be delayed separately.

Protection functions

Monitoring and supervision functions

The 7SD610 relay provides comprehensive monitoring functions covering both hardware and software. Furthermore, the measured values are continuously checked for plausibility. Therefore the current and voltage transformers are also included in this monitoring system.

Current transformer / Monitoring functions

A broken wire between the CTs and relay inputs under load may lead to maloperation of a differential relay if the load current exceeds the differential setpoint. The 7SD610 provides fast broken wire supervision which immediatelly blocks all line ends if a broken wire condition is measured by a local relay. This avoids maloperation due to broken wire condition. Only the phase where the broken wire is detected is blocked. The other phases remain under differential operation.

Fuse failure monitoring

If any measured voltage is not present due to short-circuit or open circuit in the voltage transformer secondary circuit the distance protection would respond with an unwanted trip due to this loss of voltage. This secondary voltage interruption can be detected by means of the integrated fuse failure monitor. Immediate blocking of distance protection is provided for all types of secondary voltage failures.

Additional measurement supervision functions are

- Symmetry of voltages and currents
- Summation of currents and voltages

Trip circuit supervision (ANSI 74TC)

One or two binary inputs for each circuit-breaker pole can be used for monitoring the circuit-breaker trip coils including the connecting cables. An alarm signal is issued whenever the circuit is interrupted.

Lockout (ANSI 86)

All binary outputs can be stored like LEDs and reset using the LED reset key. The lockout state is also stored in the event of supply voltage failure. Reclosure can only be issued after the lockout state is reset.

Local measured values

The measured values are calculated from the measured current and voltage signals along with the power factor (cos φ), the frequency, the active and reactive power. Measured values are displayed as primary or secondary values or in percent of the specific line rated current and voltage. The relay uses a 20 bit high-resolution AD converter and the analog inputs are factory-calibrated, so a high accuracy is reached. The following values are available for measured-value processing:

- Currents 3 x I_{Phase}, 3 I_0, I_E, $I_{E\ sensitive}$
- Voltages 3 x $V_{Phase\text{-}Ground,\ 3\ x}$ $V_{Phase\text{-}Phase}$, 3 V_0,V_{en},
- Symmetrical components I_1, I_2, V_1, V_2
- Real power P (Watt), reactive power Q (Var), apparent power S (VA)
- Power factor PF (= cos φ)
- Frequency f
- Differential and restraint current per phase
- Availability of the data connection to the remote line ends per minute and per hour
- Regarding delay time measuring with the GPS-version the absolute time for transmit and receive path is displayed separately.

Limit value monitoring: Limit values are monitored by means of the CFC. Commands can be derived from these limit value indications.

Protection functions

Measured values at remote line ends

Every two seconds the currents and voltages are freezed at the same time at all line ends and transmitted via the communication link. At a local line end, currents and voltages are thus available with their amount and phases (angle) locally and remotely. This allows checking the whole configuration under load conditions. In addition, the differential and restraint currents are also displayed. Important communication measurements, such as delay time or faulty telegrams per minute/hour are also available as measurements. These measured values can be processed with the help of the CFC logic editor.

Commissioning

Special attention has been paid to commissioning. All binary inputs and outputs can be displayed and activated directly. This can simplify the wiring check significantly for the user. The operational and fault events and the fault records are clearly arranged.

Furthermore, all currents and optional voltages and phases are available via communication link at the local relay and are displayed in the relay, with DIGSI 4 or with the Web Monitor.

The operational and fault events and fault records from all line ends share a common time tagging which allows to compare events registered in the different line ends on a common time base.

WEB Monitor – Internet technology simplifies visualization

In addition to the universal DIGSI 4 operating program, the relay contains a WEB server that can be accessed via a telecommunication link using a browser (e.g. Internet Explorer). The advantage of this solution is to operate the unit with standard software tools and at the same time make use of the Intranet/Internet infrastructure. This program shows the protection topology and comprehensive measurements from local and remote line ends. Local and remote measurements are shown as phasors and the breaker positions of each line end are depicted. It is possible to check the correct connection of the current transformers or the correct vector group of a transformer.

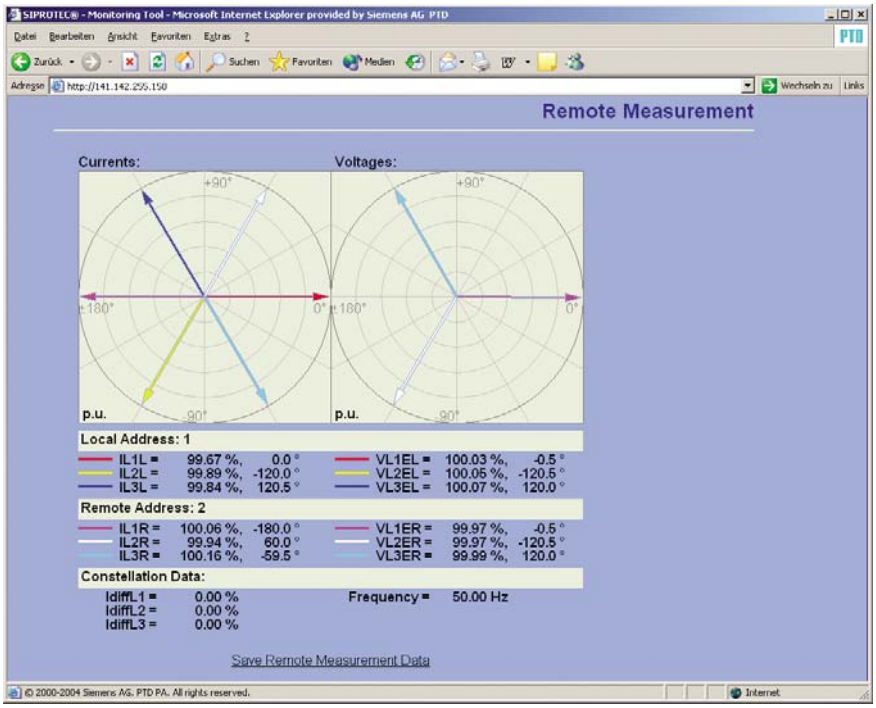


Fig. 7/16
Browser-aided commissioning: Phasor diagram

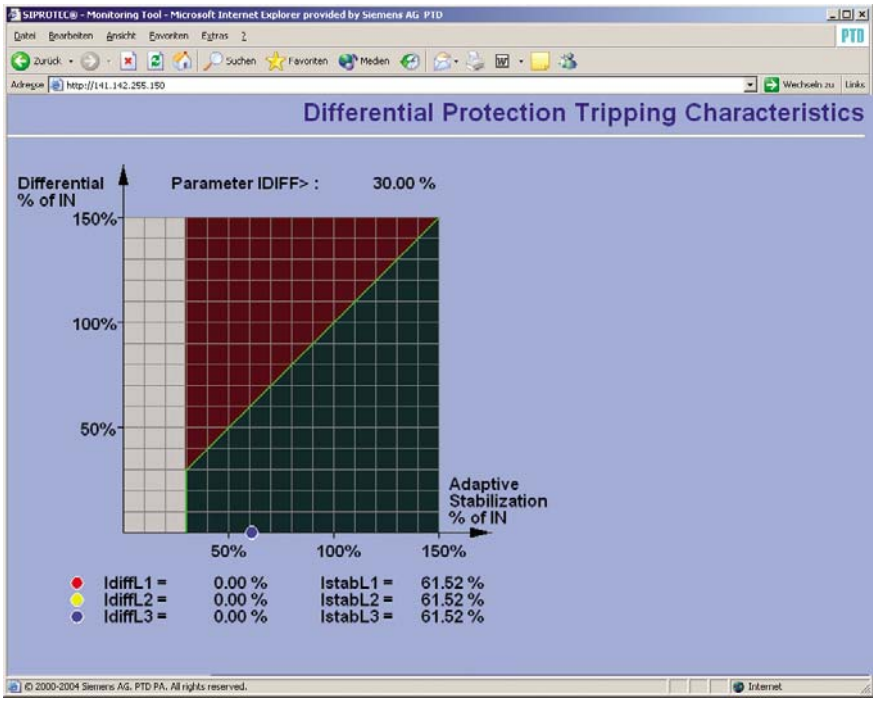


Fig. 7/17
Browser-aided commissioning:
Differential protection tripping characteristic

Stability can be checked by using the operating characteristic as well as the calculated differential and restraint values in the browser windows.
If the distance protection is active, then the valid zone characteristic (quadrilateral/mho) is displayed.

Event log and trip log messages are also available. Remote control can be used, if the local front panel cannot be accessed.

Functions

■ Control and automation 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 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

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 earthing switches
- Triggering of switching operations, indications or alarm by combination with existing information

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, communication or by key-operated switch (when available).

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”

Every switching operation and change of breaker position is kept in the status indication memory. The switch command source, switching device, cause (i.e. spontaneous change or command) and result of a switching operation are retained.

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 (intermediate position).

Chatter disable

The 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.

Filter time

All binary indications can be subjected to a filter time (indication suppression).

Indication filtering and delay

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.

Transmission lockout

A data transmission lockout can be activated, so as to prevent transfer of information to the control center during work on a circuit bay.

Test operation

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

Functions

With respect to communication, particular emphasis has been placed on high flexibility, data security and use of customary standards in the field of energy automation. The concept of the communication modules allows interchangeability on the one hand, and, on the other hand, is open for future standards.

Local PC interface

The PC interface provided on the front panel on the unit allows the parameters, status and fault event data to be rapidly accessed by means of the DIGSI 4 operating program. Use of this program is particularly advantageous during testing and commissioning.

Rear-mounted interfaces

The service and system communication interfaces are located at the rear of the unit. In addition, the 7SD610 is provided with a protection interface. The interface complement is variable and retrofitting is possible without any difficulty. These interfaces ensure that the requirements for different communication interfaces (electrical and optical) and protocols can be met.

The interfaces are designed for the following applications:

Service / modem interface

By means of the RS485 interface, it is possible to efficiently operate a number of protection units centrally via DIGSI 4. Remote operation is possible on connection of a modem. This offers the advantage of rapid fault clarification, especially in the case of unmanned power plants.

In the case of the 7SD610, a PC with a standard browser can be connected to the service interface (refer to "Commissioning program").

System interface

This interface is used to carry out communication with a control or protection and control system and supports a variety of communication protocols and interface designs, depending on the module connected.

Commissioning aid via a standard Web browser

In the case of the 7SD610, a PC with a standard browser can be connected to the local PC interface or to the service interface (refer to "Commissioning program"). The relays include a small Web server and sends its HTML pages to the browser via an established dial-up network connection.

Retrofitting: Modules for every type of communication

Communication modules for retrofitting are available for the entire SIPROTEC 4 unit range. These ensure that, where different communication interfaces (electrical or optical) and protocols (IEC 61850 Ethernet, IEC 60870-5-103, PROFIBUS-DP, DNP 3.0, MODBUS, DIGSI, etc.) are required, such demands can be met.

Safe bus architecture

- RS485 bus
  With this data transmission via copper conductors, electromagnetic fault influences are largely eliminated by the use of twisted-pair conductor. Upon failure of a unit, the remaining system continues to operate without any disturbances.
- Fiber-optic double ring circuit
  The fiber-optic double ring circuit is immune to electromagnetic interference. Upon failure of a section between two units, the communication system continues to operate without disturbance.

It is generally impossible to communicate with a unit that has failed. If a unit were to fail, there is no effect on the communication with the rest of the system.

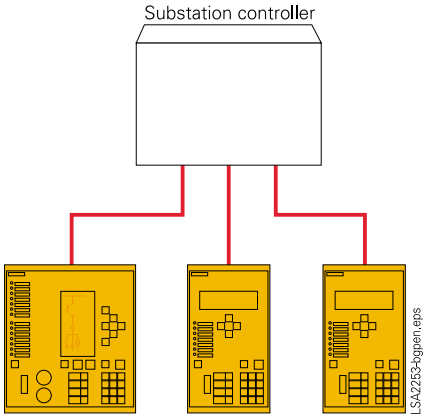


Fig. 7/18
IEC 60870-5-103 star-type RS232 copper conductor connection or fiber-optic connection

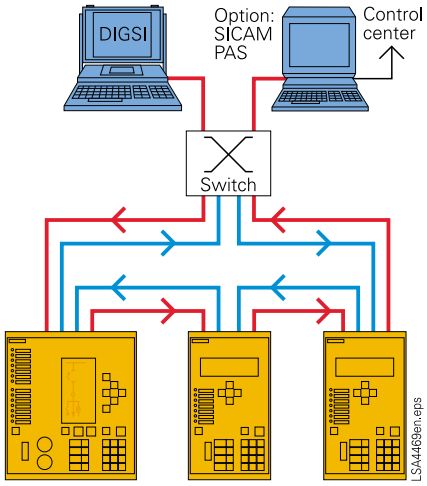


Fig. 7/19
Bus structure for station bus with Ethernet and IEC 61850

Communication

IEC 61850 Ethernet

Since 2004, 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 ans system interlocking. Access to the units via the Ethernet bus is also possible with DIGSI.

IEC 60870-5-103

IEC 60870-5-103 is an internationally standardized protocol for the efficient communication in the protected area.
IEC 60870-5-103 is supported by a number of protection device manufacturers and is used worldwide.

PROFIBUS-DP

PROFIBUS-DP is an industry-recognized standard for communications and is supported by a number of PLC and protection device manufacturers.

MODBUS RTU

MODBUS RTU is an industry-recognized standard for communications and is supported by a number of PLC and protection device manufacturers.

DNP 3.0

DNP 3.0 (Distributed Network Protocol Version 3) is a messaging-based communication protocol. The SIPROTEC 4 units are fully Level 1 and Level 2 compliant with DNP 3.0. DNP 3.0 is supported by a number of protection device manufacturers.

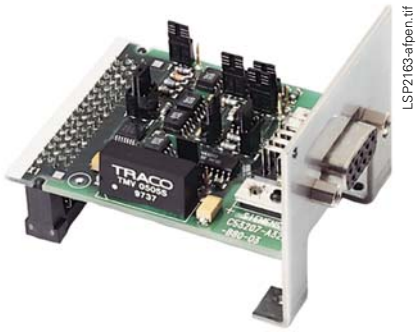


Fig. 7/20
R232/RS485 electrical communication module

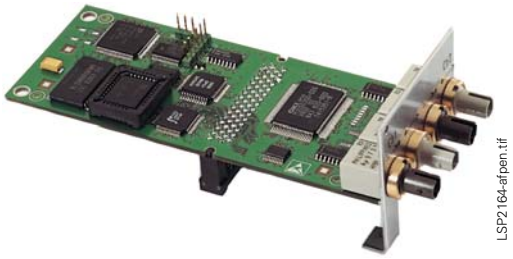


Fig. 7/21
Communication module, optical double-ring

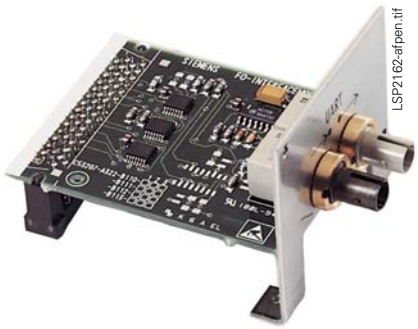


Fig. 7/22
Fiber-optic communication module

Fig. 7/23
Fiber-optic Ethernet communication module for IEC 61850 with integrated Ethernet switch

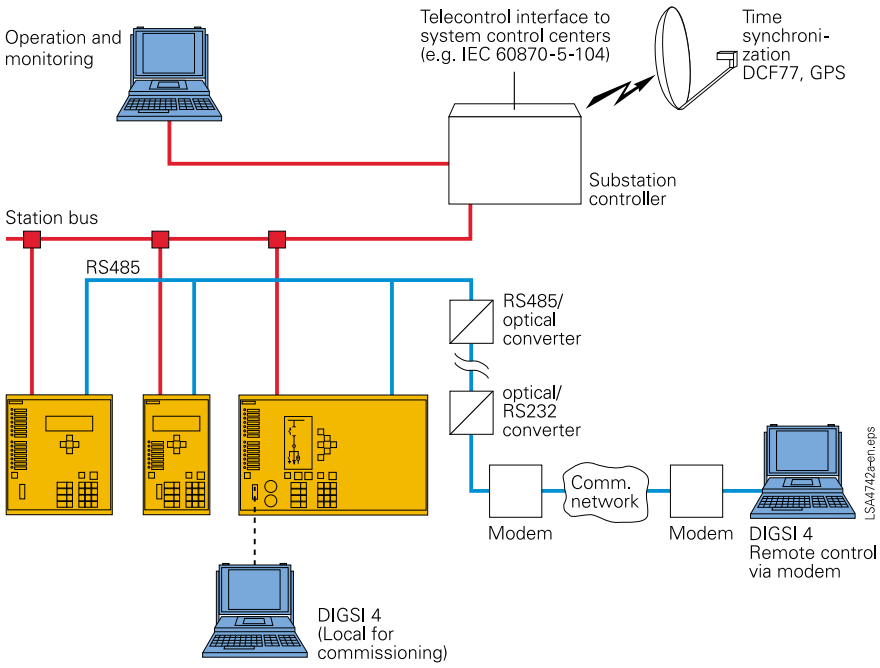


Fig. 7/24
System solution: Communications

Communication

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. 7/18).

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. 7/19).

Via modem and service interface, the protection engineer has access to the protection devices at all times. This permits remote maintenance and diagnosis (cyclic testing).

Parallel to this, local communication is possible, for example, during a major inspection.

Serial protection data interface (R2R interface)

The 7SD610 provides one protection data interface to cover two line end applications.

In addition to the differential protection function, other protection functions can use this interface to increase selectivity and sensitivity as well as covering advanced applications.

- Fast phase-selective teleprotection signaling using the directional stages of the overcurrent protection with POTT or PUTT schemes
- Two terminal line applications can be implemented without additional logic
- Interclose command transfer with the auto-reclosure “Adaptive dead time” (ADT) mode
- 4 remote signals for fast transfer of binary signals
- Flexible utilization of the communication channels by means of the programmable CFC logic

The protection data interfaces have different options to cover new and existing communication infrastructures.

- FO5[1], OMA1[2] module:
  820 nm fiber-optic interface with clock recovery/ST connectors for direct connection with multi-mode FO cable up to 1.5 km for the connection to a communication converter.
- FO6[1], OMA2[2] module:
  820 nm fiber-optic interface/ST connectors for direct connection up to 3.5 km with multi-mode FO cable.

New fiber-optic interfaces, series FO1x

- FO17[1]: For direct connection up to 24 km[3], 1300 nm, for mono-mode fiber 9/125 µm, LC-Duplex connector
- FO18[1]: For direct connection up to 60 km[3], 1300 nm, for mono-mode fiber 9/125 µm, LC-Duplex connector
- FO19[1]: For direct connection up to 100 km[3], 1550 nm, for mono-mode fiber 9/125 µm, LC-Duplex connector

The link to a multiplexed communication network is made by separate communication converters (7XV5662). These have a fiber-optic interface with 820 nm and 2 ST connectors to the protection relay. The link to the communication network is optionally an electrical X21/G703-64 kbit/s or G703-E1/-T1 interface.

For operation via copper wire communication (pilot wires or twisted telephone pair), a modern communication converter for copper cables is available. This operates with both the two-wire and three-wire copper connections which were used by conventional differential protection systems before. The communication converter for copper cables is designed for 5 kV insulation voltage. An additional 20 kV isolation transformer can extend the field of applications of this technique into ranges with higher insulation voltage requirements. The connection via FO cable to the relay is interference-free. With SIPROTEC 4 and the communication converter for copper cables a digital follow-up technique is available for two-wire protection systems (up to 15 km) and all three-wire protection systems using existing copper communication links.

Different communication converters are listed under "Accessories".

Communication data:

- 32-bit CRC-check according to CCITT and ITU
- Each protection relay possesses a unique relay address
- Continuous communication link supervision: Individual faulty data telegrams do not constitute an immediate danger, if they occur only sporadically. The statistical availability, per minute and hour, of the serial protection data interface can be displayed.
- Supported network interfaces X21/RS422 with 64 or 128 or 512 kbit/s; or G703-64 kbit/s and G703-E1 (2,048 kbit/s) or G703-T1 (1,554 kbit/s).
- Max. channel delay time 0.1 ms to 30 ms (in steps of 0.1 ms)
- Protocol HDLC

1) For flush-mounting housing.

2) For surface-mounting housing.

3) For surface-mounting housing the internal FO module OMA1 will be delivered together with an external repeater.

Communication

Communication possibilities between relays

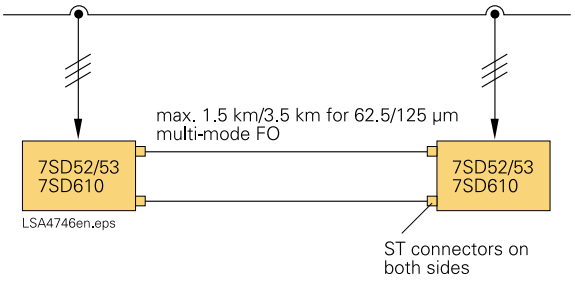


Fig. 7/25
Direct optical link up to 1.5 km/3.5 km, 820 nm

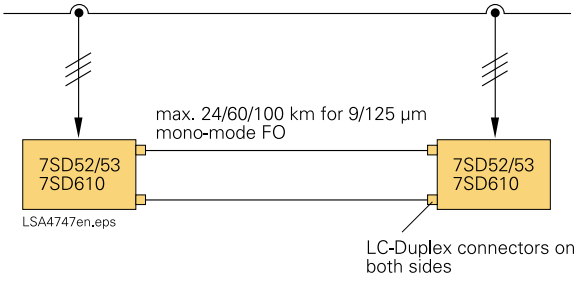


Fig. 7/26
Direct optical link up to 25/60 km with 1300 nm
or up to 100 km with 1550 nm

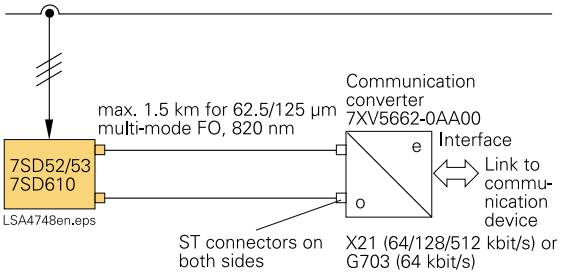


Fig. 7/27
Connection to a communication network CC-XG

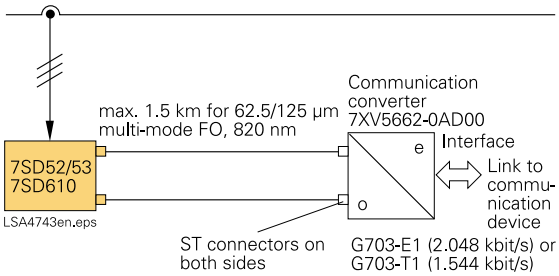


Fig. 7/28
Connection to a communication network CC-2M

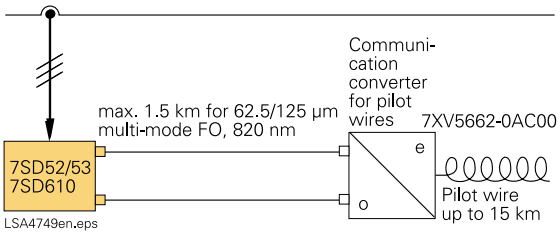


Fig. 7/29
Connection to a pilot wire

Typical connection

Connection to current and voltage transformers

A typical connection is to the phase CT. The residual current at the I_E input is formed by summation of the phase currents. This ensures optimum supervision functions for the current.

Optionally, voltages are measured by means of voltage transformers and are fed to the unit as a phase-to-earth voltage. The zero voltage is derived from the summation voltage by calculation performed in the unit.

As a matter of fact, the 7SD610 unit does not require any voltage transformers for operation of the differential protection.

Alternative current connection

3 phase current transformers with neutral point in the line direction, I_4 connected to a current transformer in the neutral point of a grounded (earthed) transformer for restricted earth-fault protection (REF) or directional ground (earth)-fault protection.

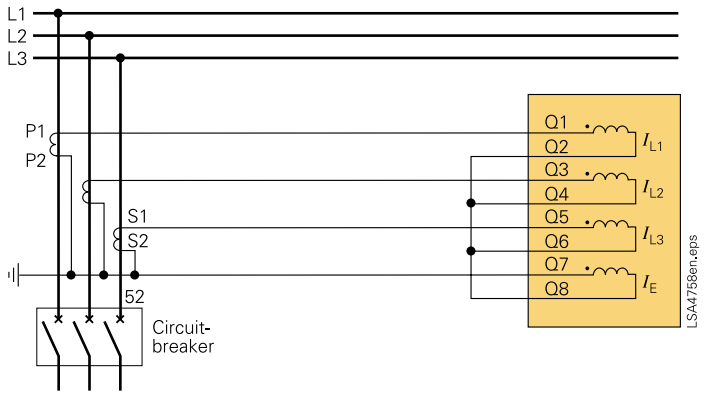


Fig. 7/30
Typical connection to current transformers

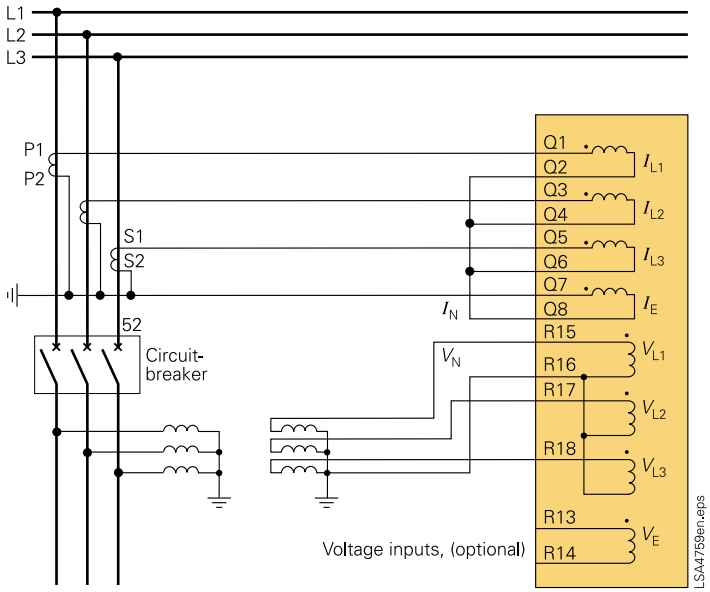


Fig. 7/31
Typical connection to current transformers with optional voltage inputs

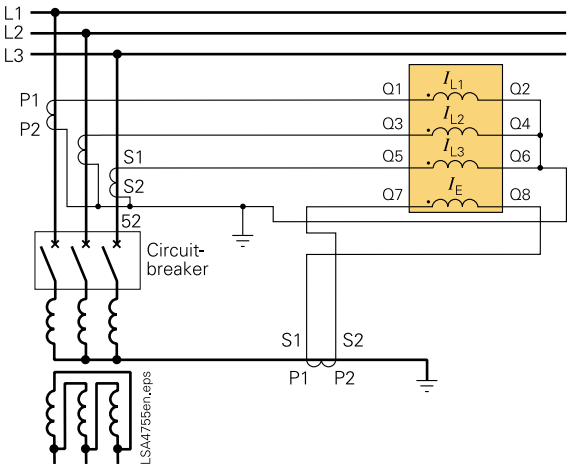


Fig. 7/32
Connection for transformer with restricted earth-fault protection (REF)

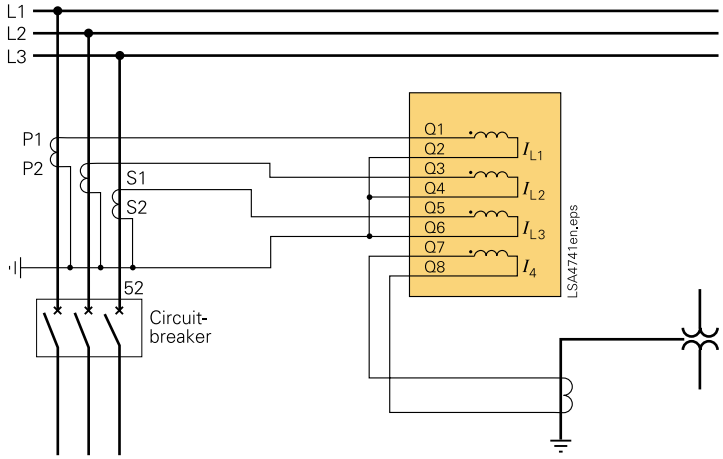


Fig. 7/33
Alternative connection of current transformers for measuring neutral current of a grounded (earthed) power transformer

Technical data

General unit data

Analog inputs

Rated frequency	50 or 60 Hz (selectable)
Rated current I_N	1 or 5 A (selectable)
Rated voltage V_N	80 to 125 V (selectable)
Power consumption	
in CT circuits with I_N = 1 A	Approx. 0.05 VA
with I_N = 5 A	Approx. 0.3 VA
in VT circuits	Approx. 0.1 VA
Thermal overload capacity	I_N
in CT circuits (for I_N = 5 A)	100 A for 1 s 30 I_N for 10 s 4 I_N continuous
Dynamic (peak value)	250 I_N (half sine)
In VT circuits for highly sensitive earth-fault protection	300 A for 1 s 100 A for 10 s 15 A continuous
in VT circuits	230 V per phase continuous

Auxiliary voltage

Rated voltages	24 to 48 V DC
Ranges are settable by means of jumpers	60 to 125 V DC[1)] 110 to 250 V DC[1)] and 115 V AC (50/60 Hz)[1)]
Permissible tolerance	-20 % to +20 %
Superimposed AC voltage (peak-to-peak)	≤ 15 %
Power consumption	
Under normal operating conditions	Approx. 8 W
During pickup with all inputs and outputs activated	Approx. 18 W
Bridging time during failure of the auxiliary voltage	
V_{aux} ≥ 110 V	≥ 50 ms

Binary inputs

Number	7 (marshallable)
Rated voltage range	24 to 250 V, bipolar
Pickup threshold	17 or 73 V (selectable)
Functions are freely assignable	
Minimum pickup threshold	
Ranges are settable by means of jumpers for each binary input	17 or 73 V DC, bipolar
Maximum permissible voltage	300 V DC
Current consumption, energized	Approx. 1.8 mA

Output relay

Command / indication relay	
Number	5 (marshallable) 1 alarm contact (not marshallable)
Switching capacity	
Make	1000 W/VA
Break	30 VA
Break (with resistive load)	40 W
Break (with L/R ≤ 50 ms)	25 W
Switching voltage	250 V
Permissible total current	30 A for 0.5 seconds 5 A continuous

1) Ranges are settable by means of jumpers.

LEDs

Number	
RUN (green)	1
ERROR (red)	1
LED (red), function can be assigned	7

Unit design

Housing 7XP20	For dimensions refer to dimension drawings, part 17
Degree of protection acc. to EN 60529	
Surface-mounting housing	IP 51
Flush-mounting housing	
front	IP 51
rear	IP 50
for the terminals	IP 20 with terminal cover put on
Weight	
Flush-mounting housing 1/3 x 19"	4 kg
Surface-mounting housing 1/3 x 19"	6 kg

Serial interfaces

Operating interface 1 for DIGSI 4 or browser *(front of unit)*

Connection	Non-isolated, RS232, front panel, 9-pin subminiature connector (SUB-D)
Baud rate	4800 to 115200 baud, setting as supplied: 38400 baud; parity 8E1

Time synchronization *(rear of unit DCF77/IRIG-B signal format IRIG-B000)*

Connection	9-pin subminiature connector (SUB-D) (terminals with surface-mounting housing)
Voltage levels	5, 12 or 24 V (optional)
Dielectric test	500 V/50 Hz

Service interface (op. interface 2) for DIGSI 4/modem/service/browser *(rear of unit)*

Isolated RS232/RS485	9-pin subminiature connector (SUB-D)
Dielectric test	500 V/50 Hz
Distance for RS232	Max. 15 m
Distance for RS485	Max. 1000 m

System interface *(rear of unit)*

Refer to ordering code	IEC 61850 Ethernet IEC 60870-5-103 PROFIBUS-DP DNP 3.0, MODBUS
Isolated RS232/RS485	9-pin subminiature connector (SUB-D)
Baud rate	4800 to 38400 baud
Dielectric test	500 V/50 Hz
Distance for RS232	Max. 15 m
Distance for RS485	Max. 1000 m
For fiber-optic cable	ST connector
Optical wavelength	λ = 820 nm
Permissible attenuation	Max. 8 dB for 62.5/125 µm fiber
Distance (spanned)	Max. 1.5 km

Technical data

System interface, continued	
PROFIBUS RS485	
Dielectric test	500 V/50 Hz
Baud rate	Max. 12 Mbaud
Distance	1 km at 93.75 kbd; 100 m at 12 Mbd
PROFIBUS fiber-optic[2)]	
Only for flush-mounting housing	ST connector
For surface-mounting housing	Optical interface with OLM[2)]
Baud rate	Max. 1.5 Mbaud
Optical wavelength	λ = 820 nm
Permissible attenuation	Max. 8 dB for 62.5/125 µm fiber
Distance	500 kbit/s 1.6 km; 1500 kbit/s 530 m
Protection data interface (R2R interface)	
FO5[1)], OMA1[2)]: Fiber-optic interface with clock recovery for direct connection up to 1.5 km or for connection to a comm. converter, 820 nm	For multi-mode fiber 62.5/125 µm, ST connectors Permissible fiber attenuation: 8 dB
FO6[1)], OMA2[2)]: Fiber-optic interface for direct connection up to 3.5 km, 820 nm	For multi-mode fiber 62.5/125 µm, ST connectors Permissible fiber attenuation: 16 dB
New fiber-optic interfaces, series FO1	
FO17[1)]: for direct connection up to 24 km[3)], 1300 nm	For mono-mode fiber 9/125 µm, LC-Duplex connector Permissible fiber attenuation: 13 dB
FO18[1)]: for direct connection up to 60 km[3)], 1300 nm	For mono-mode fiber 9/125 µm, LC-Duplex connector Permissible fiber attenuation: 29 dB
FO19[1)]: for direct connection up to 100 km[3)], 1550 nm	For mono-mode fiber 9/125 µm, LC-Duplex connector Permissible fiber attenuation: 29 dB
Relay communication equipment	
External communication converter 7XV5662-0AA00 for communication networks X21/G703-64 kbit/s	
External communication converter to interface between the relays, optical 820 nm interface and the X21/RS422/G703-64 kbit/s interface of a communication device	
X21/G703, RS422 selectable by jumpers. Baud rate selectable by jumpers	
Input: fiber-optic 820 nm with clock recovery	Max. 1.5 km with 62.5/125 µm multi-mode FO cable to device side
Output: X21 (RS422) electrical interface on communication device	64/128/512 kbit (selectable by jumper) max. 800 m, 15-pin connector
G703-64 kbit/s electrical interface on communication device	64 kbit/s, max. 800 m, screw-type terminal
External communication converter 7XV5662-0AD00 for communication networks with G703-E1 or G703-T1	
External communication converter to interface between the relays, optical 820 nm interfac and G703-E1 or G703-T1 interface of a communication network	
Inputs: 2 fiber-optic inputs 820 nm, 1 RS232 input	Max. 1.5 km with 62.5/125µm multi-mode 1 FO cable to device side
Output: G703.5 G703.6	 E1: 2,048 kbit/s T1: 1,554 kbit/s
Electrical interface on communication network	max. 800 m, screw-type terminal

External communication converter 7XV5662-0AC00 for pilot wires	
External communication converter to interface between relays, optical 820 nm interface and a pilot wire or twisted telephone pair.	
Typical distance	15 km
Fiber-optic 820 nm with clock recovery	Max. 1.5 km with 62.5/125 µm multi-mode FO cable
Pilot wire	Screw-type terminal 5 kV isolated
Permissible time delay (duration of data transmission)	
Delay of telegrams due to transmission for one unit to the other. Delay is constantly measured and adjusted	Max. 30 ms per transmission path Permissible max. value can be selected
Electrical tests	
Specification	
Standards	IEC 60255 (product standards) ANSI/IEEE C37.90.0/.1/.2 UL 508 For further standards see "Individual functions"
Insulation tests	
Standards	IEC 60255-5
Voltage test (100 % test)	
All circuits except for auxiliary supply, binary inputs and communication interfaces	2.5 kV (r.m.s.), 50 / 60 Hz
Auxiliary voltage and binary inputs (100 % test)	3.5 kV DC
RS485/RS232 rear side communication interfaces and time synchronization interface (100 % test)	500 V (r.m.s.), 50 / 60 Hz
Impulse voltage test (type test)	
All circuits except for communication interfaces and time synchronization interface, class III	5 kV (peak); 1.2/50 µs; 0.5 J 3 positive and 3 negative impulses at intervals of 5 s
EMC tests for noise immunity; *type tests*	
Standards	IEC 60255-6, IEC 60255-22 (product standards) (type tests) EN 50082-2 (generic standard) DIN 57435 part 303
High frequency test IEC 60255-22-1, class III and VDE 0435 part 303, class III	2.5 kV (peak); 1 MHz; τ = 15 ms; 400 surges per s; test duration 2 s
Electrostatic discharge 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
Irradiation with RF field, non-modulated IEC 60255-22-3 (report), class III	10 V/m; 27 to 500 MHz
Irradiation with RF field, amplitude-modulated IEC 61000-4-3, class III	10 V/m; 80 to 1000 MHz; 80 % AM; 1 kHz

1) For flush-mounting housing.
2) For surface mounting housing.
3) For surface mounting housing the internal FO module OMA1 will be delivered together with an external repeater.

7

Technical data

Irradiation with 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 transients, bursts 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 installation, class III	Impulse: 1.2/50 µs
Auxiliary supply	Common (longitudinal) mode: 2 kV; 12 Ω; 9 µF Differential (transversal) mode: 1 kV; 2 Ω; 18 µF
Measurement inputs, binary inputs, binary output relays	Common (longitudinal) mode: 2 kV; 42 Ω; 0.5 µF Differential (transversal) mode: 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; 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 oscillation 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 50081-1 (generic standard)
Conducted interference voltage on lines, only auxiliary voltage IEC-CISPR 22	150 kHz to 30 MHz Limit class B
Radio interference field strength IEC-CISPR 22	30 to 1000 MHz Limit 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 on each of the 3 axes in both directions
Seismic vibration IEC 60255-21-2, 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 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 on each of the 3 axes in both directions
Continuous shock IEC 60255-21-2, class 1 IEC 60068-2-29	Half-sinusoidal Acceleration 10 *g*, duration 16 ms, 1000 shocks on each of the 3 axes in both directions

Climatic stress test	
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 °C)	–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 stress; 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 in the year up to 93 % relative humidity; moisture condensation during operation is not permitted

Technical data

Functions

Differential protection (ANSI 87L, 87T)

Sensitive differential current trip stage $I_{Diff}>$

Setting range		
$I_{Diff}> I_N$	secondary 1 A	0.1 to 20 A (steps 0.01 A)
	secondary 5 A	0.5 to 100 A
Tripping time		Typical 35 ms with FO cable
$I_{Diff}> 2 \times I_{Diff} >$ (setting value)		

High current differential trip stage $I_{Diff}>>$

Setting range		
$I_{Diff}>>$	secondary 1 A	0.8 to 100 A (steps 0.01 A)
	secondary 5 A	4.0 to 50 A
Tripping time		Typical 16 ms with FO cable
$I_{Diff}> 2 \times I_{Diff} >>$ (setting value)		

Vector group adaption with transformers in the differential zone

Adaption of connection sympol	0 to 11 (x 30°)(step 1)
Neutral point connection	Grounded (earthed) or not grounded (earthed)(for each winding)

Inrush restaint

Restraint ratio 2nd harmonic I_{2fn}/I_{fN}	10 % to 45 % (step 1 %)
Max. current for restraint	1.1 A to 25 A[1)] (step 0.1 A)
Crossblock function	Can be switched on and off
Max. operative time for crossblock $T_{oper\ crossblk}$	0 to 60 s (step 0.01 s) or deactivated (operating up to release)

Backup / emergency overcurrent protection (ANSI 50N, 51N, 67, 67N)

Operating modes	Backup (always active) or emergency (e.g. loss of data connection)
Characteristic	2 definite-time stages / 1 inverse-time stage

Definite-time stage (ANSI 50, 50N)

Phase current pickup $I_{ph}>>$	0.1 to 25 A (1A) / 0.5 to 125 A (5A) (step 0.01 A) or deactivated
Earth current pickup $3I_0>>$	0.05 to 25 A (1A) / 0.25 to 125 A (5A) (step 0.01 A) or deactivated
Phase current pickup $I_{ph}>$	0.1 to 25 A (1A) / 0.5 to 125 A (5A) (step 0.01 A)
Earth current pickup $3I_0>$	0.05 to 25 A (1A) / 0.25 to 125 A (5A) (step 0.01 A)
Phase current pickup $I_{ph} >$ with directional element	0.1 to 25 A(1 A) / 0.5 to 125 A(5 A)
Earth current pickup $3I_0 >$ with directional element	0.05 to 25 A(1 A) / 0.25 to 125 A(5 A) (step 0.01 A)
Time delay	0 to 30 s (step 0.01 s) or deactivated
Tolerances	
Current pickup	≤ 3 % setting value or 1 % of I_N
Delay times	± 1 % setting value or 10 ms
Operating time	Approx. 25 ms

Inverse-time stage (ANSI 51, 51N)

Phase current pickup I_p	0.1 to 4 A (1A) / 0.5 to 20 A (5A) (step 0.01 A)
Earth current pickup $3I_{0P}$	0.05 to 4 A (1A) / 0.25 to 20 A (5A) (step 0.01 A)
Phase current pickup $I_p >$ with directional element	0.1 to 4 A(1 A) / 0.5 to 20 A(5 A) (step 0.01 A)
Earth current pickup $3I_{0P} >$ with directional element	0.05 to 25(1 A) / 0.25 to 20 A(5 A) (step 0.01 A)
Tripping characteristics	
Tripping time characteristics acc. to IEC 60255-3	Normal inverse; very inverse; extremely inverse; long time inverse
Tripping time characteristics acc. to ANSI/IEEE (not for DE region, see selection and ordering data 10th position)	Inverse; short inverse; long inverse; moderately inverse; very inverse; extremely inverse; definite inverse
Time multiplier for IEC characteristics T	T_p = 0.05 to 3 s (step 0.01 s) or deactivated
Time multiplier for ANSI characteristics D	D_{IP} = 0.5 to 15 (step 0.01) or deactivated
Pickup threshold	Approx. 1.1 I/I_p (ANSI: I/I_p = M)
Reset threshold	Approx. 1.05 x I/I_p (ANSI: I/I_p = M)
Tolerances Operating time for 2 ≤ I/I_p ≤ 20	≤ 5 % of setpoint ± 15 ms

Instantaneous high-speed switch-onto-fault overcurrent protection (ANSI 50HS)

Operating mode	Active only with connected auxiliary contacts
Characteristic	2 independent stages
Pickup current $I>>>$	0.1 to 15 A (1A) / 0.5 to 75 A (5A) (step 0.01 A) or deactivated
Pickup current $I>>>>$	1 to 25 A (1A) / 5 to 125 A (5A) (step 0.01 A) or deactivated
Reset ratio	Approx. 0.95
Tolerances Current starting	≤ 3 % of setting value or 1 % I_N

Auto-reclosure (ANSI 79)

Number of auto-reclosures	Up to 8
Operating modes with line voltage check	Only 1-pole; only 3-pole, 1 or 3-pole, adaptive AR Discrimination between successful and non-successful reclose attempts
Dead times $T_{1\text{-}ph}$, $T_{3\text{-}ph}$, T_{Seq}	0.01 to 1800 s (step 0.01 s) or deactivated
Action times	0.01 to 300 s (step 0.01 s) or deactivated
Reclaim times	0.5 to 300 s (step 0.01 s)
CLOSE command duration	0.01 to 30 s (steps 0.01 s)
Tolerances Time stages Voltage limit values	1 % of setting value or 10 ms ≤ 3 % of setting value or 0.5 V

Technical data

Breaker failure protection *(ANSI 50BF)*	
Number of stages	2
Pickup of current element	0.05 to 20 A (1A) / 0.25 to 100 A (5A) (step 0.01 A)
Time delays $T1_{1phase}$, $T1_{3phase}$, $T2$	0 to 30 s (steps 0.01 s) or deactivated
Additional functions	CB synchronism monitoring
Reset time	10 ms, typical
Tolerances	
Current limit value	≤ 3 % of setting value or 1 % I_N
Time stages	1 % of setting value or 10 ms
Voltage protection *(ANSI 59, 27)*	
Operating modes	Local tripping or only indication
Overvoltage protection	
Pickup values V_{PH-Gnd}>>, V_{PH-Gnd}> (phase-ground (earth) overvoltage)	1 to 170 V (step 0.1 V) or deactivated
Pickup values V_{PH-PH}>>, V_{PH-PH}> (phase-phase overvoltage)	2 to 220 V (step 0.1 V) or deactivated
Pickup values $3V_0$>>, $3V_0$> ($3V_0$ can be measured via V4 transformers or calculated by the relay) (zero-sequence overvoltage)	1 to 220 V (step 0.1 V) or deactivated
Pickup values V_1>>, V_1> (positive-sequence overvoltage)	2 to 220 V (step 0.1 V) or deactivated
Measured voltage	Local positive-sequence voltage or calculated remote positive-sequence voltage (compounding)
Pickup values V_2>>, V_2> (negative-sequence overvoltage)	2 to 220 V (step 0.1 V) or deactivated
Reset ratio (settable)	0.5 to 0.98 (step 0.01)
Undervoltage protection	
Pickup values V_{PH-Gnd}<<, V_{PH-Gnd}< (phase-ground (earth) undervoltage)	1 to 100 V (step 0.1 V) or deactivated
Pickup values V_{PH-PH}<<, V_{PH-PH}< (phase-phase undervoltage)	1 to 175 V (step 0.1 V) or deactivated
Pickup values V_1<<, V_1< (positive-sequence undervoltage)	1 to 100 V (step 0.1 V) or deactivated
Blocking of undervoltage protection stages	Minimum current; binary input
Reset ratio	1.05
Time delays	
Time delay for all over- and undervoltage stages	0 to 100 s (steps 0.01 s) or deactivated
Command / pickup time	Approx. 40 ms
Tolerances	
Voltage limit values	≤ 3 % of setting value or 0.5 V
Time stages	1 % of setting value or 10 ms
Frequency protection *(ANSI 81)*	
Number of frequency elements	4
Setting range	45.5 to 54.5 Hz (in steps of 0.01) at f_{nom} = 50 Hz 55.5 to 64.5 Hz (in steps of 0.01) at f_{nom} = 60 Hz
Delay times	0 to 600 s or ∞ (in steps of 0.01 s)
Operating voltage range	6 to 230 V (phase-to-ground (earth))
Pickup times	Approx. 85 ms
Dropout times	Approx. 30 ms
Hysteresis	Approx. 20 mHz
Dropout condition	Voltage = 0 V and current = 0 A
Tolerances	
Frequency	12 m Hz for V = 29 to 230 V
Delay times	1 % of the setting value or 10 ms
Restricted earth-fault protection *(ANSI 87N)*	
Multiple availability	2 times (option)
Settings	
Differential current I_{REF}>/I_{Nobj}	0.05 to 2.00 (steps 0.01)
Limit angle φ_{REF}	110 ° (fixed)
Time delay T_{REF}	0.00 to 60.00 s (steps 0.01 s) or deactivated (no trip)
The set times are pure delay times	
Operating times	

Pickup time (in ms) at frequency	50 Hz	60 Hz
At 1.5 · setting value I_{REF}>, approx.	35	30
At 2.5 · setting value I_{REF}>, approx.	33	29
Dropout time (in ms), approx.	26	23

Dropout ratio, approx.	0.7
Overcurrent-time protection for phase and residual currents	
Multiple availability	3 times (option)
Characteristics	
Definite-time stages (DT)	I_{Ph} >>, $3I_0$ >>, I_{Ph} >, $3I_0$ >
Inverse-time stages (IT)	I_P, $3I_{0P}$
Acc. to IEC	Inverse, very inverse, extremely inverse, long-time inverse
Acc. to ANSI	Inverse, moderately inverse, very inverse, extremely inverse, definite inverse, short inverse, long inverse
	Alternatively, user-specified trip and reset characteristics
Reset characteristics (IT)	Acc. to ANSI with disk emulation
Current stages	
High-current stages I_{Ph} >>	0.10 to 35.00 A [1] (steps 0.01 A) or deactivated (stage ineffective)
T_{IPh} >>	0.00 to 60.00 s (steps 0.01 s) or deactivated (no trip)
$3I_0$ >>	0.05 to 35.00 A [1] (steps 0.01 A) or deactivated (stage ineffective)
T_{3I0} >>	0.00 to 60.00 s (steps 0.01 s) or deactivated (no trip)
Definite-time stages I_{Ph} >	0.10 to 35.00 A [1] (steps 0.01 A) or deactivated (stage ineffective)
T_{IPh}	0.00 to 60.00 s (steps 0.01 s) or deactivated (no trip)
$3I_0$ >	0.05 to 35.00 A [1] (steps 0.01 A) or deactivated (stage ineffective)
T_{3I0} >	0.00 to 60.00 s (steps 0.01 s) or deactivated (no trip)

Technical data

Inverse-time stages	I_P	0.10 to 4.00 A [1] (steps 0.01 A)
Acc. to IEC	T_{IP}	0.05 to 3.20 s (steps 0.01 s) or deactivated (no trip)
	$3I_{0P}$	0.05 to 4.00 A [1] (steps 0.01 A)
	T_{3I0P}	0.05 to 3.20 s (steps 0.01 s) or deactivated (no trip)
Inverse-time stages	I_P	0.10 to 4.00 A [1] (steps 0.01 A)
Acc. to ANSI	D_{IP}	0.50 to 15.00 s (steps 0.01 s) or deactivated (no trip)
	$3I_{0P}$	0.05 to 4.00 A [1] (steps 0.01 A)
	D_{3I0P}	0.50 to 15.00 s (steps 0.01 s) or deactivated (no trip)

Thermal overload protection (ANSI 49)

Setting range	
Factor k to IEC 60255.8	0.1 to 4 (steps 0.01)
Time constant τ	1 to 999.9 min (steps 0.1 min)
Thermal alarm stage $\Theta_{Alarm}/\Theta_{Trip}$	50 to 100 % referred to tripping temperature (steps 1 %)
Current-based alarm stage I_{alarm}	0.1 to 4 $A_{(1A)}$ / 0.5 to 5 $A_{(5A)}$ (steps 0.01 A)
Calculating mode for overtemperature	Θ_{max}, Θ_{mean}, Θ with I_{max}
Pickup time characteristic	$t = \tau \ln \frac{I^2 - I_{pre}^2}{I^2 - (k\, I_N)^2}$
Reset ratio	
Θ/Θ_{Alarm}	Approx. 0.99
Θ/Θ_{Trip}	Approx. 0.99
I / I_{Alarm}	Approx. 0.99
Tolerances	Class 10 % acc. to IEC 60255-8

Additional functions

Operational measured values

Representation	Primary, secondary and percentage referred to rated value
Currents	3 x I_{Phase} ; $3I_0$; I_E; I_1; I_2
Tolerances	
10 to 50 % I_N	Typical ≤ 1 % of 50 % I_N
50 to 200 % I_N	Typical ≤ 1 % of measured value
Voltages	3 x $V_{Phase-Earth}$; 3 x $V_{Phase-Phase}$; $3V_0$, V_1, V_2, V_{en}
Tolerances	
10 to 50 % V_N	Typical ≤ 1 % of 50 % V_N
50 to 200 % V_N	Typical ≤ 1 % of measured value
Power with direction indication	P, Q, S
Tolerances	
P: for $\lvert\cos\varphi\rvert$ = 0.7 to 1 and V/V_N, I/I_N = 50 to 120 %	Typical ≤ 3 %
Q: for $\lvert\sin\varphi\rvert$ = 0.7 to 1 and V/V_N, I/I_N = 50 to 120 %	Typical ≤ 3 %
S: for V/V_N , I/I_N = 50 to 120 %	Typical ≤ 2 %
Frequency	f
Tolerance	≤ 20 mHz
Power factor	p.f. ($\cos\varphi$)
Tolerance for $\lvert\cos\varphi\rvert$ = 0.7 to 1	Typical ≤ 3 %
Remote measurements	3 x $I_{Phase-Earth}$; 3 I_0, 3 x $V_{Phase-Earth}$; $3V_0$
Overload measured values	Θ/Θ_{Trip} L1; Θ/Θ_{Trip} L2; Θ/Θ_{Trip} L3; Θ/Θ_{Trip}

Fault record storage

Measured analog channels	3 x I_{Phase}, $3I_0$, $3I_{Diff}$ 3 x V_{Phase}, $3V_0$, $3I_{Restraint}$
Max. number of available recordings	8, backed up by battery if auxiliary voltage supply fails
Sampling intervals	20 samplings per cycle
Total storage time	Approx. 10 s
Binary channels	Pickup and trip information; number and contents can be freely configured by the user

Further additional functions

Measured value supervision	Current sum Current symmetry Voltage sum Voltage symmetry Voltage phase sequence Fuse failure monitor
Indications	
Operational indications	Buffer size 200
System disturbance indication	Storage of signals of the last 8 faults, buffer size 600
Switching statistics	Number of breaking operations per CB pole Sum of breaking current per phase Breaking current of last trip operations Max. breaking current per phase
Circuit-breaker test	TRIP/CLOSE cycle, 3 phases TRIP/CLOSE cycle per phase
Dead time for CB TRIP / CLOSE cycle	0 to 30 s (steps 0.01 s)
Commissioning support	Operational measured values, CB test, status display of binary indication inputs, setting of output relays, generation of indications for testing serial interfaces, commissioning support via Web-browser, test mode, commissioning mode

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 89/336/EEC) and electrical equipment designed for use within certain voltage limits (Council Directive 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 has been developed and manufactured for application in an industrial environment according to the EMC standards.

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".

Selection and ordering data

Description	Order No.	Order code
7SD61 differential protection relay for two line ends with 4-line display, housing width 1/3", 7 LEDs	7SD610□-□□□□□-□□□□	□□□
Measurement input		
I_{phase} = 1 A[1], I_E = 1 A (min. = 0.05 A)	1	
I_{phase} = 5 A[1], I_E = 5 A (min. = 0.25 A)	5	
Rated auxiliary voltage (converters, binary inputs)		
24, 48 V DC, binary input threshold 17 V[3]	2	
60, 125 V DC[2], binary input threshold 17 V[3]	4	
110, 250 V DC[2], 115/230 V AC, binary input threshold 73 V[3]	5	
Unit design/number of binary inputs and outputs		
For panel flush mounting, screw-type terminals 1/3 x 19"/7 BI, 6 BO	B	
For panel surface mounting, 2-tier terminals, 1/3 x 19"/7 BI, 6 BO	F	
For panel flush mounting, plug-in terminals, 1/3 x 19"/7 BI, 6 BO	K	
Region-specific default settings / language settings		
Region DE, language: German (selectable)	A	
Region World, language: English (GB) (selectable)	B	
Region US, language: English (USA) (selectable)	C	
Region FR, language: French (selectable)	D	
Region World, language: Spanish (selectable)	E	
System interfaces; functions and hardware		
No system interface	0	
IEC 60870-5-103 protocol, electrical RS232	1	
IEC 60870-5-103 protocol, electrical RS485	2	
IEC 60870-5-103 protocol, optical 820 nm, ST connector	3	
PROFIBUS-DP Slave, electrical RS485	9	L 0 A
PROFIBUS-DP Slave, 820 nm optical, double ring, ST connector[4]	9	L 0 B
MODBUS, electrical RS485	9	L 0 D
MODBUS, optical 820 nm, ST connector[4]	9	L 0 E
DNP 3.0, electrical RS485	9	L 0 G
DNP 3.0, 820 nm optical, ST connector[4]	9	L 0 H
IEC 61850, 100 Mbit Ethernet, electrical, double, RJ45 connector (EN 100)	9	L 0 R
IEC 61850, 100 Mbit Ethernet, optical, double, ST connector (EN 100)[5]	9	L 0 S
DIGSI/modem interface rear of unit and protection data interface	9	M □ □
DIGSI / modem interface (rear side of unit)		
DIGSI 4, electrical RS232		1
DIGSI 4, electrical RS485		2
Protection data interface (R2R interface)		
FO5: Optical 820 nm, 2 ST connectors, FO length up to 1.5 km for direct connection or via communication networks		A
FO6: Optical 820 nm, 2 ST connectors, FO length up to 3.5 km for direct connection via multi-mode fiber		B
FO17: Optical 1300 nm, LC-Duplex connector, FO cable length up to 24 km for direct connection via mono-mode FO cable		G
FO18: Optical 1300 nm, LC-Duplex connector, FO cable length up to 60 km for direct connection via mono-mode FO cable[6]		H
FO19: Optical 1550 nm, LC-Duplex connector, FO cable length up to 100 km for direct connection via mono-mode FO cable[7]		J

see next page

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 in three stages by means of jumpers.

4) For surface-mounting housing applications, please select option A (820 nm, 1.5 km) together with an external repeater (see "Accessories" for Order No.).

5) Not possible for surface-mounting housing (position 9 = F).

6) For distances less than 25 km, two optical attenuators 7XV5107-0AA00 are required to avoid optical saturation of the receiver element.

7) For distances less than 50 km, two optical attenuators 7XV5107-0AA00 are required to avoid optical saturation of the receiver element.

Selection and ordering data

Description	Order No.
7SD61 differential protection relay for two line ends with 4-line display, housing width 1/3", 7 LEDs	*7SD610□-□□□□□□-□□□□*

Functions 1

Tripping only 3-pole, without auto-reclosure	*0*
Tripping only 3-pole, with auto-reclosure	*1*
Tripping 1 and 3-pole, without auto-reclosure	*2*
Tripping 1 and 3-pole, with auto-reclosure	*3*

Backup protection function

With emergency/backup overcurrent-time protection	*B*
With emergency/backup overcurrent-time protection, with breaker failure protection	*C*
With directional emergency/backup overcurrent-time protection	*R*
With directional emergency/backup overcurrent-time protection, with breaker failure protection	*S*

Additional functions 1

4 remote commands	Transformer extension with vector group adaption (ANSI 87T)	Over/undervoltage protection V>, V< (ANSI 27, 59) Over/underfrequency protection (ANSI 81)	Restricted earth-fault protection (ANSI 87N)	
				A
		■		*B*
	■			*E*
	■	■		*F*
■				*J*
■		■		*K*
■	■			*N*
■	■	■		*P*
■	■		■	*S*
■	■	■	■	*T*

Additional functions 2

Without additional functions	*0*
With external GPS synchronization of the differential protection	*1*

Accessories

Description	Order No.
Opto-electric communication converter CC-XG (connection to communication network)	
Converter to interface to X21 or RS422 or G703-64 kbit/s synchronous communication interfaces Connection via FO cable for 62.5 / 125 µm or 50 / 120 µm and 820 nm wavelength (multi-mode FO cable) with ST connector, max. distance 1.5 km Electrical connection via X21/RS422 or G703-64 kbit/s interface	*7XV5662-0AA00*
Opto-electric communication converter CC-2M to G703-E1/-T1 communication networks with 2,048 / 1,554 kbit/s	
Converter to interface between optical 820 nm interface and G703-E1/-T1 interface of a communication network Connection via FO cable for 62.5/125 µm or 50/120 µm and 820 nm wavelength (multi-mode FO cable) with ST connector, max. distance 1.5 km Electrical connection via G703-E1/-T1 interface	*7XV5662-0AD00*
Opto-electric communication converter (connection to pilot wire)	
Converter to interface to a pilot wire or twisted telephone pair (typical 15 km length) Connection via FO cable for 62.5/125 µm or 50/120 µm and 820 nm wavelength (multi-mode FO cable) with ST connector; max. distance 1.5 km, screw-type terminals to pilot wire	*7XV5662-0AC00*
Additional interface modules	
Protection data interface mod. opt. 820 nm, multi-mode FO cable, ST connector, 1.5 km	*C53207-A351-D651-1*
Protection data interface mod. opt. 820 nm, multi-mode FO cable, ST connector, 3.5 km	*C53207-A351-D652-1*
Further modules	
Protection data interface mod. opt. 1300 nm, mono-mode FO cable, LC-Duplex connector, 24 km	*C53207-A351-D655-1*
Protection data interface mod. opt. 1300 nm, mono-mode FO cable, LC-Duplex connector, 60 km	*C53207-A351-D656-1*
Protection data interface mod. opt. 1550 nm, mono-mode FO cable, LC-Duplex connector, 100 km	*C53207-A351-D657-1*
Optical repeaters	
Serial repeater (2-channel), opt. 1300 nm, mono-mode FO cable, LC-Duplex connector, 24 km	*7XV5461-0BG00*
Serial repeater (2-channel), opt. 1300 nm, mono-mode FO cable, LC-Duplex connector, 60 km	*7XV5461-0BH00*
Serial repeater (2-channel), opt. 1550 nm, mono-mode FO cable, LC-Duplex connector, 100 km	*7XV5461-0BJ00*
Time synchronizing unit with GPS output	
GPS 1 sec pulse and time telegram IRIG B/DCF 77	*7XV5664-0AA00*
Isolation transformer (20 kV) for pilot wire communication	*7XR9516*
Voltage transformer miniature circuit-breaker	
Rated current 1.6 A; thermal overload release 1.6 A; overcurrent trip 6 A	*3RV1611-1AG14*

Accessories

Description	Order No.
DIGSI 4	
Software for configuration and operation of Siemens protection units running under MS Windows (Windows 2000/XP Professional) device templates, Comtrade Viewer, electronic manual included as well as "Getting started" manual on paper, connecting cables (copper)	
Basis Full version with license for 10 computers, on CD-ROM (authorization by serial number)	*7XS5400-0AA00*
Professional Complete version: 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*
SIGRA 4	
(generally contained in DIGSI Professional, but can be ordered additionally) 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 (Windows 2000/XP Professional). Incl. templates, electronic manual with license for 10 PCs. Authorization by serial number. On CD-ROM.	*7XS5410-0AA00*
Connecting cable	
Cable between PC/notebook (9-pin connector) and protection unit (9-pin connector) (contained in DIGSI 4, but can be ordered additionally)	*7XV5100-4*
Manual for 7SD61 V4.6	
English	*C53000-G1176-C145-4*

Fig. 7/34 Mounting rail for 19" rack

Fig. 7/35
2-pin connector

Fig. 7/36
3-pin connector

Fig. 7/37
Short-circuit link for current terminals

Fig. 7/38
Short-circuit link for voltage terminals/ indications terminals

Description		Order No.	Size of package	Supplier	Fig.
Connector	2-pin	*C73334-A1-C35-1*	1	Siemens	7/35
	3-pin	*C73334-A1-C36-1*	1	Siemens	7/36
Crimp connector	CI2 0.5 to 1 mm^2	*0-827039-1*	4000	AMP [1]	
		0-827396-1	1	AMP [1]	
	CI2 1 to 2.5 mm^2	*0-827040-1*	4000	AMP [1]	
		0-827397-1	1	AMP [1]	
	Type III+ 0.75 to 1.5 mm^2	*0-163083-7*	4000	AMP [1]	
		0-163084-2	1	AMP [1]	
Crimping tool	For Type III+	*0-539635-1*	1	AMP [1]	
	and matching female	*0-539668-2*		AMP [1]	
	For CI2	*0-734372-1*	1	AMP [1]	
	and matching female	*1-734387-1*		AMP [1]	
19" mounting rail		*C73165-A63-D200-1*	1	Siemens	7/34
Short-circuit links	For current terminals	*C73334-A1-C33-1*	1	Siemens	7/37
	For other terminals	*C73334-A1-C34-1*	1	Siemens	7/38
Safety cover for terminals	Large	*C73334-A1-C31-1*	1	Siemens	
	Small	*C73334-A1-C32-1*	1	Siemens	

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

Connection diagram

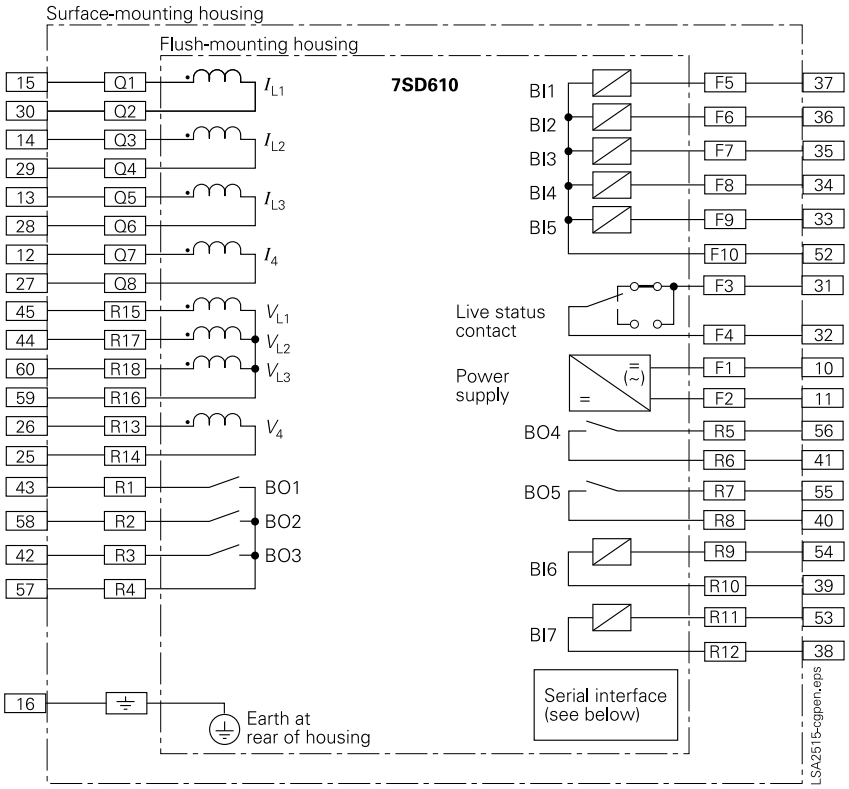


Fig. 7/39
Connection diagram

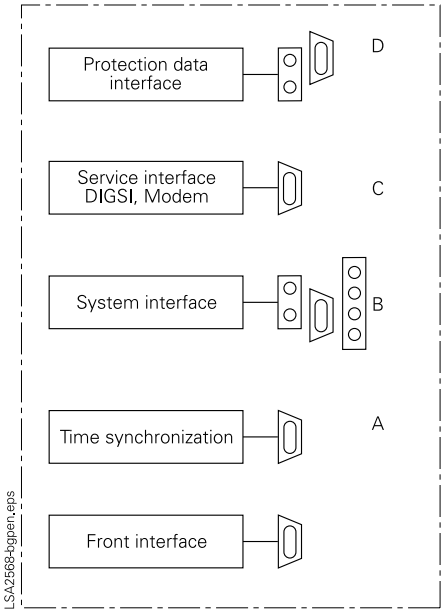
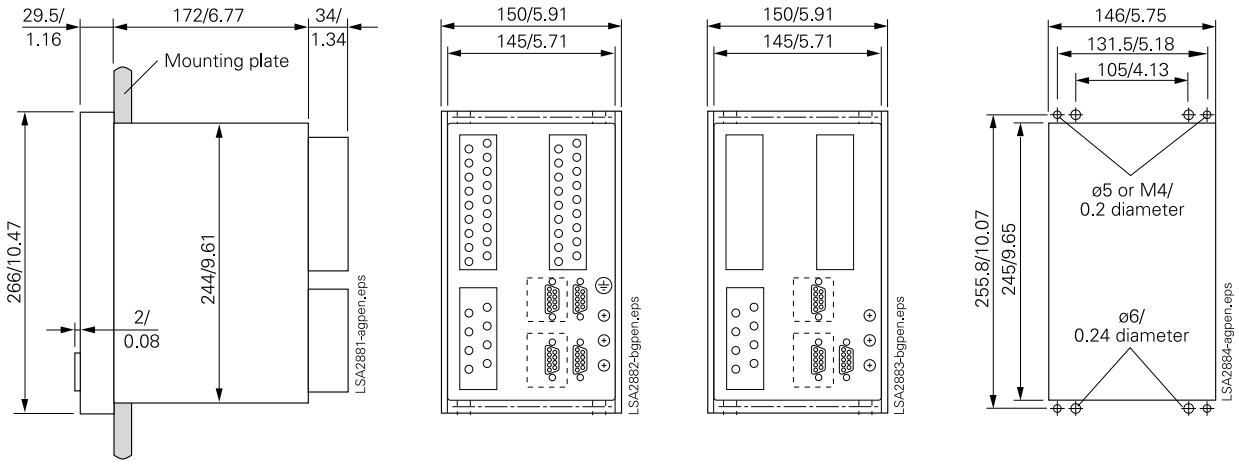


Fig. 7/40
Serial interfaces

Dimension drawings in mm / inch

Dimension drawings for SIPROTEC 4
1/3 x 19" housing (7XP20)



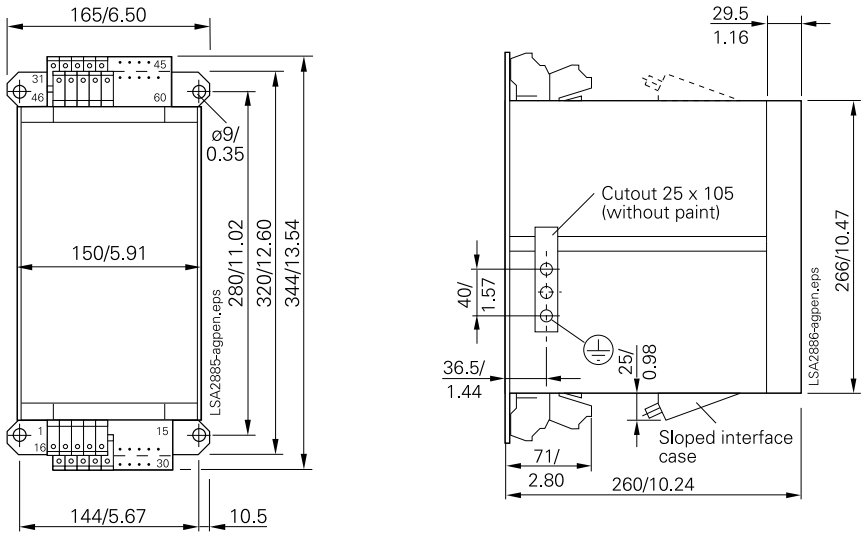
Side view

Rear view
7SA610, 7SD61, 7SJ64

Rear view
7SJ61, 7SJ62, 7UT612, 7UM611

Panel cutout

Fig. 17/24
Housing for panel flush mounting/ cubicle mounting (1/3 x 19")



Front view

Side view

Fig. 17/25
1/3 x 19" surface-mounting housing, terminals at top and bottom