SIPROTEC 4 7VK61 breaker management relay

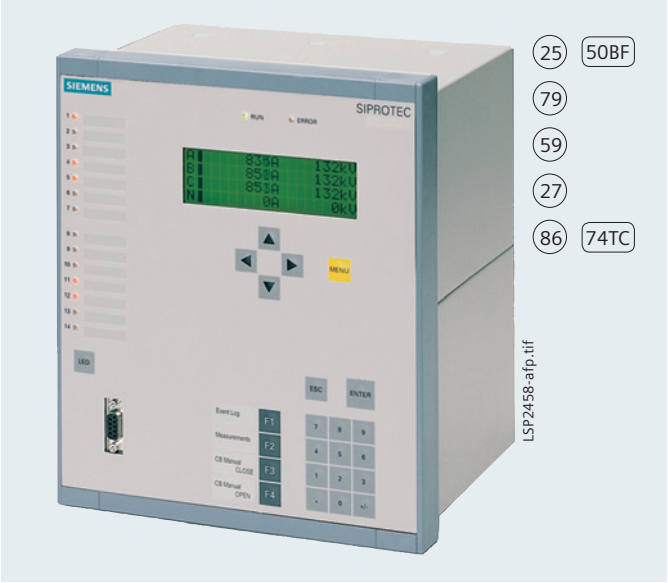

Fig. 10/1 SIPROTEC 4 7VK61 breaker management relay

Description

The SIPROTEC 4 breaker management relay 7VK61 is a highly flexible auto-reclosure, synchro-check and circuit-breaker failure protection unit.

This unit is used for the single and three-pole auto-reclosure of a circuit-breaker, after this circuit-breaker has tripped due to a fault. The synchro-check function ensures that the two circuits being reconnected by closing the circuit-breaker are within a defined safe operating state before the CLOSE command is issued.

The 7VK61 is also applicable as circuit-breaker failure protection. A breaker failure occurs when the circuit-breaker fails to correctly open and clear the fault after single or three-pole trip commands have been issued by the protection. It is then necessary to trip the relevant busbar zone (section) to ensure fault clearance. Together with the above-mentioned protection functions, the following additional functions of the 7VK61 can be applied: end-fault protection, pole-discrepancy protection, overvoltage protection and undervoltage protection. As a member of the numerical SIPROTEC 4 relay family, it also provides control and monitoring functions and therefore supports the user with regard to a cost-effective power system management.

Function overview

Protection functions

- Single and/or three-pole auto-reclosure
- Synchro-check with live/dead line/bus measurement
- Closing under asynchronous conditions (consideration of CB operating time)
- Circuit-breaker failure protection with two stages (single and three-pole with/without current)
- End-fault protection
- Pole-discrepancy protection
- Overvoltage/undervoltage protection

Control function

- Commands for control of CB and isolators

Monitoring functions

- Operational measured values
- Self-supervision of the relay
- Event buffer and fault protocols
- Oscillographic fault recording
- Monitoring of CB auxiliary contacts
- Switching statistics

Features

- All functions can be used separately
- Initiation/start by phase-segregated or 3-pole trip commands
- Auto-reclosure for max. 8 reclose cycles
- Evolving/sequential trip recognition
- Auto-reclosure with ADT, DLC, RDT
- Synchro-check with ΔV, $\Delta\varphi$, Δf measurement
- Breaker failure protection with highly secure 2-out-of-4 current check detectors
- Breaker failure protection with short reset time and negligible overshoot time

Communication interfaces

- Front interface for connecting a PC
- System interface for connecting to a control system via various protocols
  – IEC 61850 Ethernet
  – IEC 60870-5-103 protocol
  – PROFIBUS-FMS/-DP
  – DNP 3.0
- Rear-side service/modem interface
- Time synchronization via
  – IRIG-B or DCF77 or system interface

Application

Application

The 7VK61 provides highly flexible breaker management. It applies to single-breaker, ring-bus, and 1½ breaker installations. The auto-reclosure, synchronism-check, breaker failure protection and voltage protection functions can be used separately or combined. Therefore the current and voltage transformer connection can be selected according to the required application.

The auto-reclosure function closes the circuit-breaker after this circuit-breaker has tripped due to a fault. The check-synchronism function ensures that the two circuits being reconnected by closing the circuit-breaker are within a defined safe operating state before the CLOSE command is issued.

The numerical 7VK61 relay provides rapid backup fault clearance in case the circuit-breaker nearest to the fault fails to respond to a TRIP command. It is suitable for power systems of all voltage levels with single and/or three-pole circuit-breaker operation. The initiation signal can be issued from any protection or supervision equipment. Information from the circuit-breaker auxiliary contact is only required for the breaker failure protection during faults which produce little or no fault current flow, for instance due to a trip from the power transformer Buchholz protection.

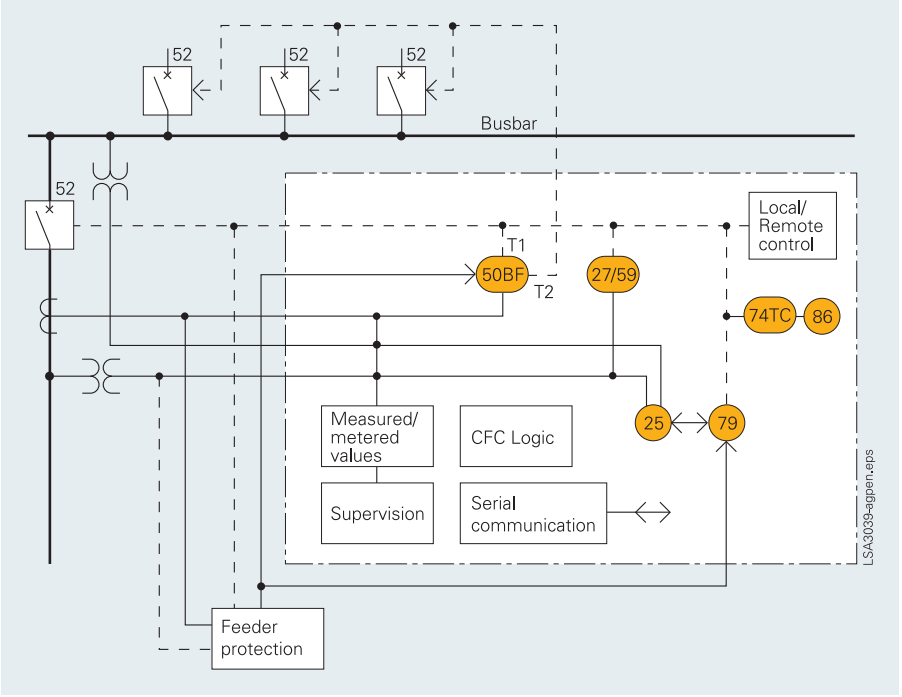

Fig. 10/2 Application and function diagram

Cost-effective power system management

The SIPROTEC 4 units are numerical relays which also provide control and monitoring functions and therefore support the user with regard to a cost-effective power system management. The security and reliability of the power supply is increased as a result of minimizing the use of hardware.

The local operation has been designed according to ergonomic criteria. Large, easy-to-read backlit displays are provided.

The SIPROTEC 4 units have a uniform design and a degree of functionality which represents a benchmark-level of performance in protection and control.

If the requirements for protection, control and interlocking change, it is possible in the majority of cases to implement such changes by means of parameterization using DIGSI 4 without having to change the hardware.
The use of powerful microcontrollers and the application of digital measured-value conditioning and processing largely suppresses the influence of higher-frequency transients, harmonics and DC components.

ANSI	Protection functions
50BF	Breaker-failure protection
59/27	Overvoltage/undervoltage protection
25	Synchro-check
79	Auto-reclosure
74TC	Trip circuit supervision
86	Lockout (CLOSE command interlocking)

10

Construction

Connection technique and housing with many advantages

⅓ and ½-rack sizes are available as housing widths of the SIPROTEC 4 7VK61 relays, referred to a 19" modular frame system. This means that previous models can always be replaced. The height is a uniform 255 mm for flush-mounting housings and 266 mm for surface-mounting housings for all housing widths. 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 the housing in the form of screw-type terminals. The communication interfaces are located in a sloped case at the top and bottom of the housing.

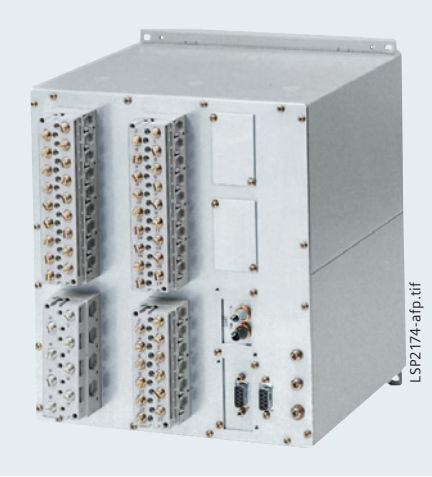

Fig. 10/3 Flush-mounting housing with screw-type terminals

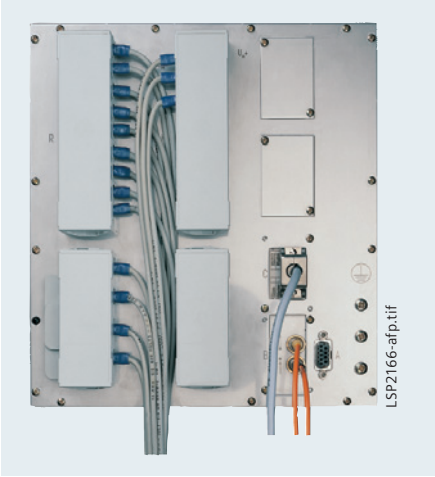

Fig. 10/4 Rear view of flush-mounting housing with covered connection terminals andwirings

Fig. 10/5 Surface-mounting housing with screw-type terminals, example 7SA63

Fig. 10/6 Communication interfaces in a sloped case in a surface-mounting housing

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Protection functions

Auto-reclosure (ANSI 79)

The 7VK61 relay is equipped with an auto-reclose function (AR). Usually the auto-reclosure interacts with the feeder protection via binary inputs and outputs.

The function includes several operating modes:

- 3-pole auto-reclosure for all types of faults; different dead times are available depending on 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 and 3-pole auto-reclosing for multi-phase faults
- Multiple-shot auto-reclosure
- Interaction with the internal or an external synchro-check
- Monitoring of the circuit-breaker auxiliary contacts.

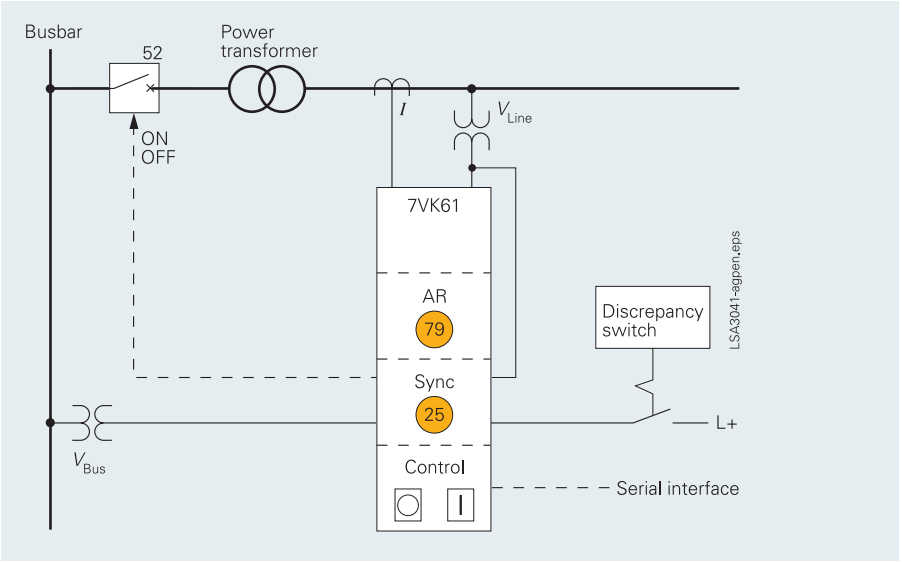

Fig. 10/7 Auto-reclosure and synchro-check with voltage measurement across a power transformer

In addition to the above-mentioned operating modes, several other operating principles can be employed by means of the integrated programmable logic (CFC).

The 7VK61 allows the line-side voltages to be evaluated. A number of voltage-dependent supplementary functions are thus available:

- ADT
  The adaptive dead time is employed only if auto-reclosure at the remote station was successful (reduction of stress on equipment).
- DLC
  By means of dead-line check, reclosure is effected only when the line is deenergized (prevention of asynchronous breaker closure in case that the synchronism check can not be used).
- RDT
  Reduced dead time is employed in conjunction with auto-reclosure where no teleprotection method is employed: when faults within the zone extension of a distance feeder protection 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, that the fault has been cleared by the protection on the faulted downstream feeder and that reclosure with reduced dead time may take place.

Synchro-check (ANSI 25)

Where two network sections are switched in by control command or following a 3-pole auto-reclosure, it must be ensured that both network sections are mutually synchronous. For this purpose, a synchronism-check function is provided. After verification of the network synchronism, the function releases the CLOSE command. Consideration of the duration of the CB operating time before issuing the CLOSE command (especially important under asynchronous conditions and when several circuit-breakers with different operating times are to be operated by one single relay).

In addition, reclosing can be enabled for different criteria, e.g., when the busbar or line are not carrying a voltage (dead line or dead bus).

Breaker failure protection (ANSI 50BF)

The 7VK61 relay incorporates a two-stage circuit-breaker failure protection to detect failures of tripping command execution, for example due to a defective circuit-breaker. The current detection logic is phase-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 the busbar trip command will be generated. The breaker failure protection will usually be initiated by external feeder protection relays via binary input signals. Trip signals from the internal auto-reclosure logic or from the voltage protection can start the breaker failure protection as well.

Overvoltage protection, undervoltage protection (ANSI 59, 27)

The 7VK61 contains a number of overvoltage measuring elements. Each measuring element is of two-stage design. The following measuring elements are available:

- Phase-to-ground overvoltage
- Phase-to-phase overvoltage
- Zero-sequence overvoltage
  The zero-sequence voltage can be connected to the 4th voltage input (not in conjunction with syncho-check) or be derived from the phase voltages.
- 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 7VK61 is fitted, in addition, with three two-stage undervoltage measuring elements:

- Phase-to-ground 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.

End-fault protection

When the circuit-breaker is open, the area located between the current transformer and the circuit-breaker can be optimally protected by means of the end-fault protection. In the event of a fault, an independently settable time delay is started after a valid initiation has been received and the circuit-breaker auxiliary contacts indicate an open circuit-breaker position, with current still flowing (see Fig. 10/8). Depending on the mounting position of the current transformer, instantaneous tripping of the busbar section or intertripping of the circuit-breaker at the opposite end occurs.

Pole-discrepancy protection

This function ensures that any one or two poles of a circuit-breaker do not remain open for longer than an independently settable time (i.e. unsymmetrical conditions). This time stage is initiated when current (above the set value) is flowing in any 1 or 2 phases, but not in all 3 phases. Additionally, the circuit-breaker auxiliary contacts (if connected) are interrogated and must show the same condition as the current measurement. Should this time delay expire, then a three-pole trip command is issued. This function is normally used when single-pole auto-reclosing is applied.

Fig. 10/8 End-fault between circuit-breaker and current transformer

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. The trip circuit supervision function requires one or two independent potential-free binary inputs per trip circuit. To make existing (non potential-free) binary inputs potential-free, external optocoupler modules can be applied.

Lockout (ANSI 86)

Under certain operating conditions, it is advisable to block CLOSE commands after a final TRIP command of the relay has been issued. Only a manual 'Reset' command unblocks the CLOSE command. The 7VK61 is equipped with such an interlocking logic.

Monitoring functions

The 7VK61 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.

If all voltages are connected, the relay will detect secondary voltage interruptions by means of the integrated fuse failure monitor. Immediate alarm and blocking of the synchronism check and dead line check is provided for all types of secondary voltage failures. Additional measurement supervision functions are

- Symmetry of voltages and currents (in case of appropriate transformer connection)
- Broken-conductor supervision (if current transformers are connected)
- Summation of currents and voltages (in case of appropriate transformer connection)
- Phase-sequence supervision (if three voltage transformers are connected)

Communication

With respect to communication, particular emphasis is placed on the customer requirements in energy automation:

- Every data item is time-stamped at the source, i.e. where it originates.
- Already during the process of communication, information is assigned to the cause thereof (e.g. assignment of the indication "circuit-breaker TRIP" to the corresponding command).
- The communication system automatically handles the transfer of large data blocks (e.g. fault recordings or parameter data files). The user has access to these features without any additional programming effort.
- For the safe execution of a control command the corresponding data telegram is initially acknowledged by the unit which will execute the command. After the release and execution of the command a feedback signal is generated. At every stage of the control command execution particular conditions are checked. If these are not satisfied, command execution may be terminated in a controlled manner.

The units offer a high degree of flexibility by supporting different standards for connection to industrial and power automation systems. By means of the communication modules, on which the protocols run, exchange and retrofit is possible. Therefore, the units will also in future allow for optimal adaptation to changing communication infrastructure such as the application of Ethernet networks (which will also be used increasingly in the power supply sector in the years to come).

Local PC interface

The serial RS232 PC interface accessible from the front of the unit permits quick access to all parameters and fault event data. The use of the DIGSI 4 operating program is particularly advantageous during commissioning.

Service/modem interface

7VK61 units are always fitted with a rear-side hardwired service interface, optionally as RS232 or RS485. In addition to the front-side operator interface, a PC can be connected here either directly or via a modem.

Time synchronization interface

The time synchronization interface is a standard feature in all units. The supported formats are IRIG-B and DCF77.

Reliable bus architecture

- RS485 bus
  With this data transmission via copper conductors, electromagnetic fault influences are largely eliminated by the use of twisted-pair conductors. Upon failure of a unit, the remaining system continues to operate without any problem.
- 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 usually impossible to communicate with a unit that has failed. Should a unit fail, there is no effect on the communication with the rest of the system.

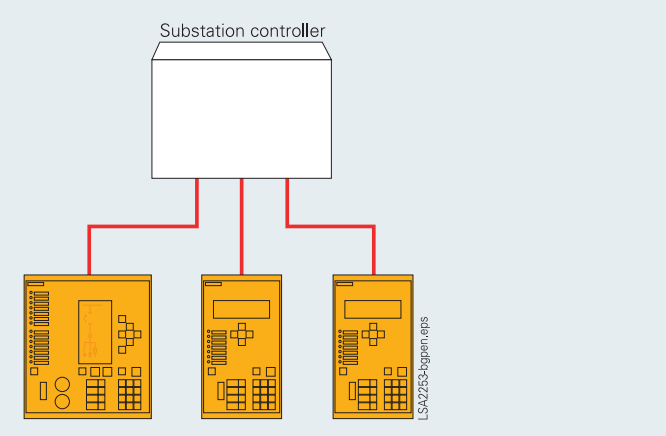

Fig. 10/9 IEC 60870-5-103 star-type RS232 copper conductor connection or fiber-optic connection

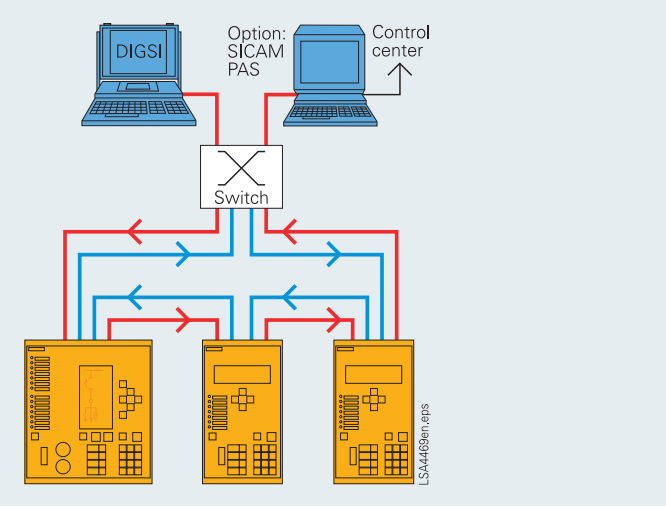

Fig. 10/10 Bus structure for station bus with Ethernet and IEC 61850 with fiber-optic ring

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 protocols (IEC 61850, IEC 60870-5-103, PROFIBUS, DNP, etc.) are required, such demands can be met. For fiber-optic communication, no external converter is required for SIPROTEC 4.

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 be possible with DIGSI.

IEC 60870-5-103 protocol

IEC 60870-5-103 is an internationally standardized protocol for efficient communication with protection relays. IEC 60870-5-103 is supported by a number of protection device manufacturers and is used worldwide. Supplements for the control function are defined in the manufacturer-specific part of this standard.

PROFIBUS-DP

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

DNP 3.0

DNP 3.0 (Distributed Network Protocol, Version 3) is an internationally recognized protection and bay unit communication protocol. SIPROTEC 4 units are Level 1 and Level 2 compatible.

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 equipped with IEC 60870-5-103 interfaces can be connected to SICAM in parallel via the RS485 bus or connected in star by fiber- optic link. Through this interface, the system is open for the connection of units of other manufacturers (see Fig. 10/14).

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. Units with an IEC 60870-5-103 interface are connected with PAS via the Ethernet station bus by means of serial/ Ethernet converters. DIGSI can also be used via the same station bus.

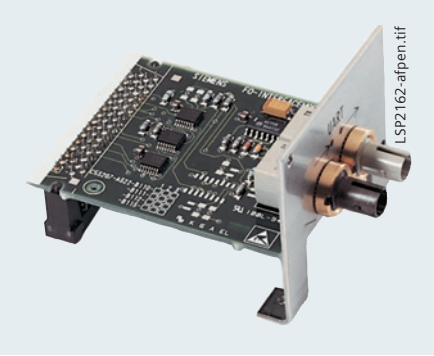

Fig. 10/11 820 nm fiber-optic communication module

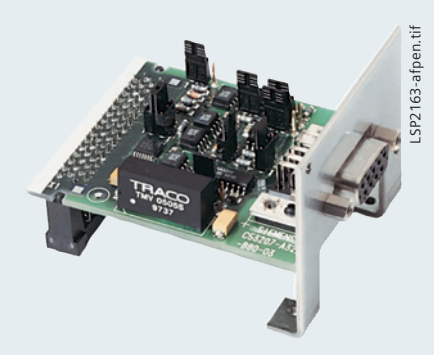

Fig. 10/12 RS232/RS485 electrical communication module

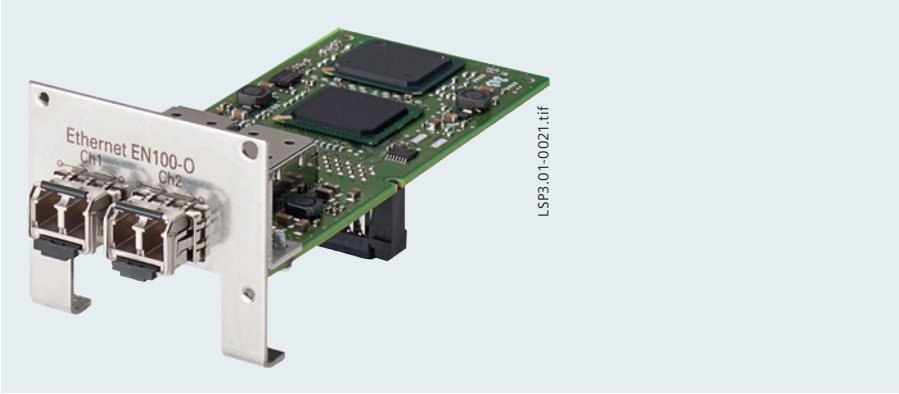

Fig. 10/13 Fiber-optic Ethernet communication module for IEC 61850 with integrated Ethernet switch

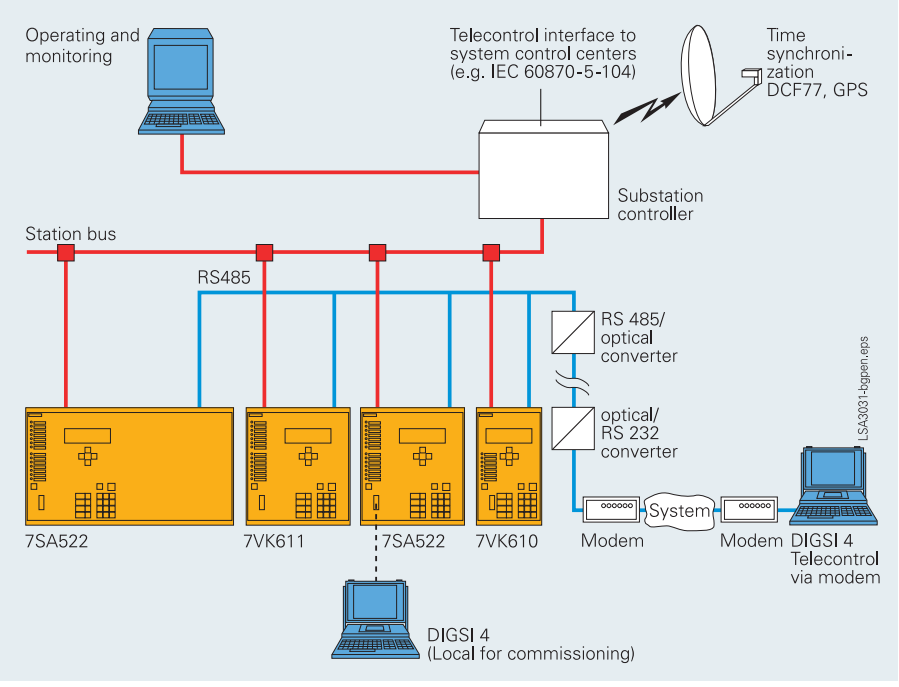

Fig. 10/14 Communication

Typical connection

Typical connection

Connection for current and voltage transformers

With the transformer connection as shown in Fig. 10/15, it is possible to use the complete scope of functions of 7VK61, i.e. breaker failure protection, synchronism-check with 3-phase dead line check (with or without auto-reclosure), complete measured value monitoring, voltage protection, and the complete range of operational measured values.

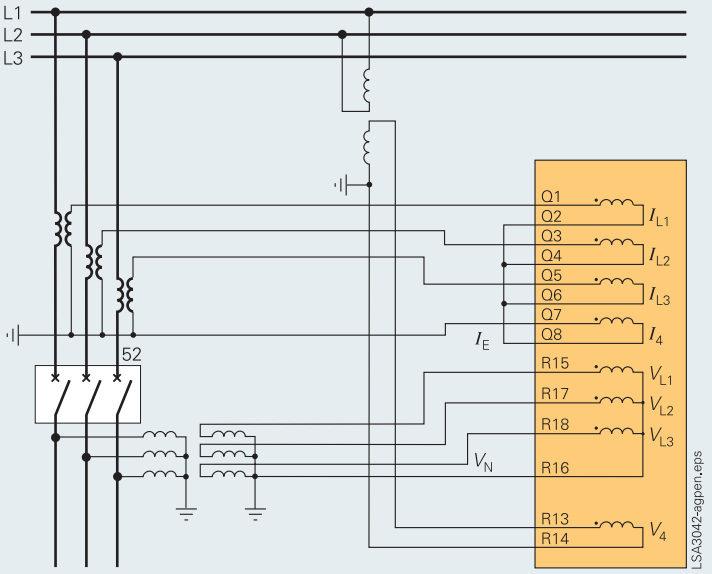

Fig. 10/15 Complete connection of all current and voltage transformers

Alternative: Connection for current transformers only

The connection for current transformers only provides breaker failure protection and current operational measured values.

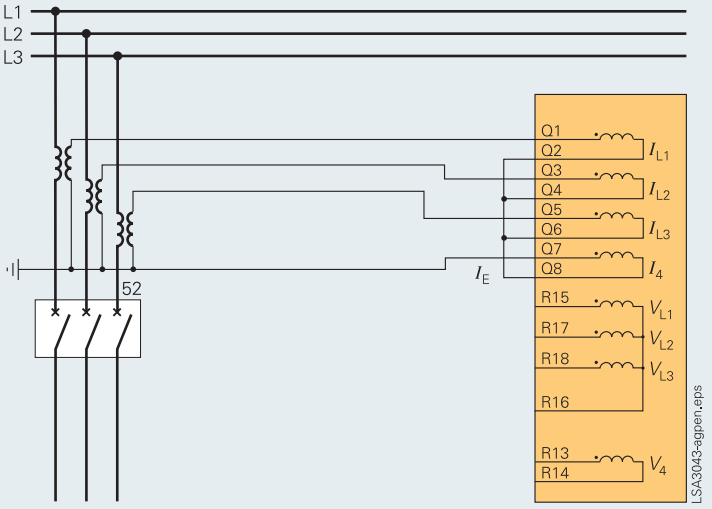

Fig. 10/16 Typical current transformer connection for breaker failure protection

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Alternative: Connection for two voltage transformers

In case of a connection for two voltage transformers, synchro-check and two operational measured voltages, and additionally synchro-check measured values are applicable. Dead line check is performed for the connected line voltage only.

Note: Please connect the two voltages always to the terminals R15/R16 and R13/R14 with the appropriate polarity. The setting address 106 "Voltage transformer" must then be set to "single-phase". The terminals R17 and R18 must not be connected.

The connection of the voltage V_{L1-L2} as shown in Fig. 10/17 is just an example: any other of the shown combinations is possible for synchronization.

The two voltage transformer connection can also be combined with the current transformer connection according to Fig. 10/16.

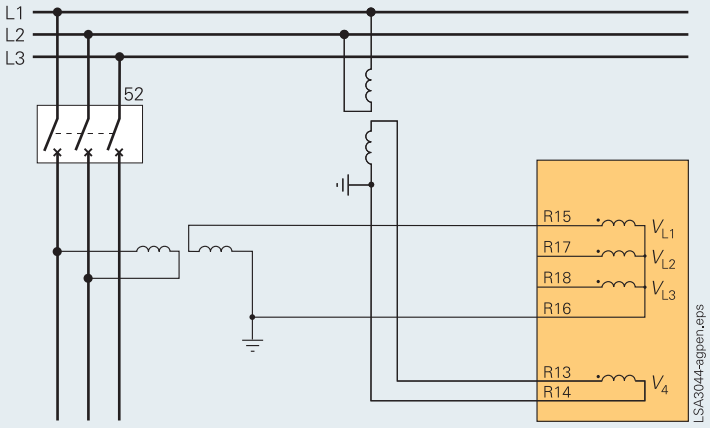

Fig. 10/17 Typical voltage transformer connection for synchro-check with single voltage dead line check

Technical data

General unit data	
Analog inputs	
Rated frequency	50 or 60 Hz (selectable)
Rated current I_{nom}	1 or 5 A (selectable)
Rated voltage V_{nom}	80 to 125 V (selectable)
Power consumption	
With I_{nom} = 1 A	Approx. 0.05 VA
With I_{nom} = 5 A	Approx. 0.30 VA
Voltage inputs	≤ 0.10 VA
Overload capacity of current circuit	
Thermal (r.m.s.)	500 A for 1 s 150 A for 10 s 20 A continuous
Dynamic (peak value)	1250 A (half cycle)
Thermal overload capacity of voltage circuit	230 V continuous
Auxiliary voltage	
Rated voltages	DC 24, 48 V DC 60, 125 V DC 110, 250 V and AC 115, 230 V (50/60 Hz)
Permissible tolerance	-20 % to +20 %
Superimposed AC voltage (peak-to-peak)	≤ 15 %
Power consumption	
Quiescent	Approx. 5 W
Energized	Approx. 8 W to 14 W, depending on design
Bridging time during failure of the auxiliary voltage	
For V_{aux} = 48 V and V_{aux} ≥ 110 V	≥ 50 ms
For V_{aux} = 24 V and V_{aux} = 60 V	≥ 20 ms
Binary inputs	
Quantity	
7VK610	7
7VK611	20
Rated voltage range	24 to 250 V, bipolar
Pickup threshold	DC 19 or 88 V or 176 V, bipolar
Functions are freely assignable	
Minimum pickup voltage Ranges are settable by means of jumpers for each binary input	DC 19 or 88 V or 176 V, bipolar (3 operating ranges)
Maximum permissible voltage	DC 300 V
Current consumption, energized	Approx. 1.8 mA
Input impulse suppression	220 nF coupling capacitance at 220 V with a recovery time >60 ms

Output contacts	
"Unit ready" contact (live status contact)	1 NC/NO contact[1)]
Command/indication relay	
Quantity	
7VK610	5 NO contacts,
7VK611	14 NO contacts, 4 NC/NO contacts[1)]
NO/NC contact	
Switching capacity	
Make	1000 W/VA
Break, contacts	30 VA
Break, contacts (for resistive load)	40 W
Break, contacts (for τ = L/R ≤ 50 ms)	25 VA
Switching voltage	250 V
Permissible total current	30 A for 0.5 seconds 5 A continuous
Operating time, approx.	
NO contact	8 ms
NO/NC contact (selectable)	8 ms
Fast NO contact	5 ms
LEDs	
Quantity	
RUN (green)	1
ERROR (red)	1
LED (red), function can be assigned	
7VK610	7
7VK611	14
Unit design	
Housing	7XP20
Dimensions	Refer to part 14 for dimension drawings
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	
⅓ x 19"	5 kg
½ x 19"	6 kg
Surface-mounting housing	
⅓ x 19"	9.5 kg
½ x 19"	11 kg

1) Can be set via jumpers.

10

Serial interfaces	
Operating interface, front of unit for DIGSI 4	
Connection	Non-isolated, RS232, 9-pin subminiature connector (SUB-D)
Baud rate	4800 to 115200 baud setting as supplied: 38400 baud; parity 8E1
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)
Service/modem interface for DIGSI4/modem/service	
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	
	IEC 61850 Ethernet IEC 60870-5-103 protocol PROFIBUS-FMS PROFIBUS-DP DNP 3.0
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
PROFIBUS RS485	
Dielectric test	500 V / 50 Hz
Baud rate	Max. 12 Mbaud
Distance	1000 m at 93.75 kbaud; 100 m at 12 Mbaud
PROFIBUS fiber-optic	
Only for flush-mounting housing	ST connector
For surface-mounting housing	Optical interface with OLM[1)]
Baud rate	Max. 1.5 Mbaud
Optical wavelength	λ = 820 nm
Permissible attenuation	Max. 8 dB for glass-fiber 62.5/125 µm
Distance	500 kB/s 1.6 km 1500 kB/s 530 m

Electrical tests	
Specifications	
Standards	IEC 60255 (product standards) IEEE C37.90.0/.1/.2 VDE 0435 For further standards see "Individual tests"
Insulation tests	
Standards	IEC 60255-5 and 60870-2-1
Voltage test (100 % test)	
All circuits except for auxiliary supply, binary inputs, communication and time synchronization interfaces	2.5 kV (r.m.s.), 50 Hz
Auxiliary voltage and binary inputs (100 % test)	DC 3.5 kV
RS485/RS232 rear side communication interfaces and time synchronization interface (100 % test)	500 V (r.m.s.), 50 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 in intervals of 5 s
EMC tests for noise immunity; type tests	
Standards	IEC 60255-6; IEC 60255-22 (product standard) EN 61000-6-2 (generic standard), VDE 0435 Part 301, DIN VDE 0435-110
High-frequency test IEC 60255-22-1 class III and VDE 0435 Part 303, class III	2.5 kV (peak); 1 MHz; τ = 15 µs; 400 surges per s; test duration 2 s; R_i = 200 Ω
Electrostatic discharge IEC 60255-22-2 class IV and EN 61000-4-2, class IV	8 kV contact discharge; 15 kV air discharge; both polarities; 150 pF; R_i = 330 Ω
Irradiation with HF field, IEC 60255-22-3 class III IEC 61000-4-3, class III	10 V/m; 80 to 1000 MHz; 80 % AM; 1 kHz 10 V/m; 1.4 to 2 GHz; 80 % AM; 1 kHz
Irradiation with HF field, IEC 60255-22-31, IEC 61000-4-3	Class III, 10 V/m
Amplitude-modulated	80; 160; 450; 900 MHz; 80 % AM 1kHz; duration >10 s
Pulse-modulated	900 MHz, 50 % PM, repetition frequency 200 Hz
Fast transient disturbance/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

1) Conversion with external OLM
Fiber-optic interface please complete order number at 11th position with **4** (FMS RS485) or **9** and Order Code **L0A** (DP RS485) or **9** and Order Code **L0G** (DNP 3.0) and additionally a suitable external repeater.

10

Technical data

EMC tests for noise immunity; type tests (continued)	
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, IEEE C37.90.1	2.5 kV (peak); 1 MHz; τ = 50 µs; 400 surges per second, duration 2 s, R_i = 200 Ω
Fast transient surge withstand capability, IEEE C37.90.1	4 kV; 5/50 ns; 5 kHz burst length = 15 ms; repetition rate 300 ms; both polarities; R_i = 50 Ω; duration 1 min
Radiated electromagnetic interference 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 61000-6-3 (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
Harmonic currents on the network lead at AC 230 V, IEC 61000-3-2	Class A limits are observed
Voltage fluctuations and flicker on the network incoming feeder at AC 230 V, IEC 61000-3-3	Limits are observed

Mechanical stress test	
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 60255-21-3, 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 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	Semi-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	Semi-sinusoidal Acceleration 10 *g*, duration 16 ms, 1000 shocks on each of the 3 axes in both directions

Climatic stress tests	
Standard	IEC 60255-6
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 (Legibility of display may be impaired above +55 °C / +131 °F)	-20 °C to +70 °C / -4 °F to +158 °F
Recommended permanent operating temperature acc. to IEC 60255-6	-5 °C to +55 °C / +23 °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 proounced temperature changes that could cause condensation.	Annual average on ≤ 75 % relative humidity; on 56 days per year up t o 93 % relative humidity; condensation is not permitted.

Functions	
Auto-reclosure (ANSI 79)	
Number of auto-reclosures	Up to 8
Operating mode	Only 1-pole; only 3-pole, 1- or 3-pole
Operating modes with line voltage check	DLC – dead-line check ADT – adaptive dead time RDT – reduced dead time
Dead times $T_{1\text{-ph}}$, $T_{3\text{-ph}}$, T_{Seq}	0 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)
Start-signal monitoring time	0.01 to 300 s (steps 0.01 s)
Additional functions	Synchro-check request 3-phase intertripping InterCLOSE command to the remote end Check of CB ready state Blocking with manual CLOSE
Voltage limit values for DLC, ADT, RDT	
Healthy line voltage $_{PH-E}$	30 to 90 V (steps 1 V)
Dead line voltage $_{PH-E}$	2 to 70 V (steps 1 V)
Tolerances	
Time stages	1 % of setting value or 10 ms
Voltage limit values	≤ 3 % of setting value or 1 V
Synchro-check (ANSI 25)	
Initiate options	Auto-reclosure; Manual CLOSE control Control commands
Operating modes	
With auto-reclosure	Synchro-check Line dead/busbar live Line live/busbar dead Line and busbar dead Bypassing
For manual closure and control commands	As for auto-reclosure
Permissible voltage difference	1 to 60 V (step 0.1 V)
Permissible frequency difference	0.03 to 2 Hz (step 0.01 Hz)
Permissible angle difference	2 to 80 ° (step 1°)
Max. duration of synchronization	0.01 to 600 s (steps 0.01 s) or deactivated
Release delay with synchronous networks	0 to 30 s (steps 0.01 s)
Minimum measuring time	Approx. 80 ms
Tolerances	
Time stages	1 % of setting value or 10 ms
Voltage limit values	≤ 2 % of setting value or 1 V

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
Dropout (overshoot) time, internal	≤ 15 ms, typical; 25 ms, max.
End-fault protection	For fault between open CB and CT, with intertrip to the remote line end
Pole discrepancy supervision	Initiation if not all CB poles are closed or open
Monitoring time	0 to 30 s (steps 0.01 s) or deactivated
Tolerances	
Current limit value	≤ 5 % of setting value or 1 % I_{nom}
Time stages	1 % of setting value or 10 ms
Voltage protection (ANSI 59, 27)	
Operating modes	Local tripping and/or carrier trip for remote end
Overvoltage protection	
Pickup values V_{PH-E}>>, V_{PH-E}> (phase-ground overvoltage)	1 to 170 V (step 0.1 V)
Pickup values V_{PH-PH}>>, V_{PH-PH}> (phase-phase overvoltage)	2 to 220 V (step 0.1 V)
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)
Pickup values V_1>>, V_1> (positive-sequence overvoltage)	2 to 220 V (step 0.1 V)
Pickup values V_2>>, V_2> (negative-sequence overvoltage)	2 to 220 V (step 0.1 V)
Reset ratio (settable)	0.5 to 0.98 (step 0.01)
Undervoltage protection	
Pickup values V_{PH-E}<<, V_{PH-E}< (phase-ground undervoltage)	1 to 100 V (step 0.1 V)
Pickup values V_{PH-PH}<<, V_{PH-PH}< (phase-phase undervoltage)	1 to 170 V (step 0.1 V)
Pickup values V_1<<, V_1< (positive-sequence undervoltage)	1 to 100 V (step 0.1 V)
Blocking of undervoltage protection stages	Minimum current; binary input
Reset ratio (settable)	1.01 to 1.20 (step 0.01)
Time delays	
Time delay for all stages	0 to 100 s (step 0.01 s) or deactivated
Command / pickup time	Approx. 34 ms at f_{nom} = 50 Hz Approx. 30 ms at f_{nom} = 60 Hz
Tolerances	
Voltage limit values	≤ 3 % of setting value or 1 V
Time stages	1 % of setting value or 10 ms
Trip circuit supervision (ANSI 74TC)	
Number of supervisable trip circuits	Up to 3
Number of required binary inputs per trip circuit	1 or 2
Indication relay	1 to 30 s (steps 1 s)

Technical data

Additional functions	
Operational measured values	
Representation	Primary, secondary and percentage referred to rated value
Currents	3 x I_{Phase} ; $3I_0$; I_1; I_2
Tolerances	Typ. 0.3 % of indicated measured value or 0.5 % I_{nom}
Voltages	3 x $V_{Phase-Ground}$; 3 x $V_{Phase-Phase}$; $3V_0$, V_1, V_2, V_{SYNC}, V_{en}
Tolerances	Typ. 0.25 % of indicated measured value or 0.01 % V_{nom}
Power with direction indication	P, Q, S
Tolerances	
P: for |cos φ| = 0.7 to 1 and V/V_{nom}, I/I_{nom} = 50 to 120 %	Typical ≤ 1%
Q: for |sin φ| = 0.7 to 1 and V/V_{nom} , I/I_{nom} = 50 to 120 %	Typical ≤ 1%
S: for V/V_{nom}, I/I_{nom} = 50 to 120 %	Typical ≤ 1%
Frequency Tolerance	f ≤ 10 mHz
Power factor	PF
Tolerance for |cos φ| = 0.7 to 1	Typical ≤ 0.02
Energy meters	
Four-quadrant meters	W_{P+}; W_{P-}; W_{Q+}; W_{Q-}
Tolerance	
for |cos φ| > 0.7 and V > 50 % V_{nom} and I > 50 % I_{nom}	5 %
Oscillographic fault recording	
Analog channels	3 x I_{Phase}, $3I_0$ 3 x V_{Phase}, $3V_0$, V_{SYNC}, V_{en}
Max. number of available recordings	8, backed-up by battery if auxiliary voltage supply fails
Sampling intervals	20 samplings per cycle
Total storage time	> 15 s
Binary channels	Pickup and trip information; number and contents can be freely configured by the user
Max. number of displayed binary channels	40
Control	
Number of switching units	Depends on the number of binary / indication inputs and indication / command outputs
Control commands	Single command / double command 1, 1 plus 1 common or 2 pole
Feed back	CLOSE, TRIP, intermediate position
Interlocking	Freely configurable
Local control	Control via menu, function keys, control keys (if available)
Remote control	Control protection, DIGSI, pilot wires

Further additional functions	
Measured value supervision	Current sum Current symmetry Voltage sum Voltage symmetry Phase sequence Fuse failure monitor
Indications Operational indications	Power direction Buffer size 200
System disturbance indication	Storage of indications 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 operation Max. breaking current per phase
Circuit-breaker test	TRIP/CLOSE cycle, 3 phases TRIP/CLOSE 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 inputs, setting of output relays, generation of indications for testing serial interfaces
Phase rotation adjustment	Clockwise or anti-clockwise

CE conformity

This product complies with the directive of the Council of the European Communities on the approximation of the laws of the Member States relating to electromagnetic compatibility (EMC Council Directive 2004/108/EG previous 89/336/EEC) and concerning electrical equipment for use within specified voltage limits (Low-voltage directive 2006/95/EG previous 73/23/EEC).

This conformity is proved by tests conducted by Siemens AG in accordance with Article 10 of the Council Directive in agreement with the generic standards EN 61000-6-2 and EN 61000-6-4 for the EMC directive and with the standard EN 60255-6 for the low-voltage directive.

This device is designed and produced for industrial use.

The product conforms with the international standard of the series IEC 60255 and the German standard VDE 0435.

Selection and ordering data

Description	Order No. 7VK61 □□-□□□□□□-4Y□0-□□□	Order code
7VK61 breaker management relay		
Housing, binary inputs (BI) and outputs (BO)		
Housing ⅓ 19", 7 BI, 6 BO incl. 1 live-status contact,	0	
Housing ½ 19", 20 BI, 19 BO incl. 1 live-status contact	1	
Measuring inputs (4 x V, 4 x I)		
I_{ph} = 1 A, I_e = 1 A (min. = 0.05 A)[1]	1	
I_{ph} = 5 A, I_e = 5 A (min. = 0.25 A)[1]	5	
Rated auxiliary voltage (power supply, threshold of binary inputs)		
DC 24 to 48 V, binary input threshold 19 V[3]	2	
DC 60 to 125 V [2], binary input threshold 19 V[3]	4	
DC 110 to 250 V [2], AC 115 to 230 V, binary input threshold 88 V[3]	5	
DC 220 to 250 V [2], AC 115 to 230 V, binary input threshold 176 V[3]	6	
Unit version		
For panel flush mounting	A	
For panel surface mounting	E	
Region-specific default settings/language settings and functions versions		
Region DE, language: German, selectable	A	
Region World, language: English, selectable	B	
Region US, language:US-English, selectable	C	
Region FR, language: French, selectable	D	
Region World, language: Spanish, selectable	E	
Region World, language: Italian, selectable	F	
Port B system interface		
Empty	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-FMS Slave, electrical RS485	4	
PROFIBUS-FMS Slave, optical, double ring, ST connector [4]	6	
PROFIBUS-DP Slave, RS485	9	L 0 A
PROFIBUS-DP Slave, optical 820 nm, double ring, ST connector [4]	9	L 0 B
DNP 3.0, RS485	9	L 0 G
DNP 3.0, optical 820 nm, ST connector [4]	9	L 0 H
IEC 61850, 100 Mbit Ethernet, electrical, double, RJ45 connector	9	L 0 R
IEC 61850, 100 Mbit Ethernet, optical, double, LC connector [5]	9	L 0 S
Port C service interface		
DIGSI 4/modem, electrical RS232	1	
DIGSI 4/modem, electrical RS485	2	

Functions

Breaker failure protection 1-/3-pole or 3-pole only	Auto-reclosure 1-/3-pole or 3-pole only and synchro-check	Over/Undervoltage protection	
■			C
■		■	D
	■		N
	■	■	P
■	■		Q
■	■	■	R

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

2) Transition between the 3 auxiliary ranges can be selected by means of jumpers.

3) The binary input thresholds are selectable in 3 steps by means of jumpers.

4) Optical interfaces are not available with surface mounting housings (position **9** = E). Please order the version with RS485 interface and a separate electrical/optical converter.

5) For surface-mounting housing applications please order the relay with electrical Ethernet interface and use a separate fiber-optic switch.

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 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 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 2000/XP Professional Edition Incl. templates, electronic manual with license for 10 PCs. Authorization by serial number. On CD-ROM.	**7XS5410-0AA00**
	Connecting cable (copper)	
	Cable between PC/notebook (9-pin connector) and protection unit (9-pin connector) (contained in DIGSI 4, but can be ordered additionally)	**7XV5100-4**
	Voltage transformer miniature circuit-breaker	
	Rated current 1.6 A; thermal overload release 1.6 A; overcurrent trip 6 A	**3RV1611-1AG14**
	Manual for 7VK61	
	For the latest version please visit	**www.siemens.com/siprotec**

Fig. 10/18 Mounting rail for 19" rack

Fig. 10/19
2-pin connector

Fig. 10/20
3-pin connector

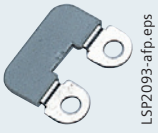

Fig. 10/21
Short-circuit link for current contacts

Fig. 10/22
Short-circuit link for voltage contacts/ indications contacts

Accessories	Description		Order No.	Size of package	Supplier	Fig.
	Connector	2-pin	**C73334-A1-C35-1**	1	Siemens	10/19
		3-pin	**C73334-A1-C36-1**	1	Siemens	10/20
	Crimp connector	CI2 0.5 to 1 mm²	**0-827039-1**	4000	AMP [1]	
			0-827396-1	1	AMP [1]	
		CI2 0.5 to 2.5 mm²	**0-827040-1**	4000	AMP [1]	
			0-827397-1	1	AMP [1]	
		Type III+ 0.75 to 1.5 mm²	**0-163084-7**	4000	AMP [1]	
			0-163083-2	1	AMP [1]	
	Crimping tool	For type III+ and matching female	**0-539635-1**	1	AMP [1]	
			0-539668-2		AMP [1]	
		for CI2 and matching female	**0-734372-1**	1	AMP [1]	
			1-734387-1		AMP [1]	
	19"-mounting rail		**C73165-A63-D200-1**	1	Siemens	10/18
	Short-circuit links	For current terminals	**C73334-A1-C33-1**	1	Siemens	10/21
		For other terminals	**C73334-A1-C34-1**	1	Siemens	10/22
	Safety cover for terminals	large	**C73334-A1-C31-1**	1	Siemens	10/4
		small	**C73334-A1-C32-1**	1	Siemens	10/4

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

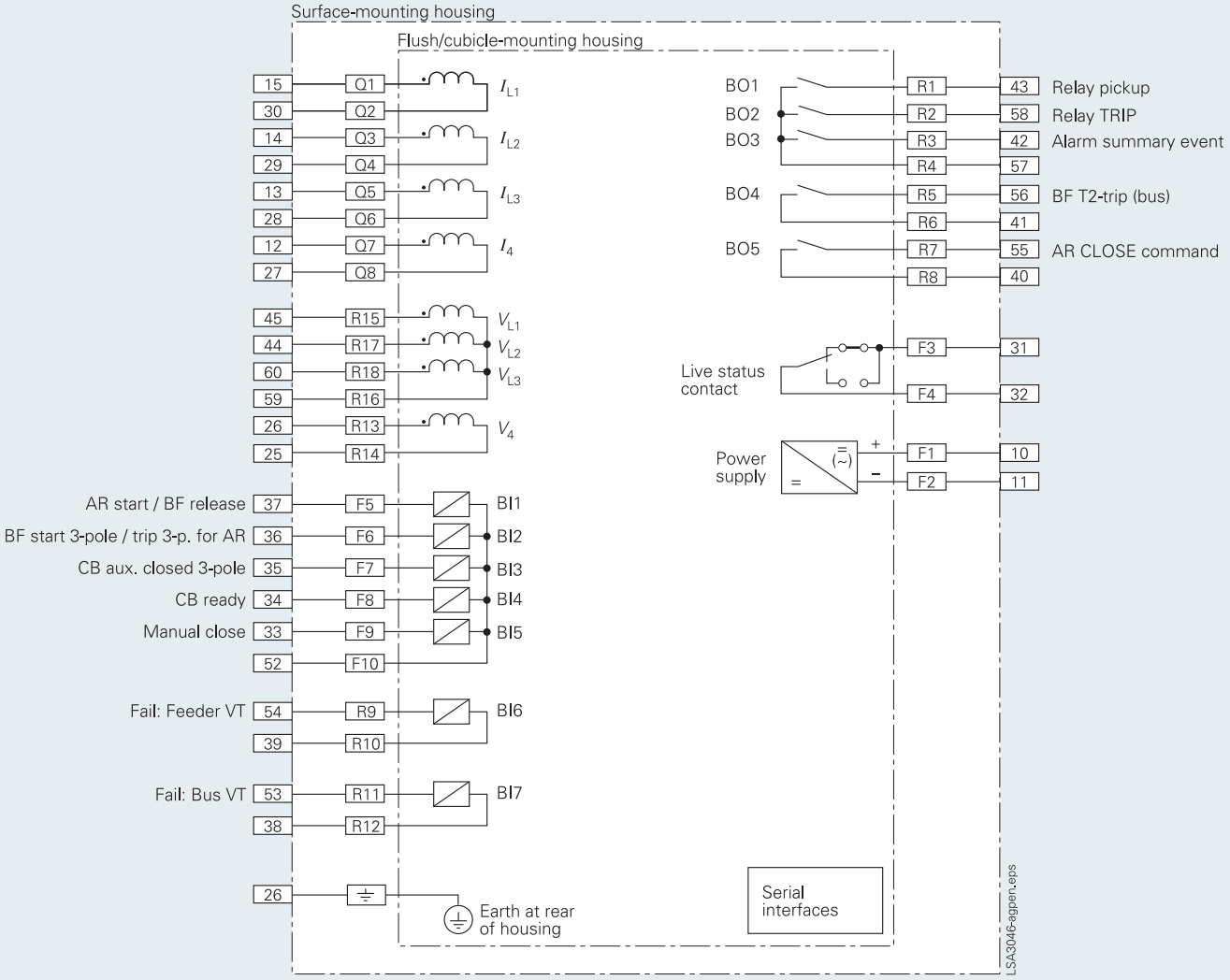

Fig. 10/23 Connection diagram 7VK610, ⅓ x 19" housing

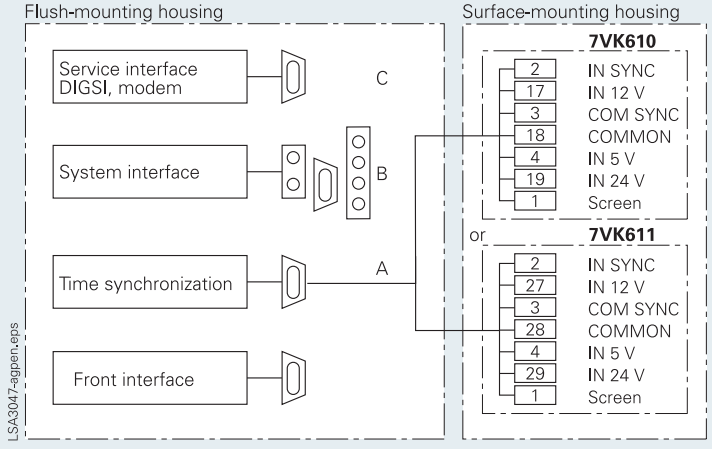

Fig. 10/24 Serial interfaces

Connection diagrams

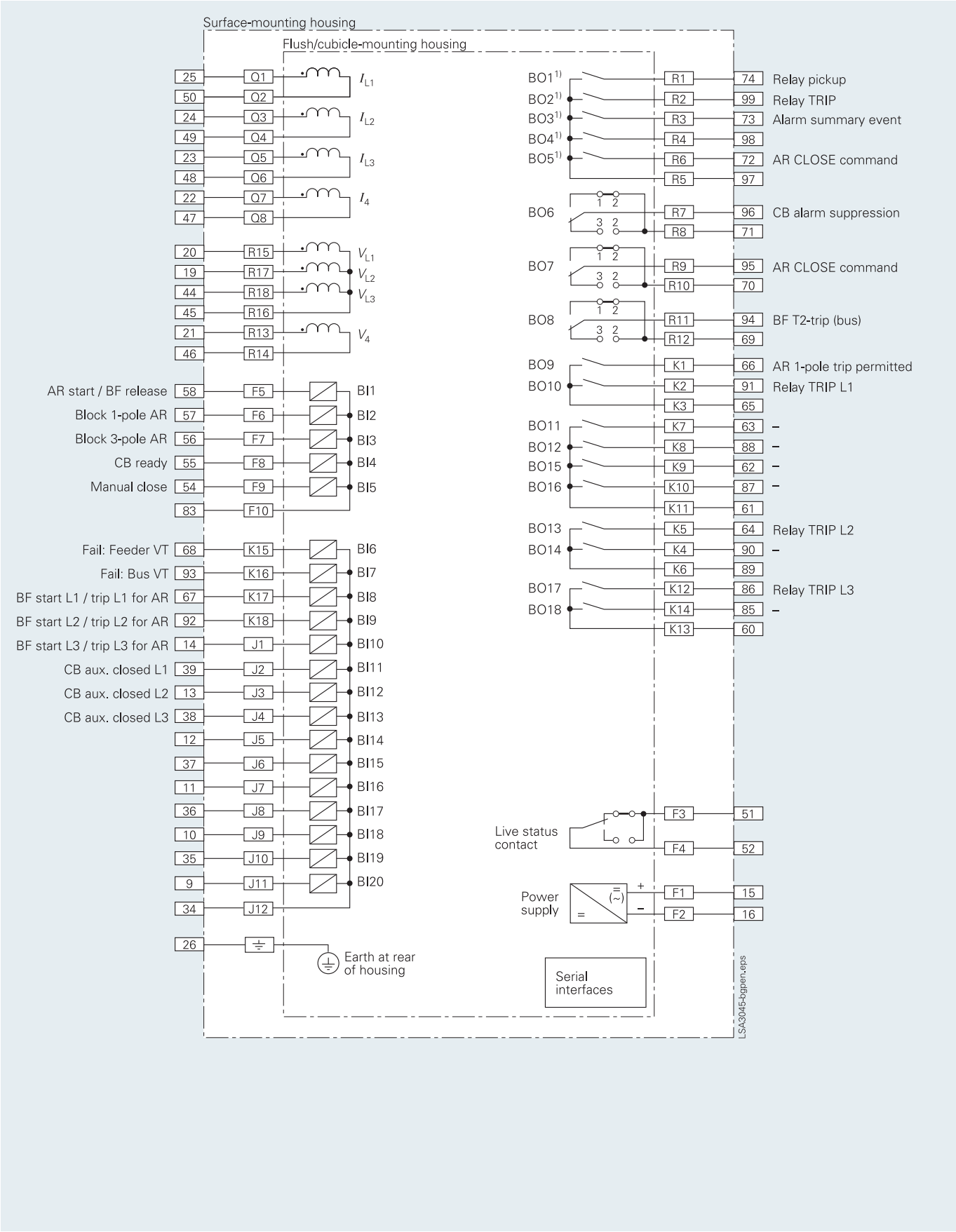

Fig. 10/25 Connection diagram 7VK611, ½ x 19" housing