SIPROTEC 7SD60
Numerical Pilot-Wire Current Differential Protection Relay

Fig. 7/1
SIPROTEC 7SD600
numerical current differential protection relay

Description

The 7SD600 relay is a numerical current differential protection relay, simple to set, operating in conjunction with the remote station via a two pilot-wire link. It is connected to the primary current transformers via an external summation current transformer. The primary field of application of the relay is protection of short overhead lines and cables with two line ends. However, transformers and reactors may be located within the protection zone. Features like inrush restraint, lockout, modern PCM-intertrip facilities, full self-monitoring facilities, local and remote interrogation are integrated in the unit.

Function overview

Differential protection relay for overhead lines and cables

- Current differential protection with external summation current transformer 4AM49 (87L)
- Suitable for use for distances of approx. 12 km max. via two pilot wires (1200 Ω loop resistance)
- Differential protection can be combined with an overcurrent release
- Pilot-wire monitoring function
- Bidirectional remote tripping
- Circuit-breaker intertripping at the remote station
- Seal-in of the TRIP command until manual reset (Lockout function)
- Minimal current transformer requirements due to integrated saturation detector
- Restraint against inrush/undelayed trip for high differential fault currents
- Emergency overcurrent protection

Operational measured values

- Local and remote current
- Differential current
- Restraint current

Monitoring functions

- Hardware
- Firmware
- Spill current supervision

Hardware

- Local operation by means of integrated keyboard
- LCD display for settings and analysis
- Housing

– Flush-mounting housing 1/6 19" 7XP20
– Surface-mounting housing 1/6 19" 7XP20

Communication

- Via personal computer and DIGSI 3
- Via RS232↔RS485 converter
- With modem
- With substation control system via IEC 60870-5-103 protocol
- 2 kV isolated RS485 interface, bus connection possible

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Application

The 7SD60 relay is a numerical current differential protection relay, simple to set, and is operated in conjunction with the remote station via a two pilot-wire link.

It is connected to the primary current transformers via an external summation current transformer. The unit operates internally on the summated current taken from the secondary side of the summation current transformer. The link to the remote station is realized by means of a pair of symmetrical pilot wires allowing distances of up to approximately 12 km. Adaptation to the pilot-wire resistance is effected by means of software within the unit. Therefore, matching is not necessary.

The primary field of application of the unit is protection of short overhead lines and cables with two line ends. However, transformers and reactors may be located within the protection zone. The unit can be fitted with inrush restraint in such cases. A differential protection instantaneous tripping stage is also provided in this case. Vector group adaptation is not effected inside the unit and must, if necessary, be effected by means of a matching current transformer.

The 7SD60 can be fitted with a pilot-wire monitoring function. In addition to monitoring the pilot-wire link to the remote station, this also includes bidirectional circuit-breaker intertripping and a remote tripping command.

If the differential protection becomes inactive due to a pilot-wire failure, the relay has an emergency overcurrent function as an option. It includes one definite-time overcurrent stage and can be delayed.

This unit substitutes the 7SD24 steady-state differential protection. However, direct interoperation with the 7SD24 is not possible. On replacement of a 7SD24, its external summation current transformer can be used as the input transformer for the 7SD60.

ANSI	
(87L, 87T)	ΔI for lines/cables, transformers
(85)	Intertrip, remote trip
(86)	Lockout function
(50)	Single-stage, definite-time emergency overcurrent protection

Construction

The compact 7SD60 protection relay contains all the components for:

- Measured-value acquisition and evaluation
- Operation and LCD indications
- Alarm and command contacts
- Input and evaluation of binary signals
- Data transmission via the RS485 bus interface to DIGSI or a substation control system
- Auxiliary voltage supply

The primary current transformers are connected to the 4AM49 summation current transformer. At the rated current value of either 1 A or 5 A, the latter outputs a current of 20 mA which is measured by the 7SD60 unit. The summation current transformer is supplied together with the protection unit, if so ordered.

The unit can be supplied in two different housings. The one for flush mounting in a panel or cubicle has connection terminals at the rear.

The version for panel surface mounting is supplied with terminals accessible from the front. Alternatively, the unit can be supplied with two-tier terminals arranged above and below the unit.

Fig. 7/2
Rear view flush-mountig housing

Protection functions

Mode of operation of the differential protection relay

An external summation current transformer 4AM49, which can be supplied as an accessory either in a 1 A or a 5 A version, allows any secondary currents of the primary current transformers (see Fig. 7/3) to be connected. The standard ratios of the three primary windings of the summation current transformer are IL1:IL2:IL3 = 5:3:4 (IL1:IL3:IL0 = 2:1:3) (see Fig. 7/6). In consequence, the sensitivity of the tripping characteristic for single-phase faults is appreciably higher compared to that for two-phase and three-phase faults. Since the current on such faults is often weak, an amplification factor of 1.7 to 2.8 referred to the symmetrical response value is achieved.

Other sensitivity values can, however, be obtained by altering the connections at the summation CT.

With a symmetrical three-phase current of 1 x I_N, the secondary current of the summation current transformer is 20 mA.

The 7SD60 measures and digitalizes the current I_{M1} of the local relay by means of a sensitive current input (see Fig. 7/6). A voltage drop occurs across a fixed-value resistor R_b installed in the unit. With a through-flowing load or a through- flowing short-circuit current, the voltage drop at both ends of the line is approximately equal but of opposite polarity, so that no current flows through the pilot wire. On occurrence of an internal fault, different values are obtained for the voltage drop across R_b at both ends. In consequence, a current I_a flows through the pilot wire, which is measured by means of the current transformer. In conjunction with the pilot- wire resistance (available as a parameter in the unit) and the internal resistor R_a, it is possible to calculate the differential current from the measured current flowing through the pilot wire. As soon as an adjustable value is reached, the protection relay trips the line at both ends.

Matching of the sensitivity of the unit for different values of pilot-wire resistance is effected by the firmware of the unit during parameter setting, so that time-consuming matching of the pilot-wire resistance is unnecessary.

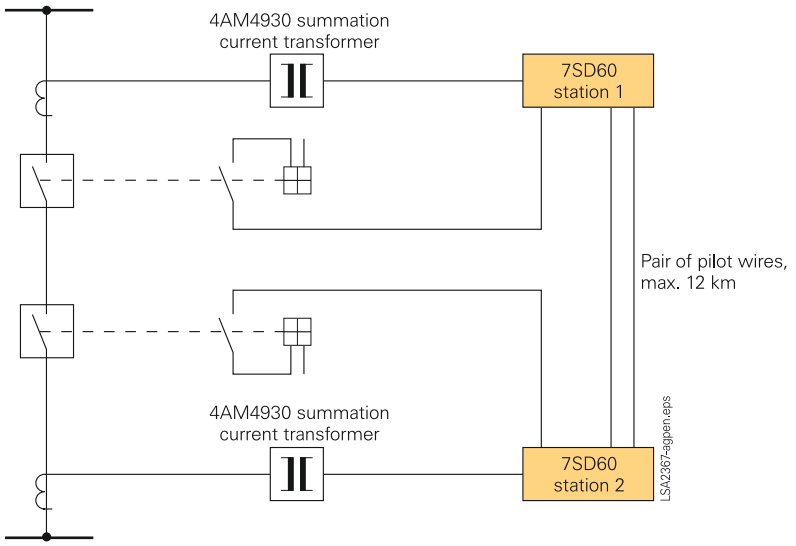
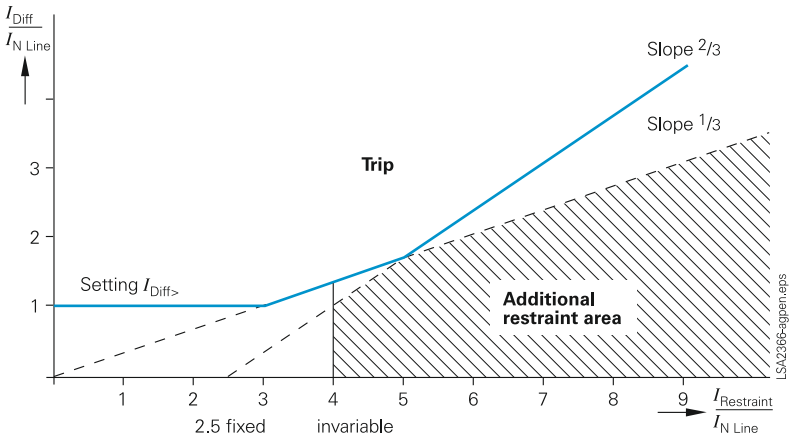


Fig. 7/3
7SD60 line differential protection for operation with two pilot wires



I_{Diff} = $|I_1 + I_2|$
$I_{Restraint}$ = $|I_1| + |I_2|$
I_1 = current at local relay end of line, current flowing into the line is positive
I_2 = current at remote relay, current flowing into the line is positive
$I_{N\ Line}$ = rated current of the line

Fig. 7/4
Trip characteristic of differential protection

Trip characteristic of the differential protection relay

The main function of the unit is current comparison protection. The trip characteristic is fixed and takes into account both the linear and the non-linear errors of the current transformers. It is only necessary to set the tripping value $I_{Diff>}$, although the standard setting is suitable for most applications. It should be parameterized according to the rated current of the line; sensitive setting is possible even when the current transformer rated currents and the line rated currents differ by as much as a factor of 2. Differences in the current transformation ratios at the ends of the line must, however, be compensated for by means of external matching current transformers.

In some cases, this can be realized by the summation current transformer.

Protection functions

Overcurrent release / differential current monitoring

The differential protection function can be combined with an additional overcurrent release. To this end, the criteria "overcurrent" and "differential current" are linked logically so that a TRIP command is given out by the differential function only when a differential current and an overcurrent coexist.

By this means it is often possible to avoid malfunctioning due to pilot-wire short-circuit or wire-break of a connection between a current transformer and the summation current transformer. For this purpose, the 7SD60 is fitted with an additional differential current monitoring function, which can effectively block the differential protection after a delay of some seconds on reaching of an adjustable value of differential current in conjunction with simultaneous operational current I_{M1} within the load range.

Saturation detector

Improved stability on single-ended saturation of the primary current transformers is ensured by means of an integrated saturation detector. It provides additional stability during external faults. 5 ms are enough time to measure an external fault due to a high restraint and small differential current. Indication is done within the additional restraint area (see Fig. 7/4). If – due to CT saturation – the differential current flows into the trip area, the differential trip is blocked for a certain time. Transient saturation of current transformers caused by decaying DC components in the short-circuit current can thus be recognized.

As a result, the requirements on the current transformers are reduced so that they are only required to conduct the steady-state through-flowing short-circuit current without saturation.

Pilot-wire link / pilot-wire monitoring

The link to the remote station comprises a symmetrical pair of wires (e.g. telephone lines). The maximum permissible distance between two stations is approximately 12 km. 7XR9513 (20 kV) or 7XR9515 (5 kV) isolation transformers can be employed for potential isolation against interference induced by longitudinal voltages where the pilot wires run parallel to power cables over long distances.

Since the pilot wires form an integral part of the differential protection, these are normally monitored continuously. This function is available as an option. To achieve this, 2 kHz pulses with a defined pulse width ratio are transmitted to the remote relay via the pilot wires. Detection of a fault in the pilot-wire link results in blocking of the differential protection.

Emergency overcurrent protection

If the differential protection becomes inactive due to a pilot-wire failure or an internal or external blocking of the differential function, the relay offers a single-stage, definite-time overcurrent function. It works with the local flowing operational current I_{M1}. The pickup value and the delay time are settable via parameters in the device.

Circuit-breaker intertripping / remote tripping

Normally, tripping is effected at both stations as a result of current comparison. Tripping at one end only can occur when an overcurrent release is used or with short-circuit currents only slightly above the tripping value. Circuit-breaker intertripping can be parameterized in the unit with integral pilot-wire monitor, so that definite tripping at both ends of the line is assured.

In addition, it is possible by means of a binary input to output a remote tripping command for both directions. The command transmission time is approximately 80 ms.

Lockout of the TRIP command with manual reset

The TRIP command can be locked-out after tripping. In particular, in the case of transformers within the protection zone, reclosure of the line is normally effected only after the cause of the fault has been ascertained by the user. Manual reset is possible either via the operator panel (with password) or via a binary input. As a result, premature reclosure of the circuit-breaker is prevented. The logic state of the TRIP command remains stored even during failure of the auxiliary supply voltage, so that it is still present on restoration of the auxiliary supply voltage.

Inrush restraint / instantaneous tripping stage

Where transformers or reactors are located within the protection zone, inrush restraint can be supplied as an option. This inrush restraint evaluates the second harmonic of the differential current, which is typical for inrush phenomena. If the second harmonic value of the differential current referred to the fundamental frequency exceeds a preset value, tripping by the differential protection is blocked. In the case of high-current internal faults, whose amplitude exceeds the inrush current peak, tripping can be carried out instantaneously.

Vector group adaptation is not effected inside the unit and must, where necessary, be brought about by means of an external matching transformer scheme.

Features

Serial data transmission

As standard, the unit is fitted with an RS485 interface. This is suitable for connection to a bus and allows up to 32 devices to be connected via a two-wire serial interface (use of a third core for earth is recommended). A PC is connected via this interface using an RS232↔RS485 converter, thus allowing the DIGSI operator program to be used, by means of which PC-aided planning, parameter setting and evaluation can be performed. By this readout, it is also possible to output the fault recordings stored by the unit on occurrence of faults.

Using an RS485↔820 nm optical converter as an accessory (7XV5650, 7XV5651), it is possible to provide an interference-free and isolated link to a central control system or a remote control system employing DIGSI, thus allowing economically viable configurations to be used, e.g. for remote diagnostics.

The serial interface can also be set to the IEC 60870-5-103 protocol (VDEW - Association of German Utilities - interface), thus allowing the unit to be integrated in a substation control system. However, only 2 messages (ready for operation and the trip signal) and the fault recording are available.
For this reason, it is recommended to use the 7SD610 unit combined with an external communication converter for pilot wires in those cases in which integration in the substation control system is a prime consideration.

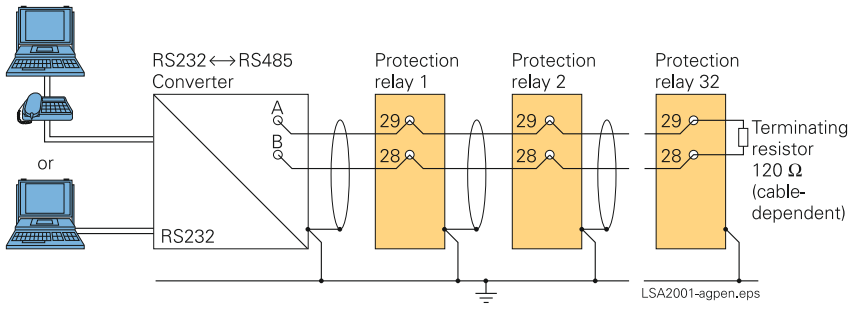
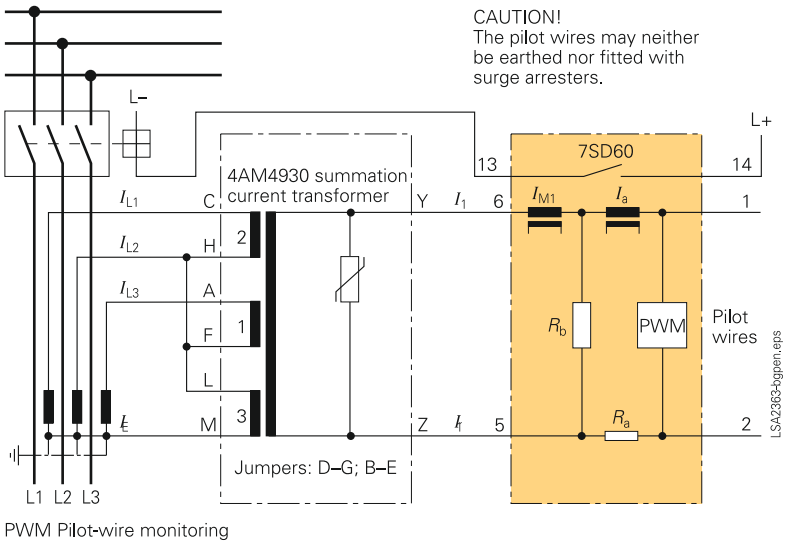


Fig. 7/4
Bus communication via RS485 interface
For convenient wiring of RS485 bus, use bus cable system 7XV5103 (see part 13 of this catalog).

Connection diagrams



PWM Pilot-wire monitoring

Fig. 7/6
Standard connection L1-L3-E, suitable for all types of networks

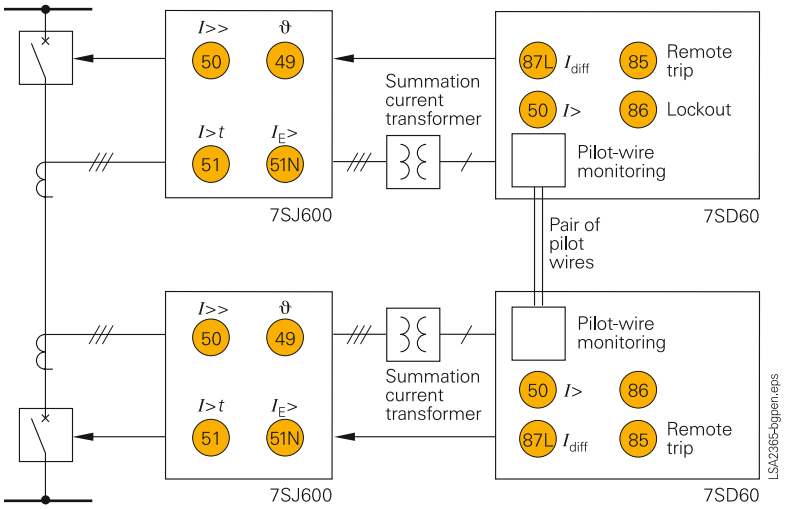


Fig. 7/7
Protection configuration with main (7SD60) and backup overcurrent (7SJ60) protection

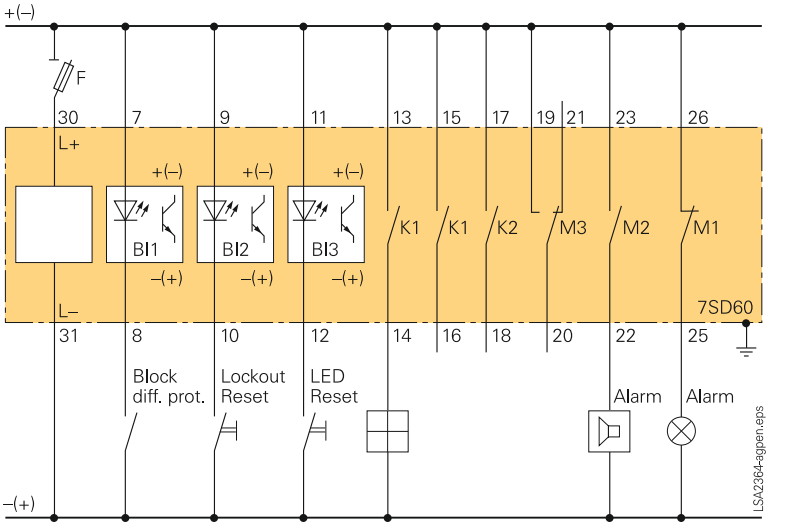


Fig. 7/8
Typical circuit for auxiliary voltage supply

Technical data

General unit data

Input circuits

Rated current I_N	20 mA without summation current transformer 1 or 5 A with summation current transformer
Rated frequency f_N	50/60 Hz parameterizable
Thermal overload capability current path	
Continuous	2 x I_N
For 10 s	30 x I_N
For 1 s	100 x I_N

Auxiliary voltage

Auxiliary voltage via integrated DC/DC converter	
Rated auxiliary DC voltage/ permissible variations	24/48 V DC /19 to 58 V DC 60/110/125 V DC /48 to 150 V DC 220/250 V DC /176 to 300 V DC
Superimposed AC voltage V_{aux} Peak-to-peak	≤ 12 % at rated voltage ≤ 6 % at limits of admissible voltage
Power consumption	
Quiescent	Approx. 2 W
Energized	Approx. 4 W
Bridging time during failure/ short-circuit of auxiliary voltage	≥ 50 ms (at V_{aux} ≥ 100 V AC/DC) ≥ 20 ms (at V_{aux} ≥ 24 V DC)
Rated auxiliary voltage AC V_{aux}/ permissible variations	115 V AC / 88 to 133 V AC

Command contacts

Number of relays	2 (marshallable)
Contacts per relay	2 NO or 1 NO
Switching capacity	
Make	1000 W/VA
Break	30 W/VA
Switching voltage	250 V
Permissible current	
Continuous	5 A
For 0.5 s	30 A

Signal contacts

Number of relays	3 (2 marshallable)
Contacts per relay	1 CO
Switching capacity	
Make	1000 W/VA
Break	30 W/VA
Switching voltage	250 V AC/DC
Permissible current	5 A

Binary inputs

Number	3 (marshallable)
Operating voltage	24 to 250 V DC
Current consumption, energized	Approx. 2.5 mA independent of operating voltage
Pick-up threshold reconnectable	By solder bridges
Rated aux. voltages 24/48/60 V DC	
$V_{pick-up}$	≥ 17 V DC
$V_{drop-off}$	< 8 V DC
Rated aux. voltages 110/125/220/250 V DC	
$V_{pick-up}$	≥ 74 V DC
$V_{drop-off}$	< 45 V DC

Unit design

Housing	7XP20
Dimensions	For dimensions, see dimension drawings, part 15
Weight	
With housing for surface mounting	Approx. 4.5 kg
With housing for flush mounting/cubicle mounting	Approx. 4 kg
Degree of protection acc. to EN 60529	
Housing	IP 51
Terminals	IP 21

Serial interface (Isolated)

Standard	RS485
Test voltage	2.8 kV DC for 1 min
Connection	Via wire to housing terminals, 2 data transmission lines, 1 earthing cable for connection to an RS485↔RS232 converter, cables have to be shielded, screen has to be earthed Setting at supply: 9600 baud
Baud rate	Min. 1200 baud; max. 19200 baud

Technical data

Electrical tests

Specification

Standards	IEC 60255-5 ANSI/IEEE C37.90.0

Insulation tests

Voltage test (routine test)	
All circuits except DC voltage supply	2 kV (r.m.s.), 50 Hz
and RS485	2.8 kV DC
Only DC voltage supply and RS485	
Impulse voltage test (type test)	
All circuits, class III	5 kV (peak), 1.2/50 µs, 0.5 J; 3 positive and 3 negative impulses at intervals of 5 s
Test crosswise:	
Measurement circuits, pilot wire connections, power supply, binary inputs, class III, (no tests crosswise over open contacts, RS458 interface terminals)	

EMC tests for noise immunity; type tests

Standards	IEC 60255-6; IEC 60255-22 (international product standard) EN 50082-2 (generic standard) VDE 0435, Part 303 (German product standard)
High-frequency test IEC 60255-22-1, VDE 0435 Part 303; class III	2.5 kV (peak); 1 MHz; τ = 15 µs; 400 surges; duration 2 s
Electrostatic discharge IEC 60255-22-2, EN 61000-4-2; class III	4/6 kV contact discharge; 8 kV air discharge; both polarities; 150 pF; R_i = 330 Ω
Irradiation with RF field, non-modulated IEC 60255-22-3 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; AM 80 %; 1 kHz
Irradiation with RF field, pulse-modulated IEC 61000-4-3/ENV 50204; class III	10 V/m, 900 MHz; repetition rate 200 Hz, duty cycle 50 %
Fast transients/bursts IEC 60255-22-3, IEC 61000-4-4, class IV	2 kV; 5/50 ns; 5 kHz; burst length = 15 ms; repetition rate 300 ms; both polarities; R_i = 50 Ω; duration 1 min
Line-conducted RF amplitude-modulated IEC 61000-4-6, class III	10 V; 150 kHz to 80 MHz; AM 80 %; 1 kHz
Power frequency magnetic field IEC 61000-4-8; class IV; EN 60255-6	30 A/m; 50 Hz, continuous 300 A/m for 3 s; 50 Hz; 0.5 mT, 50 Hz
Oscillatory surge withstand capability ANSI/IEEE C37.90.1 (common mode)	2.5 to 3 kV (peak), 1 MHz to 1.5 MHz decaying oscillation; 50 shots per s; duration 2 s; R_i = 150 Ω to 200 Ω
Fast transient surge withstand capability ANSI/IEEE C37.90.1 (common mode)	4 to 5 kV; 10/150 ns; 50 shots per s both polarities; duration 2 s; R_i = 80 Ω
Radiated electromagnetic interference ANSI/IEEE C37.90.2	10 to 20 V/m; 25 to 1000 MHz; amplitude and pulse-modulated
High-frequency test Document 17C (SEC) 102	2.5 kV (peak, alternating polarity) 100 kHz, 1 MHz, 10 and 50 MHz, decaying oscillation; R_i = 50 Ω

EMC tests for interference emission; type tests

Standard	EN 50081- (generic standard)
Conducted interference voltage on lines, auxiliary voltage only, EN 55022, VDE 0878 Part 22, CISPR 22, limit value, limit class B	150 kHz to 30 MHz
Interference field strength EN 55011, VDE 0875 Part 11, IEC CISPR 11, limit value, limit class A	30 to 1000 MHz

Mechanical dynamic tests

Vibration, shock stress and seismic vibration

During operation

Standards	IEC 60255-21; IEC 60068-2
Vibration IEC 60255-21-1, class I IEC 60068-2-6	Sinusoidal 10 to 60 Hz; ± 0.035 mm amplitude; 60 to 150 Hz; 0.5 *g* acceleration; sweep rate 1 octave/min; 20 cycles in 3 orthogonal axes
Shock IEC 60255-21-2, class I	Half-sine 5 *g* acceleration, duration 11 ms, 3 shocks in each direction of 3 orthogonal axes
Seismic vibration IEC 60255-21-3, class I IEC 60068-2-6	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) Sweep rate 1 octave/min 1 cycle in 3 orthogonal axes

During transport

Standards	IEC 60255-21; IEC 60068-2
Vibration IEC 60255-21-1, class II IEC 60068-2-6	Sinusoidal 5 Hz to 8 Hz: ±7.5 mm amplitude 8 Hz to 150 Hz: 2 *g* acceleration Sweep rate 1 octave/min 20 cycles in 3 orthogonal axes
Shock IEC 60255-21-2, class I IEC 60068-2-27	Half-sine Acceleration 15 *g*, duration 11 ms, 3 shocks Shocks in each direction of 3 orthogonal axes
Continuous shock IEC 60255-21-2, class I IEC 60068-2-29	Half-sine Acceleration 10 *g*, duration 16 ms, 1000 shocks in each direction of 3 orthogonal axes

Technical data

Climatic stress test

Temperatures

Standards	EN 60255-6, IEC 60255-6 DIN VDE 0435 Part 303	
Recommended temperature	-5 to +55 °C (>55 °C/131 °F decreased display contrast)	
Limit temperature		
During service	-20 to +70 °C	- 4 to +158 °F
During storage	-25 to +55 °C	-13 to +131 °F
During transport (Storage and transport with standard works packing!)	-25 to +70 °C	-13 to +158 °F

Humidity

It is recommended to arrange the units in such a way that they are not exposed to direct sunlight or pronounced temperature changes that could cause condensation	Mean value per year ≤ 75 % relative humidity, on 30 days a year up to 95 % relative humidity, condensation not permissible!

Functions

Line differential protection

Note	All current values refer to the symmetrical current using standard connection
Setting ranges	
Current threshold I_1 (release by local station current)	$I/I_{N\,Line}$: 0 to 1.5 (step 0.01)
Differential current	$I/I_{N\,Line}$: 0.5 to 2.5 (step 0.01)
Delay time t	0 to 60 s (step 0.01 s)
Restraint by 2nd harmonic (see Fig. 7/4)	
$2f_N/f_N$	10 to 80 %
Reset ratio	Approx. 0.7 – drop-off ratio ($I_{Restraint} = 0$)
Inherent delays	
TRIP time for two-end supply at 4 x set value	Approx. 20 to 28 ms without restraint by 2nd harmonic Approx. 32 to 42 ms with restraint by 2nd harmonic
Drop-off time	Approx. 35 ms
Tolerances at preset values under reference conditions	
Local station current threshold	± 3 % of setpoint, min. 0.02 x I_N
Differential current	± 5 % of setpoint, min. 0.02 x I_N
Influence parameters	
Auxiliary supply voltage $0.8 \le V_{aux}/V_{auxN} \le$ x 1.15	≤ 1 %
Temperature in range $0\,°C \le \Theta_{amb} \le 40\,°C$	≤ 1 %/10 K
Frequency in range $0.9 \le f/f_N \le 1.1$	≤ 4 %
Pilot wires	
Number	2 Symmetric telephone pairs are recommended with loop resistance 73 Ω/km and capacitance 60 nF/km
Core-to-core asymmetry at 800 Hz	Max. 10^{-3}
Maximum loop resistance	1200 Ω
Permissible induced longitudinal voltages	
On direct connection of the pilot wires	≤ 1.2 kV, however, max. 60 % of the test voltage of the pilot wires
For connection via isolating transformer	≥ 1.2 kV, however, max. 60 % of the test voltage of the pilot wires and max. 60 % of the test voltage of the isolating transformers
Pilot-wire monitoring and intertripping (optional)	
Monitoring signal	2000 Hz, pulse-code modulation
Alarm signal delay	1 to 60 s (step 1 s)
Inherent delay time of intertripping	Approx. 65 ms
Extension of the intertripping signal	0 to 5 s (step 0.01 s)

Emergency overcurrent protection

Setting ranges	
Overcurrent pickup value I_{M1} / I_{Nline}	0.1 to 15 (step 0.1)
Delay time	0.0 to 60 s (step 0.01 s)

Remote trip

Note	Tripping of the remote end circuit-breaker for units with pilot-wire monitoring only
Setting ranges	
Prolongation time for transmission to remote station	0 to 60 s (step 0.01 s)
Delay time for reception from the remote station	0 to 60 s (step 0.01 s)
Prolongation time for reception from the remote station	0 to 60 s (step 0.01 s)
Tolerances	
Delay time/release delay	1 % and 10 ms respectively
Inherent delay	
Transmission time without delay	Approx. 80 ms

Lockout function

Lockout seal-in of trip command	For differential protection and remote trip until reset
Lockout reset	By means of binary input and/or local operator panel/DIGSI

Additional functions

Operational measured values	
Operational currents	I_1, I_2, I_{Diff}, $I_{restraint}$
Measurement range	0 to 240 % I_N
Tolerance (I_1)	3 % of rated value or of measured value
Fault event recording	Storage of the events relating to the last 8 faults
Time-tagging	
Resolution for operational events	1 s
for fault events	1 ms
Fault recording (max. 8 faults)	
Storage time (from response or trip command)	Total of 5 s max., pre-trigger and post-fault time settable
Maximum length per recording T_{max}	0.30 to 5.00 s (step 0.01 s)
Pre-trigger time T_{pre}	0.05 to 0.50 s (step 0.01 s)
Post-fault time T_{post}	0.05 to 0.50 s (step 0.01 s)
Time resolution at 50 Hz	1 instantaneous value per 1.66 ms
Time resolution at 60 Hz	1 instantaneous value per 1.38 ms
Circuit-breaker test	Using test circuit

Technical data

4AM4930 summation current transformer

Power consumption in the circuit with standard connection L1-L3-E (Fig. 7/6) referred to the through-flowing rated current (7SD600 unit in operation).

I_N		in phase (approx. VA) L1	L2	L3
1 A	Single-phase	2.2	1.3	1.7
	Symmetrical three-phase	0.6	0.2	0.35
5 A	Single-phase	3.5	1.5	2.2
	Symmetrical three-phase	0.7	0.2	0.5

	Connections	4AM4930-7DB I_N = 1 A	4AM4930-6DB I_N = 5 A
CT rated current			
Number of turns			
Primary windings	A to B	5	1
	C to D	10	2
	E to F	15	3
	G to H	30	6
	I to K	30	6
	K to L	30	6
	L to M	60	12
Secondary windings	Y to Z	1736	1736
Thermal rating			
Continuous current in Amperes	A to B	4.5	20
	C to D	4.5	20
	E to F	4.5	20
	G to H	4.5	20
	I to K	1.2	6.5
	K to L	1.2	6.5
	L to M	1.2	6.5
	Y to Z	0.2	0.2
Secondary rated current with standard connection (see Fig. 7/6) and symmetrical 3-phase current	Y to Z	20 mA	20 mA

Requirements for the current transformers (CT)

$$K'ssc \geq \frac{I_{scc\,max\,(ext.\,fault)}}{I_{pn}}$$

and:

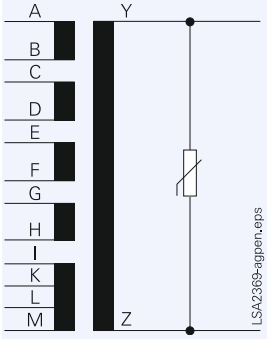
$$\frac{3}{4} \leq \frac{(K'_{ssc} \cdot I_{pn})_{end1}}{(K'_{ssc} \cdot I_{pn})_{end2}} \leq \frac{4}{3}$$

K'_{ssc1} = effective symmetrical short-circuit current factor end 1

K'_{ssc2} = effective symmetrical short-circuit current factor end 2

$I_{scc\,max}$ = maximum symmetrical short-circuit current

I_{pn} = CT rated primary current



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.

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.
7SD60 numerical pilot-wire current comparison protection relay	*7SD600☐-☐☐A☐0-☐DA0*
Rated current; rated frequency	
20 mA, 50/60 Hz; without external summation current transformer	*0*
1 A, 50/60 Hz; with external summation CT 4AM4930-7DB00-0AN2	*1*
5 A, 50/60 Hz; with external summation CT 4AM4930-6DB00-0AN2	*5*
Rated auxiliary voltage	
24, 48 V DC	*2*
60, 110, 125 V DC	*4*
220, 250 V DC, 115 V AC, 50/60 Hz	*5*
Unit design	
For panel surface mounting with terminals at the side	*B*
with terminals on top and bottom	*D*
For panel flush mounting or cubicle mounting	*E*
Operating language	
English – alternatively either German or Spanish can be selected	*0*
Scope of functions	
Differential protection	*0*
Differential protection, inrush restraint	*1*
Differential protection, pilot-wire monitoring, remote trip	*2*
Differential protection, pilot-wire monitoring, remote trip, inrush restraint	*3*

Accessories

DIGSI 4

Software for configuration and operation of Siemens protection units running under MS Windows (Windows 2000 or 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 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 and 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*

Accessories

Description	Order No.
*Converter R232 (V.24) - RS485**	
With connecting cable 1 m, PC adapter, with plug-in power supply unit 230 V AC	*7XV5700-0□□00*[1]
With plug-in power supply unit 110 V AC	*7XV5700-1□□00*[1]
Converter RS485-FO	
Rated auxiliary voltage 24 to 250 V DC and 250 V AC	
Single optical interface	*7XV5650-0BA00*
Double optical interface (cascadable)	*7XV5651-0BA00*
Summation current transformer	
1 A, 50/60 Hz, for 7SD600	*4AM4930-7DB00-0AN2*
5 A, 50/60 Hz, for 7SD600	*4AM4930-6DB00-0AN2*
Isolating transformer	
Up to 20 kV	*7XR9513*
Up to 5 kV	*7XR9515*
Manual for 7SD60	
English	*E50417-G1176-C069-A3*

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1) Possible versions see part 13.

* RS485 bus system up to 115 kbaud
RS485 bus cable and adaptor
7XV5103-□AA□□; see part 13.

Connection diagram

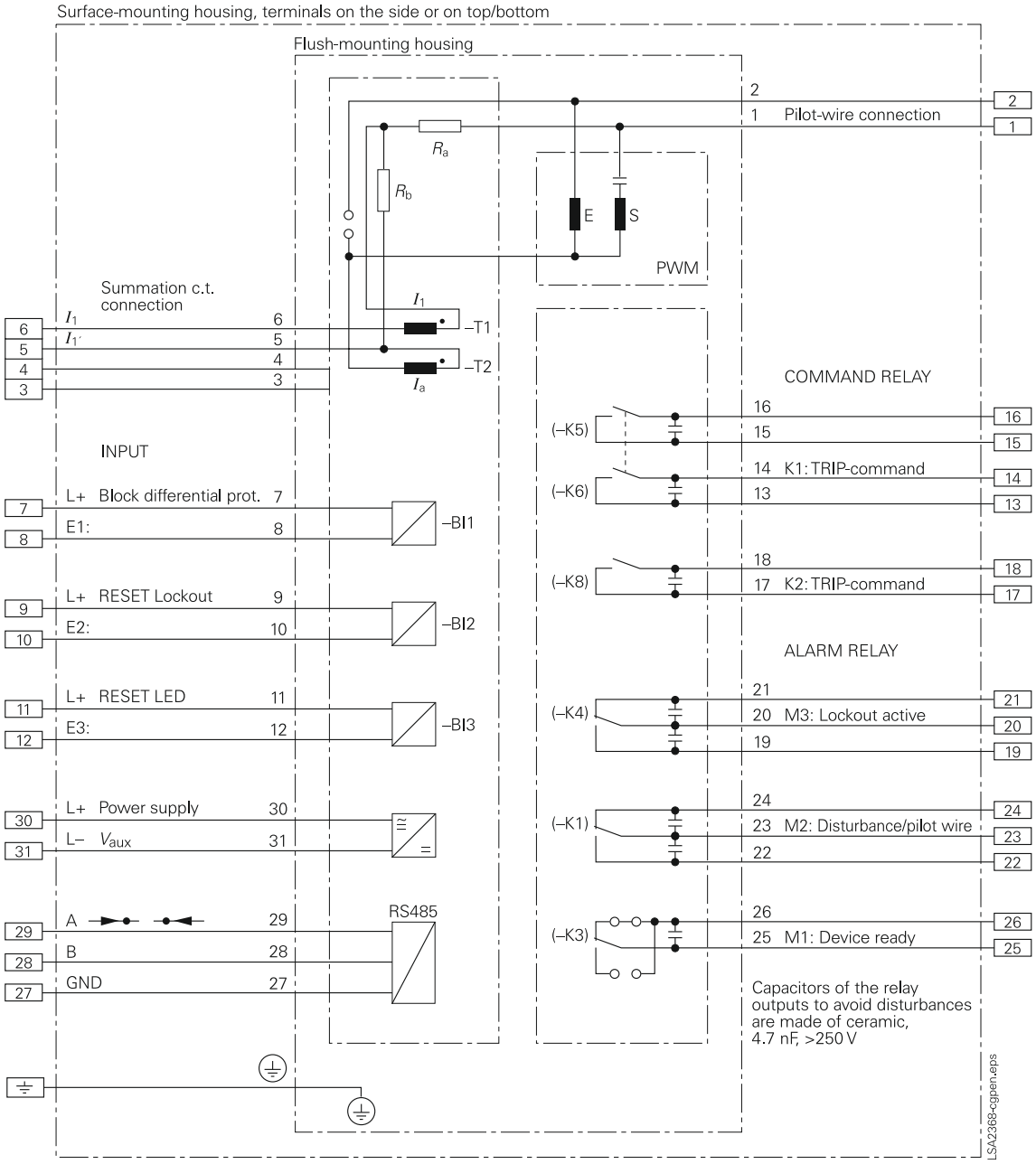

Fig. 7/9 Connection diagram of the 7SD60 current differential protection