

## SIPROTEC 7VH60 High-Impedance Differential Protection Relay



Fig. 9/33 SIPROTEC 7VH60 high-impedance protection relay

### Function overview

- Robust static design
- Auxiliary DC supply monitor
- Fast operating time (15 ms)
- Simple pickup voltage setting by resistors through shorting links
- LED alarm indicator
- Option “Bus-wire alarm” (supervision)
- Option “Blocked external” by binary input
- Wide-range auxiliary power supply
- Latched trip contact (lockout function). Reset by binary input.
- Adjustable max. voltage pickup setting by a jumper between 60 V or 240 V

### Description

The SIPROTEC 7VH60 relay is designed for fast and selective differential protection based on the high-impedance circulating current principle. It is used for the protection of machine stator windings, busbars and transformer and reactor windings against phase-to-phase and phase-to-earth short-circuits.

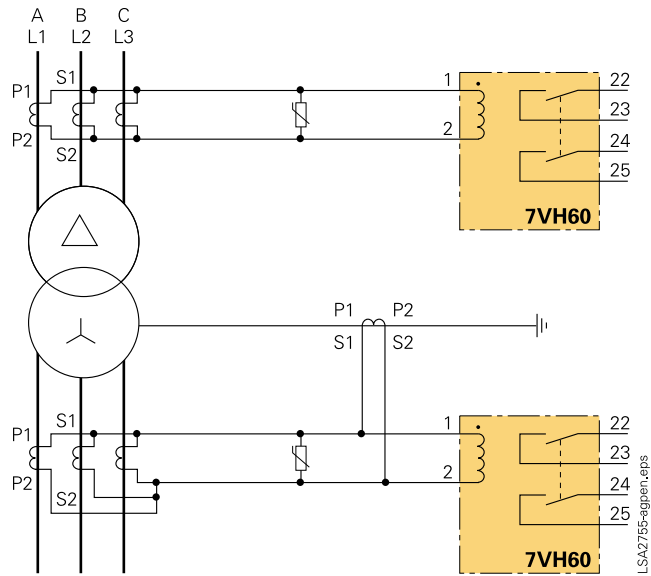
As an option, the relay includes a bus-wire supervision and the differential function can be blocked by a binary input.

**Application**

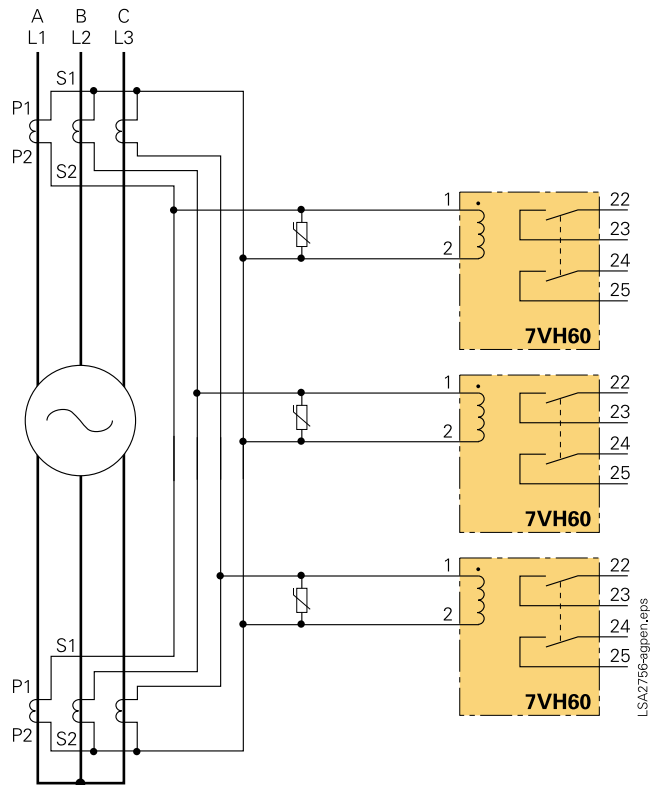
The relatively simple electronic design of the 7VH60 provides a robust and reliable relay suitable for all high-impedance circulating-current protection applications.

The use of a static measuring circuit ensures constant and fast tripping times.

Optionally, the relay is available with a bus-wire supervision feature. If during operation a differential current above the supervision pickup threshold but below the relay pickup voltage is detected, the differential protection is blocked after a selectable span of time. The bus-wire supervision pickup threshold is settable by means of jumpers. Likewise, the delay time for pickup of the supervision can be set by jumpers within a range between 1 s and 10 s.



**Fig. 9/34** Restricted earth-fault protection of power transformer windings



**Fig. 9/35** Differential protection of a generator or busbar

### Construction

The SIPROTEC 7VH60 high-impedance differential relay contains all the components needed for:

- Acquisition and evaluation of measured values
- Operation and LED display
- Output of trip commands and signals
- Input and evaluation of binary signals
- Auxiliary voltage supply.

All protection functions including the DC/DC converter are accommodated on a printed circuit board of double-height Eurocard format.

An earthing screw is provided at the housing to which earthing strips can be connected in order to ensure low-impedance earthing.

The heavy-duty current plug connector provides automatic shorting of the CT circuits whenever the module is withdrawn.

There are two unit versions available.

The flush-mounting and cubicle-mounting versions have their terminals accessible from the rear.

The surface-mounting version has the terminals accessible from the front.



Fig. 9/36

### Protection functions

The 7VH60 relay is a single-pole sensitive current relay. The AC input impedance of the relay is adjusted by means of a series of high-wattage resistors. The relay setting in voltage pickup value is effected by removing shorting links from the rear terminals. When a shorting link is screwed between the terminals, the resistor is shorted out and when the shorting link is removed, the resistor is in circuit.

Each resistor has a voltage value which is the pickup current of 20 mA multiplied by the resistors ohmic value. The relay voltage setting is determined by adding up the voltage drops at the resistors which are not shorted out by shorting links (series resistors in circuit) plus a minimum base voltage setting. A maximum setting of 60 V (shorting links of the left side) or 240 V (shorting links on the right side) is possible. On delivery, the shorting links are pre-installed in either right-side or left-side position, depending on the ordered version.

The input from the CT varistor is connected to terminals 1 and 2. The sensitive relay input transformer galvanically isolates the relay static measuring circuit from the main current transformers.

The AC measured current is filtered and rectified to a proportional DC voltage. This voltage is monitored by a Schmidt trigger circuit. If the set DC voltage, equivalent to the relay rated operating current of 20 mA is exceeded, then the trigger operates to energize the trip contact as well as the operation LED.

The auxiliary DC supply is connected to terminals 30 and 31. An auxiliary DC supply monitoring circuit consisting of a green LED and an NO/NC relay contact is provided to indicate the status of the DC supply.

### Technical data

#### General unit data

#### Measuring circuits

Pickup current	20 mA
Max. settings	
24 V version	240 V <sup>1)</sup>
6 V version	60 V
Rated frequency $f_N$	50/60 Hz
Thermal rating of current input	
10 s	2 x setting (volts)
For 1 s	5 x setting (volts)
Tripping threshold (in steps of 6 V)	Max. 60 V <sup>1)</sup>
Hysteresis is 0.875 - 0.975 times the tripping voltage	
Tripping threshold (in steps of 24 V)	Max. 240 V
Tripping time	
2 x setting	< 30 ms
3 x setting	< 20 ms
5 x setting	< 13 ms
Reset time	20 ms

#### Bus-wire supervision circuit (option)

Pickup threshold settable by jumpers (in steps of 10 %)	10 - 70 % of tripping threshold Factory setting 20 %
Time delay settable by jumpers (in steps of 1 s)	1 - 10 seconds Factory setting 5 s

1) With a jumper, the max. setting range can be changed from 60 to 240 V.

## Technical data

**Auxiliary voltage**

Auxiliary voltage supply via integrated wide-range power supply

Rated auxiliary DC voltage $V_{aux}$	24 to 250 V DC
Permissible voltage ranges	19.2 to 300 V DC
Superimposed AC voltage, peak-to-peak	< 12 % of the power supply voltage
Power consumption	
Quiescent	4 W
Energized	5 W
Bridging time in the event of power failure/short-circuit of the auxiliary supply voltage	> 50 ms at $V > 110$ V > 10 ms at $V > 24$ V DC
Rated auxiliary AC voltage $V_{aux}$ , 50/60 Hz	115 V AC, 230 V AC
Permissible voltage ranges (AC)	88 to 133 V, 176 to 265 V

**Command relay (trip)**

Number of relays	1
Number of contacts	2 NO
Switching capacity	
Make	1000 W/VA
Break	30 W/VA
Switching voltage	250 V
Permissible current	5 A continuous 30 A for 0.5 s

**Alarm relays**

2 alarm relays	1 for service 1 for supervision (option)
Contacts per relay	1 NC (service) 1 NO (supervision - option)
Switching capacity	
Make	1000 W/VA
Break	30 W/VA
Switching voltage	250 V
Permissible current	5 A

**Binary inputs**

Number	1 for external reset 1 for external block
Rated voltage range	24 to 250 V DC, bipolar
Current consumption, energized	Approx. 1.8 mA (independent of the control voltage)
Operating points	Settable by jumpers
For rated voltages 24/48/60 V DC	$V_{pickup} > 17$ V DC $V_{drop-off} < 8$ V DC
For rated voltages 110/125/220/250 V DC	$V_{pickup} > 74$ V DC $V_{drop-off} < 45$ V DC
Maximum permissible voltage	300 V DC

**LEDs**

LED	Green	Service
LED	Red	Blocked
LED 1	Red	Trip stored
LED 2	Red	Bus-wire alarm (supervision)
LED 3	Red	Trip blocked (external)
LED 4	Red	Trip not started (Test)

**Electrical tests****Specification**

Standards	IEC 60255-5
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**Insulation tests**

High-voltage test (100 % test) all circuits except for power supply and binary inputs	2.5 kV (r.m.s.), 50/60 Hz
High-voltage test (100 % test) only power supply and binary inputs	3.5 kV DC
Impulse voltage test (type test) all circuits, class III	5 kV (peak value); 1.2/50 $\mu$ s; 0.5 J; 3 positive and 3 negative impulses at intervals of 5 s

**EMC tests for interference immunity; type test**

Standards	IEC 60255-6 and 60255-22 (product standards) EN 50082-2 (generic standard) DIN 57435 Part 303 EN 50263 (product standard)
High-frequency test IEC 60255-22-1, class III and VDE 0435 part 303, class III	2.5 kV (peak); 1 MHz; $\tau = 15$ $\mu$ s; 400 surges per s; test duration 2 s
Electrostatic discharge IEC 60255-22-2, class III and IEC 61000-4-2, class III	4 kV/6 kV contact discharge; 8 kV air discharge, both polarities; 150 pF; $R_i = 330$ $\Omega$
Irradiation with radio-frequency field, non-modulated IEC 60255-22-3 (report) class III	10 V/m; 27 MHz to 500 MHz
Irradiation with radio-frequency field, non-modulated IEC 61000-4-3, class III	10 V/m; 80 MHz to 1000 MHz; 80 % AM; 1 kHz
Irradiation with radio-frequency field, pulse-modulated IEC 61000-4-3/ENV 50204, class III	10 V/m; 900 MHz; repetition frequency 200 Hz; duty cycle of 50 %
Fast transient interference/burst IEC 60255-22-4 and IEC 6100-4-4, class IV	4 kV; 5/50 ns; 5 kHz; burst length = 15 ms; repetition rate 300 ms; both polarities; $R_i = 50$ $\Omega$ ; test duration 1 min
High-energy surge voltages (Surge), IEC 61000-4-5; class III	
Power supply	Common mode: 2 kV; 12 $\Omega$ ; 9 $\mu$ F Diff. mode: 1 kV; 2 $\Omega$ ; 18 $\mu$ F
Measuring inputs, binary inputs and relay outputs	Common mode: 2 kV; 42 $\Omega$ ; 0.5 $\mu$ F Diff. mode: 1 kV; 42 $\Omega$ ; 0.5 $\mu$ F
Line-conducted HF, amplitude-modulated; IEC 6100-4-6, class III	10 V; 150 kHz to 80 MHz; 80 % AM; 1 kHz
Power frequency magnetic field; 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

Selection and ordering data

Description	Order No.
<i>7VH60 high-impedance differential protection relay</i>	<i>7VH600□-□□A□0-□AA0</i>
<i>Varistor pickup voltage</i>	
Without varistor	0
With varistor up to 125 V <sub>rms</sub> , 600 A/1S/S256	1
With varistor 125 V <sub>rms</sub> to 240 V <sub>rms</sub> , 600 A/1S/S1088	2
<i>With integrated converter</i>	
24 V to 250 V DC / 80 V to 264 V AC	0
<i>Unit design</i>	
For panel surface mounting with terminals at the side (7XP20 housing)	B
For panel flush mounting or cubicle mounting with terminals at the back (7XP20 housing)	E
<i>Factory setting for pickup voltage</i>	
60 V <sup>1)</sup>	1
240 V <sup>1)</sup>	2
<i>Additional functions</i>	
Settable command lockout	0
Settable command lockout, bus-wire supervision	1

Accessories

External shorting link	C73334-A1-C34-1
Varistor up to 125 V <sub>rms</sub> ; 600 A/1S/S256	W73028-V3125-A1
Varistor 125 V <sub>rms</sub> to 240 V <sub>rms</sub> ; 600 A/1S/S1088	W73028-V3300-A2

1) (Can be modified by shorting links and jumper X51).

Connection diagram

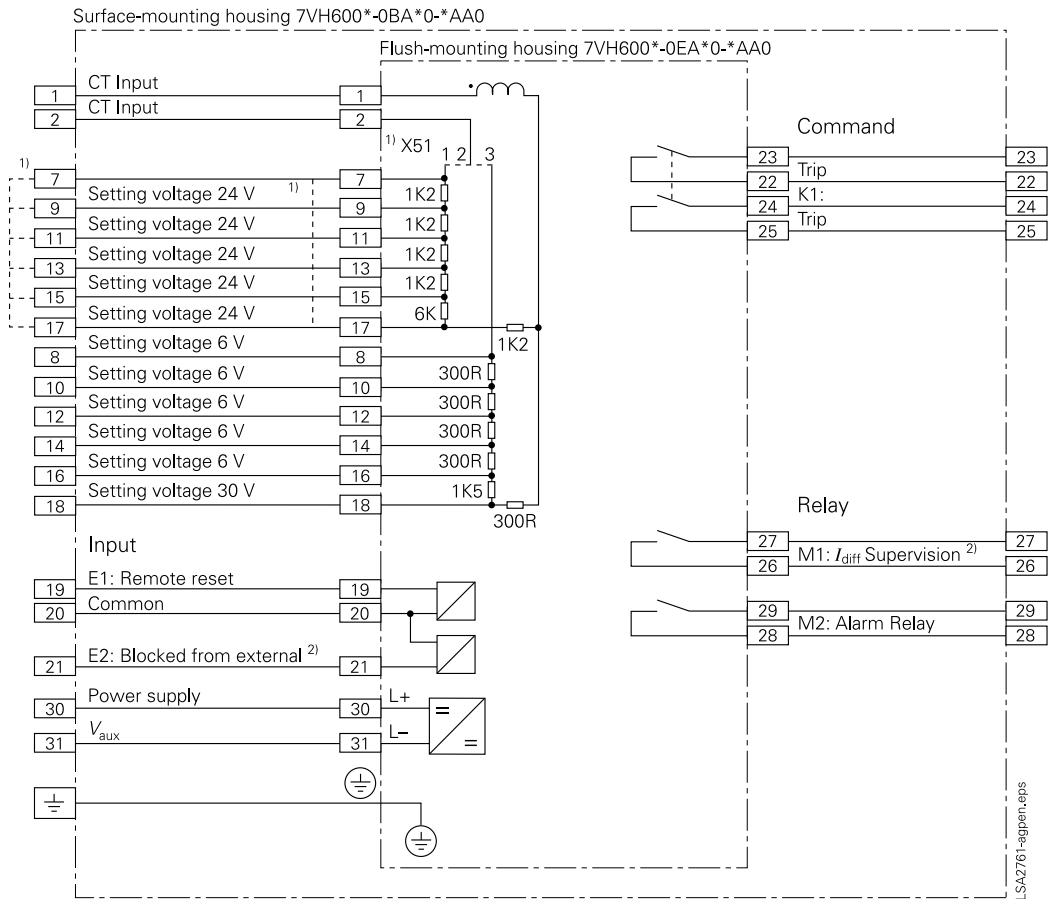


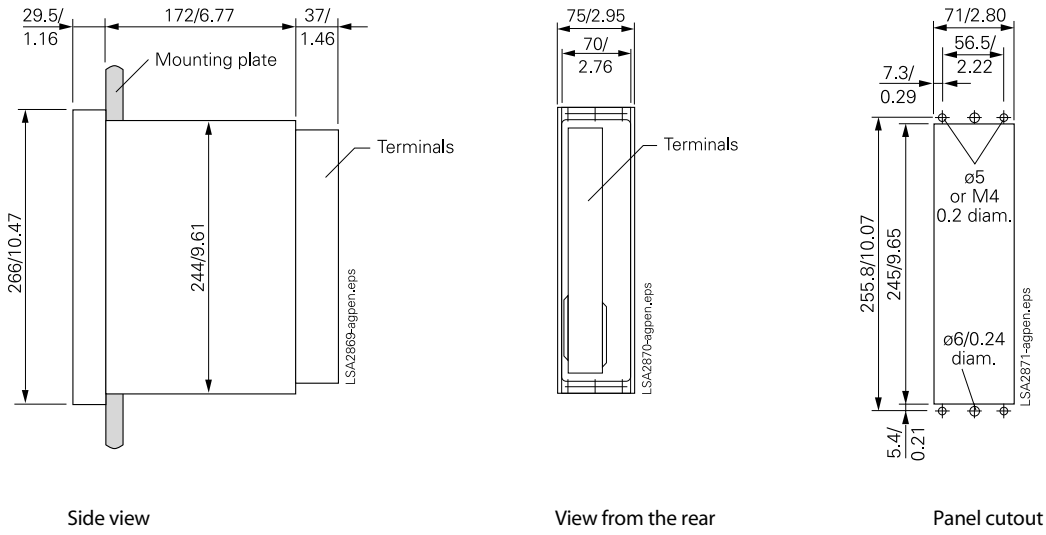
Fig. 9/37 Connection diagram

1) Delivery condition of connectors for 24 V.

2) Input and contacts only available with bus-wire supervision (ordering option).

Dimension drawings in mm / inch

Dimension drawings for 1/6 x 19" housing (7XP20)



**Fig. 17/38**  
Housing for panel flush mounting/  
cubicle mounting, terminals at rear (1/6 x 19")