SIPROTEC 7SN60
Transient Earth-Fault Protection Relay

Fig. 10/35
SIPROTEC 7SN60
transient earth-fault relay

Description

The highly sensitive 7SN60 transient earth-fault relay determines the direction of transient and continuous earth faults in systems with isolated neutral, in systems with high-impedance resistive earthing and in compensated systems. Continuous earth faults are indicated with a delay, either in conjunction with a transient earth fault and subsequently persisting displacement voltage, or with just the displacement voltage present.

Function overview

Protection functions

- Units for panel surface mounting or flush mounting in 7XP20 housing, with terminals on the side or terminals on the top/bottom
- Both fault directions indicated by LEDs and signaled by relays
- High pickup sensitivity due to separate detection and evaluation of total current and displacement voltage
- 1 A and 5 A rated current selectable for current transformer matching
- 16 selectable pickup thresholds for detection of transients in the current path, even with higher steady-state total currents of 10 to 300 mA
- Fixed pickup threshold of 5 V for detection of transients in the voltage path, even in the case of higher steady-state displacement voltages
- 4 selectable pickup thresholds for evaluation of the displacement voltage of 10 to 50 V
- Optional suppression of switching operations by evaluation of the displacement voltage after a switching-induced transient has occured
- Wide-range power supply for connection to 110/230 V AC systems, 60 to 250 V DC station batteries or 100 V DC voltage transformers without switchover or 24 to 60 V DC
- Binary inputs for remote reset and blocking with extremely wide input voltage range of 24 to 250 V DC
- Automatic reset of direction indications and signals after 3 or 10 s (selectable)
- Automatic reset in case of intermittent earth faults only after the last earth-fault, i.e. the correct indication and signal of the first earth fault is preserved
- Detection of the displacement voltage and earth-fault indication/signal, independent of a transient fault detection
- Signaling and indication of a continuous earth fault possible only in the forward direction
- Fault indication if sensitivity is set too high

Construction

The relay contains all the components needed for

- Acquisition and evaluation of measured values
- Operation and display
- Output of signals and trip commands
- Power supply

The rated CT currents applied to the SIPROTEC 7SN60 can be 1 or 5 A. This is selectable via a jumper inside the relay.

Three different housings are available. The flush-mounting/cubicle-mounting housings have terminals accessible from the rear. The surface-mounting housing has terminals either on the side or on the top and bottom.

Fig. 10/36 Rear view

Protection functions

Earth-fault directional determination

The highly sensitive 7SN60 transient earth-fault relay determines the direction of transient and continuous earth faults in systems with isolated neutral, in systems with high-impedance resistive earthing and in compensated systems.

Continuous earth faults are indicated with a delay, either in conjunction with a transient earth fault and subsequently persisting displacement voltage, or with just the displacement voltage present.

In the event of an earth fault, the neutral-point voltage to earth can be as high as the full-phase voltage.

The phase-to-earth capacitances of the non-earth-faulted phases are charged via the transformer inductance.

This charging process is bound up with a strong current surge (starting oscillation).

The amplitude of this current surge depends on the expands of the system and on the contact resistance values at the earth-fault location.

This current flows via the phase-to-earth capacitances of the unaffected lines to earth, enters the earth-faulted phase via the earth-fault location and flows back from there to the feeding transformer.

Thus the direction of the earth-fault induced current surge is identical to that of the short-circuit current at the same location.

At measuring point A, as a result of the transformer summation circuit, the earth current of the faulted line is not included in the measurement, as this current portion flows through the summation transformer of the relevant Holmgreen circuit and back, thereby canceling itself out.

It is the total of the capacitive earth currents from the non-faulted system which has an effect. In the diagram they are summated on the upper line. The capacitive currents of the non-faulted lines 1, 3 and 2, 4 accumulate vectorially, which explains why only three arrows instead of four are shown at the measuring point A.

With a transient earth fault, the equalizing current forming a damped oscillation of 100 to more than 1000 Hz decays after only a few periods.

The displacement voltage V_{EM} thereupon also returns to zero. In earthed systems this takes place after a number of periods (decay of the Petersen coil - earth capacitance oscillation circuit); in non-earthed systems this occurs after a very short time.

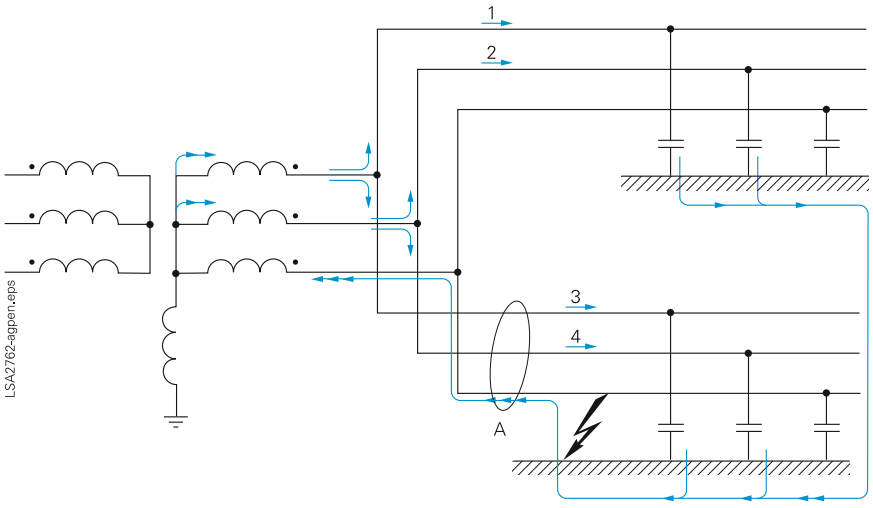

Fig. 10/37 Fault currents in the system

Protection functions

In the case of a continuous earth fault, the equalizing current in the non-earthed system changes into the mostly capacitive continuous earth current or, in compensated systems, into the relatively low residual active current.

For the directional determination, the direction of the first transient of neutral current and displacement voltage is considered.

The relay indicates the direction of the transient earth fault by LEDs (red = forward direction, yellow = reverse direction) and the relevant signaling relay pickups.

Continuous earth faults are indicated after a settable time by an LED on the relay and signaled by a signaling relay.

Detection of the fault location

If the system is of radial configuration, the red lamp immediately indicates the faulted line.

If one of the lines consists of several sections, the fault is upstream of the last red lamp.

The transient earth-fault relay can also be used without restrictions in any type of meshed systems. Transient earth-fault relays distributed at suitable points throughout the system allow detection of the earth-fault location from the directional indications.

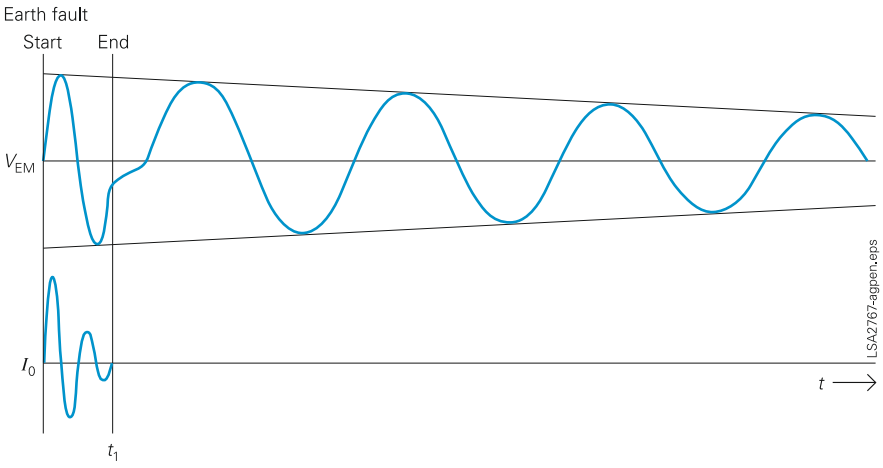

Fig. 10/38 Neutral current and displacement voltage

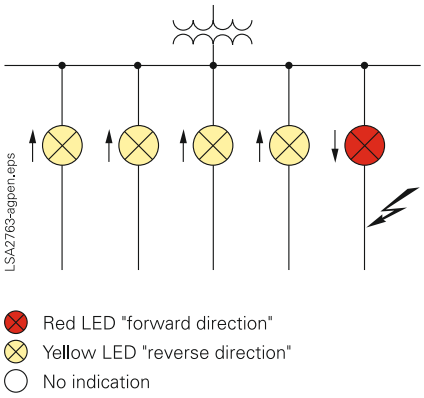

Fig. 10/39 Radial system

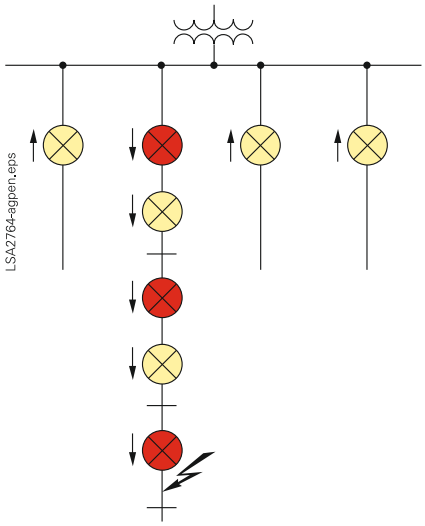

Fig. 10/40 Cascaded radial system

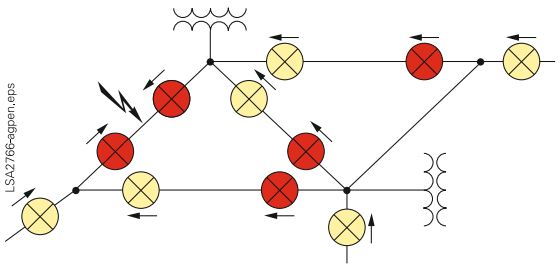

Fig. 10/41 Meshed system

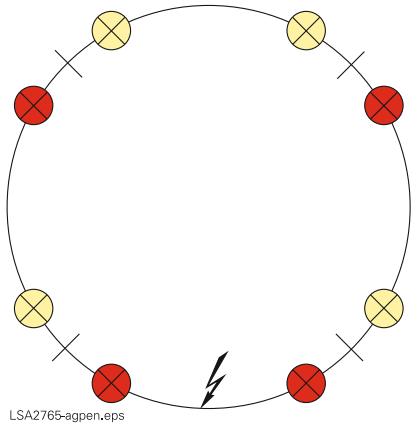

Fig. 10/42 Ring system

Typical connection

Connection of the current and voltage transformers

Figures 10/43 and 10/44 show the connection of the current and voltage transformer set in Holmgreen circuit.

In Fig. 10/43, the star point at the line-side of the CT must be connected to terminal 1 while the star point at the busbar side of the CTs must be connected to terminal 2.

The three phase voltages V_{L1}, V_{L2} and V_{L3} are connected to terminals 7, 8, 9 respectively. The earthed star point of the voltage transformer is connected to terminal 10.

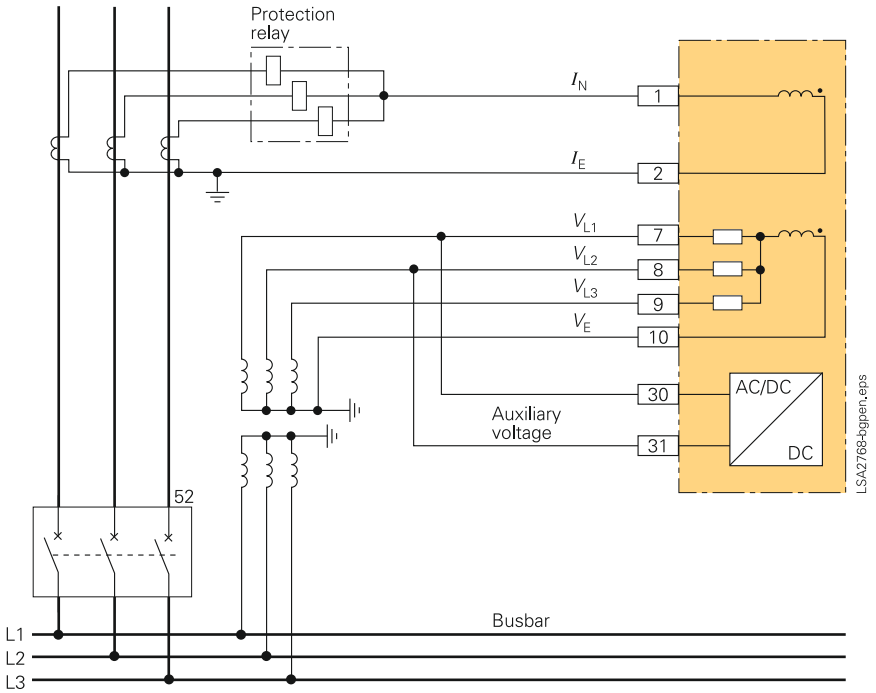

Fig. 10/43 Connection of transformers and auxiliary power supply for panel flush-mounting housing and panel surface-mounting housing (terminals on the side)

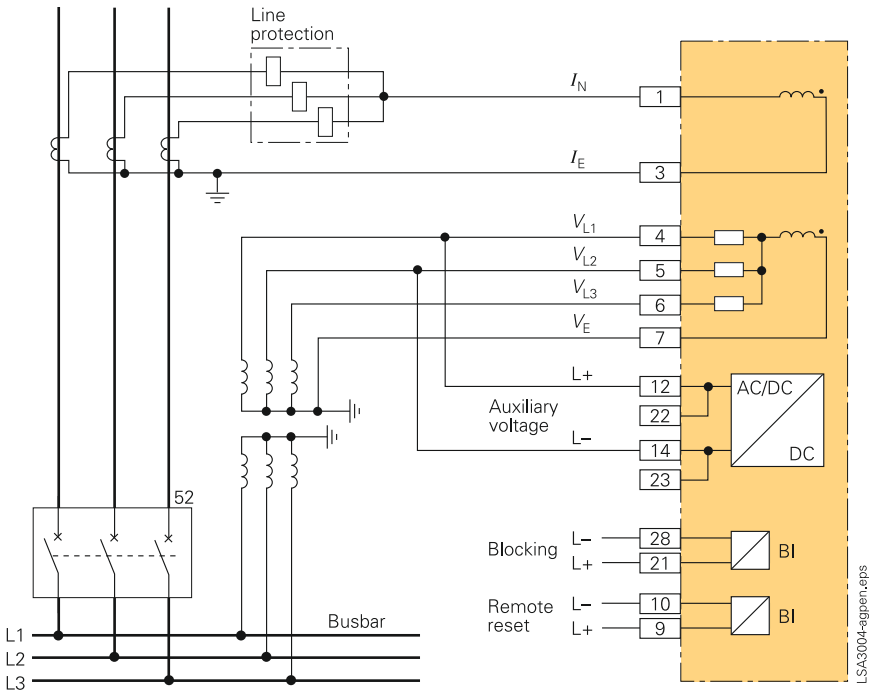

Fig. 10/44 Connection of transformers and auxiliary power supply for panel surface-mounting housing (terminals on the top/bottom)

Technical data

General unit data		
Measuring circuit		
Rated current I_0	1 or 5 A	
Input impedance Z at 50 Hz and I_N	< 0.05 Ω	
Rated voltage V_N	100/110 V AC	
Rated frequency f_N	50 Hz (16.7 Hz)	
Thermal rating		
- In voltage path, continuous	140 V AC	
- In current path, continuous	4 x I_N	
10 s	30 x I_N	
1 s (at 1 A)	100 x I_N	
1 s (at 5)	300 A	
Auxiliary voltage		
Rated auxiliary voltage V_{aux}	60 – 250 V DC and 100 – 230 V AC without switchover	
Power consumption at	Quiescent	Energized
60 V DC	3.1 W	4.5 W
110 V DC	3.0 W	4.5 W
220 V DC	3.6 W	4.6 W
250 V DC	3.7 W	4.8 W
100 V AC	2.9 VA	4.2 VA
110 V AC	3.0 VA	4.2 VA
230 V AC	4.6 VA	5.8 VA
Binary inputs		
Input voltage for blocking and remote reset input	24 - 250 V DC	
Pickup thresholds for		
– Blocking X30 pin 1-2, remote reset X31 pin 1-2	Approx. 19 V	
– Blocking X30 pin 2-3, remote reset X31 pin 2-3	Approx. 75 V	
Signaling relays		
Number of relays, forward or reverse direction	2 NO contacts	
Number of relays, continuous earth-fault signal	1 NO contact	
Number of relays, alarm	1 NC contact	
Switching capacity Make (all relays)	1000 W/VA	
Switching capacity Break (all relays)	30 W/VA	
Switching voltage	250 V AC/DC	
Permissible switching current		
Continuous	5 A	
0.5 s	30 A	
Unit design		
Housing, dimensions	SIPROTEC housing of 1/6 width Refer to part 15 for dimension drawings	
For flush mounting, terminals at the top/bottom	6 current / 25 voltage terminals	
For panel surface mounting, terminals on the side	6 current / 25 voltage terminals	
Weight	Approx. 4 kg	
Standards		
DIN VDE 0435, Part 303 and IEC 60255-5		

Selection and ordering data

Description	Order No.
7SN60 transient earth-fault protection relay	*7SN6000-☐☐A00*
In SIPROTEC housing 1/6 width Rated frequency 50 Hz	
Rated auxiliary voltage	
60 - 250 V DC and 100 - 230 V AC without switchover	*0*
24 - 48 V DC	*1*
For panel surface mounting with terminals on the side	*B*
For panel surface mounting with terminals at top/bottom part	*D*
For panel flush mounting or cubicle mounting	*E*

Connection diagram

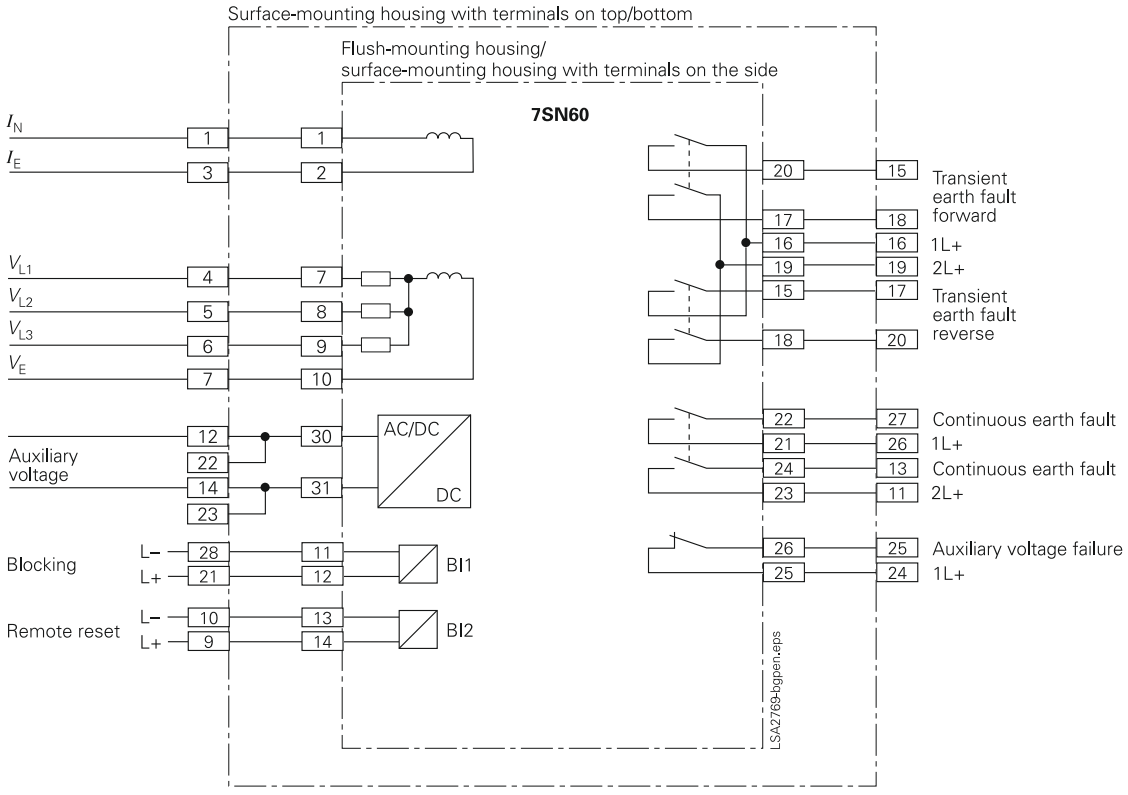

Fig. 10/45 Connection diagram