



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

### Description

The highly sensitive 7SN60 transient ground-fault relay determines the direction of transient and continuous ground faults in systems with isolated neutral, in systems with high-impedance resistive grounding and in compensated systems. Continuous ground faults are indicated with a delay, either in conjunction with a transient ground 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 occurred
- Wide-range power supply for connection to AC 110/230 V systems, DC 60 to 250 V station batteries or DC 100 V voltage transformers without switchover or DC 24 to 60 V
- Binary inputs for remote reset and blocking with extremely wide input voltage range of DC 24 to 250 V
- Automatic reset of direction indications and signals after 3 or 10 s (selectable)
- Automatic reset in case of intermittent ground faults only after the last ground-fault, i.e. the correct indication and signal of the first ground fault is preserved
- Detection of the displacement voltage and ground-fault indication/signal, independent of a transient fault detection
- Signaling and indication of a continuous ground fault possible only in the forward direction
- Fault indication if sensitivity is set too high

# Relays for Various Protection Applications/7SN60

## Construction, protection functions



Fig. 10/36 Rear view

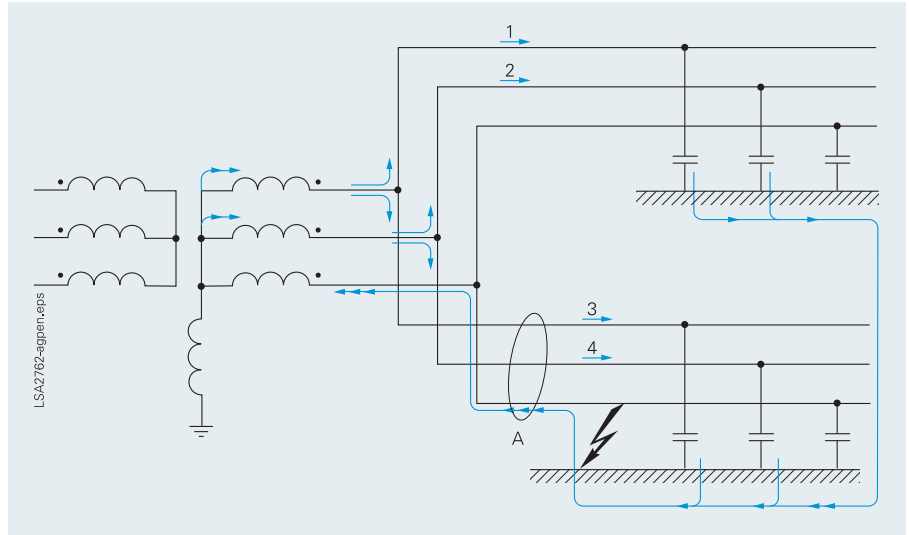


Fig. 10/37 Fault currents in the system

### 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.

### Protection functions

#### Ground-fault directional determination

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

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

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

The phase-to-ground capacitances of the non-ground-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 ground-fault location.

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

Thus the direction of the ground-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 ground 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 ground 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 ground 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 grounded systems this takes place after a number of periods (decay of the Petersen coil - ground capacitance oscillation circuit); in non-grounded systems this occurs after a very short time.

In the case of a continuous ground fault, the equalizing current in the non-grounded system changes into the mostly capacitive continuous ground 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 ground fault by LEDs (red = forward direction, yellow = reverse direction) and the relevant signaling relay pickups.

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

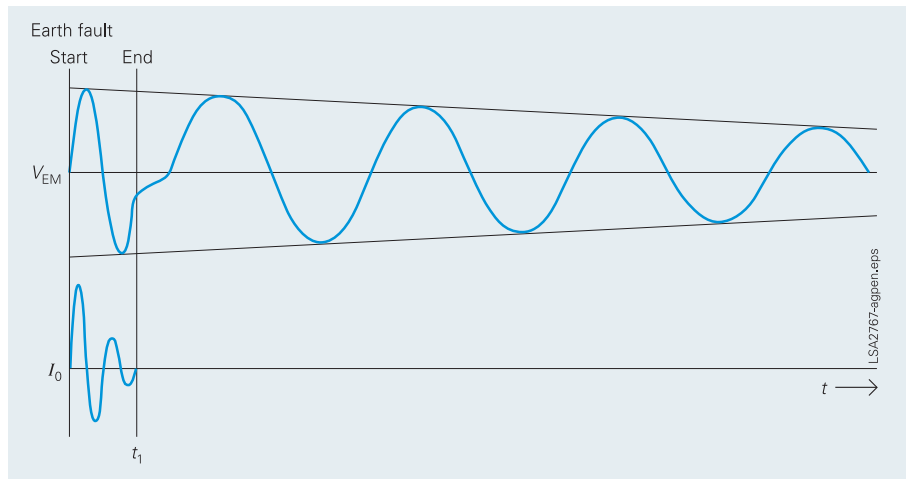


Fig. 10/38 Neutral current and displacement voltage

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

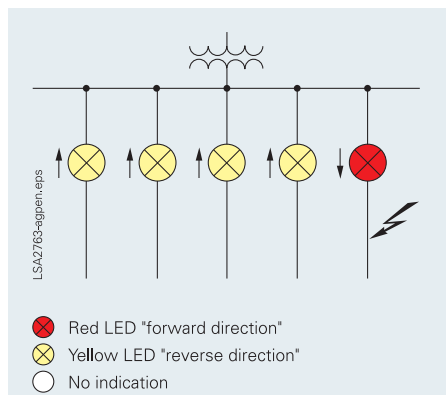


Fig. 10/39 Radial system

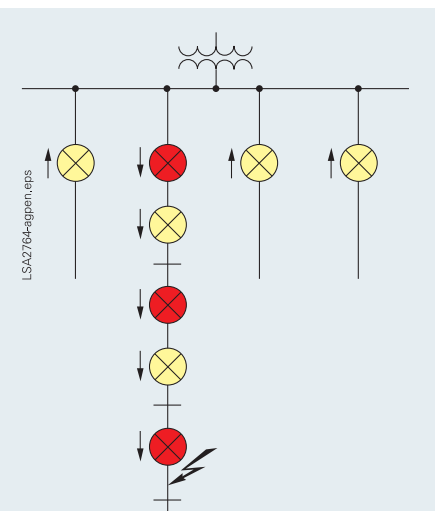


Fig. 10/40 Radial system

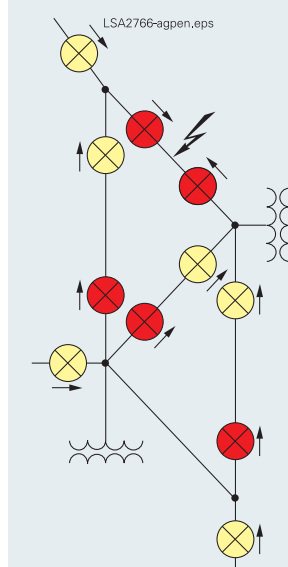


Fig. 10/41 Meshed system

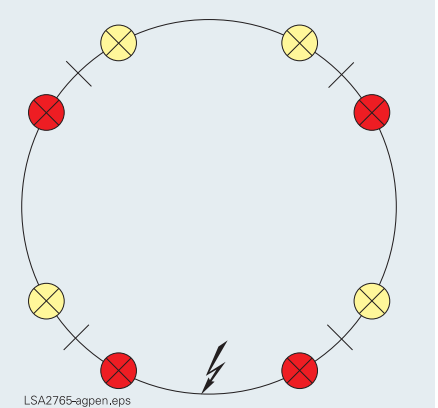


Fig. 10/42 Ring system

# Relays for Various Protection Applications/7SN60

## Typical connection

### 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 grounded star point of the voltage transformer is connected to terminal 10.

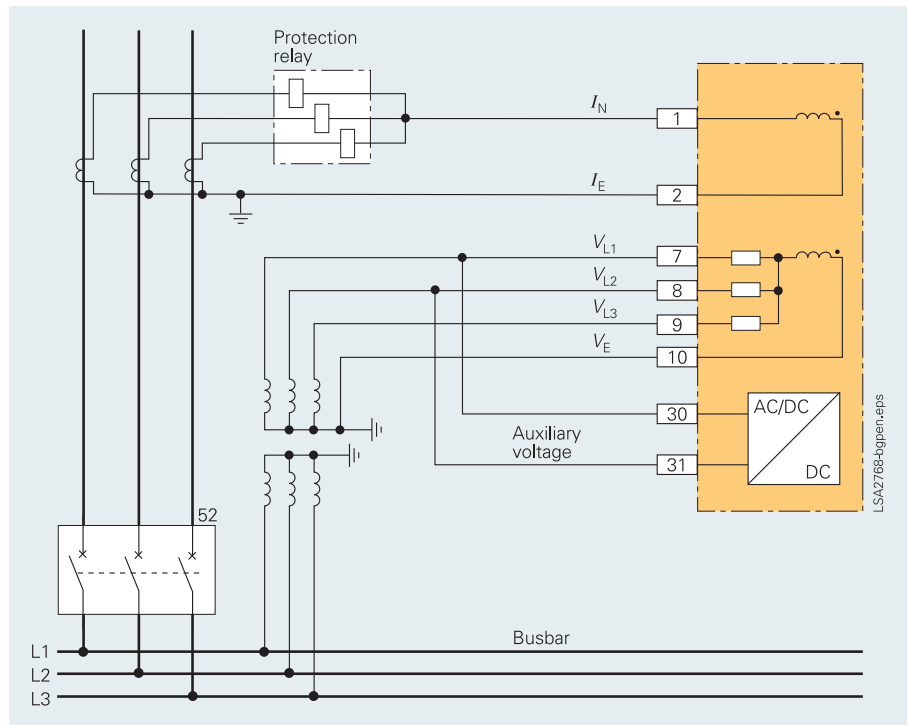


Fig. 10/43 Connection of transformers and auxiliary power supply for panel flush-mounting housing and panel surface-mounting housing (terminals on the side)

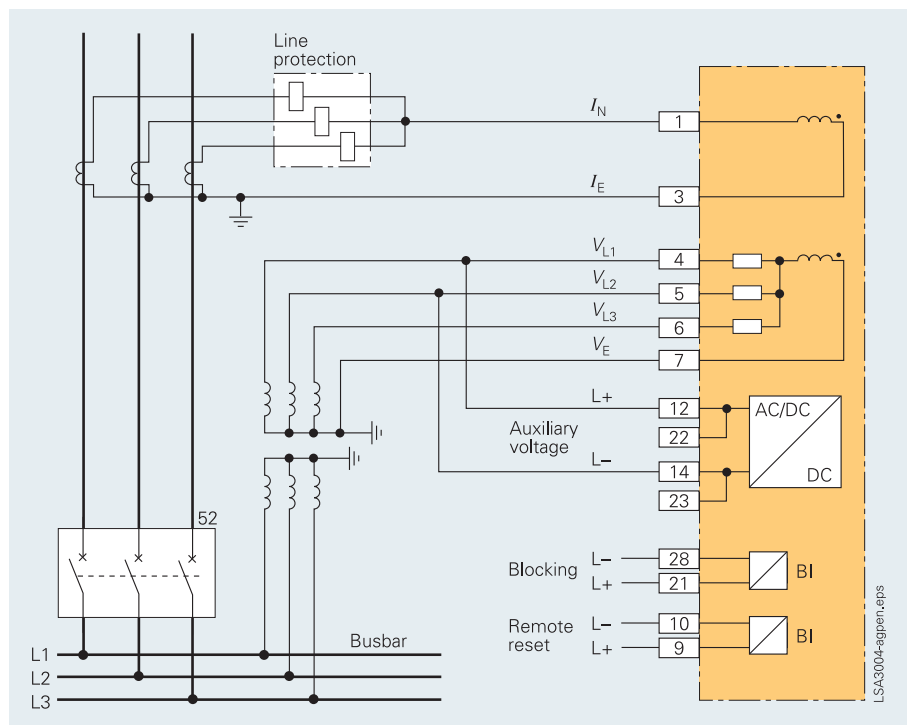


Fig. 10/44 Connection of transformers and auxiliary power supply for panel surface-mounting housing (terminals on the top/bottom)

General unit data	
<i>Measuring circuit</i>	
Rated current $I_0$	1 or 5 A
Input impedance $Z$ at 50 Hz and $I_N$	< 0.05 $\Omega$
Rated voltage $V_N$	AC 100/110 V
Rated frequency $f_N$	50 Hz (16.7 Hz)
Thermal rating	
- In voltage path, continuous	AC 140 V
- 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
<i>Auxiliary voltage</i>	
Rated auxiliary voltage $V_{aux}$	DC 60 – 250 V and AC 100 – 230 V without switchover
Power consumption at	Quiescent      Energized
DC 60 V	3.1 W      4.5 W
DC 110 V	3.0 W      4.5 W
DC 220 V	3.6 W      4.6 W
DC 250 V	3.7 W      4.8 W
AC 100 V	2.9 VA      4.2 VA
AC 110 V	3.0 VA      4.2 VA
AC 230 V	4.6 VA      5.8 VA
<i>Binary inputs</i>	
Input voltage for blocking and remote reset input	DC 24 – 250 V
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
<i>Signaling relays</i>	
Number of relays, forward or reverse direction	2 NO contacts
Number of relays, continuous ground-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	AC/DC 250 V
Permissible switching current	
Continuous	5 A
0.5 s	30 A
<i>Unit design</i>	
Housing, dimensions	SIPROTEC housing of 1/6 width Refer to part 14 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
<i>Standards</i>	
DIN VDE 0435, Part 303 and IEC 60255-5	

# Relays for Various Protection Applications/7SN60

## Selection and ordering data, connection diagram

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

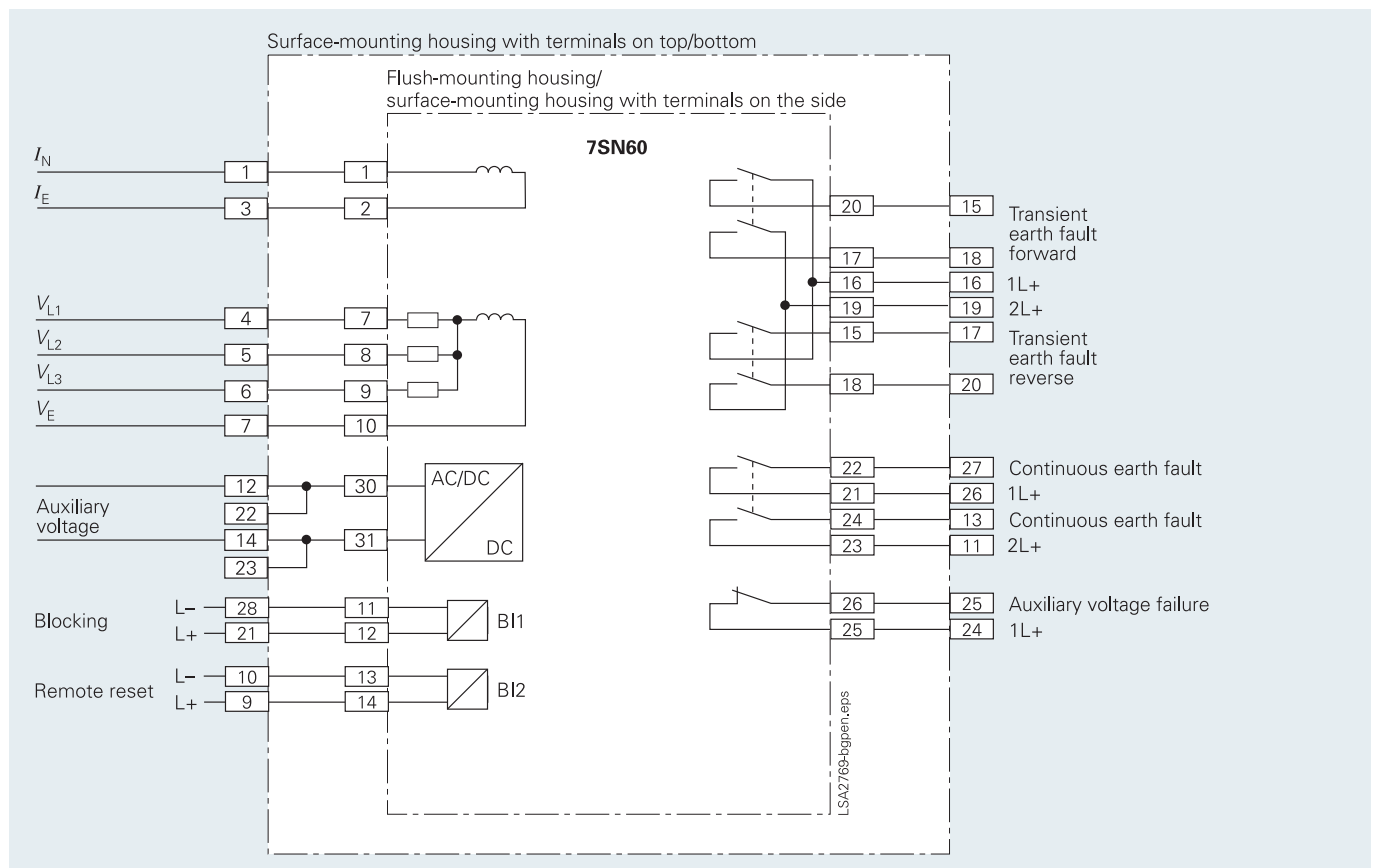


Fig. 10/45 Connection diagram

10