



Fig. 10/26 SIPROTEC 7SV600 numerical circuit-breaker failure protection relay

### Description

The SIPROTEC 7SV600 is a numerical relay used for circuit-breaker failure protection. A 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 unit. It is then necessary to trip the relevant busbar zone (section) to ensure fault clearance.

Generally, the monitoring of the current is sufficient as the criterion for the indication that the circuit-breaker has successfully cleared the fault ("current condition"). However, under certain fault conditions (e.g. overvoltage), little or no current may flow, making the measurement of current unreliable for indication of the circuit-breaker status ("no current condition"). The 7SV600 operates correctly for both these conditions. The relay is suitable for use at all voltage levels and in all applications. The current transformers can either be of the closed iron core or linear type. The relay can be incorporated in conventional switchgear systems and modem substation control systems e.g. SICAM.

### Function overview

#### Protection functions

- Circuit-breaker failure protection (single or three-pole with/without current)
- Independently settable delay times for operation with and without current
- Single or two-stage time delay of the busbar trip command
- Re-trip (cross trip) stage (1<sup>st</sup> stage of the 2-stage operation)
- Intertrip facility (via teleprotection interface)
- End-fault protection with intertrip
- "No current" control using the circuit-breaker auxiliary contacts

#### Features

- Highly sensitive current detection
- 2-out-of-4 check of the current detectors
- Short reset time, negligible overshoot time
- Can be initiated by phase-segregated or common-phase trip commands
- End-fault protection
- Assignable output relays, LEDs and binary inputs

#### Monitoring functions

- Monitoring of circuit-breaker auxiliary contacts
- Operational current measured values
- Self-supervision of the relay
- Event buffer
- Fault protocols
- Oscillographic fault recording

#### Communication interfaces

- 1 x RS485 interface
  - IEC 60870-5-103 protocol
  - DIGSI

### Hardware

- Digital inputs:
  - 3 binary inputs
- Digital outputs:
  - 4 output relays

#### Front design

- Display for operation and measured values
- 6 LEDs for local alarm

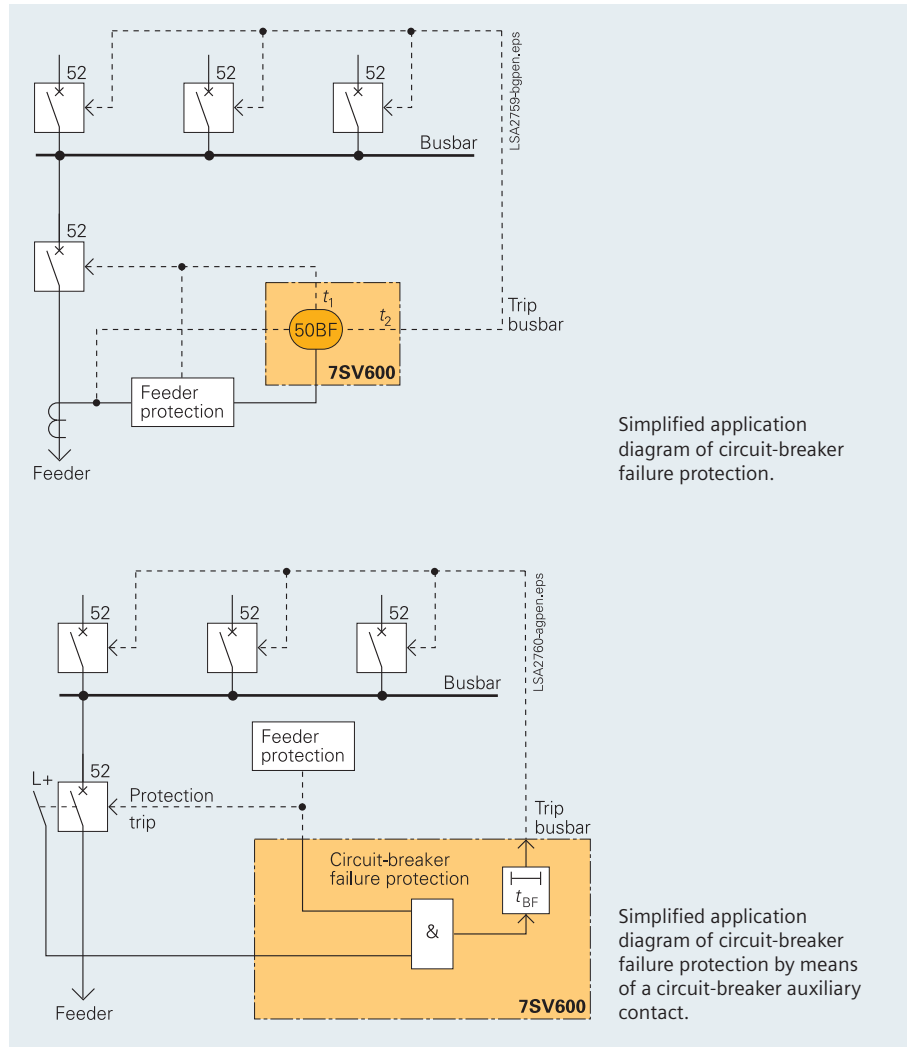
# Relays for Various Protection Applications/7SV600

## Application

### Application

The numerical circuit-breaker failure protection relay 7SV600 provides rapid backup fault clearance instruction to the associated circuit-breakers in case the circuit-breaker nearest to the fault fails to respond.

It is suitable for power systems of all voltage levels. The initiation signal can be derived from any protection or supervision equipment or, in case of manual opening, from the control discrepancy switch of the breaker. Information from the circuit-breaker auxiliary contact is required for the breaker failure protection to function during faults which produce little or no current flow (possible only with common-phase initiation).



Simplified application diagram of circuit-breaker failure protection.

Simplified application diagram of circuit-breaker failure protection by means of a circuit-breaker auxiliary contact.

Fig. 10/27 Typical applications

### Construction

The relay contains all the components needed for

- Acquisition and evaluation of measured values
- Operation and display
- Output of signals and trip commands
- Input and evaluation of binary signals
- SCADA interface (RS485)
- Power supply

The rated CT currents applied to the SIPROTEC 7SV600 can be 1 or 5 A. This is selectable via a jumper inside the relay.

Three different housings are available. The flush-mounting versions have terminals accessible from the rear. The surface-mounting version has terminals accessible from the front.

### Protection functions

The breaker failure protection can operate single-stage or two-stage. When used as single-stage protection, the bus trip command is given to the adjacent circuit-breakers if the protected feeder breaker fails. When used as two-stage protection, the first stage can be used to repeat the trip command to the relevant feeder breaker, normally on a different trip coil, if the initial trip command from the feeder protection is not successful. The second stage will result in a bus trip to the adjacent breakers, if the command of the first stage is not successful.

The bus trip command from the breaker failure protection can be routed to all circuit-breakers linked to the same busbar (section) as the breaker that failed. It can also be transmitted to the remote end by means of a suitable communication link (e.g. PLC, radio wave, or optical fiber).

The isolator replica which is necessary in case of multiple busbar sections is not part of the 7SV600 relay.

The current level is monitored in each of the three phases against a set threshold. In addition, the zero-sequence component or the negative-sequence component of the phase currents derived by symmetrical component analysis is monitored. This ensures high security against malfunction by use of a 2-out-of-4 check of the current detectors.

The version with phase-segregated initiation enables reliable breaker failure detection even during single-pole auto-reclose cycles, provided the phase-segregated trip signals of the feeder protection are connected to the 7SV600.

If the protected circuit-breaker is not operational (e.g. air pressure failure or spring not charged), instantaneous bus trip of the adjacent circuit-breakers can be achieved following a feeder protection trip, provided the relay is informed via binary input of the breaker status (possible only for common-phase initiation).



Fig. 10/28 Rear view of surface-mounting housing

An end-fault protection function is integrated in the 7SV600 relay. An end fault is a short-circuit located between the circuit-breaker and the current transformer set of the feeder. For this fault, current flow is detected, although the auxiliary contacts of the breaker indicate open breaker poles.

A command signal is generated which can be transmitted to the remote-end breaker (possible only for common-phase initiation).

Special measures are taken to prevent malfunction of the relay. Besides the mentioned 2-out-of-4 check of the current detection elements, the trip signals of the feeder protection can be connected in a redundant manner, so that they can be checked for plausibility (possible only for common-phase initiation).

Continuous monitoring of the measured values permits rapid annunciation of any fault in the instrument transformer circuits. Continuous plausibility monitoring of the internal measured value processing circuits and monitoring of the auxiliary voltages to ensure that they remain within tolerance are obviously inherent features.

# Relays for Various Protection Applications/7SV600

## Serial data transmission, connection diagrams

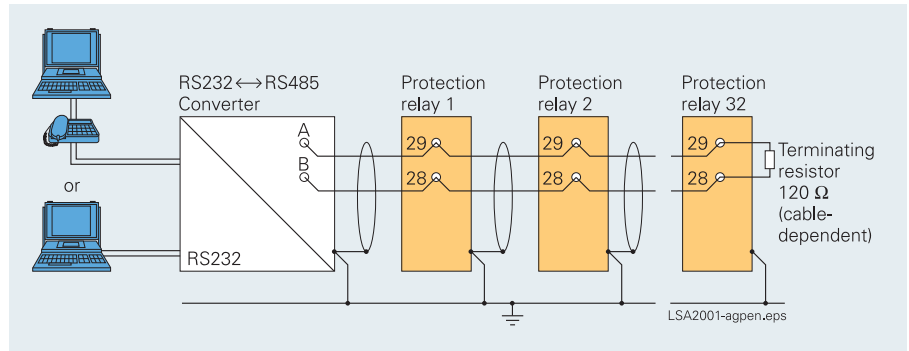
### Serial data transmission

A PC can be connected to ease setup of the relay using the Windows-based program DIGSI which runs under MS-Windows.

It can also be used to evaluate up to 8 oscillographic fault records, 8 fault logs and the operational event buffer. As an option, a system interface is available.

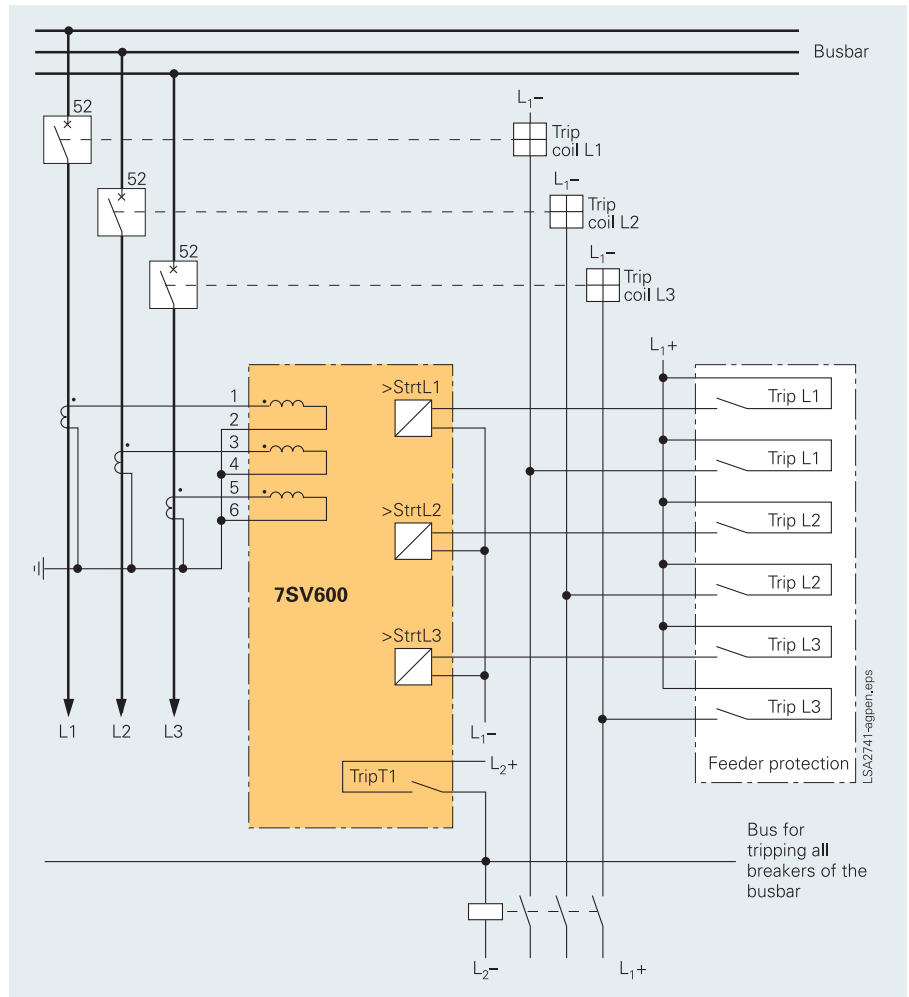
The SIPROTEC 7SV600 transmits a subset of data via IEC 60870-5-103 protocol:

- General fault detection of the device
- General trip of the device
- Current in phase L2 [%] =
- Breaker failure trip T1 (local trip)
- Breaker failure trip T2 (busbar trip)
- Circuit-breaker defective: Trip
- Trip by end-fault protection
- Trip by monitoring current symmetry
- Breaker failure protection is active



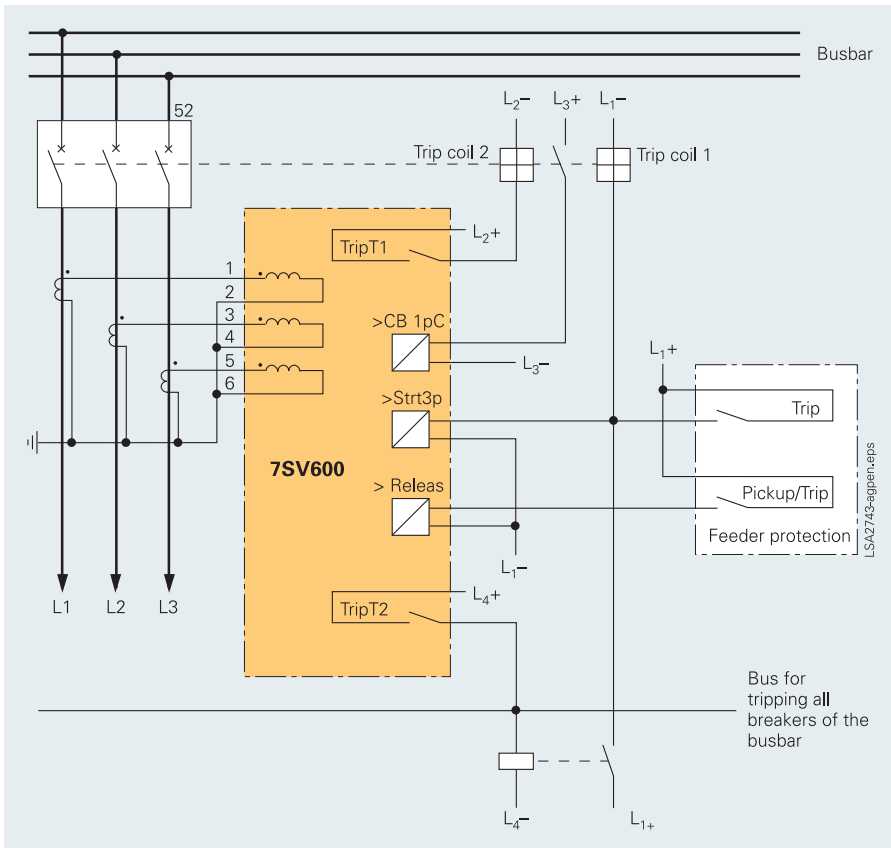
**Fig. 10/29** Wiring communication RS485  
For convenient wiring of the RS485 bus, use bus cable system 7XV5103  
(see part 13 of this catalog)

### Connection diagrams

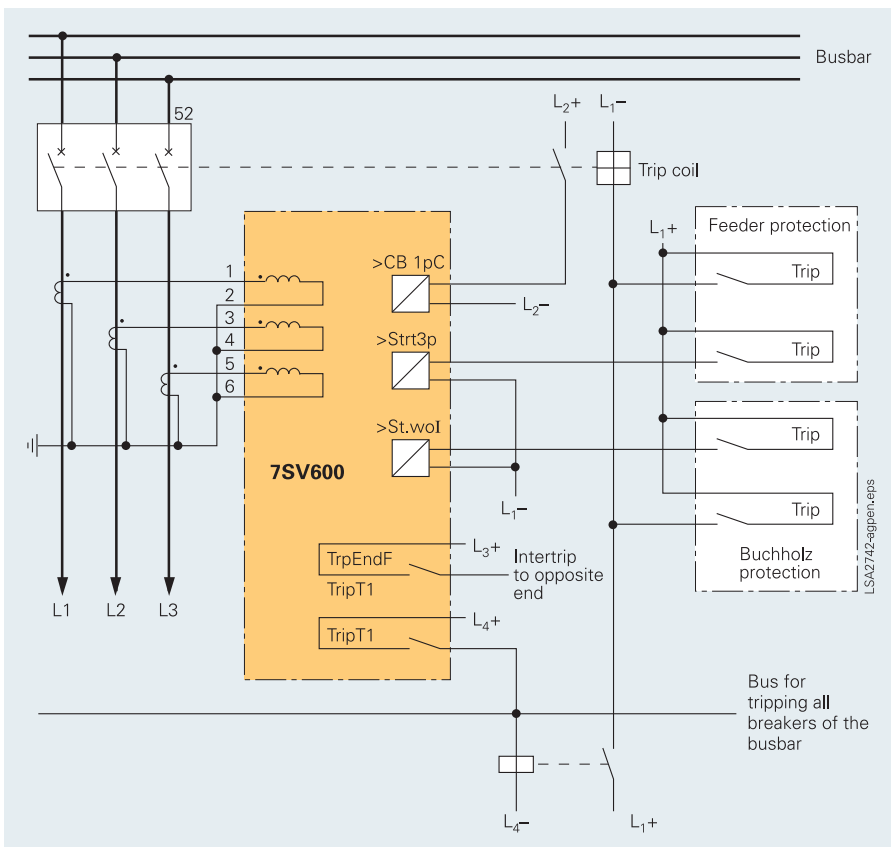


**Fig. 10/30**  
Connection example for single-stage breaker failure protection with phase-segregated initiation

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**Fig. 10/31**  
Connection example for 2-stage breaker failure protection, common-phase initiation, CB interrogation



**Fig. 10/32**  
Connection example for single-stage breaker failure protection with common-phase initiation and Buchholz protection, CB interrogation is imperative; additional intertrip signal to the opposite line end in case of breaker failure or end fault

# Relays for Various Protection Applications/7SV600

## Technical data

General unit data		Binary inputs	
<i>Measuring circuits</i>		<i>Unit design</i>	
Rated current $I_N$	1 to 5 A	Number	3 (can be marshalled)
Rated frequency $f_N$ can be parameterized	50 or 60 Hz (selectable)	Rated operating voltage	DC 24 to 250 V
Power consumption of current inputs		Current consumption	Approx. 2.5 mA, independent of operating voltage
At $I_N = 1$ A	< 0.1 VA	Pick-up threshold	selectable by plug-in jumpers
At $I_N = 5$ A	< 0.2 VA	Rated aux. voltage DC 24/48/60 V	$V_{pick-up} \geq$ DC 17 V
Overload capability current path, Thermal (r.m.s.)	100 x $I_N$ for $\leq 1$ s 30 x $I_N$ for $\leq 10$ s 4 x $I_N$ continuous	Rated aux. voltage DC 110/125/220/250 V	$V_{drop-off} <$ DC 8 V $V_{pick-up} \geq$ DC 74 V $V_{drop-off} <$ DC 45 V
Dynamic (pulse current)	250 x $I_N$ one half cycle		
<i>Auxiliary voltage</i>			
Power supply via integrated DC/DC converter			
Rated auxiliary voltage $V_{Aux}$ DC	DC 24 / 48 V DC 60 / 110 / 125 V DC 220 / 250 V	Weight	
Permissible variations	DC 19 to 58 V DC 48 to 150 V DC 176 to 300 V	In housing for surface mounting	Approx. 4.5 kg
Superimposed AC voltage	$\leq 12\%$ at rated voltage	In housing for flush mounting	Approx. 4.0 kg
Peak-to-peak	$\leq 6\%$ at limits of admissible voltage	Degree of protection acc. to EN 60529	
Power consumption		Housing	IP 51
Quiescent	Approx. 2 W	Terminals	IP 21
Energized	Approx. 4 W	<i>Serial interface</i>	
Bridging time during failure/short-circuit of auxiliary voltage	$\geq 50$ ms at $V_{rated} \geq$ DC 110 V $\geq 20$ ms at $V_{rated} \geq$ DC 24 V	Isolated	
Rated auxiliary voltage $V_{Aux}$	AC 115 V, 50/60 Hz AC 230 V, 50/60 Hz	Standard	RS485
Permissible variations	AC 92 to 133 V AC 184 to 265 V	Test voltage	DC 2.8 kV
		Connection	Data cable on terminals, two data wires, one frame reference, for connection of a personal computer or similar; core pairs with shield, shield must be grounded; communication possible via modem
<i>Heavy duty (command) contacts</i>		Baud rate	As delivered 9600 baud min. 1200 baud; max. 19200 baud
Command (trip) relays, number	2 (can be marshalled)	<i>Electrical tests</i>	
Contacts per relays	2 NO	<i>Specifications</i>	
Switching capacity		Standards	IEC 60255-5; ANSI/IEEE C37.90.0
Make	1000 W/VA	<i>Insulation tests</i>	
Break	30 W/VA	High voltage test (routine test) except DC voltage supply input and RS485	2 kV (r.m.s.); 50 Hz
Switching voltage	250 V	High voltage test (routine test) only DC voltage supply input and RS485	DC 2.8 kV
Permissible current	5 A continuous 30 A for 0.5 s	High voltage test (type test) Between open contacts of trip relays	1.5 kV (r.m.s.), 50 Hz
<i>Signal contacts</i>		Between open contacts of alarm relays	1 kV (r.m.s.), 50 Hz
Signal/alarm relays	2 (can be marshalled)	Impulse voltage test (type test) all circuits, class III	5 kV (peak); 1.2/50 $\mu$ s; 0.5 J; 3 positive and 3 negative impulses at intervals of 5 s
Contact per relays	1 CO		
Switching capacity			
Make	1000 W/VA		
Break	30 W/VA		
Switching voltage	250 V		
Permissible current	5 A		

### EMC tests for noise immunity; type tests

Standards: IEC 60255-6, IEC 60255-22 (product standards); EN 50082-2 (generic standard) VDE 0435, part 303	
High frequency IEC 60255-22-1, class III	2.5 kV (peak); 1 MHz; $\tau = 15 \mu\text{s}$ ; 400 shots/s; 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 to 500 MHz
Irradiation with radio-frequency field, amplitude-modulated; IEC 61000-4-3, class III	10 V/m; 80 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 50 %
Fast transients/bursts IEC 60255-22-4 and IEC 61000-4-4, class III	2 kV; 5/50 ns; 5 kHz; burst length 15 ms; repetition rate 300 ms; both polarities; $R_i = 50 \Omega$ ; duration 1 min
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 ANSI/IEEE C37.90.1 (common mode)	2.5 to 3 kV (peak); 1 to 1.5 MHz, decaying oscillation; 50 surges per s; duration 2 s; $R_i = 150 \Omega$ to 200 $\Omega$
Fast transient surge withstand capability ANSI/IEEE C37.90.1 (common mode)	4 to 5 kV; 10/150 ns; 50 surges per s; both polarities; duration 2 s; $R_i = 80 \Omega$
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; $R_i = 50 \Omega$

### EMC tests for interference emission; type tests

Standard	EN 50081-* (generic standard)
Conducted interference voltage, aux. voltage CISPR 22, EN 55022	150 to 30 MHz  Limit class B
Radio interference field strength CISPR 11, EN 55011	30 to 1000 MHz Limit class A

### Mechanical stress tests

#### Vibration, shock stress and seismic vibration

##### During operation

Standards	IEC 60255-21 and IEC 60068-2
Vibration IEC 60255-21-1, class I IEC 60068-2-6	Sinusoidal 10 to 60 Hz: $\pm 0.035$ 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 Acceleration 5 g, duration 11 ms, 3 shocks in each direction of 3 orthogonal axes
Seismic vibration IEC 60255-21-3, class I IEC 60068-3-3	Sinusoidal 1 to 8 Hz: $\pm 3.5$ mm amplitude (horizontal axis) 1 to 8 Hz: $\pm 1.5$ 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 transportation

Standard	IEC 60255-21 and IEC 60068-2
Vibration IEC 60255-21-1, class II IEC 60068-2-6	Sinusoidal 5 to 8 Hz: $\pm 7.5$ mm amplitude; 8 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 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

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## Technical data

Climatic stress tests	
<i>Temperatures</i>	
Permissible temperature during service	-20 °C to +70 °C (> 55 °C decreased display contrast)
Recommended temperature during service	-5 °C to +55 °C
Permissible temperature during storage	-25 °C to +55 °C
Permissible temperature during transport	-25 °C to +70 °C
Storage and transport with standard works packaging!	
<i>Humidity</i>	
Permissible humidity	Mean value per year ≤ 75 % relative humidity; on 30 days per year 95 % relative humidity; condensation not permissible!
We recommend that all units are installed such that they are not subjected to direct sunlight, nor to large temperature fluctuations which may give rise to condensation.	

Service conditions	
<p>The relay is designed for use in industrial environment, for installation in standard relay rooms and compartments so that with proper installation electromagnetic compatibility (EMC) is ensured. The following should also be heeded:</p> <ul style="list-style-type: none"> <li>All contactors and relays which operate in the same cubicle or on the same relay panel as the digital protection equipment should, as a rule, be fitted with suitable spike quenching elements.</li> <li>All external connection leads in substations from 100 kV upwards should be shielded with a shield capable of carrying power currents and grounded at both sides. No special measures are normally necessary for substations of lower voltages.</li> </ul>	<ul style="list-style-type: none"> <li>The shield of the RS485 cable must be grounded.</li> <li>It is not permissible to withdraw or insert individual modules under voltage. In the withdrawn condition, some components are electrostatically endangered; during handling the standards for electrostatically endangered components must be observed. The modules are not endangered when plugged in.</li> </ul> <p>WARNING! The relay is not designed for use in residential, commercial or light-industrial environment as defined in EN 50081.</p>

Functions	
<i>Breaker supervision</i>	
Current detection	
Setting range	0.05 x I <sub>N</sub> to 4.00 x I <sub>N</sub> (steps 0.01 x I <sub>N</sub> )
Drop-off ratio	Approx. 0.9
Tolerance	0.01 x I <sub>N</sub> or 5 % of set value
Initiation conditions	
Depending on ordered version	Phase-segregated initiation (single-pole trip from feeder protection) or common-phase initiation (three-pole trip from feeder protection) and common-phase initiation (three-pole trip from non-short-circuit protection)
Times	
Pickup time	Approx. 15 ms with measured quantities present Approx. 25 ms after switch-on of measured quantities
Drop-off time with sinusoidal measured quantities	≤ 10 ms
Drop-off time maximum	≤ 25 ms
Delay times for all time stages	0.00 s to 32.00 s (steps 0.01 ms) or deactivated
Delay time tolerance	1 % of set value or 10 ms
The set times are pure delay times.	

Additional functions	
<i>Operational value measurements</i>	
Operational current values	I <sub>L1</sub> ; I <sub>L2</sub> ; I <sub>L3</sub>
Measurement range	0 % to 240 % I <sub>N</sub>
Tolerance	3 % of rated value or of measured value
<i>Steady-state measured value supervision</i>	
Current unbalance	I <sub>max</sub> /I <sub>min</sub> > symmetry factor as long as I > I <sub>limit</sub>
<i>Fault event data storage</i>	
Storage of annunciations of the last eight faults with max. 30 messages each	
<i>Time assignment</i>	
Resolution for operational annunciations	1 s
Resolution for fault event annunciations	1 ms
Max. time deviation	0.01 %
<i>Data storage for fault recording (max. 8 fault events)</i>	
Total storage time (fault detection or trip command = 0 ms)	Max. 5 s, selectable pre-trigger and post-fault time
Max. storage period per fault event T <sub>max</sub>	0.30 to 5.00 s (steps 0.01 s)
Pre-trigger time T <sub>pre</sub>	0.05 to 0.50 s (steps 0.01 s)
Post-fault time T <sub>post</sub>	0.05 to 0.50 s (steps 0.01 s)
Sampling rate	1 instantaneous value per ms at 50 Hz 1 instantaneous value per 0.83 ms at 60 Hz

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# Relays for Various Protection Applications/7SV600

## Selection and ordering data

Description	Order No.
<b>7SV600 numerical circuit-breaker failure protection relay</b>	<b>7SV600</b> □ - □ □ □ <b>AA0</b> - □ <b>DA0</b>
<b>Rated current; rated frequency</b>	
1 A; 50/60 Hz	1
5 A; 50/60 Hz	5
<b>Rated auxiliary voltage</b>	
DC 24, 48 V	2
DC 60, 110, 125 V	4
DC 220, 250 V / AC 115 V, 50/60 Hz	5
AC 230 V, 50/60 Hz	6
<b>Unit design</b>	
For panel surface mounting with terminals on both sides	B
For panel surface mounting with terminals at top and bottom	D
For panel flush mounting / cubicle mounting	E
<b>Options</b>	
For common-phase initiation	0
For common-phase initiation or phase-segregated initiation	1

Accessories	Description	Order No.
	<b>DIGSI 4</b> Software for configuration and operation of Siemens protection units running under MS Windows (version Windows 2000/XP Professional Edition) device templates, Comtrade Viewer, electronic manual included as well as "Getting started" manual on paper, connecting cables (copper)	<b>7XS5400-0AA00</b>
	<b>Basis</b> Full version with license for 10 computers, on CD-ROM (authorization by serial number)	<b>7XS5402-0AA00</b>
	<b>Professional</b> 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)	
	<b>RS232 (V.24) ↔ RS485 converter *</b>	<b>7XV5700</b> - □ □ □ <b>00</b>
	Plug-in auxiliary power supply unit AC 220 V/50 Hz	0
	Plug-in auxiliary power supply unit AC 110 V/60 Hz	1
	With RS485 connecting cable for 7SJ6, 7RW6, 7SD6, 7SV6 A	A
	With RS485 connecting cable with 9-pin connector for SIMEAS Q	B
	With RS485 connecting cable with plug connector for SIMEAS T	C
	Without RS232 connecting cable	A
	With RS232 connecting cable 7XV5100-2 for PC/notebook, 9-pin connector (female)	B
	With RS232 adapter, 25-pin connector (male) to 9-pin connector (female) for connection to notebook/PC	C
	<b>Converter full-duplex fiber-optic cable ↔ RS485</b> With power supply DC 24 – 250 V and AC 110/230 V	<b>7XV5650-0BA00</b>
	<b>Manual for 7SV600</b> For the latest version please visit	<a href="http://www.siemens.com/siprotec">www.siemens.com/siprotec</a>
	*) RS485 bus system up to 115 kbaud RS485 bus cable and adaptor 7XV5103-□AA□□; see part 13.	

# Relays for Various Protection Applications/7SV600

## Connection diagram

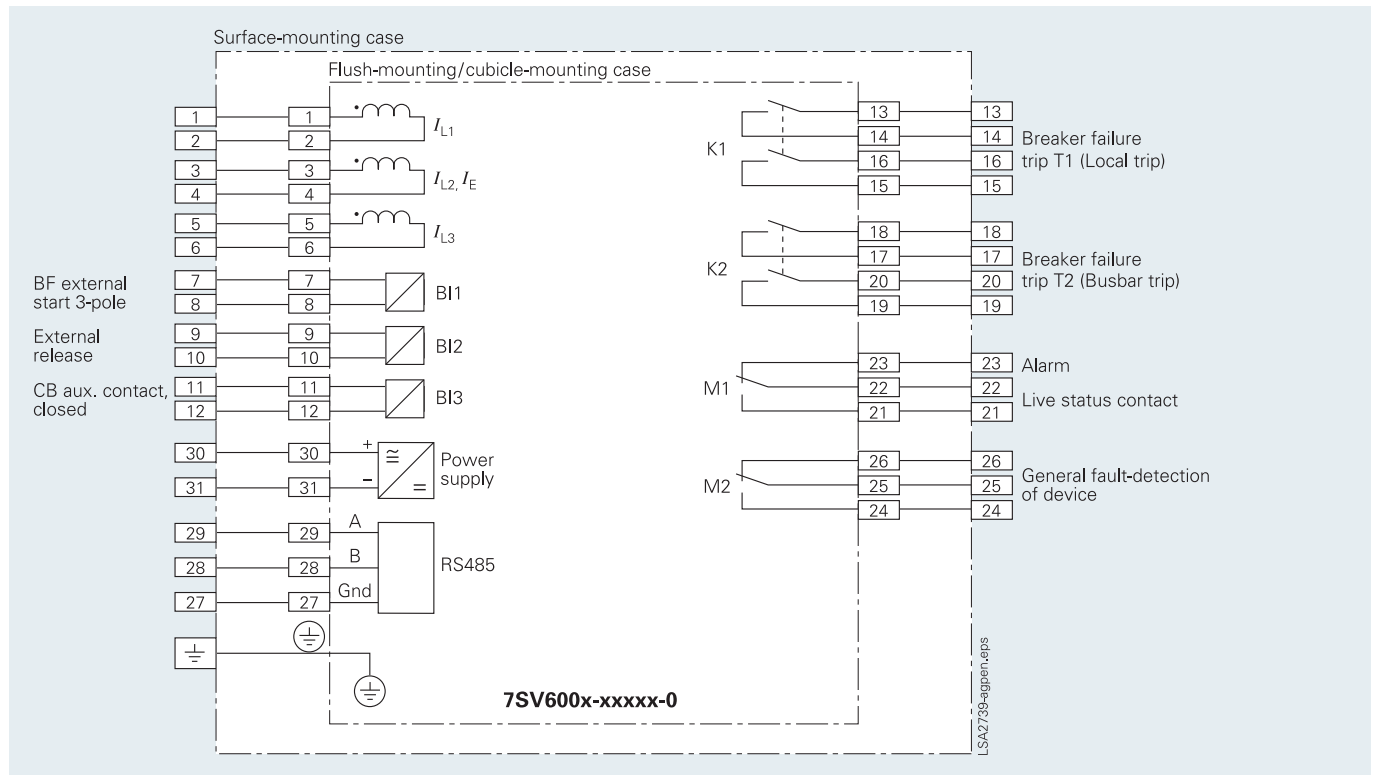


Fig. 10/33 General connection diagram of 7SV600 with presettings for common-phase initiation

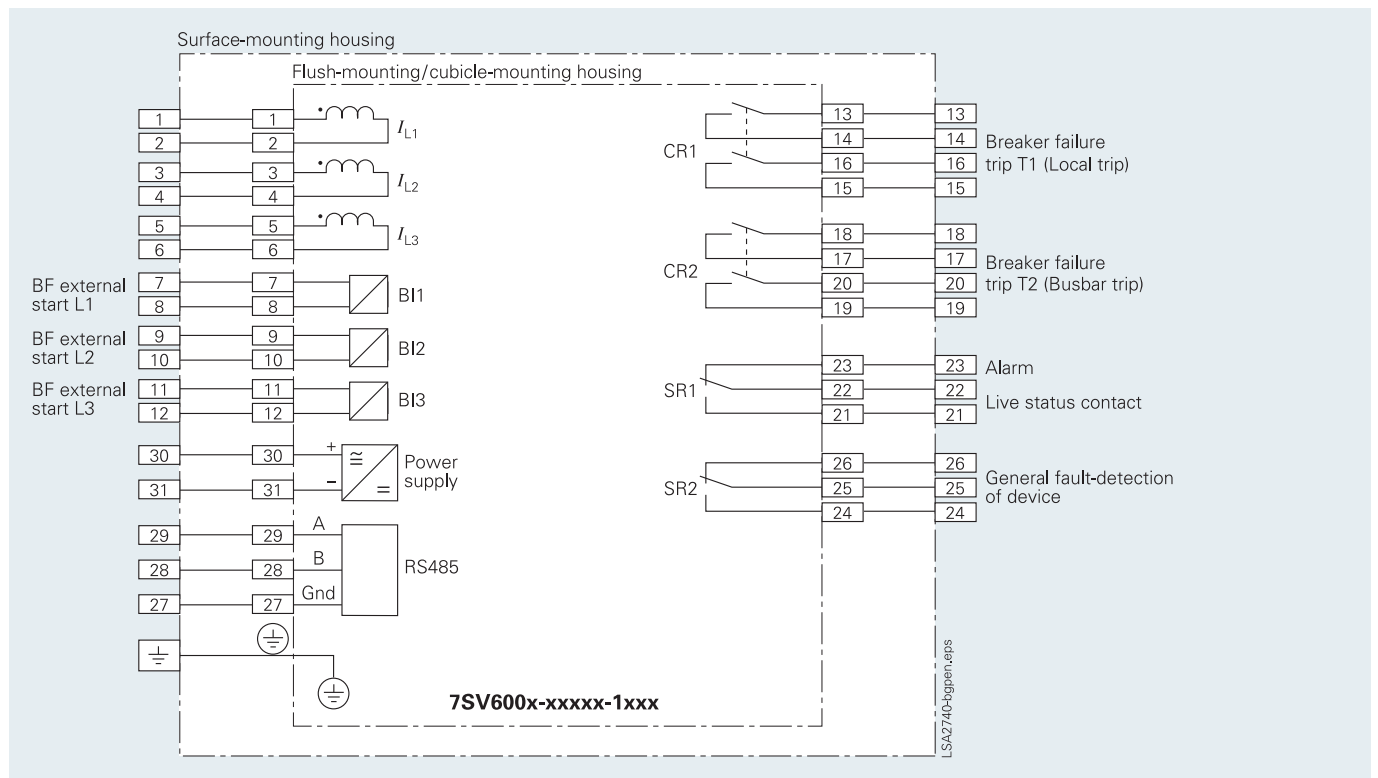


Fig. 10/34 General connection diagram of 7SV600 with presettings for phase-segregated initiation

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