

## SIPROTEC easy 7SJ45 Numerical Overcurrent Protection Relay Powered by CTs



**Fig. 5/1** SIPROTEC easy 7SJ45 numerical overcurrent protection relay powered by current transformers (CT)

### Description

The SIPROTEC easy 7SJ45 is a numerical overcurrent protection relay which is primarily intended as a radial feeder or transformer protection (backup) in electrical networks. It provides definite-time and inverse-time overcurrent protection according to IEC and ANSI standards. The 7SJ45 relay does not require auxiliary voltage supply. It imports its power supply from the current transformers.

### Function overview

- Operation without auxiliary voltage via integrated CT power supply
- Standard current transformers (1 A/5 A)
- Low power consumption: 1.4 VA at  $I_N$  (of the relay)
- Easy mounting due to compact housing
- Easy connection via screw-type terminals

### Protection functions

- 2-stage overcurrent protection
- Definite-time and inverse-time characteristics (IEC/ANSI)
- High-current stage  $I_{>>}$  or calculated earth-current stage  $I_{E>}$  or  $I_{Ep>}$  selectable
- Trip with pulse output (24 V DC / 0.1 Ws) or relay output (changeover contact)
- Repetition of trip during circuit-breaker failure (relays with pulse output)
- Combination with electromechanical relays is possible due to the emulation algorithm

### Monitoring functions

- Hardware and software are continuously monitored during operation

### Front design

- Simple setting via DIP switches (self-explaining)
- Settings can be executed without auxiliary voltage – no PC
- Integrated mechanical trip indication optionally

### Additional features

- Optional version available for most adverse environmental conditions (condensation permissible)
- Flush mounting or surface (rail) mounting

### Application

The SIPROTEC easy 7SJ45 is a numerical overcurrent protection relay which is primarily intended as a radial feeder or transformer protection (backup) in electrical networks. It provides definite-time and inverse-time overcurrent protection according to IEC and ANSI standards. The convenient setting with DIP switches is self-explanatory and simple.

The 7SJ45 relay does not require auxiliary voltage supply. It imports its power supply (1.4 VA at  $I_N$ , sum of all phases) from the current transformers.

Impulse output for low-energy trip release or contact output for additional auxiliary transformer are available. An optional integrated trip indication shows that a trip occurred.

ANSI	IEC	Protection functions
50	$I >>$	Instantaneous overcurrent protection
50, 51	$I > t, I_p$	Time-overcurrent protection (phase)
50N, 51N	$I_E > t, I_{Ep}$	Time-overcurrent protection (earth)

### Construction

Within its compact housing the protection relay contains all required components for:

- Measuring and processing
- Alarm and command output
- Operation and indication (without a PC)
- Optional mechanical trip indication
- Auxiliary supply from current transformers
- Maintenance not necessary

The housing dimensions of the units are such that the 7SJ45 relays can in general be installed into the existing cutouts in cubicles. Alternative constructions are available (surface mounting and flush mounting). The compact housing permits easy mounting, and a version for the most adverse environmental conditions, even with extreme humidity, is also available.

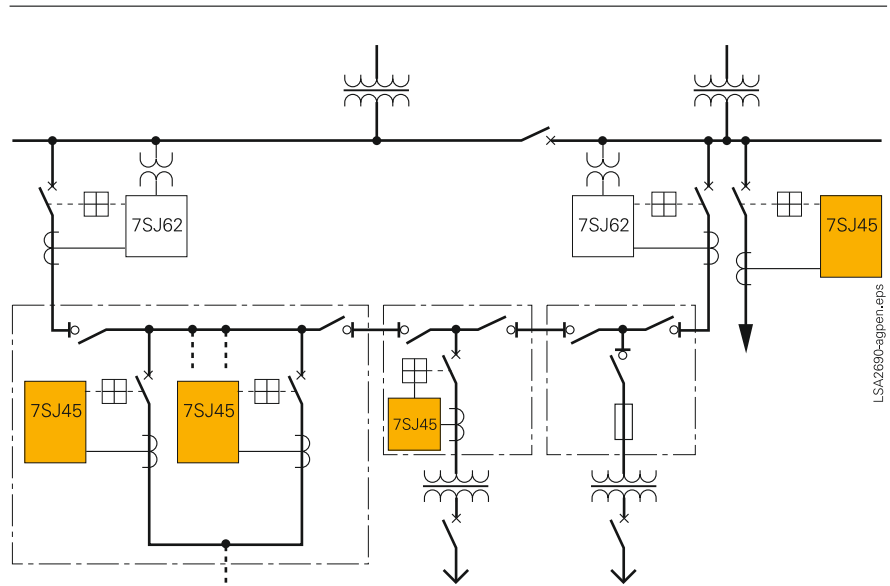


Fig. 5/2 Typical application



Fig. 5/3 Application in distribution switchgear



Fig. 5/4 Screw-type terminals

**Protection functions**

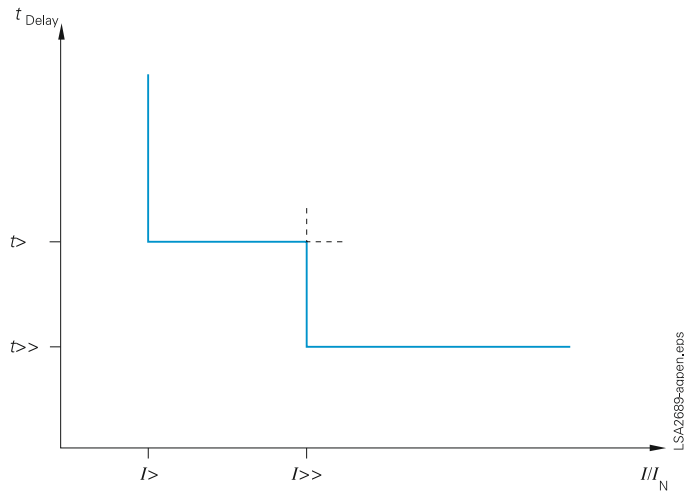
The overcurrent function is based on phase-selective measurement of the three phase currents.

The earth (ground) current  $I_E$  (Gnd) is calculated from the three line currents  $I_{L1}$  (A),  $I_{L2}$  (B), and  $I_{L3}$  (C).

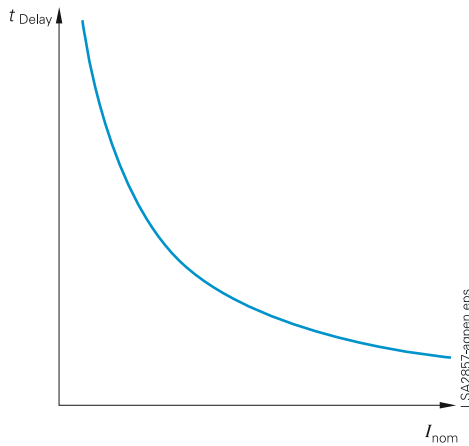
The relay has always a normal stage for phase currents  $I > (50/51)$ . For the second stage, the user can choose between a high-current stage for phase currents  $I >> (50)$  or a normal stage for calculated earth currents  $I_E > (50N/51N)$ .

The inverse-time overcurrent protection with integrating measurement method (disk emulation) emulates the behaviour of electromechanical relays.

The influence of high-frequency transients and transient DC components is largely suppressed by the implementation of numerical measured-value processing.



**Fig. 5/5** Definite-time overcurrent characteristic



**Fig. 5/6** Inverse-time overcurrent characteristic

*Available inverse-time characteristics*

Characteristics acc. to	ANSI/IEEE	IEC 60255-3
Moderately inverse/normal inverse	•	•
Very inverse	•	•
Extremely inverse	•	•

Connection diagrams

Pulse output or relay output are optionally available.

Pulse output

These relays require a low-energy trip release (24 V DC/0.1 Ws) in the circuit-breaker, and are intended for modern switchgear. In case of circuit-breaker failure, a repetition of the tripping signal is initiated.

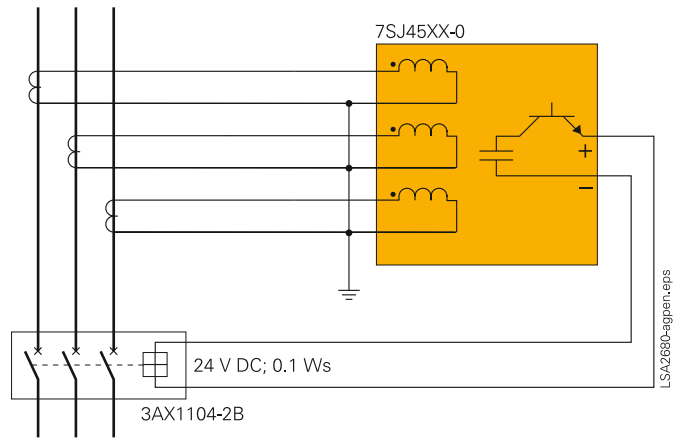


Fig. 5/7 Connection of 3 CTs with pulse output

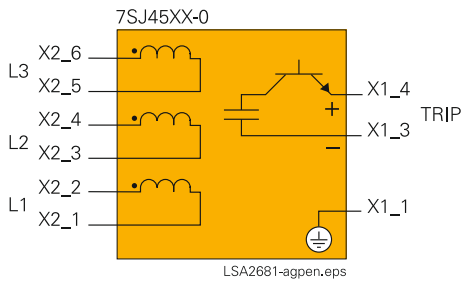


Fig. 5/8 Connection diagram 7SJ45 with impulse output

Relay output

These relays can be applied with all conventional switchgear. A transformer that provides the trip circuit energy, must be connected in the current transformer circuit.

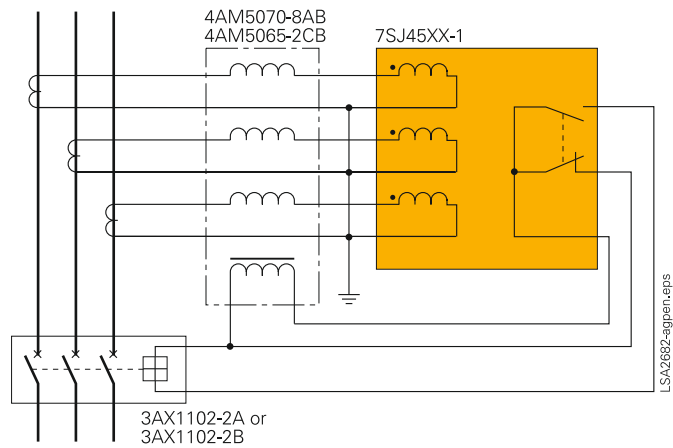


Fig. 5/9 Connection of 3 CTs with trigger transformer and relay output

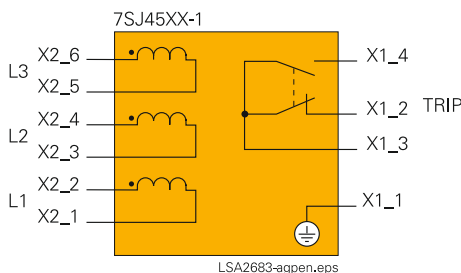


Fig. 5/10 Connection diagram 7SJ45 with relay output

## Technical data

## General unit data

## Analog input

System frequency $I_N$	50 or 60 Hz (selectable)
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## Current transformer inputs

Rated current, normal earth current $I_N$	1 or 5 A	
Power consumption At $I_N = 1 / 5$ A	Approx. 1.4 VA at $I_N$ (relay)	
Rating of current transformer circuit	Thermal (r.m.s.)	50 · $I_N$ for 1 s 15 · $I_N$ for 10 s 2 · $I_N$ continuous
	Dynamic (peak)	100 · $I_N$ for half a cycle
	Recommended primary current transformers	10 P 10, 2.5 VA or according to the requirements and required tripping power

## Output relays

## Pulse output (7SJ45XX-0\*)

Number	1 pulse output 24 V DC / 0.1 Ws
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## Relay output (7SJ45XX-1\*)

Number	1 changeover contact	
Contact rating	Make	1000 W/VA
	Break	30 VA
		40 W resistive
		25 VA at L/R ≤ 50 ms
Rated contact voltage	≤ 250 V DC or ≤ 240 V AC	
Permissible current per contact	5 A continuous 30 A for 0.5 s (inrush current)	

## Unit design

Housing	Flush mounting DIN 43700/IEC 61554 Adaptable for rail mounting (recommended for local mounting only)	
Dimensions (WxHxD) in mm	78.5 x 147 x 205.8 (incl. transparent cover and terminal blocks)	
Weight (mass) approx.	1.5 kg	
Degree of protection according to IEC 60529		
Housing	Front	IP 51
	Rear	IP 20
Protection of personnel	IP1X	

## UL-listing

Listed under "69CA".	
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## Electrical tests

## Specifications

Standards	IEC 60255 (product standards) ANSI C37.90.0/1/2; UL508 See also standards for individual tests
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## Insulation tests

Standards	IEC 60255-5
Voltage test (routine test)	2.5 kV (r.m.s.), 50 Hz, 1 min
All circuits except for pulse output-earth	
Voltage test (type test) across open command contacts	1.0 kV (r.m.s.), 50 Hz, 1 min
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 in intervals of 1 s

## EMC tests for interference immunity; type tests

Standards	IEC 60255-6, IEC 60255-22, EN 50263 (product standards) EN 50082-2 (generic standard) EN 61000-6-2 IEC 61000-4 (basic standards)
High-frequency test IEC 60255-22-1, class III	2.5 kV (peak); 1 MHz; τ = 15 ms; $R_i = 200 \Omega$ ; 400 surges/s; duration ≥ 2 s
Electrostatic discharge IEC 60255-22-2, class III EN 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, amplitude-modulated IEC 60255-22-3 and IEC 61000-4-3, class III	10 V/m; 80 to 1000 MHz; 80 %; 1 kHz; AM
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 % 30 V/M; 1890 MHz; repetition frequency 200 Hz; duty cycle 50 %
Fast transient interference/bursts IEC 60255-22-4 and IEC 61000-4-4, class IV	4 kV; 5/50 ns; 5 kHz; burst duration = 15 ms; repetition rate 300 ms; both polarities; $R_i = 50 \Omega$ ; duration 1 min
High-energy surge voltage, IEC 61000-4-5 installation, class III Measuring inputs, binary outputs	Impulse: 1.2/50 μs Circuit groups to earth: 2 kV; 42 Ω, 0.5 μF Across circuit groups: 1 kV; 42 Ω, 0.5 μF
Line-conducted HF, amplitude-modulated, IEC 60255-22-6 and IEC 61000-4-6, class III	10 V; 150 kHz to 80 MHz; 80 %; 1 kHz; $R_i = 150 \Omega$
Power frequency magnetic field IEC 61000-4-8, class IV IEC 60255-6	30 A/m continuous; 300 A/m for 5 s; 50 Hz 0.5 mT; 50 Hz
Damped wave IEC 60694, IEC 61000-4-12, class III	2.5 kV (peak, polarity alternating) 100 kHz, 1 MHz, 10 MHz and 50 MHz, $R_i = 200 \Omega$ , duration ≥ 2 s
Oscillatory surge withstand capability ANSI/IEEE C37.90.1 Not across open contacts	2.5 to 3 kV (peak); 1 to 1.5 MHz damped wave; 50 shots per s; duration ≥ 2 s; $R_i = 150 \Omega$ to 200 Ω
Fast transient surge withstand capability ANSI/IEEE C37.90.1 not across open contacts	4 to 5 kV; 10/150 ns; 50 and 120 surges per ≥ 2 s; both polarities; duration ≥ 2 s; $R_i = 80 \Omega$
Radiated electromagnetic interference ANSI/IEEE C37.90.2	35 V/m; 25 to 1000 MHz amplitude and pulse-modulated

## EMC tests for interference emission; type test

Standard	EN 50081-* (generic)
Interference field strength IEC CISPR 22	30 to 1000 MHz, class B

## Technical data

## Mechanical stress tests

## Vibration, shock stress and seismic vibration

## During operation

Standards	IEC 60255-21 and IEC 60068-2
Vibration	Sinusoidal
IEC 60255-21-1, class II	10 to 60 Hz
IEC 60068-2-6	± 0.075 mm amplitude: 60 to 150 Hz; 1 g acceleration Frequency sweep 1 octave/min 20 cycles in 3 perpendicular axes
Shock IEC 60225-21-2; class I	Semi-sinusoidal 5 g acceleration, duration 11 ms, each 3 shocks in both directions of the 3 axes
Seismic vibration	Sinusoidal
IEC 60255-21-3; class I	1 to 8 Hz: ± 4.0 mm amplitude (horizontal vector)
IEC 60068-3-3	1 to 8 Hz: ± 2.0 mm amplitude (vertical vector) 8 to 35 Hz: 1 g acceleration (horizontal vector) 8 to 35 Hz: 0.5 g acceleration (vertical vector) Frequency sweep 1 octave/min 1 cycle in 3 perpendicular axes

## During transport (flush mounting)

Standards	IEC 60255-21 and IEC 60068-2
Vibration	Sinusoidal
IEC 60255-21-1, class 2	5 Hz to 8 Hz: ± 7.5 mm amplitude; 8 Hz to 150 Hz: 2 g acceleration frequency sweep 1 octave/min 20 cycles in 3 perpendicular axes
IEC 60068-2-6	
Shock	Semi-sinusoidal
IEC 60255-21-2, class 1	15 g acceleration, duration 11 ms, each 3 shocks in both directions of the 3 axes
IEC 60068-2-27	
Continuous shock	Semi-sinusoidal
IEC 60255-21-2, class 1	10 g acceleration, duration 16 ms, each 1000 shocks in both directions of the 3 axes
IEC 60068-2-29	

## Climatic stress tests

## Temperatures

Temperatures during service	-20 °C to +70 °C / -4 °F to +158 °F With continuous current 2I <sub>N</sub> : -20 °C to +55 °C / -4 °F to +131 °F
Permissible temperature during storage	-25 °C to +55 °C / -13 °F to +131 °F
Permissible temperature during transport	-25 °C to +85 °C / -13 °F to +185 °F

## Humidity

Permissible humidity class (standard)	Annual mean value ≤ 75 % relative humidity; on 30 days per year up to 95 % relative humidity; condensation not permissible.
Permissible humidity class (condensation proof)	Condensation is permissible according to IEC 60654-1, class III

## Functions

## Overcurrent protection

## Definite time (DT O/C ANSI 50/51)

Setting range / steps	
Current pickup $I_{>>}$ (phases)	2 I <sub>N</sub> to 20 I <sub>N</sub> or deactivated, step 0.5 I <sub>N</sub>
Current pickup $I_{>}$ (phases)	0.5 I <sub>N</sub> to 6.2 I <sub>N</sub>
3-phase supply: see note*	or deactivated, step 0.1 I <sub>N</sub>
Current pickup $I_{E>}$	0.5 I <sub>N</sub> to 6.2 I <sub>N</sub>
3-phase supply: see note*	or deactivated, step 0.1 I <sub>N</sub>
Delay times $T_{I>>}$	0 to 1575 ms, step 25 ms
Delay times $T_{I>}$	0 to 6300 ms, step 100 ms
The set time delays are pure delay times.	

## Inverse time (IEC or ANSI 51)

Setting range / steps	
Current pickup $I_p$ (phases)	0.5 I <sub>N</sub> to 4 I <sub>N</sub>
3-phase supply: see note*	or deactivated, step 0.1 I <sub>N</sub>
Current pickup $I_{Ep>}$ (earth calculated)	0.5 I <sub>N</sub> to 4 I <sub>N</sub>
3-phase supply: see note*	or deactivated, step 0.1 I <sub>N</sub>
Delay times $T_{Ip}$ (IEC)	0.05 to 3.15 s, step 0.05 s
Delay times D (ANSI)	0.5 to 15.00 s, step 0.25 s

## Trip times

Total time delay impulse output	Approx. 32 ms
Total time delay relay output	Approx. 38 ms
Reset ratio	Approx. 0.95 (with definite time) Approx. 0.91 (with inverse time)

## Tolerances

Definite time (DT O/C 50/51)	
Current pickup $I_{>>}$ , $I_{>}$ , $I_{E>}$	5 % of the set value or 5 % of I <sub>N</sub> (at threshold < I <sub>N</sub> )
Delay times $T$	1 % or 30 ms
Inverse time (IEC or ANSI 51)	
Pickup thresholds	5 % of the set value or 5 % of I <sub>N</sub> (at threshold < I <sub>N</sub> )
Time behavior for $2 \leq I/I_p \leq 20$	5 % or 50 ms

## Deviation of the measured values as a result of various interferences

Frequency in the range of $0.95 < f/f_N < 1.05$	< 2.5 %
Frequency in the range of $0.9 < f/f_N < 1.1$	< 10 %
Harmonics up to 10 % 3 <sup>rd</sup> and 5 <sup>th</sup> harmonic DC components	< 1 %
Temperature in the range of -5 °C to 70 °C / 23 °F to 158 °F	< 0.5 %/10 K

\* Note: The device allows minimum setting values of 0.5 I<sub>N</sub> (3-phase). With single supply, operation is ensured from 0.8 I<sub>N</sub> (7SJ45XX-0\*; pulse output) or 1.3 I<sub>N</sub> (7SJ45XX-1\*; relay output) onwards (printed on the front).

## Technical data

## 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).

This unit conforms to the international standard IEC 60255.

The unit has been developed and manufactured for application in an industrial environment according to the EMC standards.

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.



## Selection and ordering data

Description	Order No.
<i>SIPROTEC easy 7SJ45</i> <i>numerical overcurrent protection relay powered by CTs</i>	<b>7SJ450□-□□□00-□AA□</b>
<i>Current transformer I<sub>N</sub></i>	
1 A	1
5 A	5
<i>Trip</i>	
Pulse output (for further details refer to "Accessories")	0
Relay output (for further details refer to "Accessories")	1
<i>Unit design</i>	
For rail mounting	B
For panel flush mounting	E
<i>Region-specific functions</i>	
Region World, 50/60 Hz; standard	A
Region World, 50/60 Hz; condensation-proof	B
<i>IEC / ANSI</i>	
IEC	0
ANSI	1
<i>Indication (flag)</i>	
Without	0
With	1

## Accessories

*Protection relay with pulse output*

Low energy trip release **3AX1104-2B**

*Protection relay with relay output*

Auxiliary transformers for the trip circuit (30 VA CTs recommended)

1 A **4AM5065-2CB00-0AN2**

5 A **4AM5070-8AB00-0AN2**

Current transformer-operated trip release

0.5 A (rated operating current) **3AX1102-2A**

1 A (rated operating current) **3AX1102-2B**