



Fig. 5/11 SIPROTEC easy 7SJ46 numerical overcurrent protection relay

### Description

The SIPROTEC easy 7SJ46 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 7SJ46 relay has an AC and DC auxiliary power supply with a wide range allowing a high degree of flexibility in its application.

### Function overview

- Universal application due to integrated wide range AC/DC power supply.
- Standard current transformers (1 A/5 A)
- 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 ground-current stage  $I_{E>}$  or  $I_{Ep>}$  selectable
- Two command outputs for “trip” or “pickup”
- Combination with electromechanical relays is possible due to the emulation algorithm

### Monitoring functions

- One live contact for monitoring
- 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
- Individual phase pickup indication with stored or not stored LEDs
- Trip indication with separate LED

### Additional features

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

# Overcurrent Protection / 7SJ45

## Application, construction

### Application

The SIPROTEC easy 7SJ46 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 7SJ46 relay has an AC and DC auxiliary power supply with a wide range allowing a high degree of flexibility in its application. Phase-selective indication of protection pickup is indicated with LEDs.

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

### Construction

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

- Measuring and processing
- Pickup and command output
- Operation and indication (without a PC)
- Wide range AC/DC power supply
- Maintenance not necessary (no battery)

The housing dimensions of the units are such that the 7SJ46 relays can in general be installed into the existing panel cutouts. Alternative constructions are available (rail 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.

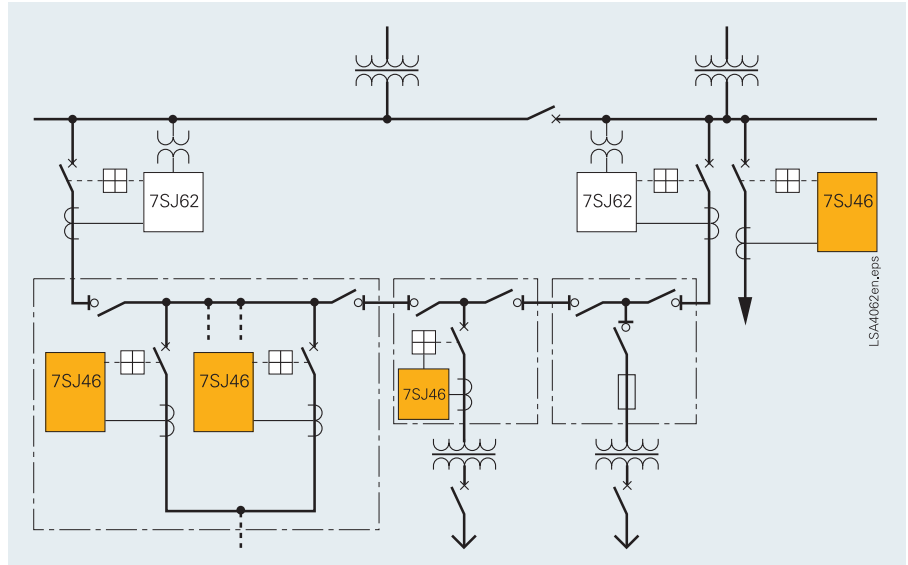


Fig. 5/12 Typical application



Fig. 5/13 Application in distribution switchgear



Fig. 5/14 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 ground currents  $I_E>$  (50N/51N).

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

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

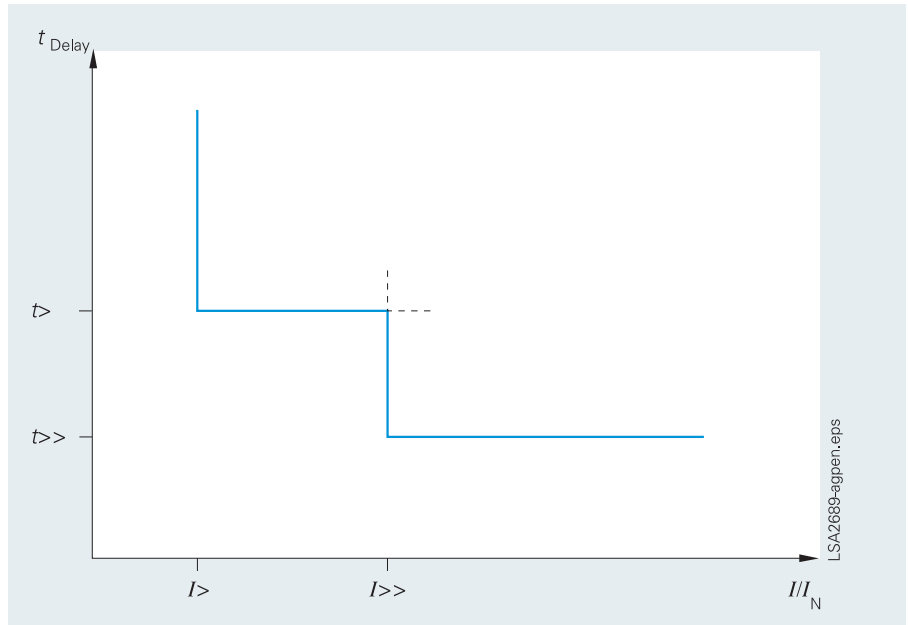


Fig. 5/15 Definite-time overcurrent characteristic

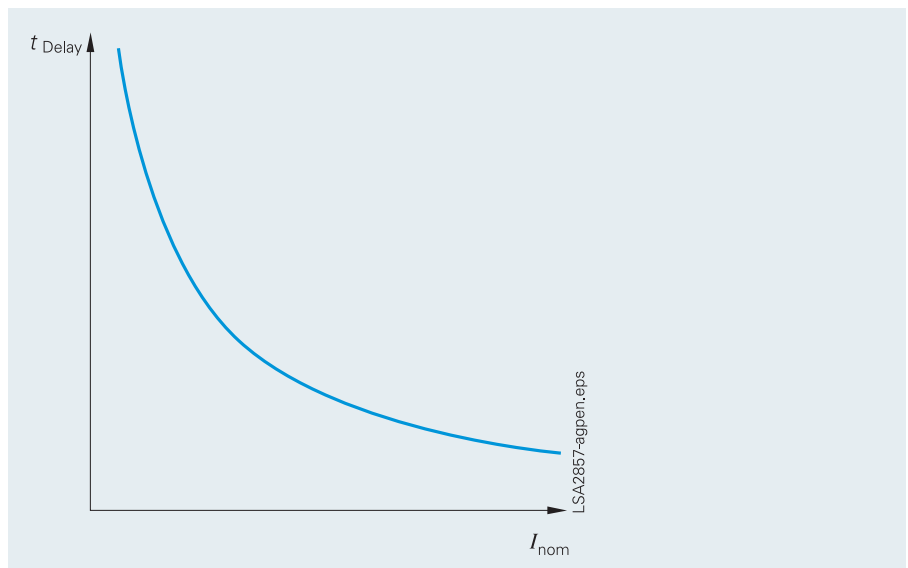


Fig. 5/16 Inverse-time overcurrent characteristic

### Available inverse-time characteristics

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

# Overcurrent Protection / 7SJ46

## Connection diagrams

### Connection diagrams

The 7SJ46 has a trip contact, a contact which is adjustable for trip or pickup, and a live contact for the self-monitoring function.

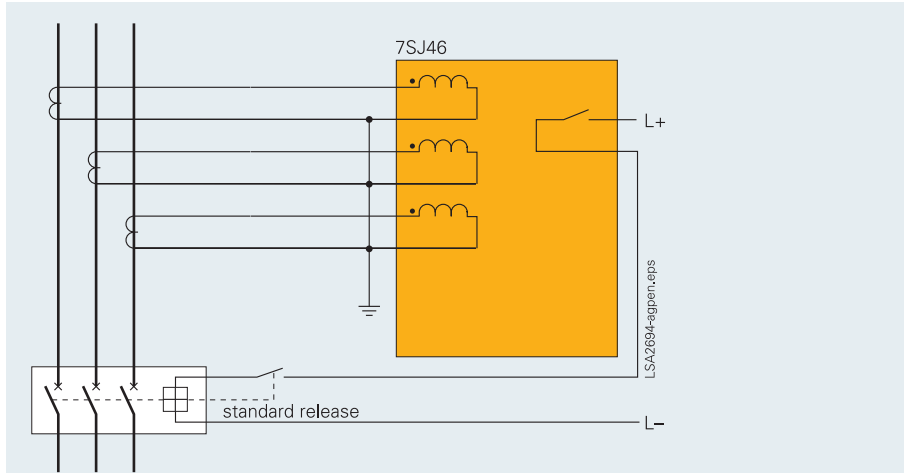


Fig. 5/17 Connection of 3 CTs

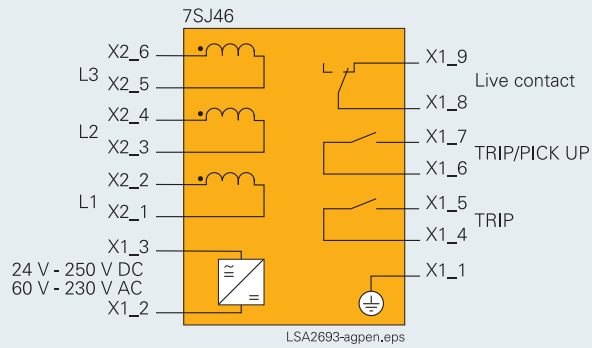


Fig. 5/18 Connection diagram 7SJ46

General unit data	
<i>Analog input</i>	
System frequency $f_N$	50 or 60 Hz (selectable)
<i>Current transformer inputs</i>	
Rated current, normal ground current $I_N$	1 or 5 A
Power consumption Per phase at $I_N = 1$ A Per phase at $I_N = 5$ A	Approx. 0.01 VA at $I_N$ Approx. 0.2 VA at $I_N$ (relay)
Rating of current transformer circuit Thermal (r.m.s.)	100 · $I_N$ for 1 s 30 · $I_N$ for 10 s 4 · $I_N$ continuous
Dynamic (peak)	250 · $I_N$ for half a cycle
<i>Auxiliary voltage AC/DC powered</i>	
Input voltage range	DC 24 to 250 V (± 20 %) AC 60 to 230 V (-20 %, +15 %)
Power consumption	DC – power supply: Approx. 1.5 W AC – power supply: Approx. 3 VA at 110 V approx. 5.5 VA at 230 V
<i>Output relays</i>	
Number	2 (normally open), 1 live contact
Contact rating	Make 1000 W/VA Break 30 VA 40 W resistive 25 VA at L/R ≤ 50 ms
Rated contact voltage	≤ DC 250 V or ≤ AC 240 V
Permissible current per contact	5 A continuous 30 A for 0.5 s (inrush current)
<i>Unit design</i>	
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 kg
Degree of protection according to IEC 60529	
Housing Front	IP 51
Rear	IP 20
Protection of personnel	IP1X
<i>UL-listing</i>	
Listed under "69CA".	
<b>Electrical tests</b>	
<i>Specifications</i>	
Standards	IEC 60255 (product standards) ANSI C37.90.0/1/1.2; UL508 See also standards for individual tests
<i>Insulation tests</i>	
Standards	IEC 60255-5
Voltage test (routine test) all circuits except auxiliary supply	2.5 kV (r.m.s.), 50 Hz, 1 min
Voltage test (routine test) auxiliary supply	3.5 kVDC; 30 s; both polarities
Voltage test (type test) Across open contacts Across open live contact	1.5 kV (r.m.s.), 50 Hz; 1 min 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
<i>EMC tests for interference immunity; type tests</i>	
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; = 330 Ω
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; 1810 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	Impulse: 1.2/50 μs
Auxiliary voltage	circuit groups to ground: 2 kV; 12 Ω, 9 μF between circuit groups: 1 kV; 2 Ω, 18 μF
Measuring inputs, binary outputs	circuit groups to ground: 2 kV; 42 Ω, 0.5 μF between 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; AM; $R_i = 150 \Omega$
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 kV to 5 kV; 10/150 ns; 50 and 120 surges per s; both polarities; duration ≥ 2 s; $R_i = 80 \Omega$
Radiated electromagnetic interference ANSI/IEEE C37.90.2	35 V/m 25 MHz to 1000 MHz amplitude and pulse-modulated
<i>EMC tests for interference emission; type test</i>	
Standard	EN 50081-* (generic)
Conducted interference voltage, auxiliary voltage IEC CISPR 22, EN 55022, DIN EN VDE 0878 Part 22	150 kHz to 30 MHz, class B
Interference field strength IEC CISPR 22	30 MHz to 1000 MHz, class B

# Overcurrent Protection / 7SJ46

## Technical data

5

Mechanical stress test	
<i>Vibration, shock and seismic vibration</i>	
<u>During operation</u>	
Standards	IEC 60255-21 and IEC 60068-2
Vibration IEC 60255-21-1, class II IEC 60068-2-6	Sinusoidal 10 to 60 Hz: ± 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 IEC 60255-21-3; class I IEC 60068-3-3	Sinusoidal 1 to 8 Hz: ± 4.0 mm amplitude (horizontal vector) 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
<u>During transport (flush mounting)</u>	
Standards	IEC 60255-21 and IEC 60068-2
Vibration IEC 60255-21-1, class 2 IEC 60068-2-6	Sinusoidal 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
Shock IEC 60255-21-2, class 1 IEC 60068-2-27	Semi-sinusoidal 15 g acceleration, duration 11 ms, each 3 shocks in both directions of the 3 axes
Continuous shock IEC 60255-21-2, class 1 IEC 60068-2-29	Semi-sinusoidal 10 g acceleration, duration 16 ms, each 1000 shocks in both directions of the 3 axes

Climatic stress tests	
<i>Temperatures</i>	
Temperatures during service	–20 °C to +70 °C / –4 °F to +158 °F with continuous current 4 I <sub>N</sub> : –20 °C to +55 °C / –4 °F to +131 °F
Maximum temperature during storage	–25 °C to +55 °C / –13 °F to +131 °F
Maximum temperature during transport	–25 °C to +85 °C / –13 °F to +185 °F
<i>Humidity</i>	
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

Function	
<i>Overcurrent protection</i>	
<i>Definite time (DT O/C ANSI 50/51)</i>	
Setting range / steps	
Current pickup I <sub>&gt;&gt;</sub> (phases)	2 I <sub>N</sub> to 20 I <sub>N</sub> or deactivated, step 0.5 I <sub>N</sub>
Current pickup I <sub>&gt;</sub> (phases)	0.5 I <sub>N</sub> to 6.2 I <sub>N</sub> or deactivated, step 0.1 I <sub>N</sub>
Current pickup I <sub>E&gt;</sub> (ground calculated)	0.5 I <sub>N</sub> to 6.2 I <sub>N</sub> or deactivated, step 0.1 I <sub>N</sub>
Delay times T <sub>1&gt;&gt;</sub>	0 to 1575 ms, step 25 ms
Delay times T <sub>1&gt;</sub>	0 to 6300 ms, step 100 ms
The set time delays are pure delay times.	
<i>Inverse time (IEC or ANSI 51)</i>	
Current pickup I <sub>p</sub> (phases)	0.5 I <sub>N</sub> to 4 I <sub>N</sub> or deactivated, step 0.1 I <sub>N</sub>
Current pickup I <sub>E p&gt;</sub> (ground calculated)	0.5 I <sub>N</sub> to 4 I <sub>N</sub> or deactivated, step 0.1 I <sub>N</sub>
Delay times T <sub>1p</sub> (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	
Switch on to fault, 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 <sub>&gt;&gt;</sub> , I <sub>&gt;</sub> , I <sub>E&gt;</sub>	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 I <sub>N</sub> (at threshold < I <sub>N</sub> )
Time behaviour for 2 ≤ II <sub>p</sub> ≤ 20	5 % or 50 ms
<i>Deviation of the measured values as a result of various interferences</i>	
Frequency in the range of 0.95 < f/f <sub>N</sub> < 1.05	< 2.5 %
Frequency in the range of 0.9 < f/f <sub>N</sub> < 1.1	< 10 %
Harmonics up to 10 % 3 <sup>rd</sup> and 5 <sup>th</sup> harmonic	< 1 %
DC components	< 5 %
Auxiliary supply voltage DC in the range of 0.8 ≤ V <sub>aux</sub> /V <sub>aux N</sub> ≤ 1.2	< 1 %
Auxiliary supply voltage AC in the range of 0.8 ≤ V <sub>aux</sub> /V <sub>aux N</sub> ≤ 1.15	< 1 %
Temperature in the range of –5 °C to 70 °C / 23 °F to 158 °F	< 0.5 %/10 K

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 2004/108/EG previous 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 eneric standards EN 50081-2 and EN 50082-2.



# Overcurrent Protection/7SJ46

## Selection and ordering data

Description	Order No.
SIPROTEC easy 7SJ46 numerical overcurrent protection relay	7SJ460□-1□□00-□AA0
<b>Current transformer <math>I_N</math></b>	
1 A	1
5 A	5
<b>Unit design</b>	
For rail mounting	B
For panel flush mounting	E
<b>Region-specific functions</b>	
Region World, 50/60 Hz; standard	A
Region World, 50/60 Hz; condensation-proof	B
<b>IEC / ANSI</b>	
IEC	0
ANSI	1