SIPROTEC easy 7SJ46
Numerical Overcurrent Protection Relay

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

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 earth-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

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.

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.

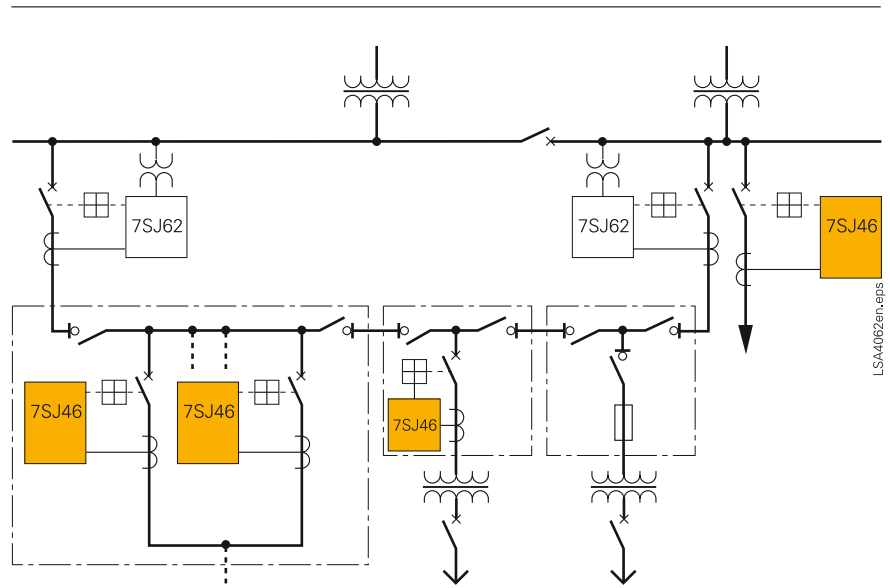| ANSI	IEC	Protection functions
50	$I\!>\!>$	Instantaneous overcurrent protection
50, 51	$I\!>\!t$, I_p	Time-overcurrent protection (phase)
50N, 51N	$I_E\!>\!t$, I_{Ep}	Time-overcurrent protection (earth)

Fig. 5/12 Typical application

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. 5/13 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 earth 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.
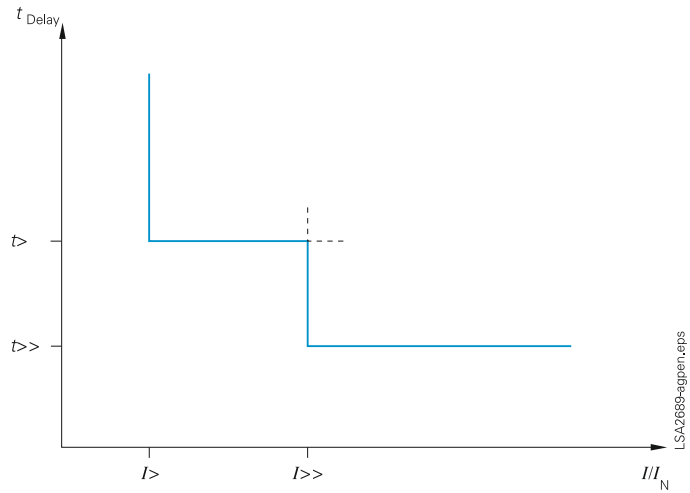
Fig. 5/15 Definite-time overcurrent characteristic
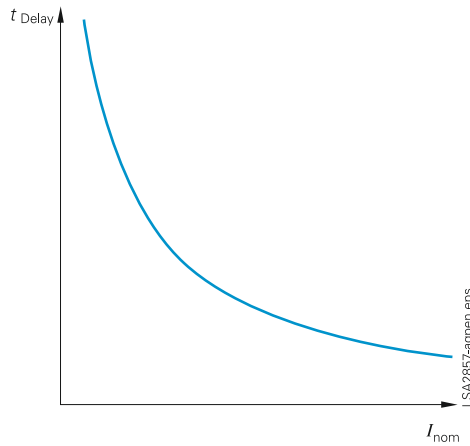
Fig. 5/16 Inverse-time overcurrent characteristic

Available inverse-time characteristics

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

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.
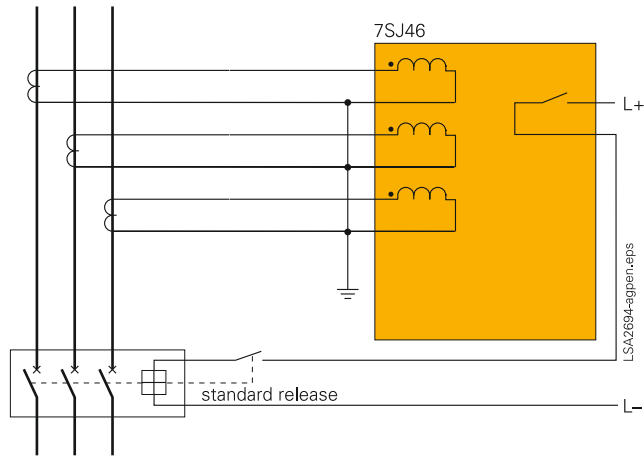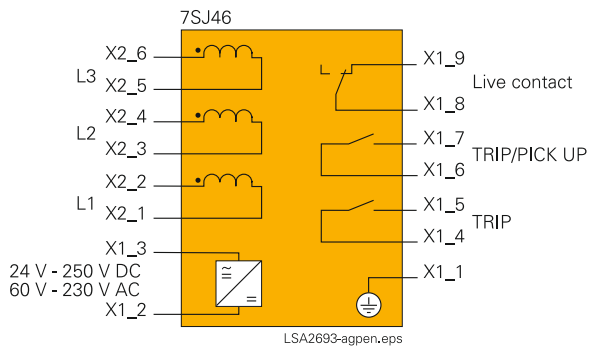
Fig. 5/17 Connection of 3 CTs

Fig. 5/18 Connection diagram 7SJ46

Technical data

General unit data	
Analog input	
System frequency f_N	50 or 60 Hz (selectable)
Current transformer inputs	
Rated current, normal earth current I_N	1 or 5 A
Power consumption	
Per phase at $I_N = 1$ A	Approx. 0.01 VA at I_N
Per phase at $I_N = 5$ A	Approx. 0.2 VA at I_N (relay)
Rating of current transformer circuit	
Thermal (r.m.s.)	$100 \cdot I_N$ for 1 s
	$30 \cdot I_N$ for 10 s
	$4 \cdot I_N$ continuous
Dynamic (peak)	$250 \cdot I_N$ for half a cycle
Auxiliary voltage AC/DC powered	
Input voltage range	24 to 250 V DC (± 20 %)
	60 to 230 V AC (−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
Output relays	
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	≤ 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 kg
Degree of protection according to IEC 60529	
Housing	
Front	IP 51
Rear	IP 20
Protection of personnel	IP 1X
U_L-listing	
Listed under "69CA".	

Electrical tests	
Specifications	
Standards	IEC 60255 (product standards) ANSI C37.90.0/.1/.2; UL508 See also standards for individual tests
Insulation tests	
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 kV DC; 30 s; both polarities
Voltage test (type test)	
Across open contacts	1.5 kV (r.m.s.), 50 Hz; 1 min
Across open live contact	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 (generic standards)
High-frequency tests IEC 60255-22-1, class III	2.5 kV (peak); 1 MHz; τ = 15 ms; R_i = 200 Ω; 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 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 length = 15 ms; repetition rate 300 ms; both polarities; R_i = 50 Ω; duration 1 min
High-energy surge voltage, IEC 61000-4-5 installation class III	Impulse: 1.2/50 µs
Auxiliary voltage	circuit groups to earth: 2 kV; 12 Ω, 9 µF between circuit groups: 1 kV; 2 Ω, 18 µF
Measuring inputs, binary outputs	circuit groups to earth: 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 Ω
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 Ω, 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 Ω 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 Ω
Radiated electromagnetic interference ANSI/IEEE C37.90.2	35 V/m 25 MHz to 1000 MHz amplitude and pulse-modulated
EMC tests for interference emission; type test	
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

Technical data

Mechanical stress test

Vibration, shock and seismic vibration

<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) Frequeny sweep 1 octave/min 1 cycle in 3 perpendicular axes

<u>During transport</u> (flush mounting)

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

Temperatures

Temperatures during service	–20 °C to +70 °C / –4 °F to +158 °F with continuous current 4 I_N: –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

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_N to 20 I_N or deactivated, step 0.5 I_N
Current pickup $I>$ (phases)	0.5 I_N to 6.2 I_N or deactivated, step 0.1 I_N
Current pickup $I_E>$ (earth calculated)	0.5 I_N to 6.2 I_N or deactivated, step 0.1 I_N
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)

Current pickup I_p (phases)	0.5 I_N to 4 I_N or deactivated, step 0.1 I_N
Current pickup $I_{Ep}>$ (earth calculated)	0.5 I_N to 4 I_N or deactivated, step 0.1 I_N
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	
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 $I>>$, $I>$, $I_E>$	5 % of the set value or 5 % of I_N (at threshold < I_N)
Delay times T	1 % or 30 ms
Inverse time (IEC or ANSI 51)	
Pickup thresholds	5 % of the set value or 5 % of I_N (at threshold < I_N)
Time behaviour for $2 \leq I/I_p \leq 20$	5 % or 50 ms

<u>Deviation of the measured values as a result of various interferences</u>	
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 % 3rd and 5th harmonic	< 1 %
DC components	< 5 %
Auxiliary supply voltage DC in the range of $0.8 \leq V_{aux}/V_{aux\,N} \leq 1.2$	< 1 %
Auxiliary supply voltage AC in the range of $0.8 \leq V_{aux}/V_{aux\,N} \leq 1.15$	< 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 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.

c(UL)us
LISTED

Selection and ordering data

Description   Order No.

SIPROTEC easy 7SJ46
numerical overcurrent protection relay   7SJ460□ – 1□□00 – □AA0

Current transformer I_N
1 A	1
5 A	5

Unit design
For rail mounting	B
For panel-flush mounting	E

Region-specific/functions
Region World, 50/60 Hz; standard	A
Region World, 50/60 Hz; condensation-proof	B

IEC / ANSI
IEC	0
ANSI	1

5