SIEMENS

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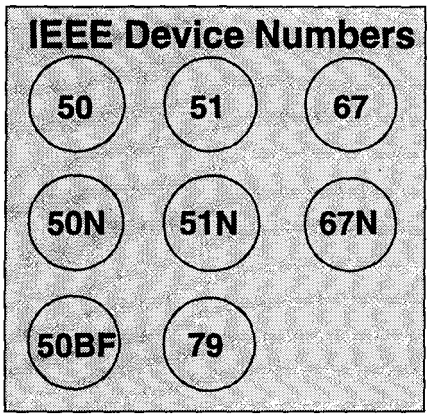
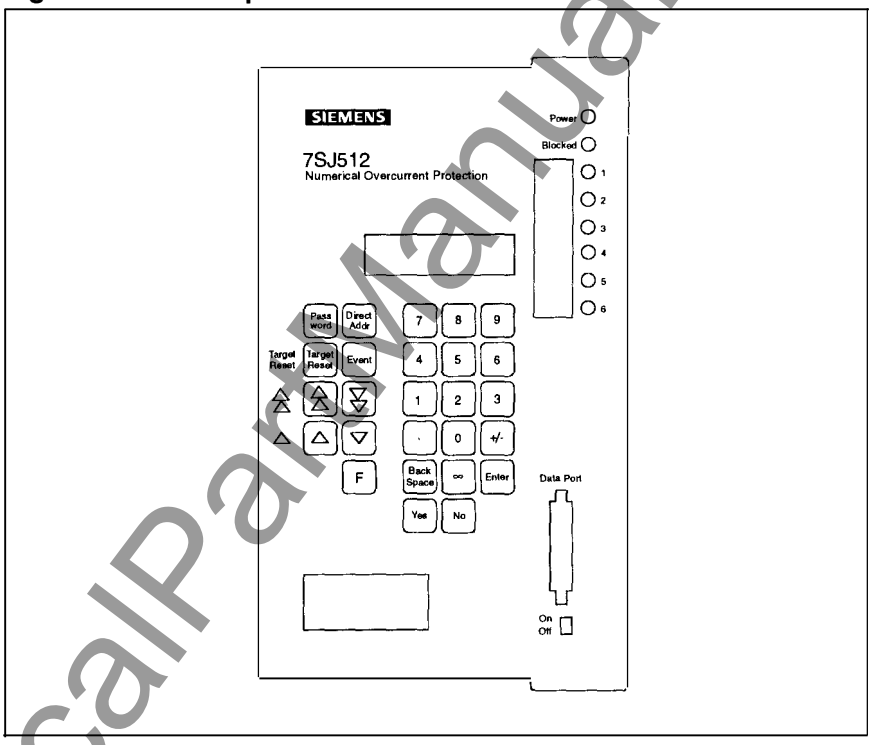
7SJ512 Numerical Overcurrent Protection



Features

- Microprocessor-Based Technology
- Fully Numerical Design
- 3-Phase and Ground Overcurrent Protection
  - Instantaneous (50/50N)
  - Definite Time (51/51N)
  - Inverse Time (51/51N)
- Standard and User Defined Inverse Time Delays
- Directional Discrimination (67, 67N)
- Automatic Multi-shot Reclose (79) (3-pole)
- High-Sensitivity Ground Fault Protection (50G/51G/59G)
- Phase Sequence Monitor (47)
- Breaker Failure Protection (50BF)
- Reverse Interlock Bus Protection
- 2nd Harmonic Restraint on Overcurrent Protection
- Nonvolatile Memory for Settings, Event Logs, and Targets
- Programmable Binary Inputs, LEDs, Signal and Trip Relays
- User Defined Functions
- Four Independent Setting Groups
- Dynamic Parameter Changeover
- Real Time Clock
- Circuit Breaker Operations Counter
- Accumulated Circuit Breaker Interrupted Current (per pole)
- Circuit Breaker Trip/Reclose Test
- Two Serial Ports
- IEC 870-5 Communication Standard

Figure 1. 7SJ512 Operator Panel



- Waveform Capture (20 samples per cycle)
- Fault Target Data
- Operations Event Log
- Metering Functions (on-line)
- Isolated DC to DC Power Supply
- Self-Monitoring
- Draw Out Construction

Description

The 7SJ512 is a microprocessor-based, three-phase and ground, overcurrent relay. The user can select definite time or inverse time protection. An additional high-set element can be set as instantaneous or time delayed. Phase and ground settings are independent. Second harmonic restraint is available for the definite and inverse time elements. A high-sensitivity ground fault protection element is also provided. As an optional feature, directional elements can be added.

All analog current inputs are isolated with internal transformers. High frequency components are removed by anti-aliasing filters. The inputs are sampled 20 times per cycle and converted to digital signals. Reliable, field-proven, numerical algorithms process the protection functions that include breaker failure protection, automatic reclose, and reverse interlocking.

The relay has a built-in numeric key pad and a 32-character liquid crystal display for setting the relay, monitoring measured and calculated values, and readout of various logs. LEDs are provided on the front for quick display of relay status and target indication (see Figure 1).

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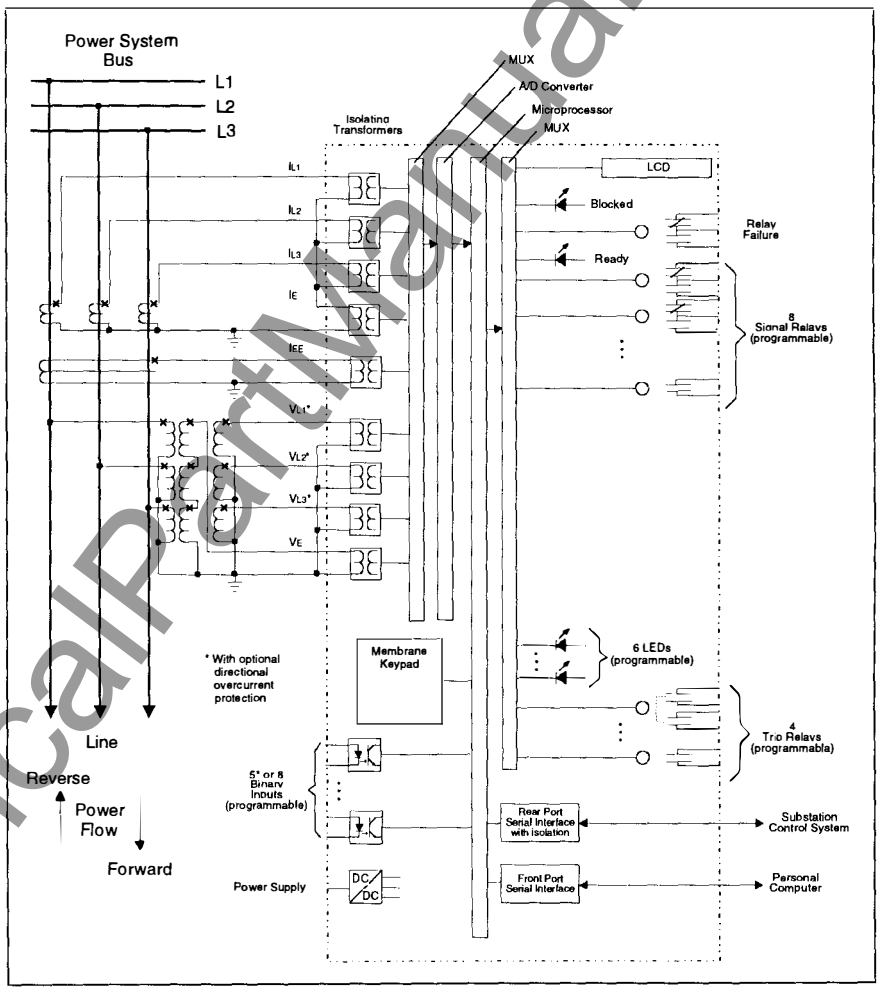
Two serial communication ports are available: one on the front for local connection of a personal computer, and, optionally, one on the back for connection to a substation control system.

The 7SJ512 has 5 current inputs, up to 4 voltage inputs, up to 8 optically isolated binary inputs, 4 trip relays, 8 signal relays and 8 LEDs. The ability to program the inputs, outputs and LEDs provides the user flexibility to configure the relay to his specific requirements. Figure 2 shows the 7SJ512 block diagram.

The relays are suitable for either panel or rack mounting and come in either a flush or surface mounting case. External connections are made on the rear for the flush mounting or on the front for the surface mounting. Screw terminals are provided which accept #10 ring lugs for current circuits and #8 ring lugs for all other circuits.

Draw out construction provides easy removal and replacement of the relay. All CT inputs are automatically shorted and all other circuits are disconnected.

Figure 2. 7SJ512 Block Diagram



Application

The 7SJ512 relay can be used as primary protection for distribution or subtransmission lines and as backup protection for transmission lines, transformers, and generators. With the optional voltage inputs, the 7SJ512 becomes a directional overcurrent relay which can be applied to loop systems.

The 7SJ512 can also be applied as a breaker failure relay initiated by either internal or external trip signals.

In addition to the protection functions, an internal automatic circuit breaker reclose function is provided. This feature allows for single and multi-shot reclose with independent trip delays after an unsuccessful reclose.

For radial distribution substations, bus protection can be implemented using the reverse interlock capability.

Waveform capture can be initiated by trip command, relay pickup, or external command. Up to 150 cycles of data, including 5 prefault cycles, are available. The resolution is 20 samples per cycle (0.83 ms at 60 Hz).

Phase and ground settings are independent. Ground current can be obtained from a separate toroidal CT or from the neutral connection of the three phase CTs.

The 7SJ512 relay stores 4 separate groups of settings. With the Parameter Changeover function, the relay, while not in pickup, can change its operating settings to another group that accommodates new or changing system conditions. Parameter Changeover can be activated through the operator panel or front serial port,

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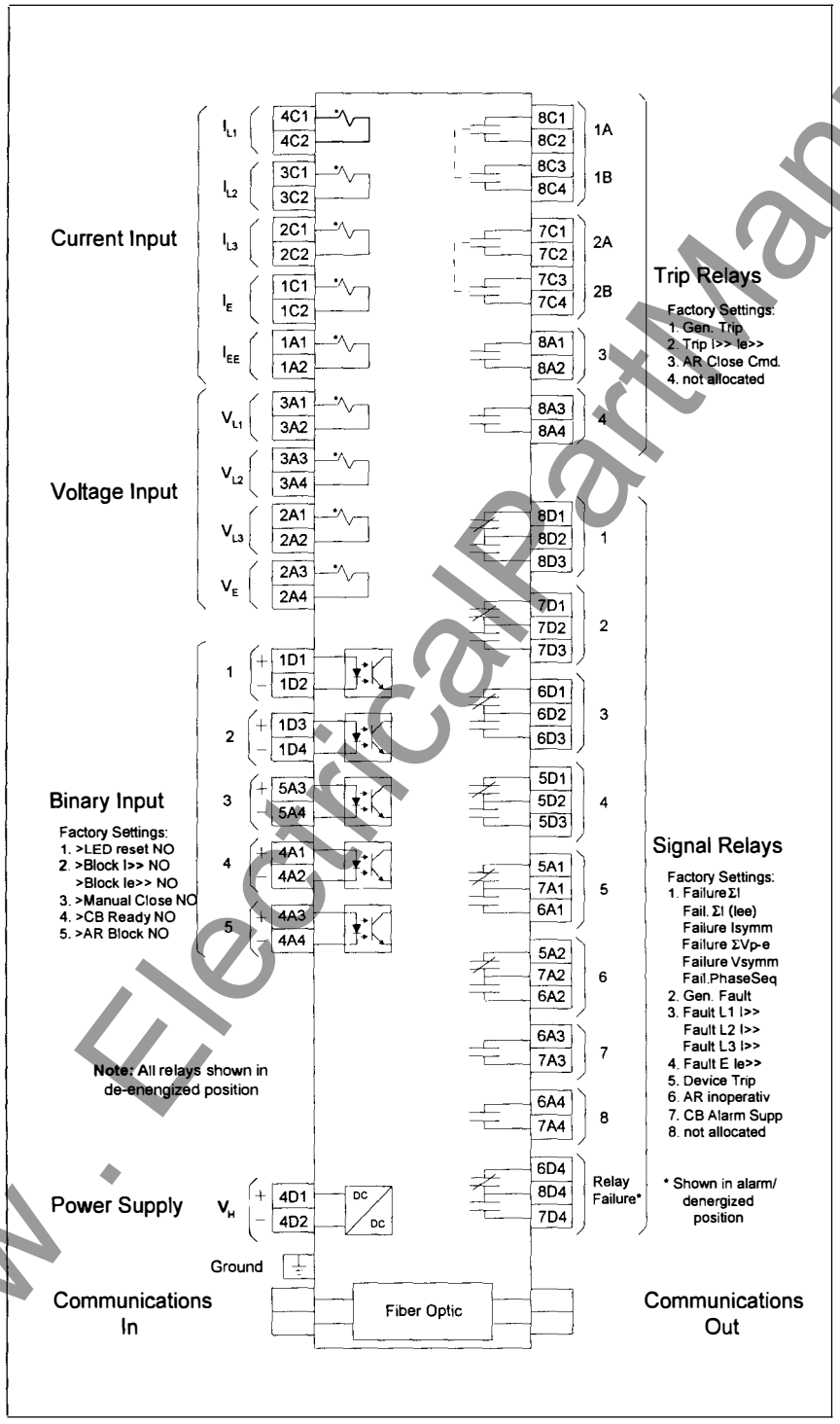
Figure 3. Connection Diagram



or by a binary input. Furthermore, a Dynamic Parameter Changeover feature allows the relay to change to an alternative set of pick-up values, under control of a binary input, even while in pickup.

Operating Principles

Digitized input values are compared against the programmed protection settings. If the values are above the specified limits, appropriate steps are taken to activate the programmed output devices. External control of all protection functions is available through the binary inputs.

Overcurrent Protection

The measured values obtained from the current inputs are compared against the programmed overcurrent settings. When the limits are exceeded, a programmed time delay is started. If the fault condition is still present at the expiration of the time delay, the specified trip relays, LEDs, or other output devices are activated. Pick-up values and time delays can be specified separately for each phase and ground.

Both definite and inverse time protection elements are provided. The following inverse time characteristics are available:

ANSI Inverse
ANSI Short Inverse
ANSI Long Inverse
ANSI Moderately Inverse
ANSI Very Inverse
ANSI Extremely Inverse
ANSI Slightly Inverse
IEC Normal Inverse
IEC Very Inverse
IEC Extremely Inverse

One user-defined characteristic is provided. The user-defined curve allows for specification of up to 60

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Figure 4. Additional Trip Time Characteristics - Neutral

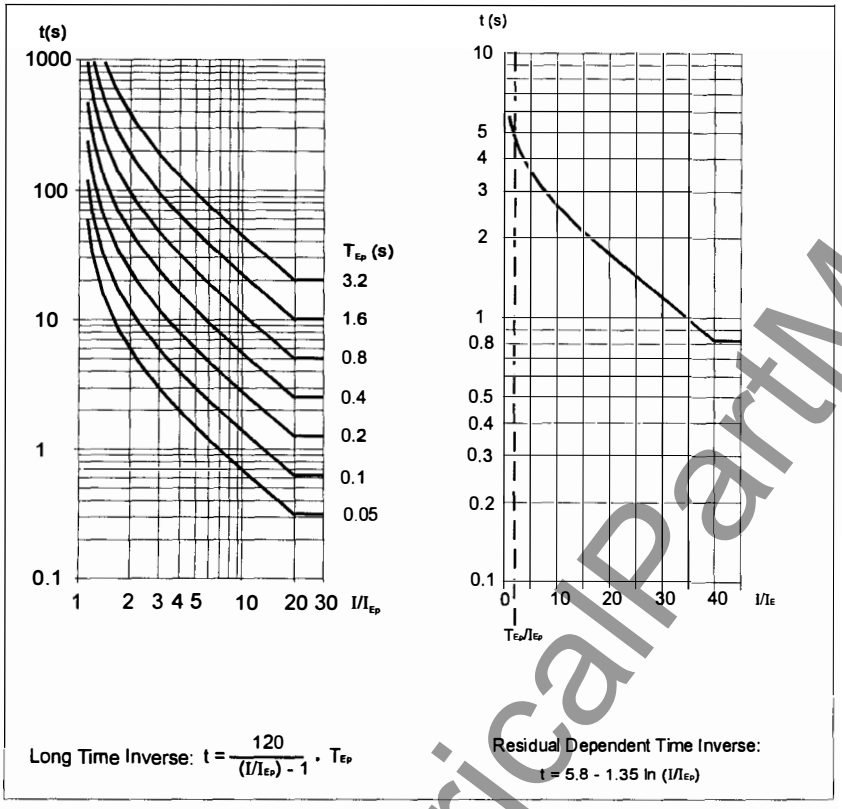
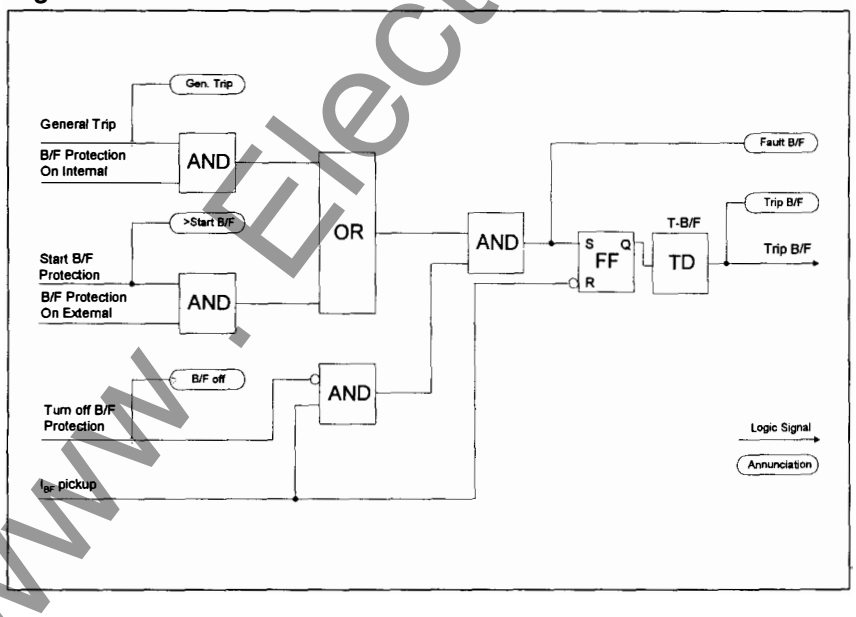


Figure 5. Breaker Failure Protection



current-time pairs. For neutral, two additional inverse characteristics, Long Time and Residual Dependent Time, are provided (see Figure 4). In addition, an independent *high-set* overcurrent element for use as an instantaneous or time delayed trip is available.

Directional Elements (Optional)
The directional overcurrent elements allow for specification of independent, directionally sensitive trip delays for phase and ground time overcurrent protection elements. Either measured or memorized phase voltages are used to determine direction. The operating direction can be specified separately for phases and ground.

2nd Harmonic Restraint
When protecting transformers, time overcurrent protection may be restrained by 2nd harmonic content. When active, 2nd harmonic restraint is selective by phase. The Crossblock feature can block time overcurrent protection on all phases when 2nd harmonic restraint is active on any one phase.

Ground Fault Protection
A highly sensitive ground fault protection element utilizes ground fault current and/or displacement voltage to detect faults in grounded or isolated systems. When both the ground current and displacement voltage are available, directional sensitivity is possible. This element operates independently of the normal overcurrent protection and provides both definite and inverse time characteristics. The choice of inverse time characteristics is the same as for neutral overcurrrent. An independent, nondirectional, high-set definite time element is also provided. If the optional directional overcurrent feature is present, the displacement voltage

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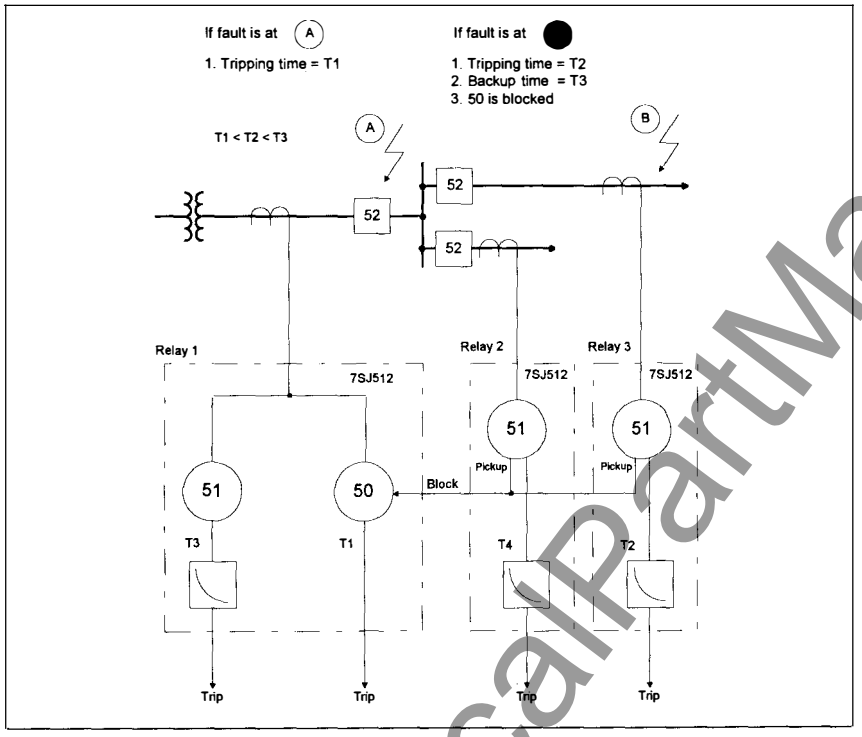
Figure 6. Reverse Interlocking



can be calculated from the phase voltages.

Breaker Failure Protection

After a circuit breaker has been signalled to trip, the breaker failure protection function can be activated to check for successful operation of the breaker. A timer is started following a trip command. During the timeout the relay checks for removal of the fault current. If the fault current is not removed before the timer expires, the relay can initiate other corrective actions (e.g., retrip, bus clearing). This protective function can also be activated by an external trip command. Figure 5 shows the breaker failure logic.

Reverse Interlocking

The programmability of the 7SJ512 relay allows implementation of reverse interlocking configurations. The principal of reverse interlocking is to block upstream relays by downstream relays so that the relay closest to the fault is the only one that trips. This technique is used for bus protection to prevent the instantaneous element of the relay protecting the supply feeder from tripping on feeder fault (see Figure 6). The time overcurrent element of the supply feeder remains in service at all times for effective local backup.

Automatic Reclose (AR)

The internal automatic circuit breaker reclose function allows rapid restoration of service following temporary faults. Multi-shot reclose with one high-speed *(rapid)* and up to nine *delayed* cycles is provided. Automatic Reclose trip delays are independent of normal overcurrent trip delays.

Automatic reclose can be initiated by any user-specified combination of protection pickups and may be blocked on faults in the reverse direction, by binary input, or by pickup of the high-set overcurrent element. Internal trip and trip-with-reclose test functions are provided.

Programmable Inputs/Outputs

The 7SJ512 relay includes a preprogrammed, integrated trip matrix. The trip and signaling relays can be programmed by the user to operate for any internal protection or alarm function, or they can be linked to an external function or command (e.g., block instantaneous trip) via the programmable binary inputs. In addition, the LEDs can be programmed to provide visual indication of trip and alarm functions. These features allow the user to configure the relay to best suit the protection system's requirements and practices.

Programming the relay is accomplished through either the operator panel keypad and display, or a personal computer attached to the operator panel data port.

Self-Checking

The 7SJ512 relay incorporates comprehensive monitoring functions which cover both hardware and software. Plausibility checks on the currents monitor the external CT and VT circuits. Detection of a failure will block the relay and provide an alarm contact output. In some cases, an LED indication is available.

Hardware

The relay monitors the auxiliary and internal reference voltages, A/D converter, trip circuits and memory modules.

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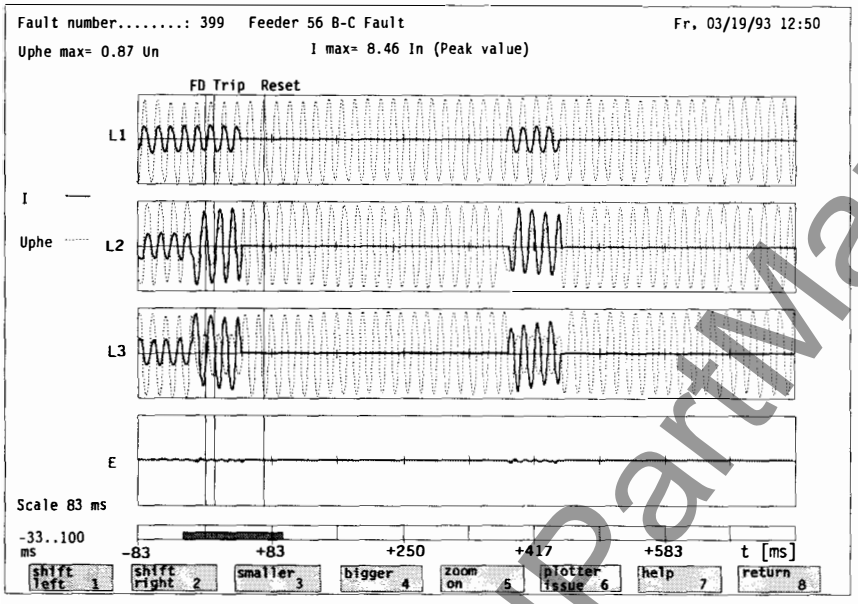
Figure 7. Waveform Capture



The internal DC voltages are monitored. If the voltages deviate outside the permissible limits, the protection functions are blocked, and an alarm occurs via a fail-safe contact. The relay can withstand transient dips in the supply voltage for up to 50 milliseconds with power input of 110 volts and above.

The trip relays are controlled by two command channels and one release channel. As long as no protection elements have picked up, the central processor checks the command channels for availability. This is a cyclic check where the channels are excited in sequence and the output signal changes are monitored. If the feedback signal changes to a low level, a fault in a channel or a relay coil is indicated. In this case, the command output is blocked and an alarm is signaled.

The complete current and voltage circuits from the measurement transformers to the A/D converter are monitored for problems. The digitized sum of the converter outputs for current and voltage will ideally be zero. User settable value for the summation factors provide margin for CT and VT performance errors, thereby eliminating nuisance alarms.

To detect interruptions or short circuits in the external CT and VT circuits (transformers and connections), the system currents are checked for symmetry. During normal operation the currents and voltages are approximately symmetrical. If the amount of asymmetry exceeds a user settable threshold, an alarm is signaled. This checking is suspended any time a protection element picks up.

Software

The memory modules are checked through a cyclic checksum process, which is compared to the stored checksum.

A watchdog timer is provided for continuous monitoring of the program sequence. It will reset the processor in the event of a processor failure or if the program falls out of step. Additional plausibility checks are performed to detect faults in the program processing caused by interference. If these faults are not eliminated after three reset attempts, the relay will take itself out of service and activate the alarm contact and LED.

Operational Values

The following measured and calculated values are available from the front panel LCD or the serial interfaces:

- Primary phase and ground rms current
- Primary phase-to-ground voltage
- Real, reactive, and apparent power
- Power factor
- Frequency
- Resistive and reactive ground fault current components
- Accumulated circuit breaker interrupted current

Two values may be continuously dislayed on the LCD during normal operation.

Fault Data

The relay stores fault target information for the last three faults. The time that the fault occurred, the element that detected the fault, and the value of the fault current are provided for each record. All of this data is stored in non-volitile memory.

In addition, the relay can be programmed to display two lines of fault information in the LCD whenever a protection element picks up. LEDs programmed to indicate pickup and/or trip events can be set to retain the indications until acknowledged by an operator.

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Waveform Capture

The relay will record the fault waveforms for the last fault. The maximum record length is 150 cycles with a sampling rate of 20 samples per cycle. The record begins 5 cycles before pick-up and can extend up to 145 cycles after pick-up. An example of the captured data, as it can be displayed with appropriate software, is shown in Figure 7.

Waveform capture can be initiated three ways: (1) internal fault detection, (2) internal trip, or (3) external command via a binary input.

Communications

An RS-232-C serial interface on the relay's operator panel (see Figure 1) allows you to connect the relay to any personal computer. The Siemens DIGSI® software package, provided with the relay, allows the user to reconfigure the relay, change settings, and retrieve data.

There also is a optional fiber optic serial interface on the back of the unit, which can be used for online communications with a remote or local substation control or monitoring system.

Figure 8. AC Connections, 3-Phase CT with Neutral Residual

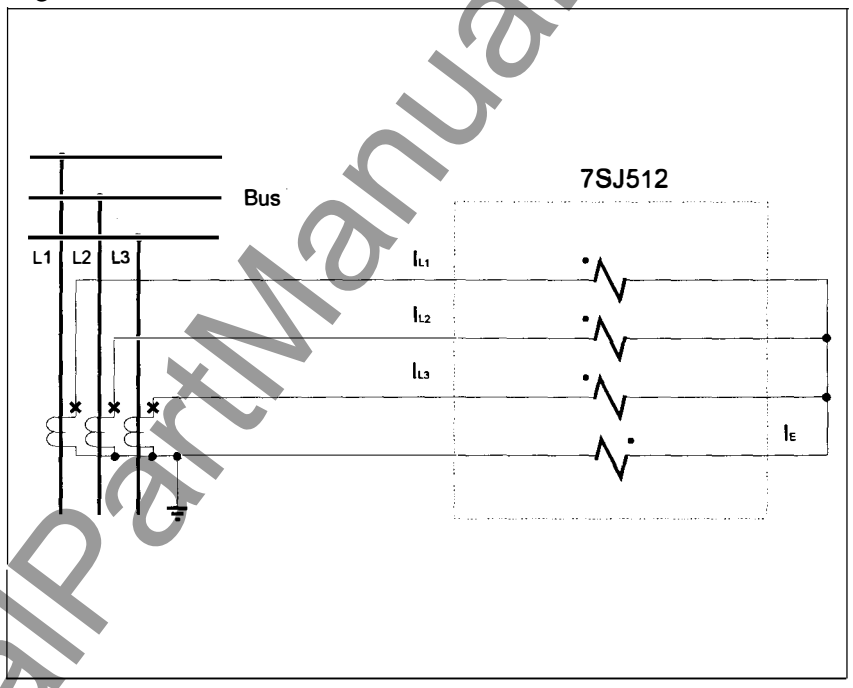

Figure 9. AC Connections, 3-Phase CT with Toroidal CT

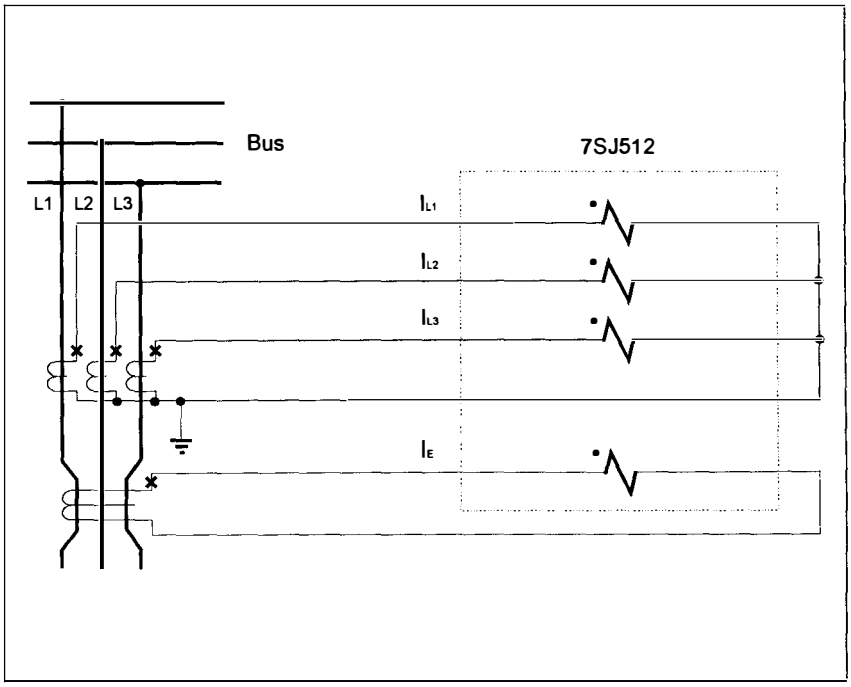

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Figure 10. AC Connections, 3-Phase VT with Open Delta

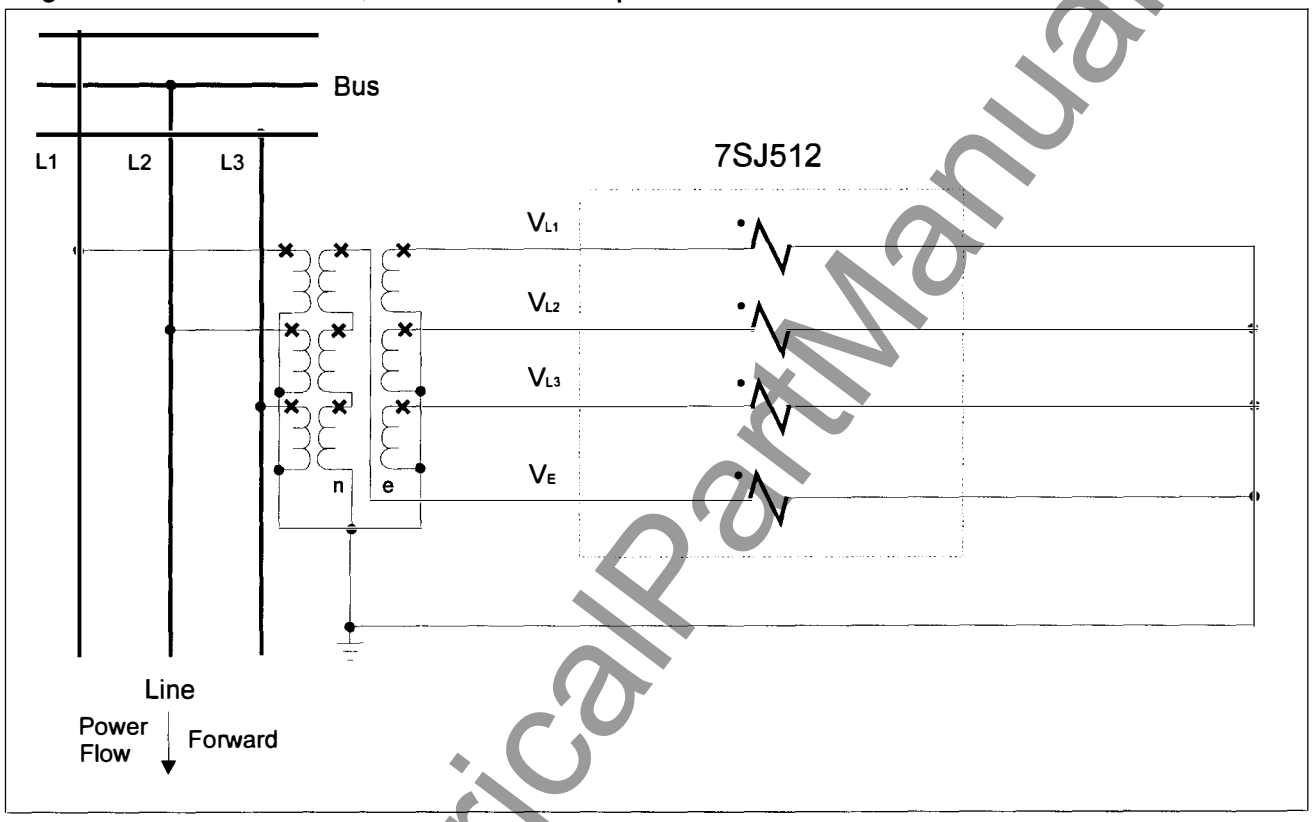
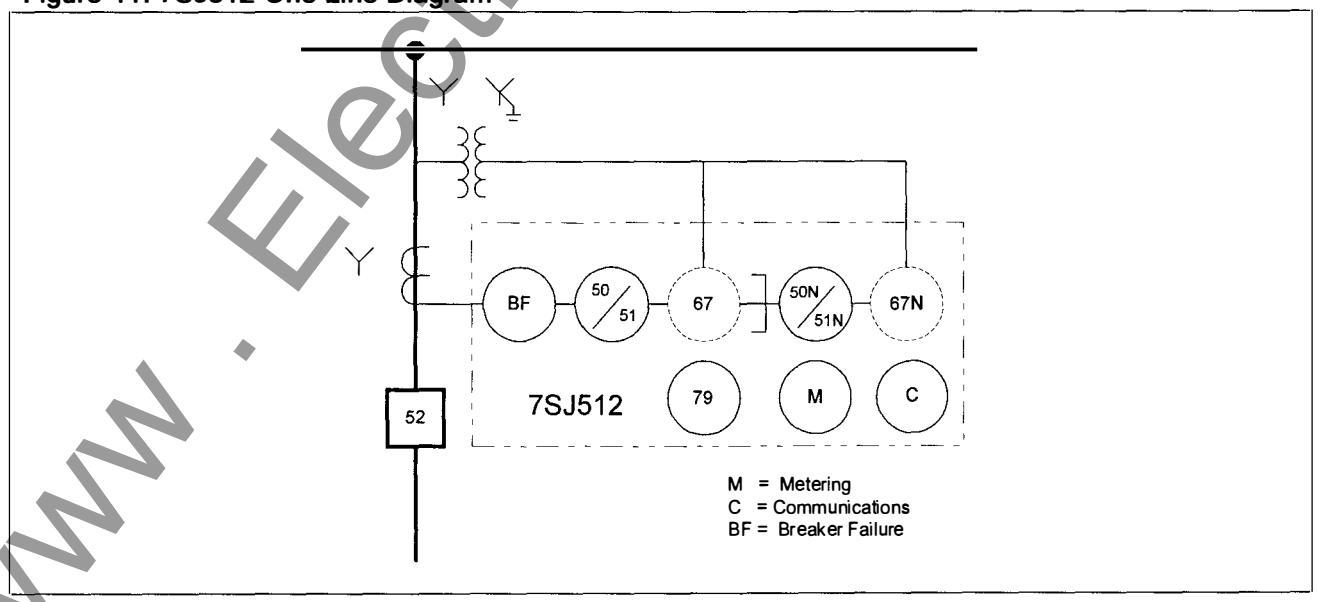


Figure 11. 7SJ512 One Line Diagram



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Technical Data - Relay Specifications

Measuring circuits		
	Rated current I_N	1 A or 5 A
	Rated voltage V_N (line-to-line)	100 V to 125 V
	Rated frequency f_N	50 Hz/60 Hz (programmable)
	Burden at I_N = 1 A	Approx. 0.1 VA per phase and neutral
	Burden at I_N = 5 A	Approx. 0.2 VA per phase and neutral
	Burden for ground fault detection at 1 A	Approx. 0.3 VA
	Burden for voltage path at 100 V	Approx. 0.5 VA per phase
	Overload capability - current path:	
	- Thermal (rms)	100 x I_N for ≤ 1 s 10 x I_N for ≤ 10 s 4 x I_N continuous
	- Dynamic (impulse)	250 x I_N for 1/2 cycle (peak value)
	Overload capability - ground fault protection:	
	- Thermal (rms)	300 A for 1 s 100 A for 10 s 15 A continuous
	Overload capability - voltage path:	
	- Thermal (rms)	140 V continuous
Power system		
DC power supply via integrated DC/DC converter	Rated voltage V_{HN} (VDC)	Operating range V_H (VDC)
	24/48	19 to 56
	60/110/125	48 to 144
	220/250	176 to 288
	Ripple, peak-to-peak	≤ 12% at rated voltage ≤ 6% at the limits of the voltage ranges
	Power consumption	
	- Quiescent	Approx. 6.5 W
	- Energized	Approx. 13 W
	Loss of DC supply ride-through	≥ 50 ms at V_H ≥ 110 VDC
Trip relays		
	Number of relays	4
	Contacts per relay	2 relays with 2 form A 2 relays with 1 form A
	Switching capacity MAKE	1000 W/VA
	Switching capacity BREAK	30 W/VA
	Switching voltage	250 V
	Permissible current	5 A continuous, 30 A for 0.5 seconds
Signal/failure relays		
	Number of signal relays	8
	Number of failure relays	1
	Contacts per relay	7 relays with 1 form C 2 relays with 1 form A
	Switching capacity MAKE	20 W/VA
	Switching capacity BREAK	20 W/VA
	Switching voltage	250 V
	Permissible current	1 A
Binary inputs		
	Number of inputs	8 *without* directional option 5 *with* directional option
	Operating voltage	24 VDC to 250 VDC
	Current consumption	Approx. 2.5 mA, independent of operating voltage

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Technical Data - Relay Specifications (cont.)

Serial interfaces	Operator interface (front port) - Connection	Non-isolated 25-pin connector on the front panel, providing an EIA RS-232-C (ISO 2110) for connection to a personal computer
	- Transmission speed	1200 bps as delivered; min. 1200 bps; max. 19200 bps
	Rear port interface - Standards	Isolated IEC 870-5 Protocol DIN 19244
	- Transmission speed	9600 bps as delivered min. 4800 bps; max. 19200 bps
	- Hamming distance	d = 4
	- Connection - Fiber Optic	Integrated F-SMA connector for direct optical fiber connection, e.g. glass fiber; 62.5/125 µm
	Optical wave length	820 nm
	Permissible line attenuation	Max. 8 dB
	Transmission distance	Max. 1.2 mi (2 km)
	Normal signal position	Settable; factory setting: "light off"
Weight	In housing for flush mounting In housing for surface mounting	17.5 lb (8.0 kg) 14.5 lb (6.5 kg)

Technical Data - System Specifications (Standards: ANSI C37.90.0, C37.90.1, C37.90.2; IEC255-5 and IEC255-6)

Insulation tests (ANSI C37.90.0; IEC 255-5)	High voltage test (routine test)	2 kV (rms), 50/60 Hz, 1 min; alt. 2.8 kVDC, 1 min
	Impulse voltage test (type test)	5 kV (peak); 1.2/50 µs; 0.5 J; 3 positive and 3 negative shots at intervals of 5 s
Disturbance tests	High frequency test (type test)	2.5 kV (peak); 1 MHz; τ = 15 ms; 400 shots per s for 2 s - ANSI C37.90.1; IEC 255-22-1 class III
	Electrostatic discharge test (type test)	8 kV (peak); 5/30 ns; 10 positive discharges - IEC 255-22-2 class III
	Radiated electromagnetic fields (type test) test with walkie-talkie	68, 151, or 450 MHz - IEC 255-22-3 class III 25 MHz - 1 GHz; 10 V/m - ANSI C37.90.2, C37.90.2
	Fast transients (type test)	2 kV (peak); 5/50 ns; 5 kHz; 4 mJ per shot - IEC 255-22-4 class III 5 kV; 10/150 ns - ANSI C37.90.1
Mechanical stress tests	During operation	10 Hz to 60 Hz: 0.035 mm amplitude 60 Hz to 500 Hz: 0.5 g acceleration
	During transport	5 Hz to 8 Hz: 7.5 mm amplitude 8 Hz to 500 Hz; 2 g acceleration

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Technical Data - System Specifications (cont.)

Climatic tests	Permissible ambient temperature during - Operation - Storage	 -20°C to +55°C (-4°F to +131°F) -25°C to +55°C (-13°F to +131°F)
	Humidity	95% non-condensing

Technical Data - Definite Time Overcurrent Protection (50/50N, 51/51N)

Setting range/steps	Overcurrent pickup setting - phases, I/I_N	0.10 to 25.00 (steps 0.01)
	Overcurrent pickup setting - neutral, I/I_N	0.05 to 25.00 (steps 0.01)
	High-set overcurrent pickup setting - phases, I/I_N	0.10 to 25.00 (steps 0.01)
	High-set overcurrent pickup setting - neutral, I/I_N	0.05 to 25.00 (steps 0.01)
	Delay time setting	0.00 s to 60.00 s (steps 0.01 s) or infinite
Times	Pickup time with:	
	2 x setting value, w/o meas. repetition	Approx. 33 ms
	2 x setting value, with meas. repetition	Approx. 50 ms
	5 x setting value, w/o meas. repetition	Approx. 25 ms
	5 x setting value, with meas. repetition	Approx. 40 ms
	Reset time	Approx. 35 ms
	Overshot time	Approx. 35 ms
	Reset ratio	Approx. 0.95
Tolerances	Pickup value	± 3% of setting value
	Delay time	± 1% of setting value or 10 ms
Influence variables	Power supply in range: $0.8 \le V_H/V_{HN} \le 1.15$	≤ 1%
	Temperature in range: $0°C \le \Theta_{AMB} \le 40°C$	≤ 0.5%/10°C
	Frequency in range: $0.98 \le f/f_N \le 1.02$	≤ 1.0%
	$0.95 \le f/f_N \le 1.05$	≤ 2.5%
	Harmonics: Up to 10% of 3rd	≤1%
	Up to 10% of 5th	≤1%

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Technical Data - Inverse Time Overcurrent Protection (51/51N)

Setting range/steps	Overcurrent pickup setting - phases, $I_p = I/I_N$ Overcurrent pickup setting - neutral, $I_{Ep} = I/I_N$	0.10 to 4.00 (steps 0.01) 0.05 to 4.00 (steps 0.01)
	Time multiplier setting - phases, T_p Time multiplier setting - neutral, T_{Ep}	0.05 s to 3.20 s (steps 0.01 s) or infinite 0.05 s to 4.00 s (steps 0.01 s) or infinite
Trip Time Characteristics	For phase, neutral, and ground: IEC 255-3 - Normal inverse - Very inverse - Extremely inverse	
	User-defined	Programmed by user
	Additionally for neutral and ground: IEC 255-3 - Long time inverse - Residual dependent time inverse	See Figure 4 where: t = trip delay T_{Ep} = time multiplier I = fault current I_{Ep} = pickup value
	Pickup threshold - except residual dependent - residual dependent	 1.1 I_S ($I_S = I_p$ or I_{Ep}) 1.0 I_S
Tolerances	Pickup value	± 3% of setting value
	Delay time for $2 \le I/I_p \le 20$ if: T_p or $T_{Ep} = 1$ T_p or $T_{Ep} \neq 1$	 ± 5% of setting value Additional ± 2% or at least ± 30 ms
Influence variables	Power supply voltage in range $0.8 \le V_H/V_{HN} \le 1.15$	≤ 1%
	Temperature in range $0°C \le \Theta_{AMB} \le 40°C$	≤ 0.5%/10°C
	Frequency in range $0.95 \le f/f_N \le 1.05$	≤ 8%

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Technical Data - Directional Determination (67) (Optional)

Phase faults	Measurement method	Phase currents polarized with quadrature voltages (Measured voltages are used unless they are too small due to fault. Then, memorized voltages are used.)
	Forwards area	-45° to +135° (if quadrature voltage is perpendicular to the fault voltage)
	Directional sensitivity	Unlimited for 1-phase and 2-phase faults. Dynamically unlimited for 3-phase faults. Steady-state approximately 7 volts phase-to-phase. No dead zone.
	Directional delay time	Characteristics and setting ranges are the same as for nondirectional overcurrent time protection (see Figures 3 and 4).
Neutral faults	Measurement method	Neutral current polarized with displacement voltage
	Forwards area	-45° to +135°
	Directional sensitivity	Approximately .1 V of displacement voltage
	Directional delay time	Characteristics and setting ranges are the same as for nondirectional overcurrent time protection (see Figures 3 and 4).
Tolerances	Angle error under reference conditions for: phase faults ground faults	 ± 5° electrical ± 5° electrical (If displacement voltage is connected to V_E)
Influence variables	Frequency dependent with: measured voltage memorized voltage	 Approx. 1° in the range $0.95 \le f/f_N \le 1.05$ Approx. 7.5° per % $\Delta f/f_N$

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Technical Data - High-Sensitivity Ground Fault Protection (50G/51G)

Displacement voltage detection	Displacement voltage setting, V_E	3 V to 100 V (steps 1 V)
	Measurement time	Approx. 60 ms
	Pickup delay setting, $T_{E/F}$	0.04 s to 320.00 s (steps 0.01 s) or infinite
	Additional trip delay setting, $T_{V_E\,TRIP}$	0.10 s to 320.00 s (steps 0.01 s) or infinite
	Measuring tolerance	± 5% of set value
	Time tolerance	± 1% of set value or ± 10 ms
Faulted phase (optional)	Measuring principal	Phase-to-ground voltage
	Undervoltage limit setting (faulted phase)	10 V to 100 V (steps 1 V)
	Overvoltage limit setting (unfaulted phase)	10 V to 100 V (steps 1 V)
	Measuring tolerance	± 5% of set value
Ground current detection	Definite time (including high-set):	
	- Pickup setting, I_{EE}	0.003 A to 1.600 A (steps 0.001 A)
	- Delay time setting	0.00 s to 320.00 s (steps 0.01 s) or infinite
	- Measurement time	Approx. 60 ms non-directional Approx. 100 ms directional
	- Measuring tolerance	± 5% of set value
	- Time tolerance	± 1% of set value or ± 10 ms
	Inverse time:	
	- Pickup setting, I_{EEp}	0.003 A to 1.400 A (steps 0.001 A)
	- Time multiplier setting	0.05 s to 4.00 s (steps 0.01 s) or infinite
	- Trip time characteristics	Same as normal inverse time protection. Curves are applicable only for currents less than 1.6 A.
	- Measuring tolerance	Same as normal inverse time protection
	- Time tolerance	± 7% of theoretical value for $2 \le I/I_{EEp} \le 20$ + 2% current tolerance or at least ± 70 ms
	Drop-out ratio	Approx. 0.95
Directional determination	Measurement	With $I_{EE} = 3\,I_0$ and $V_E = \sqrt{3}\,V_0$
	Measuring principal	Measurement of real and reactive power
	Measurement release setting	0.003 A to 1.600 A (steps 0.001) A
	Directional characteristic	$I_{EE} \cos \phi$ or $I_{EE} \sin \phi$ with programmable ±45° shift

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Technical Data - High-Sensitivity Ground Fault Protection (50G/51G) (cont.)		
Directional determination (cont.)	CT angle error correction setting	0.0° to 5.0° (steps 0.1°) for 2 operating points of the CT characteristic
	Measuring tolerance	± 10% of set value for I_{EE} < 0.45 A
	Measurement release setting	0.003 A to 1.600 A (steps 0.001) A
	Angle tolerance with: displacement voltage connected displacement voltage not connected	I_{EE} cos ϕ or I_{EE} sin ϕ ± 2° for $I_{EE} \geq$ 0.1 A, ± 7° for I_{EE} < 0.1 A ± 10°
Technical Data - Automatic Reclose (79)		
Shots	Maximum no.	1 rapid (first) plus up to 9 delayed (additional)
	Mode	3-pole only
Times	Settings:	
	- Action time	0.01 s to 320.00 s (steps 0.01 s)
	- First reclose dead time	0.01 s to 320.00 s (steps 0.01 s)
	- Additional reclose dead times	0.10 s to 1800.00 s (steps 0.01 s)
	- Reclaim time	0.50 s to 320.00 s (steps 0.01 s)
	- Reclaim time after unsuccessful reclose	0.50 s to 320.00 s (steps 0.01 s) or infinite
	- Reclaim time after manual reclose	0.50 s to 320.00 s (steps 0.01 s)
	- Duration of reclose command	0.01 s to 32.00 s (steps 0.01 s)
Technical Data - Breaker Failure Protection (50 BF)		
Setting range/steps	Pickup setting, I/I_N (phases and neutral)	0.10 to 4.00 (steps 0.01)
	Delay time setting	0.06 s to 60.00 s (steps 0.01 s) or infinite
Times	Pickup time with: Internal start External start	 Included in overcurrent time Approx. 50 ms
	Reset time	Approx. 50 ms
Tolerances	Pickup value	± 3% of setting value
	Delay time	± 1% of setting value or at least ± 20 ms

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Technical Data - Ancillary Functions Specifications

Operational measured values	Line currents	I_{L1}, I_{L2}, I_{L3}, I_E
	- Measurement range	0% to 240% of I_N
	- Tolerance	± 2% of I_N for $I < I_N$ ± 2% of measured value for $I > I_N$
	Line voltages	V_{L1-G}, V_{L2-G}, V_{L3-G} in primary kV and $\%V_N/\sqrt{3}$
	- Measurement range	0% to 120% of $V_N/\sqrt{3}$
	- Tolerance	± 2% of $V_N/\sqrt{3}$
	Power	P in MW, Q in MVAr, S in MVA and % S_N
	- Measurement range	0% to 120% of S_N
	- Tolerance	± 5% of S_N
	Power Factor	cos ϕ
	- Measurement range	-1 to +1
	- Tolerance	± 0.02
	Frequency	f and $\%f_N$
	- Measurement range	95% to 105% of f_N
	- Tolerance	± 5% of f_N
Measured value plausibility checks	Sum of currents	I_{L1}, I_{L2}, I_{L3}, I_E
	Sum of voltages (optional)	V_{L1}, V_{L2}, V_{L3}, V_E
Steady- state measured value supervision	Current unbalance	I_{max}/I_{min} > symmetry factor as long as $I > I_{limit}$
	Voltage unbalance (optional)	V_{max}/V_{min} > symmetry factor as long as $V > V_{limit}$
	Phase sequence (optional)	Clockwise phase rotation
Waveform capture	Recording time - Front port	5 cycles before fault; up to 145 cycle after fault
	- Rear port	3 cycles before fault; up to 30 cycles after fault
	Sampling rate	20 per cycle
Target log	Fault event data storage	
	- Maximum no. of faults	3 most recent
	- Maximum no. of events per fault	120
	- Sequence/display resolution	1 ms

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Technical Data - Specifications for Ancillary Functions (cont)

Event log	Operational data storage - Maximum no. of events - Sequence resolution - Display resolution	 50 most recent 1 ms 1 min
Real time clock	Accuracy Standby power - Type - Life	± 0.01% Internal lithium battery 5 years

7SJ512 Numerical Overcurrent Protection

Ordering Information

Model Number 7SJ512 □ - □□ A 1 1 - □□

Rated Current (50 or 60 Hz)

1 A	1
5 A	5

Power Supply Input Voltage

24, 48 VDC	2
60, 110, 125 VDC	4
220, 250 VDC	5

Mounting Construction

Surface mounting	B
Panel flush mounting or cubical installation	C
Panel flush mounting with screw terminals	G

Options

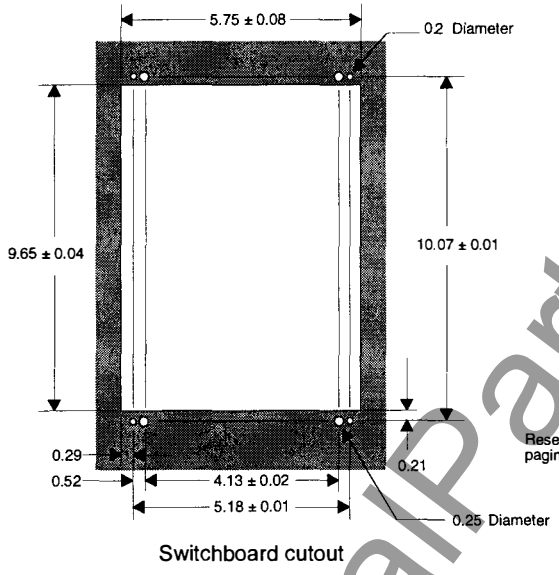
Without directional overcurrent protection	0
With directional overcurrent protection	1

Serial system interface (rear port)

Without serial interface	A
With fiber optic serial interface	C

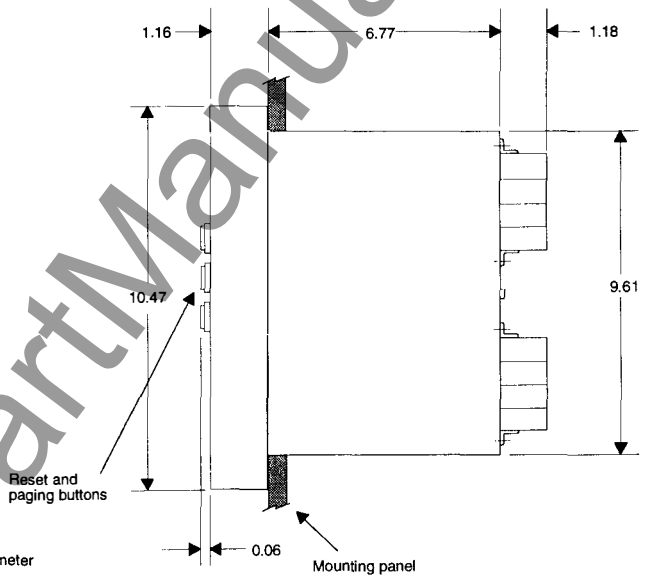
7SJ512 Numerical Overcurrent Protection

Dimensions - Flush Mounting (inches)

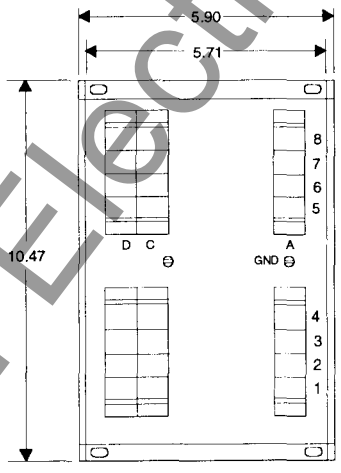


Switchboard cutout

Front view



Side View



Rear View

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