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Siprotec 7ST61 / 7ST63

Numerical overhead contact line protection
for AC traction power supply

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The numerical overhead contact line protection relay Siprotec® 7ST61 / 7ST63 is a selective and quick responding protection device for overhead contact lines fed from one or multiple points in AC traction power supplies.

The relay possesses all functions required to protect a section of the overhead contact line and can therefore be deployed universally.

Features

- Integration of protection, control, measurement and automation functions into a single unit
- Shortest tripping times due to adaptive protection algorithms
- Efficient operation due to a universal tool for all tasks
- Adaptation to different modes by parameter-set switchover
- Flexible availability of all common communication protocols

Overview

The Siprotec 7ST61 / 7ST63 numerical overhead contact line protection relay is a member of the Siprotec 4 product family, which stands for excellent quality and powerful protection relays and is characterized by the following features:

- Powerful 32-bit microprocessor system
- Completely numerical data processing and control, from the measurement of voltages and currents to the switching decision logic of the circuit-breaker
- Complete galvanic and interference-immune isolation of the internal processing circuitry from the measurement, control and power supply circuits of the switchgear via measured value transformers, binary input and output modules, and DC and AC voltage converters
- Simple operation via integrated operator panel or connected personal computer with operating software Digsj® 4
- Storage of fault indications and instantaneous values for fault recording

An integrated equipment concept arises from integration into the Siprotec family, e. g. with line, transformer and busbar differential protection.

The Siprotec 7ST61 / 7ST63 protection relays offer the following basic functions as standard:

- Distance protection
- Time overcurrent protection
- Emergency time overcurrent protection
- Thermal overload protection
- Defrosting protection (depending on product version)
- Trip circuit supervision
- Control function (Standard for 7ST63)
- Monitoring functions
- CFC (Continuous Function Chart) for implementation of user defined functions (Standard for 7ST63)

In addition to these, the following functions are available as options:

- High-speed overcurrent protection
- Voltage protection
- Circuit-breaker failure protection
- Inrush restraint
- Automatic reclosure function
- Synchronism and voltage check
- Fault locator (even for fast tripping)
- Calculation of the circuit-breaker load
- Teleprotection



Siprotec 7ST63 – combined protection and control unit

- | | |
|--|--|
| <ul style="list-style-type: none"> 1 Individual parameterizable LEDs for display of any process or device information 2 RS232 operator interface 3 Keyswitch for switching between „local and remote control“ and between „interlocked and non-interlocked operation“ 4 Illuminated LC display | <ul style="list-style-type: none"> 5 Navigation keys 6 Keys for control of the switching devices 7 Numerical operating keys 8 Four individual programmable function keys |
|--|--|

Basic functions

Distance protection (21)

- Distance protection function with three zones, high measuring accuracy, and flexible options for adaptation to power system conditions
- Impedance characteristic „combined“ or „polygonal“
- The direction characteristics „forward“, „reverse“ and „non-directional“ can be set for each distance zone
- Characteristics with separate setting of reach (impedance Z or reactance X), angle and load delimitation (resistance R)
- Instantaneous tripping when switching onto a fault

Time overcurrent protection (50/51)

- Full-value, non-directional overcurrent-time protection (definite/inverse-time) in three stages (very high current $I_{>>>}$, high current $I_{>>}$, overcurrent $I_{>}$)
- Fast tripping when switching onto a fault

Emergency time overcurrent protection (51)

- Back-up protection upon measuring voltage failure
- Single-stage back-up overcurrent-time protection ($I_{>}$ DMT)
- Instantaneous tripping when switching onto a fault

Thermal overload protection (49)

- Overhead line temperature calculated by means of a thermal model of the object being protected
- Catenary switchover
- Adjustable thermal warning stage
- Ambient temperature measurement possible

Defrosting protection (87) (depending on product version)

- Differential protection for de-icing current with parameterizable characteristic
- Back-up protection with two-level definite-time characteristic

Trip circuit supervision (74TC)

- Integrated trip circuit supervision

Control functions

- Closing and opening of switching devices manually via local control keys (7ST63), programmable function keys, via the system interface (e. g. station control system Sitras® SCS or IEC 61850) or via the operator interface (by means of personal computer and Digi 4 operator program)
- Feedback of the switching states via the CB auxiliary contacts (for commands with feedback)
- Plausibility monitoring of circuit-breaker positions and interlocking conditions for switching

Monitoring functions

- Monitoring of internal measuring circuits, the auxiliary power supply and the hardware and software, thus increasing reliability
- Monitoring of the signal of the overhead line voltage (fuse failure monitoring)
- Monitoring of ambient temperature sensing
- Monitoring of the tripping circuit possible
- Display of the operational impedances and direction

User defined functions

- Freely programmable combinations of internal and external signals to implement user-definable logic functions in CFC
- All common logic functions
- Delay times and limit queries

Further functions

- Battery-backed clock that can be synchronized via the synchronization signal (DCF 77, IRIG B by means of satellite receiver), binary input or system interface
- Constant calculation and indication of the operating measurements on the front display
- Writing of all parameters into a non-volatile memory so the setting values are retained even in the event of auxiliary power failure
- Fault value storage for the last eight power system faults (fault in the network), with real-time assignment
- Event store for storing the last 200 operational and 80 fault indications
- Communication with the control system possible via serial interfaces (depending on order variant), or optionally via data line, modem, or fiber-optic cable
- Commissioning aids such as connection and direction check and circuit-breaker check

Optional functions

High-speed overcurrent protection (50HS)

- Shortest tripping times (<2 ms) on exceeding tripping threshold
- Fault current tripping possible already in the first zero crossing of the current (in 16.7 Hz power systems)

Voltage protection (27/59)

- Two overvoltage stages for the overhead contact line ($U_{>>}$, $U_{>}$)
- Two undervoltage stages for the overhead contact line ($U_{<<}$, $U_{<}$)

Circuit-breaker failure protection (50BF)

- With independent current levels for monitoring the current flow
- Tripping by two independent, settable monitoring time levels
- Starting by tripping command of each integrated protection function
- External starting possible

Inrush restraint

- Distinction between operation and fault by means of harmonic analysis
- With blocking option for certain protection functions
 - Distance protection (from zone Z2)
 - Overcurrent-time protection and emergency definite-time tripping

Automatic reclosure function (79)

- Single or multiple reclosing (up to eight shots)
- With separate dead and operative times for the first two shots
- Testing of synchronism before reclosing (in combination with synchronism and voltage check function)

Synchronism and voltage check (25)

- Check of synchronous conditions before connection
- Alternatively check of absence of voltage before connection
- Fast measurement of voltage U_{diff} , of phase-angle difference φ_{diff} , and frequency difference f_{diff}
- Switching on asynchronous power system conditions with advance calculation of synchronization instant possible
- Settable minimum and maximum voltage
- Check of synchronous conditions or absence of voltage even before planned closure of the circuit-breaker possible

Fault location

- Calculation of fault location upon tripping, release of starting or high-speed tripping
- Output of the fault location as linear data (kilometers, miles, % of line length) or impedance data (Ω)
- New technology ALM (Advanced location modelling) also enables fault location in systems with autotransformers

Calculation of the circuit-breaker load

- Measurement and summation of the interrupted currents
- Monitoring with current-time function and logging of current-time integrals and short-circuit data
- Load-depending calculation of circuit-breaker maintenance based on the operating cycle diagram
- Alarm indication on limit violation

Further functions

- Switching statistics: counting of the tripping and closing commands initiated by the device
- Teleprotection: information exchange with opposite line-end to increase selectivity

Communication

Four serial interfaces are available for communication with external operating and control systems.

- Operator interface (front side)
- Service interface
- System interface
- Interface for time synchronization

Communication interface

Connections	RS232; RS485; fibre optic; Ethernet (electrical / optical)
Protocols (System interface)	IEC 61850, Ed. 1 and Ed. 2 IEC 60870-5-103, Profibus FMS/DP, Modbus, DNP 3.0

Operation

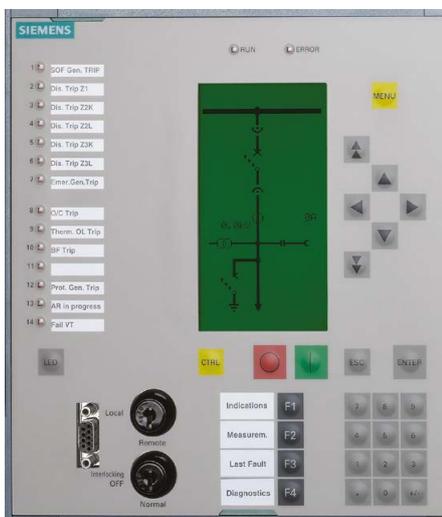
Siprotec 7ST6 can be operated via

- the operator panel on the front of the unit
- the Digi 4 user interface of your PC connected locally to the operator interface or via modem to the service interface of the relay
- the Web Interface at option IEC 61850

Siprotec 7ST6 operator panel

Routine operator actions can be performed while using the on ergonomic principles designed operator panel as well as settings of individual parameters and display information required for network management and general diagnostics can be made.

Depending on the version, the operator panel of the relay can be arranged as a 4-line display or a graphic display.



Operator panels of Siprotec 7ST61 protection relay (top) and Siprotec 7ST63 combined protection / control unit (cutaway, bottom)

Digi 4 operating and diagnostics software on PC

Digi 4 can be used for easy parameterization and operation of the Siprotec devices on a PC.

Digi 4 uses Windows techniques familiar from other applications for operator guidance. So the operator is working in a familiar system environment.

On the user interface only device-specific relevant parameters are offered during configuration and routine operation.

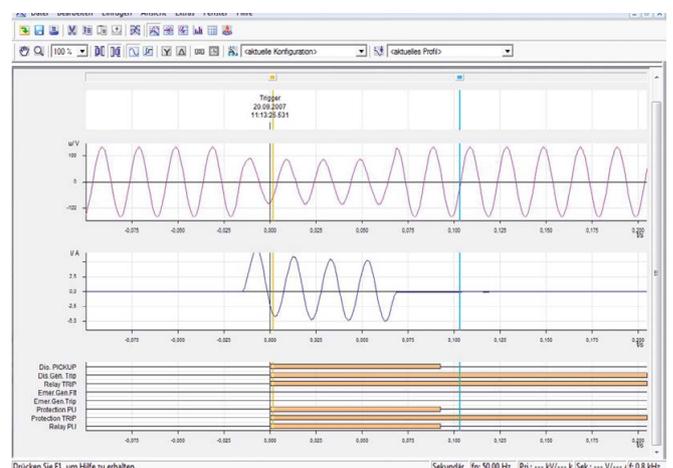
Numerous tools, such as context menus, dropdown lists for selection, permissible parameters, limit setting for digital values, and tooltips make an easy parameterization of the Siprotec devices possible.

Web Interface

With the option for the protocol IEC 61850 there comes a Web Interface for operation. This Web Interface interacts fully with the devices.

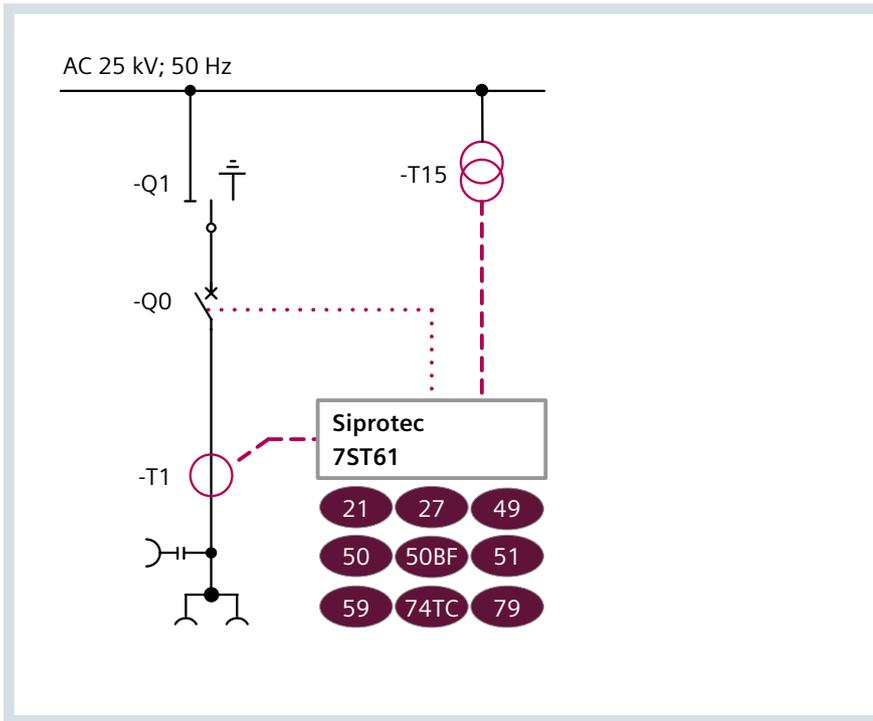
Additional functions that are available via the Web Interface:

- Polling errors, messages, logs
- Downloading fault-reports
- Display current measured values
- And much more...

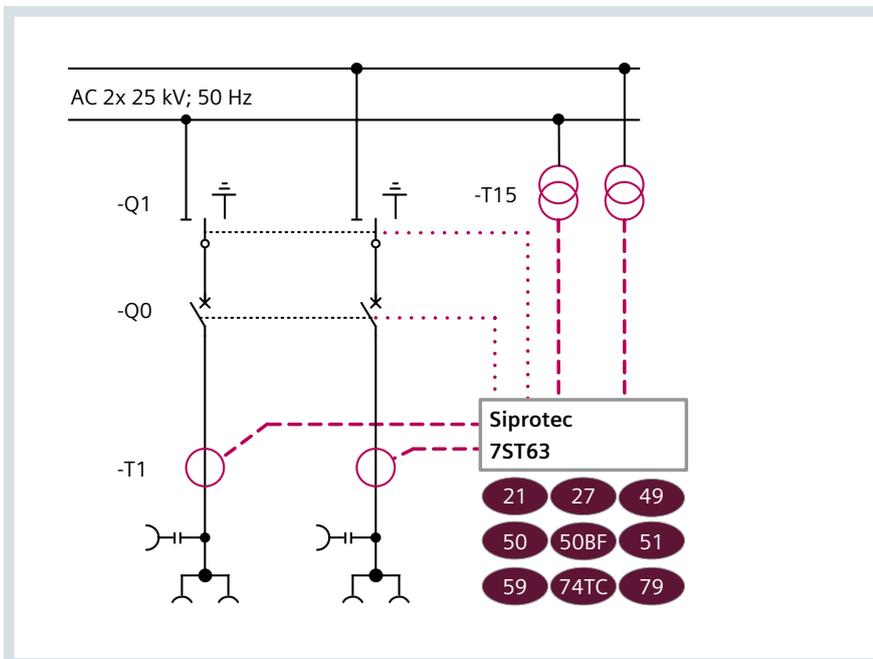


Fault display with diagnostic software Siga 4

Application area

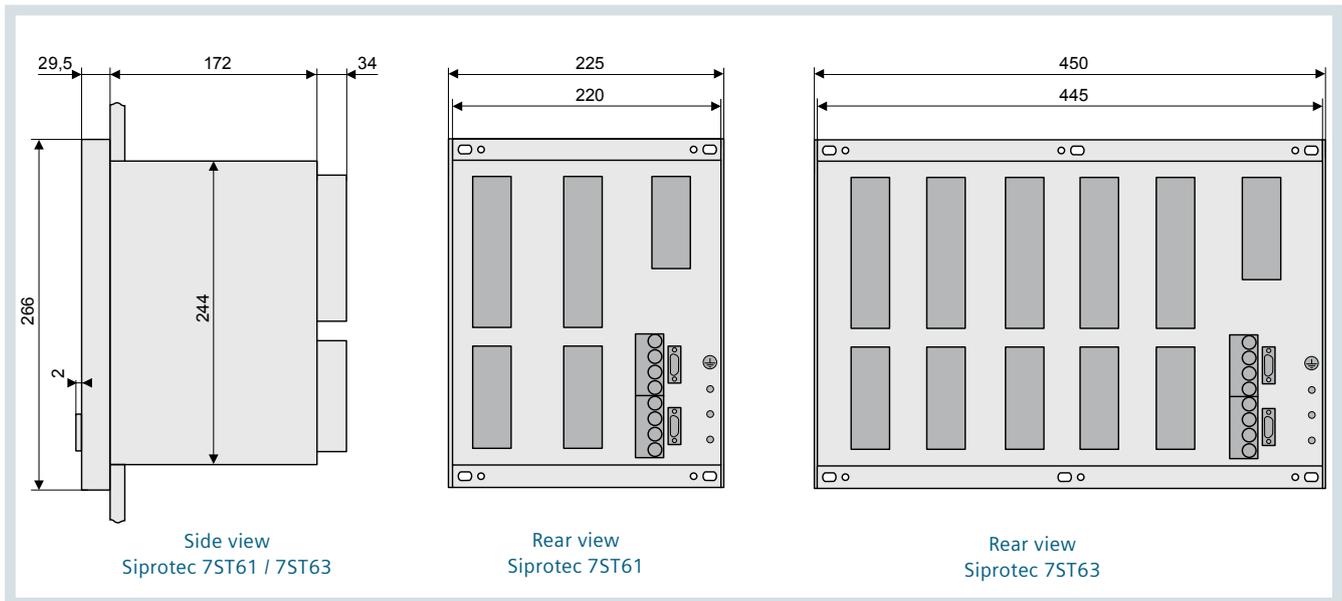


Typical configuration of an AC contact line feeder with a numerical overhead contact line protection relay (contains optional functions)



Typical configuration of an AC contact line feeder in the autotransformer system with a numerical overhead contact line control and protection relay (contains optional functions)

Technical data



Dimensions of Siprotec 7ST61 / 7ST63 (dimensions in mm)

Ambient conditions		Technical data (depending on product version)	
Climatic stress according to	IEC 60255-6	Nominal (system) frequency	[Hz] 16.7
Recommended temperature during operation*	[°C] -5...+55	adjustable	[Hz] 25; 50 or 60
Permissible humidity stress on 56 days a year (relative humidity)*		Current / voltage inputs	
• annual average	≤75 %	• number of current inputs	1 or 3
• on 56 days a year	≤93 %	• nominal current of current inputs	[A] 1 or 5
Installation altitude above sea level	[m] 1,000	• number of voltage inputs	1 or 3
* other values on request		• nominal voltage of voltage inputs (adjustable)	[V] 80...125
		Power consumption per phase	
		• at $I_N = 1\text{ A}$	[VA] approx. 0.05
		• at $I_N = 5\text{ A}$	[VA] approx. 0.3
		Binary inputs / outputs	
		• number of inputs	
		– 7ST61	12
		– 7ST63	38
		• number of outputs	
		– 7ST61	22 or 27
		– 7ST63	36
		Fast tripping	
		• shortest tripping time	[ms] <2
		Standards	IEC 60255 (product standards) ANSI / IEEE C37.90.01.1/2 UL 508 DIN 57435 T.303
Mechanical design			
Weight			
• 7ST61	[kg] 6		
• 7ST63	[kg] 10		
Degree of protection acc. to IEC 60529	IP51		

Electrical data

Auxiliary voltage (depending on product version)

Rated auxiliary voltage	[V DC]	24 / 48
	[V DC]	60 / 110 / 125
	[V DC]	110 / 125 / 220 / 250

Binary inputs

Quantity		12 (configurable)
• 7ST61		38 (configurable)
• 7ST63		
Rated voltage range	[V DC]	24...250

Output relays

Number		NO contact (normal)	NO contact / NC contact (switchable)	NO contact (fast)
<ul style="list-style-type: none"> • 7ST61 (version with one transformer) • 7ST61 (version with three transformers) • 7ST63 		21	4	2
		16	4	2
		30	4	2
Making power	[W or VA]	1,000	1,000	1,000
Breaking power		30 VA	30 VA	1,000 W or VA
• ohmic	[W]	40	40	
• at L/R ≤ 50 ms	[W or VA]	25	25	
Switching voltage AC	[V]	250	250	200
Switching voltage DC	[V]	250	250	300
Continuous current per contact	[A]	5	5	5
Total continuous current for grouped contacts	[A]	5	5	–
Max. DC inrush current with a closing time of 0.5 s for NO contacts	[A]	30	30	30

References

Since the market introduction in 2004 more than 1,700 devices of the Siprotec 7ST61 / 7ST63 overhead contact line control and protection relay are successfully in service all over the world.



Security information

In order to protect plants, systems, machines and networks against cyber threats, it is necessary to implement – and continuously maintain – a holistic, state-of-the-art industrial security concept. Siemens' products and solutions constitute one element of such a concept.

For more information about industrial security, please visit: <http://www.siemens.com/industrialsecurity>.

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