SIPROTEC 7SS60 centralized numerical busbar protection

Fig. 9/1 7SS601 measuring system

Description

The SIPROTEC 7SS60 system is an inexpensive numerical differential current protection for busbars in a centralized configuration.

It is suitable for all voltage levels and can be adapted to a large variety of busbar configurations with an unlimited number of feeders. The components are designed for single busbars, 1½-breaker configurations and double busbars with or without couplers.

Different primary CT ratios can be matched by using appropriate windings of the input current transformers.

The use of matching transformers allows phase-selective measurement. Single-phase measurement can be achieved by using summation current transformers.

Function overview

Features

- Optimized for single busbar and 1½ circuit-breaker configurations
- Suitable for double busbars with or without couplers
- Separate check zone possible
- Short trip times
- Unlimited number of feeders
- Matching of different primary CT ratios
- Differential current principle
- Low-impedance measuring method
- Numerical measured-value processing
- Suitable for all voltage levels
- Low demands on CTs thanks to additional restraint
- Measured-value acquisition via summation current transformer or phase-selective matching transformers
- Maintained TRIP command (lockout function)
- Centralized, compact design
- Combinative with separate breaker failure protection

Monitoring functions

- Primary current transformers including supply leads
- Operational measured values: Differential and restraint current
- Self-supervision of the relay
- 30 event logs
- 8 fault logs
- 8 oscillographic fault records

Communication interface

- RS485 interface for local and remote operation with DIGSI

Hardware

- Concept of modular components
- Reduced number of module types
- Auxiliary voltage DC 48 V to DC 250 V
- 7SS601 measuring system in 1/6 19-inch housing 7XP20
- Peripheral components in ½ 19-inch housing 7XP20

Front design

- Display for operation and measured values
- 6 LEDs for local indication

Application

Application

The 7SS60 system is an easily settable numerical differential current protection for busbars.

It is suitable for all voltage levels and can be adapted to a large variety of busbar configurations. The components are designed for single busbars, 1½-breaker configurations and double busbars with or without couplers.

The use of matching transformers allows phase-selective measurement.

Single-phase measurement can be achieved by using summation current transformers.

The 7SS60 is designed to be the successor of the 7SS1 static busbar protection. The existing summation current or matching transformers can be reused for this protection system.

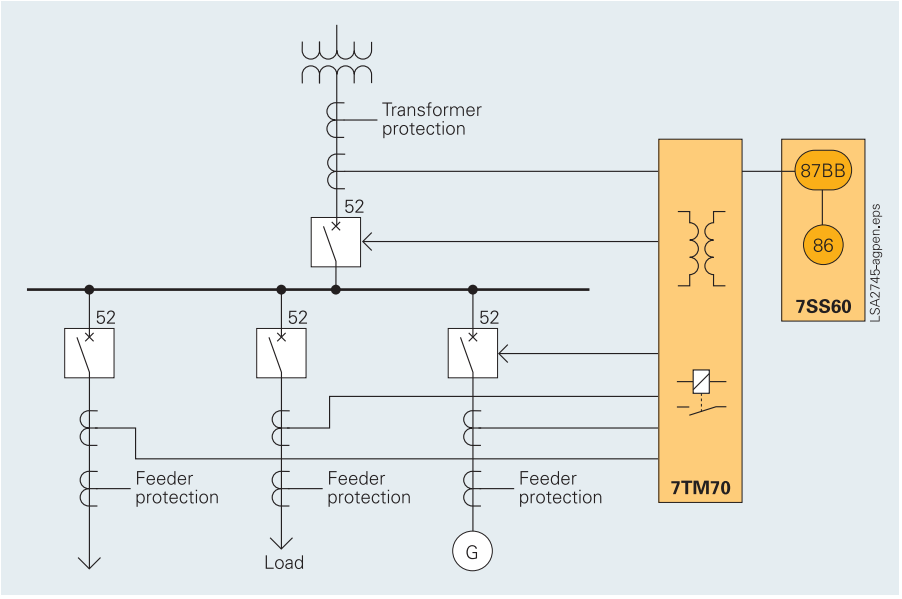

Fig. 9/2 Basic connection scheme 7SS60

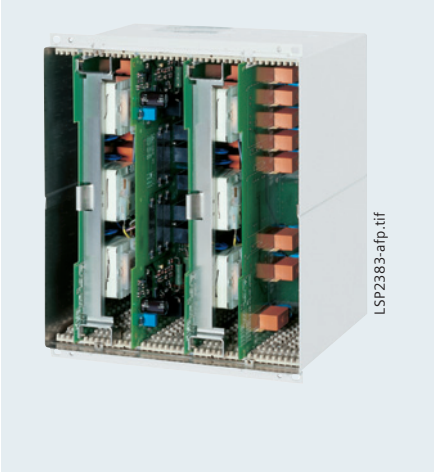

Fig. 9/3 Housing for peripheral modules (front cover removed)

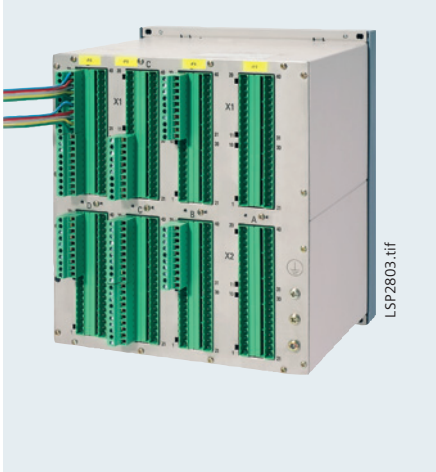

Fig. 9/4 Rear view

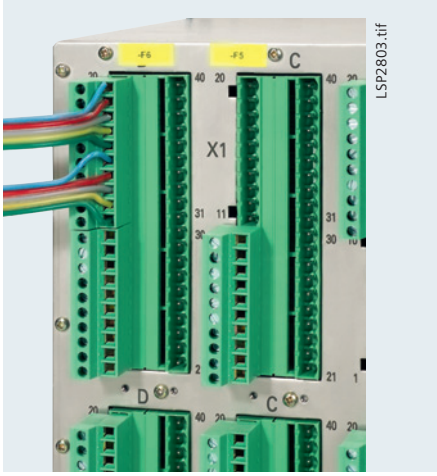

Fig. 9/5 Rear view detail

Construction

Design

The 7SS60 compactly-built protection system contains all components for:

- Measured-value acquisition and evaluation
- Operation and LC display
- Annunciation and command output
- Input and evaluation of binary signals
- Data transmission via the RS485 interface with bus capability
- Auxiliary voltage supply

The 7SS60 system comprises the following components:

- 7SS601 measuring system and the peripheral modules
- 7TM70 restraint/command output module
- 7TR71 isolator replica/preference module
- 7TS72 command output module

The number of modules required is determined by the substation configuration and the measuring principle used (summation current transformers or phase-selective measurement). The 7SS601 measuring system is accommodated in a separate housing (1/6 19-inch 7XP20) that is suited for panel flush mounting or cubicle moun- ting. The 7XP2040 peripheral module housing has a width of ½ 19 inches and can hold up to four peripheral modules.

It is suited for panel flush mounting or cubicle mounting and has plug-on connectors fitted at the rear. The primary current transformers are connected to summation current transformers of type 4AM5120-3DA/4DA or to matching transformers of type 4AM5120-1DA/2DA. With a rated current of 1 or 5 A, the current output at these transformers is 100 mA. This output current is fed onto the 7SS601 measuring system (for differential current formation) and onto the 7TM70 restraint units (for restraint current formation). The summated restraint current is fed onto the 7SS601 measuring system as well.

Functions

Functions of the components

- The 7SS601 measuring system comprises:
  - One measuring input for acquisition and processing of the differential and the restraint current
  - 3 binary inputs for acquisition of information, e.g. a blocking condition
  - 2 command relays for activation of other, feeder-specific command relays on the 7TM70 and 7TS72 peripheral modules.

In circuits with summation current transformer, one 7SS601 measuring system is required per protected zone. For phase-selective measurement, one 7SS601 measuring system is required per phase and protected zone.

- 7TM70 restraint/command output module
  This module contains 5 current transformers with rectifiers for the formation of the restraint current. It has also 5 command relays with 2 NO contacts each for output of a direct TRIP command to the circuit-breakers.
- 7TR71 isolator replica/preference module
  This module enables the two bus isolators to be detected in a double busbar. The feeder current is assigned to the corresponding measuring system on the basis of the detected isolator position. The module is also designed for an additional function. In the case of a double busbar system, for example, where both bus isolators of a feeder are closed at a time, no selective protection of the two busbars is possible. During this state, one of the two measuring systems is given priority. The module 7TR71 appropriately assigns feeder currents to the corresponding measuring system 7SS601. The module also contains an auxiliary relay with two changeover contacts.
- 7TS72 command output module
  The 7TM70 contains 5 trip relays with 2 NO contacts each. If more trip contacts are needed, the 7TS72 module can be used, providing 8 relays with 2 NO contacts each.

Protection functions

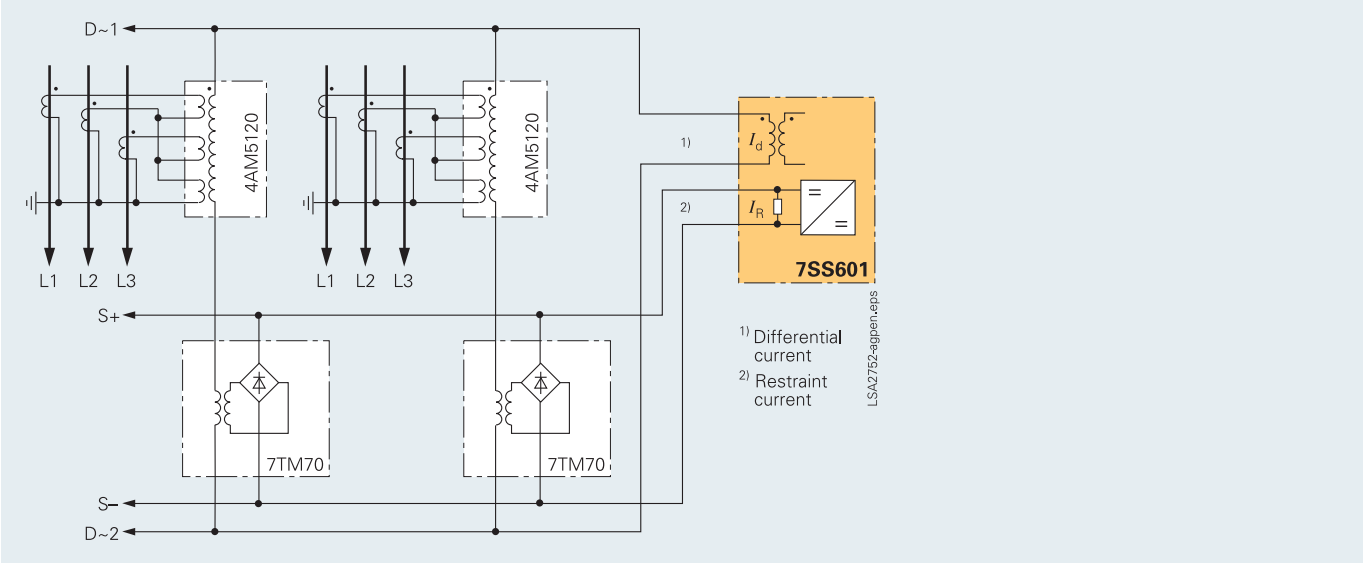

Fig. 9/6 Block diagram: Acquisition of measured values

Protection functions

Measuring principles

The feeder currents can be measured and processed according to different principles.

- Summation current transformer principle
  In the summation current transformer variant, the three secondary currents of the primary CTs are fed onto the three primary windings of the summation current transformers with a winding ratio of n1:n2:n3 = 2:1:3. According to the expected fault currents two different circuits for connecting the summation current transformer are possible. For power systems with low-resistance or solid grounding of the starpoint, the 1-phase ground-faults are sufficiently high to use the circuit with normal sensitivity (see Fig. 9/7). An increased sensitivity for ground-faults can be achieved by use of a circuit according to Fig. 9/8. With a symmetrical, three-phase current of 1 x I_N, the secondary current of the summation current transformers is 100 mA.
  Different primary CT transformation ratios can usually be compensated directly by appropriate selection of the summation CT primary windings. Where the circuit conditions do not allow this, additional matching transformers, such as the 4AM5272-3AA, should be used, preferably in the form of autotransformers (see Fig. 9/9: Protection with summation current transformer and matching transformers). The autotransformer circuit reduces the total burden for the primary CTs.
- Phase-selective measurement
  In this variant, each phase current is measured separately. To do so, each of the secondary currents of the primary transformers is fed onto a matching transformer. This transformer allows, if its primary windings are selected accordingly, to generate a normalized current from a variety of different primary CT transformation ratios (see Fig. 9/10: Phase-selective measurement). With a primary current of 1 x I_N, the secondary current of the matching transformers is 100 mA.

Function principle of the differential protection

The main function of the 7SS60 protection system is a busbar protection that operates with the differential current measuring principle. Its algorithm relies on Kirchhoff's current law, which states that in fault-free condition the vectorial sum Id of all currents flowing into an independent busbar section must be zero. Some slight deviations from this law may be caused by current transformer error, inaccuracies in the matching of the transformation ratios and measuring inaccuracies. Further errors, which may be due to e.g. transformer saturation in case of high-current external short-circuits, are counteracted by a load- dependent supplementary restraint.

The restraint current I_R is derived from the load condition. This restraint current is formed as the summated magnitudes of all currents. The differential and the restraint current are fed into the 7SS601 measuring system (see Fig. 9/6: Block diagram). With double busbars or sectionalized busbars, one measuring system 7SS601 (summation CT), respectively 3 measuring systems (phase-selective measurement) will be used for each selective section. The module 7TS71 (isolator replica/preference) appropriately assigns feeder currents to the corresponding measuring system 7SS601.

Typical connections

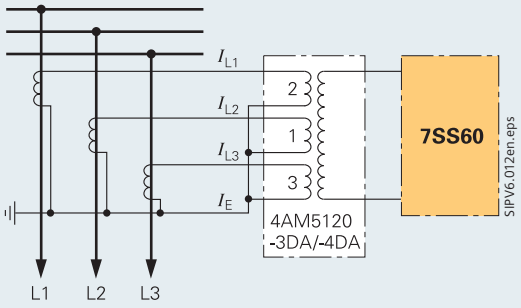

Fig. 9/7 Protection with summation current transformer (L1-L2-L3 circuit)

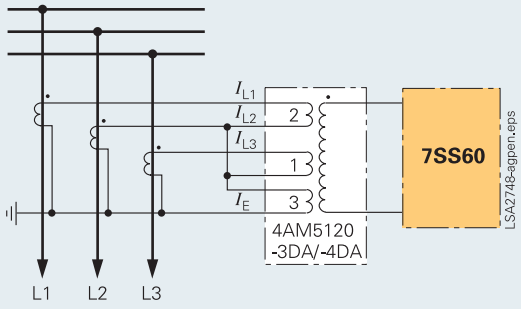

Fig. 9/8 Protection with summation current transformer (L1-L3-N circuit)

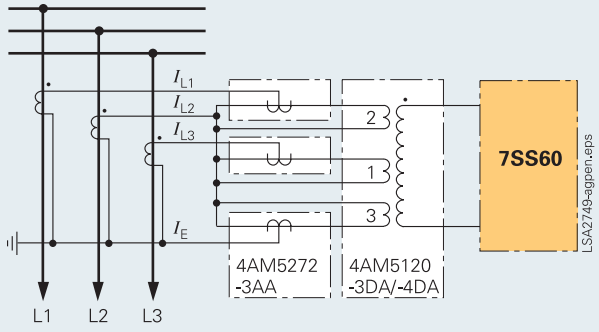

Fig. 9/9 Protection with summation current transformer and matching transformers

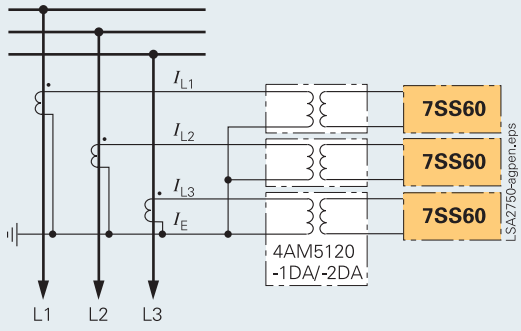

Fig. 9/10 Phase-selective measurement

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Protection functions

Pickup characteristic of the differential protection

The characteristic can be set in the parameters for $I_d >$ (pickup value) and for the k factor which considers the linear and non-linear current transformer errors. Differential currents above the set characteristic lead to tripping.

Current transformer monitoring

An independent sensitive differential current monitoring with its parameter $I_{d\ thr}$ detects faults (short-circuits, open circuit) of current transformers and their wiring even with load currents. The affected measuring system is blocked and an alarm is given. By this, the stability of the busbar protection is ensured in case of external faults.

Trip command lockout (with manual reset)

Following a trip of the differential protection, the TRIP command can be kept (sealed-in). The circuit-breakers are not reclosed until the operator has obtained information on the fault; the command must be manually reset by pressing a key or by a binary input.

The logical state of the TRIP command is buffered against a loss of the auxiliary power supply, so that it is still present on restoration of the auxiliary voltage supply.

Test and commissioning aids

The protection system provides user support for testing and commissioning. It has a wide range of integrated aids that can be activated from the keypad or from a PC using the DIGSI program. For some tests a codeword must be entered.
The following test aids are available:

- Display of operational measured values
- Interrogation of status of binary inputs and LED indicators
- Blocking of the TRIP function during testing

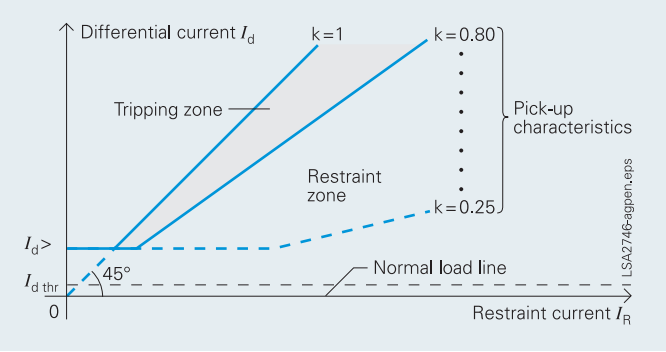

Fig. 9/11 Tripping characteristic

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Communication

Serial data transmission

The device is equipped with an RS485 interface. The interface has bus capability and allows a maximum of 32 units to be connected via a serial two-wire interface. A PC can be connected to the interface via an RS232↔RS485 converter, so that configuration, setting and evaluation can be performed comfortably via the PC using the DIGSI operating program. The PC can also be used to read out the fault record that is generated by the device when a fault occurs.

With RS485↔820 nm optical converters, which are available as accessories (7XV5650, 7XV5651), an interference-free, isolated connection to a control center or a DIGSI-based remote control unit is possible; this allows to design low-cost stations concepts that permit e.g. remote diagnosis.

Comfortable setting

The parameter settings are made in a menu-guided procedure from the integrated operator panel and the LC display. It is, however, more comfortable to use a PC for this purpose, together with the standard DIGSI operating program.

Fault recording

If a fault leads to a trip, a fault record is generated, in which the differential and the restraint current are recorded with a sampling frequency of 2 kHz. In addition, signals are stored as binary traces, which represent internal device states or binary input states. Up to eight fault records can be stored. When a ninth fault occurs, the oldest record is overwritten. A total storage capacity of 7 s is available. The most recent 2.5 s are buffered against power failure.

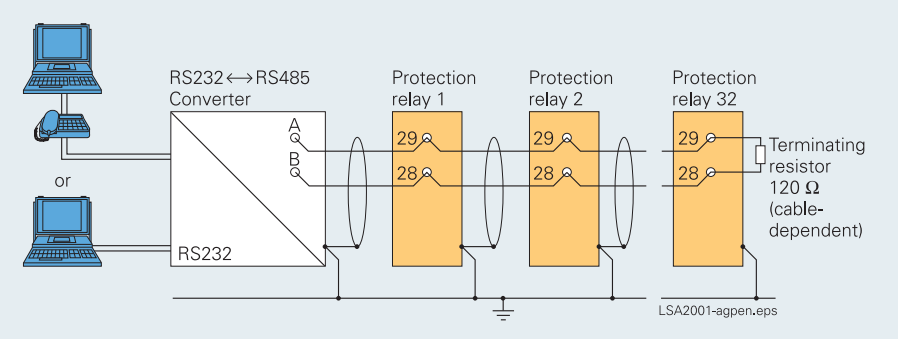

Fig. 9/12 Communication scheme

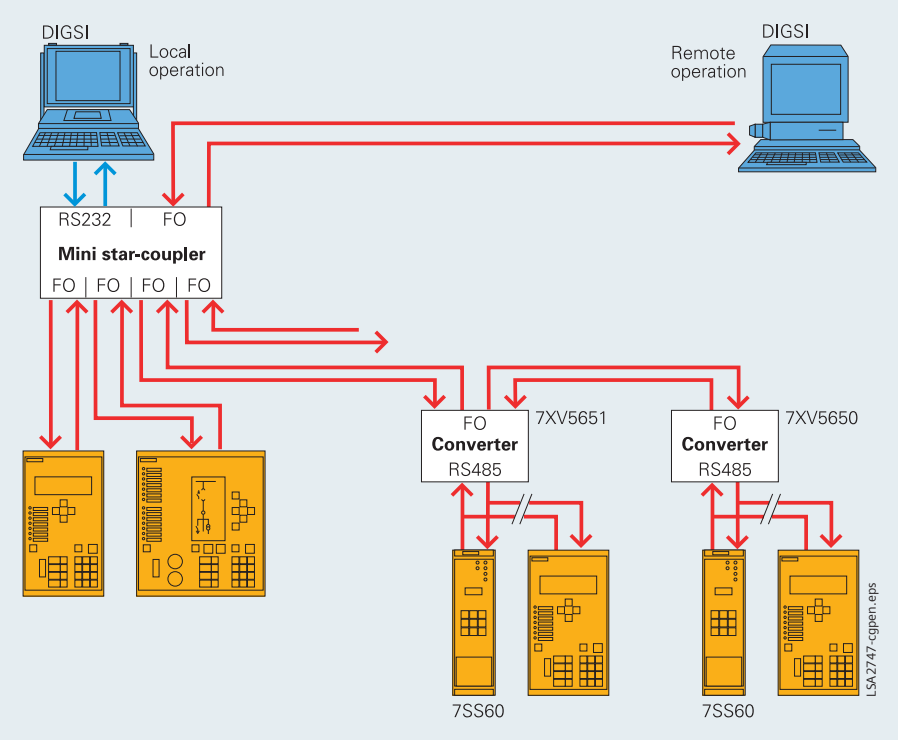

Fig. 9/13 Communication scheme

Technical data

7SS60 measuring system	
Measuring input I_d	
Rated current	100 mA
Rated frequency	50/60 Hz settable, 16.7 Hz
Dynamic overload capacity (pulse current)	250 x I_N one half cycle
Thermal overload capacity (r.m.s.) (where external summation or matching current transformers are used, their limit data must be observed)	100 x I_N for ≤ 1 s 30 x I_N for ≤ 10 s 4 x I_N continuous
Isolating voltage	2.5 kV (r.m.s.)
Measuring range for operational measured values	0 to 240 %
Measuring dynamics	100 x I_N without offset 50 x I_N with full offset
Measuring input I_R	
Rated current	1.9 mA
Dynamic overload capability (pulse current)	250 x I_N for 10 ms
Thermal overload capability (r.m.s.) (where external summation or matching current transformers are used, their limit data must be observed)	100 x I_N for ≤ 1 s 30 x I_N for ≤ 10 s 4 x I_N continuous
Isolating voltage	2.5 kV (r.m.s.)
Measuring dynamics	0 to 200 x I_N
Auxiliary voltage	
Via integrated DC/DC converter Rated auxiliary voltage V_{aux} (permissible voltage)	DC 24/48 V (DC 19 to 58 V) DC 60/110/125 V (DC 48 to 150 V) DC 220/250 V (DC 176 to 300 V) AC 115 V (AC 92 to 133 V)
Superimposed AC voltage (peak-to-peak)	≤ 15 % of rated voltage
Power consumption	Quiescent Approx. 3 W Energized Approx. 5 W
Bridging time during failure / short-circuit of auxiliary voltage	≥ 50 ms at V_{aux} ≥ DC 100 V ≥ 20 ms at V_{aux} ≥ DC 48 V
Binary inputs	
Number	3 (marshallable)
Operating voltage range	DC 24 to 250 V
Current consumption when energized	Approx. 2.5 mA Independent of operating voltage
Pickup threshold Rated aux. voltage DC 48/60 V V_{pickup} $V_{drop-off}$ Rated aux. voltage DC 110/125/220/250 V V_{pickup} $V_{drop-off}$	Can be changed by setting jumpers ≥ DC 17 V < DC 8 V ≥ DC 74 V < DC 45 V
Max. voltage	DC 300 V

Command contacts	
Number of relays	1 (2 NO contacts) 1 (1 NO contact)
Switching capacity Make Break	 1000 W/VA 30 W/VA
Switching voltage	AC/DC 250 V
Permissible current Continuous 0.5 s	 5 A 30 A
Signal contacts	
Number of relays	3 (2 marshallable)
Contacts	2 changeover contacts and 1 NO contact (can be changed to NC by jumper)
Switching capacity Make Break	 1000 W/VA 30 W/VA
Switching voltage	AC/DC 250 V
Permissible current Continuous 0.5 s	 5 A 30 A
Serial interface	
Standard	Isolated RS485
Test voltage	DC 3.5 kV
Connection	Data cable at housing terminals, 2 data lines For connection of a personal computer or similar Cables must be shielded, and shields must be grounded. As delivered 9600 baud min. 1200 baud, max. 19200 baud
Unit design	
Housing 7XP20	1/6 19"
Dimensions	See part 14
Weight	Approx. 4.0 kg
Degree of protection according to IEC 60529-1 For the unit For operator protection	 IP 51 IP 2X

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Functions	
Differential current protection	
Setting ranges for pickup threshold	
Differential current I_d>	0.20 to 2.50 I_{NO}
Restraint factor	0.25 to 0.80
Tolerance of pickup value	
Differential current I_d>	± 5 % of setpoint
Minimum duration of trip command	0.01 to 32.00 s (in steps of 0.01 s)
Time delay of trip	0.00 to 10.00 s (in steps of 0.01 s)
Times	
Minimum tripping time 50/60 Hz[1)]	10 ms
Typical tripping time 50/60 Hz[1)]	12 ms (rapid measurement) 40 ms (repeated measurement)
Minimum tripping time 16.7 Hz[1)]	12 ms
Typical tripping time 16.7 Hz[1)]	14 ms (rapid measurement) 40 ms (repeated measurement)
Reset time [2)]	28 ms at 50 Hz 26 ms at 60 Hz 70 ms at 16.7 Hz
Differential current supervision	
Pickup threshold	0.10 to 1.00 I_{NO}
Lockout function	
Lockout seal-in of trip command	Until reset
Reset	By binary input and/or local operator panel
Additional functions	
Operational measured values	
Operating currents	I_d, I_R
Measuring range	0 to 240 % I_{NO}
Tolerance	5 % of rated value
Fault logging	Buffered storage of the annunciations of the last 8 faults
Time stamping	
Resolution for operational annunciation	1 ms
Resolution for fault annunciation	1 ms
Fault recording (max. 8 fault)	Buffered against voltage failure (last 2.5 s)
Recording time (from fault detection)	Max. 7.1 s total Pre-trigger and post-fault time can be set
Max. length per record	0.2 to 5.0 s (in steps of 0.01 s)
Pre-trigger time	0.05 to 1.5 s (in steps of 0.01 s)
Post-fault time	0.01 to 1.5 s (in steps of 0.01 s)
Sampling frequency	2 kHz

Peripheral modules	
7TM700 restraint/command output module	
Measuring input I_R	
Number of restraint units	5
Rated current	100 mA
Rated frequency	16.7, 50, 60 Hz
Dynamic overload capacity (pulse current)	250 x I_N one half cycle
Thermal overload capacity (r.m.s.) (where external summation or matching current transformers are used, their limit data must be observed)	100 x I_N for ≤ 1 s 30 x I_N for ≤ 10 s 4 x I_N continuous
Auxiliary voltage (7TM700)	
Rated auxiliary voltage V_{aux} (permitted voltage range)	DC 48/60 V (DC 38 to 72 V) DC 110/125 V (DC 88 to 150 V) DC 220/250 V (DC 176 to 300 V) Settable As delivered: DC 220/250 V
Command contacts (7TM700)	
Number of relays	5
Contacts per relay	2 NO contacts
For short-term operation < 10 s[3)]	
Pickup time	Approx. 7 ms
Switching capacity	
Make	1000 W/VA
Break	30 W/VA
Switching voltage	AC/DC 250 V
Permissible currents	
Continuous	5 A
0.5 s	30 A
Weight	Approx. 2.0 kg
7TR710 isolator replica/preferential treatment module	
NOTE: The module 7TR710 can be used to implement 2 different functions: isolator replica or preferential treatment	
Isolator replica	
Number of feeders (single busbar and double busbar)	1
Number of isolators per feeder	2
Preferential treatment	
Number of preferential treatment circuits	2
Number of contacts per preferential treatment	3 changeover contacts
Switching time	< 20 ms
Number of auxiliary relays	1
Contacts of auxiliary relay	2 changeover contacts
Auxiliary voltage	
Rated auxiliary voltage V_{aux} (permissible voltage range)	DC 48/60 V (DC 38 to 72 V) DC 110/125 V (DC 88 to 150 V) DC 220/250 V (DC 176 to 300 V) Depending on the design
Relay contacts	
Switching capacity	
Make	1000 W/VA
Break	30 W/VA
Switching voltage	AC/DC 250 V
Permissible current	
Continuous	5 A
0.5 s	10 A
Weight	Approx. 0.6 kg

1) Each additional intermediate relay increases the tripping time by 7 ms.

2) Each additional intermediate relay increases the reset time by 8 ms.

3) Limited by the continuous power dissipation of the device.

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Technical data

Peripheral modules (cont'd)	
7TS720 command output module	
Auxiliary voltage	
Rated auxiliary voltage V_{aux} (permissible voltage range)	48/60 V (DC 38 to 72 V) 110/125 V (DC 88 to 150 V) 220/250 V (DC 176 to 300 V) Settable As delivered: DC 220/250 V
Command contacts	
Number of relays	8
Contacts per relay	2 NO contacts
For short term operation < 10 s[1)]	
Pickup time	Approx. 7 ms
Switching capacity Make Break	 1000 W/VA 30 W/VA
Switching voltage	AC/DC 250 V
Permissible current Continuous 0.5 s	 5 A 30 A
Weight	Approx. 0.5 kg
7SS601 measuring system	
Current connections (terminals 1 to 6)	
Screw-type terminals (ring-type cable lug) Max. outside diameter	For bolts of 6 mm 13 mm
Type For conductor cross-sections of In parallel double leaf-spring-crimp contact for conductor cross-sections of Max. tightening torque	e.g. PDIG of AMP 2.7 to 6.6 mm² AWG 12 to 10 2.5 to 4.0 mm² AWG 13 to 11 3.5 Nm
Control connections (terminals 7 to 31)	
Screw-type terminals (ring-type cable lug) Max. outside diameter	For 4 mm bolts 9 mm
Type For conductor cross-sections of In parallel double leaf-spring-crimp contact for conductor cross-sections of Max. tightening torque	e.g. PDIG of AMP 1.0 to 2.6 mm² AWG 17 to 13 0.5 to 2.5 mm² AWG 20 to 13 1.8 Nm

1) Limited by the continuous power dissipation of the device.

Connectorswith screw-type terminals	
Type	COMBICON system of PHOENIX CONTACT Front-MSTB 2.5/10-ST-5.08
For conductor cross-sections of	0.2 to 2.5 mm² (rigid and flexible) AWG 24 to 12 0.25 to 2.5 mm² (with end sleeve)
Multiple conductor connection (2 conductors of same cross-section)	0.2 to 1.0 mm² (rigid) 0.2 to 1.5 mm² (flexible) 0.25 to 1.0 mm² (flexible with end sleeve, without plastic collar) 0.5 to 1.5 mm² (flexible with TWIN end sleeve with plastic collar)
Stripping length	7 mm
Recommended tightening torque	0.5 to 0.6 Nm
Unit design	
Housing 7XP204	½ 19"
Dimensions	See part 14
Weight	Approx. 3.5 kg
Degree of protection according to IEC 60529-1 For the device For the operator protection	 IP 51 (front panel) IP 20 (rear) IP 2X (if all connectors and blanking plates are fitted)

Matching transformers

4AM5120-1DA00-0AN2

For connection to current transformers with a rated current I_N of		1 A						
Rated frequency f_N		45-60 Hz						
Winding		A-B	B-C	D-E	E-F	G-H	H-J	Y-Z
Number of turns		1	2	4	8	16	32	500
Max. current, continuous	A	6.8	6.8	6.8	6.8	6.8	6.8	0.85
Max. voltage	V	0.4	0.8	1.6	3.2	6.4	12.8	200
Max. burden	VA	1.0						

4AM5120-2DA00-0AN2

For connection to current transformers with a rated current I_N of		A				
Rated frequency f_N		45-60 Hz				
Winding		A-B	B-C	D-E	E-F	Y-Z
Number of turns		1	2	4	8	500
Max. current, continuous	A	26	26	26	26	0.85
Max. voltage	V	0.4	0.8	1.6	3.2	200
Max. burden	VA	1.2				

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Summation current matching transformers									
4AM5120-3DA00-0AN2									
For connection to current transformers with a rated current I_N of	1 A								
Rated frequency f_N	45-60 Hz								
Winding	A-B	C-D	E-F	G-H	J-K	L-M	N-O	Y-Z	
Number of turns	3	6	9	18	24	36	90	500	
Max. current, continuous A	4	4	4	4	4	4	2	0.85	
Max. voltage V	1.2	2.4	3.6	7.2	9.6	14.4	36	200	
Max. burden VA	1.8								
4AM5120-4DA00-0AN2									
For connection to current transformers with a rated current I_N of	5 A								
Rated frequency f_N	45-60 Hz								
Winding	A-B	C-D	E-F	G-H	J-K	L-M	N-O	Y-Z	
Number of turns	1	2	3	4	6	8	12	500	
Max. current, continuous A	17.5	17.5	17.5	17.5	17.5	17.5	8.0	0.85	
Max. voltage V	0.4	0.8	1.2	1.6	2.4	3.2	4.8	200	
Max. burden VA	2.5								

Matching transformer								
4AM5272-3AA00-0AN2								
Multi-tap auxiliary current transformer to match different c.t. ratios								
Rated frequency f_N	45-60 Hz							
Winding	A-B	C-D	E-F	G-H	J-K	L-M	N-O	P-Q
Number of turns	1	2	7	16	1	2	7	16
Max. current, continuous A	6	6	6	1.2	6	6	6	1.2
Max. voltage V	4	8	28	64	4	8	28	64
resistance Ω	0.018	0.035	0.11	1.05	0.018	0.035	0.11	1.05

Electrical tests	
Specifications	
Standards: IEC 60255-5; ANSI/IEEE C37.90.0	
Insulation tests	
High voltage test (routine test), measuring input I_d and relay outputs	2.5 kV (r.m.s.); 50 Hz
High voltage test (routine test), auxiliary voltage input and RS485 interface, binary inputs and measuring input I_R	DC 3.5 kV
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 5 s

EMC tests for interference immunity; type tests	
Standard	IEC 60255-6, IEC 60255-22 (international product standards) EM 50Ω082-2 (technical generic standard) DIN VDE 57435 part 303 (German product standard for protection devices)
High-frequency test IEC 60255-22-1, DIN 57435 part 303; class III	2.5 kV (peak); 1 MHz; t = 15 ms; 400 surges per s; test duration 2 s
Electrostatic discharge IEC 60255-22-2; IEC 61000-4-2; class IV	8 kV contact discharge; 15 kV air discharge; both polarities; 150 pF; R_i = 330 Ω
Irradiation with RF field, non-modulated IEC 60255-22-3 (report); class III	10 V/m; 27 to 500 MHz
Irradiation with RF field, amplitude-modulated IEC 61000-4-3, class III	10 V/m; 80 to 1000 MHz; 80 % AM; 1 kHz
Irradiation with RF field, pulse-modulated IEC 61000-4-3 / ENV 50204; class III	10 V/m; 900 MHz; repetition frequency 200 Hz; ED 50 %
Fast transient disturbance / bursts IEC 60255-22-4; IEC 61000-4-4; class III	4 kHz; 5/50 ns; 5 kHz, burst length = 15 ms; repetition rate 300 ms; both polarities; R_i = 50 Ω; test duration 1 min
High-energy surge voltages (SURGE), IEC 61000-4-5, installation, class III	Auxiliary voltage: Longitudinal test: 2 kV; 12 Ω; 9 µF Transversal test: 1 kV; 2 Ω; 18 µF Measuring inputs, binary inputs and relay outputs: Longitudinal test: 2 kV; 42 Ω; 0.5 µF Transversal test: 1 kV; 42 Ω; 0.5 µF
Line-conducted HF, amplitude-modulated IEC 61000-4-6; class III	10 V; 150 kHz to 80 MHz; 80 % AM; 1 kHz
Magnetic field with power frequency IEC 61000-4-8; class IV IEC 60255-6	30 A/m; continuous; 300 A/m for 3 s; 50 Hz; 0.5 mT
Oscillatory surge withstand capability ANSI / IEEE C37.90.1	2.5 to 3 kV (peak); 1 to 1.5 MHz; damped wave; 50 surges per s; duration 2 s; R_i = 150 to 200 Ω
Fast transient surge withstand capability ANSI / IEEE C37.90.1	4 to 5 kV; 10/150 ns; 50 surges per s; both polarities; duration 2 s; R_i = 80 Ω
Radiated electromagnetic interference ANS / IEEE C37.90.2	35 V/m; 25 to 1000 MHz
Damped oscillations IEC 61000-4-12 IEC 60694	2.5 kV (peak, alternating polarity); 100 kHz; 1, 10 and 50 MHz; damped wave; R_i = 50 Ω
EMC tests for interference emission; type test	
Standard	EN 50081-* (technical generic standard)
Conducted interference voltage on lines only auxiliary voltage, EN 55022, DIN VDE 0878 part 22, IEC CISPR 22	150 kHz to 30 MHz, limit value, class B
Radio interference field strength EN 55011; DIN VDE 0875 part 11, IEC CISPR 11	30 to 1000 MHz, limit value, class A

Technical data

Mechanical stress tests	
Vibration, shock stress and seismic vibration	
During operation	
Standards	IEC 60255-21-1 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 Sweep rate 1 octave/min 20 cycles in 3 orthogonal axes
Shock IEC 60255-21-2, class I IEC 60068-2-27	Half-sinusoidal Acceleration 5 *g*; duration 11 ms 3 shocks in each direction of the 3 orthogonal axes
Seismic vibration IEC 60255-21-3, class I IEC 60068-3-3	Sinusoidal
Horizontal axis	1 to 8 Hz: ± 3.5 mm amplitude 8 to 35 Hz: 1 *g* acceleration
Vertical axis	1 to 8 Hz: ± 1.5 mm amplitude 8 to 35 Hz: 0.5 *g* acceleration
	Frequency sweep 1 octave/min 1 cycle in 3 orthogonal axes
During transport	
Standards	IEC 60255-21 IEC 60068-2
Vibration IEC 60255-21-1, class II IEC 60068-2-6	Sinusoidal 5 to 8 Hz: ± 7.5 mm amplitude 8 to 150 Hz: 2 *g* acceleration sweep rate 1 octave/min 20 cycles in 3 orthogonal axes
Shock IEC 60255-21-2, class I IEC 60068-2-27	Half-sinusoidal Acceleration 15 *g*; duration 11 ms 3 shocks in each direction of the 3 orthogonal axes
Continuous shock IEC 60255-21-2, class I IEC 60068-2-29	Half-sinusoidal Acceleration 10 *g*; duration 16 ms 1000 shocks in each direction of the 3 orthogonal axes

Climatic stress test	
Temperatures	
Standards	IEC 60255-6
Permissible ambient temperatures	
– In service	-20 to +45/55 °C
– During storage	-25 to +55 °C
– During transport	-25 to +70 °C
Storage and transport with standard works packing	
Humidity	
Standards	IEC 60068-2-3
Permissible humidity It is recommended to arrange the units in such a way that they are not exposed to direct sunlight or pronounced temperature changes that could cause condensation.	Annual average 75 % relative humidity; on 30 days in the year up to 95 % relative humidity; condensation not permissible!

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) and electrical equipment designed for use within certain voltage limits (Council Directive 2006/95/EG previous 73/23/EEC).

This unit conforms to the international standard IEC 60255, and the German standard DIN 57435/Part 303 (corresponding to VDE 0435/Part 303).

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 for the EMC Directive and standard EN 60255-6 for the "low-voltage Directive".

Selection and ordering data

Description	Order No.
Centralized numerical busbar protection 7SS60, measuring system 50, 60, 16.7 Hz	**7SS601 □ - □ □ A □ 0 - 0 A A 0**
Rated current/frequency	
100 mA; 50/60 Hz AC	0
100 mA; 16.7 Hz AC	6
Rated auxiliary voltage	
24 to 48 V DC	2
60 to 125 V DC	4
220 to 250 V DC	5
Unit design	
Housing 7XP20 ⅙ 19-inch, for panel flush mounting or cubicle mounting	E
Measuring system	
Standard	0
Stabilizing/command output module	
5 stabilizing CTs, 5 relays with 2 NO contacts 48/60 V DC, 110/125 V DC, 220/250 V DC settable	**7TM7000-0AA00-0AA0**
Isolator replica/preference module	**7TR7100- □ AA00-0AA0**
48 to 60 V DC	3
110 to 125 V DC	4
220 to 250 V DC	5
Command output module	
8 relays with 2 NO contacts 48/60 V DC, 110/125 V DC, 220/250 V DC settable	**7TS7200-0AA00-0AA0**
Housing ½19-inch for peripheral modules 7SS60	
For panel flush mounting or cubicle mounting	**7XP2041-2MA00-0AA0**

Selection and ordering data

Accessories	Description	Order No.
	Copper interconnecting cable	
	PC (9-pole socket) and converter/protection relay	**7XV5100-2**
	Connector adapter	
	9 pin female / 25 pinmale	**7XV5100-8H**
	RS232 - RS485 converter	
	With power supply unit for AC 230 V	**7XV5700-0AA00**
	With power supply unit for AC 110 V	**7XV5700-1AA00**
	Converter	
	Full duplex fiber-optic cable↔RS485 Auxiliary voltage: DC 24 V to DC 250 V, DC 110/230 V	
	Line converter ST connector	**7XV5650-0BA00**
	Cascada converter ST connector	**7XV5651-0BA00**
	Connector for peripheral modules, as spare part	**W73078-B9005-A710**
	Extraction tool for connector	**W73078-Z9005-A710**
	Test adapter	**7XV6010-0AA00**
	Angle bracket (set)	**C73165-A63-D200-1**
	Summation current matching transformer	
	1 A, 50/60 Hz	**4AM5120-3DA00-0AN2**
	5 A, 50/60 Hz	**4AM5120-4DA00-0AN2**
	Matching transformer	
	1 A, 50/60 Hz	**4AM5120-1DA00-0AN2**
	5 A, 50/60 Hz	**4AM5120-2DA00-0AN2**
	1 A, 5 A, 50/60 Hz	**4AM5272-3AA00-0AN2**
	Manual 7SS60	
	English	**E50417-G1176-C132-A3**

Connection diagrams

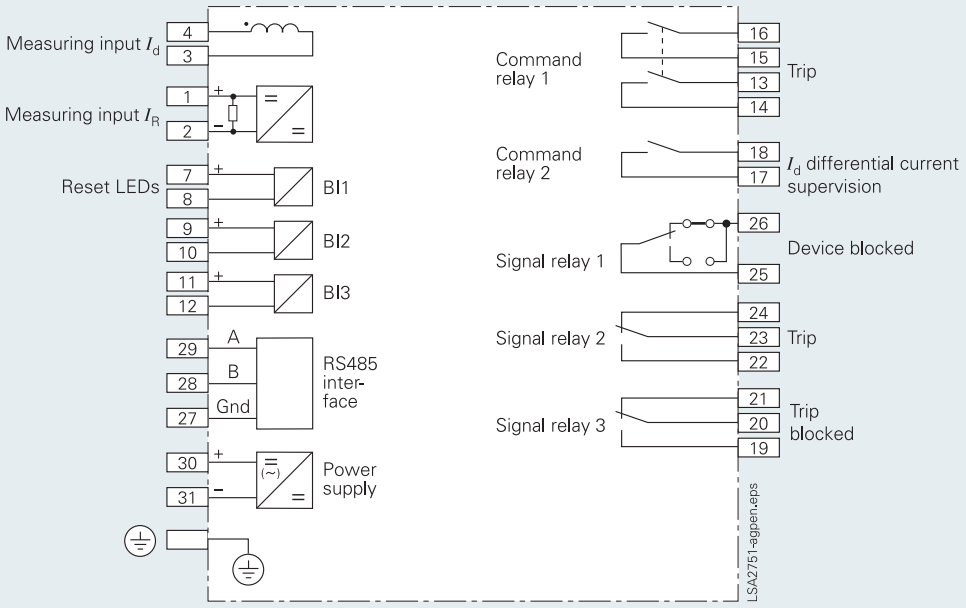

Fig. 9/14 Connection diagram for 7SS601

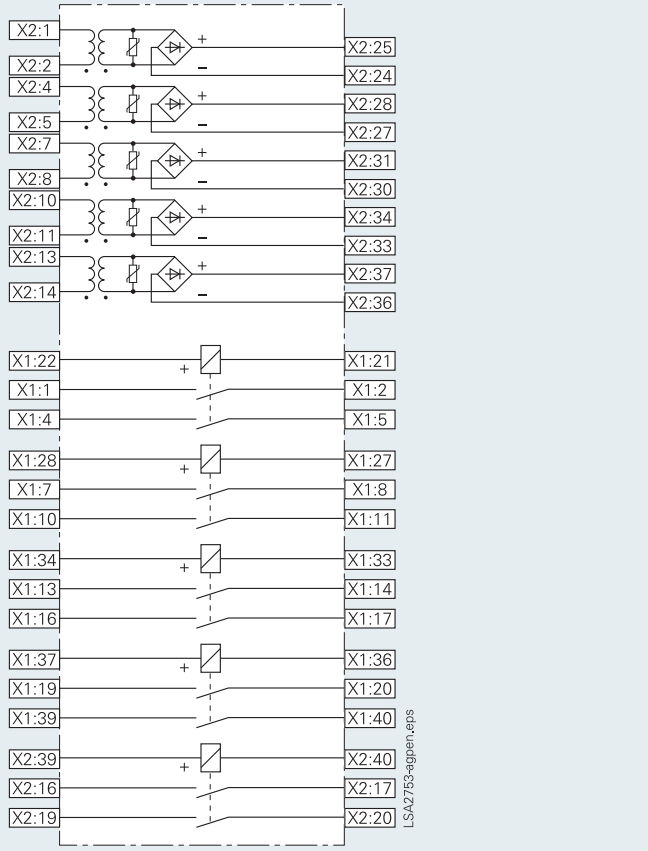

Fig. 9/15 Connection diagram for 7TM700

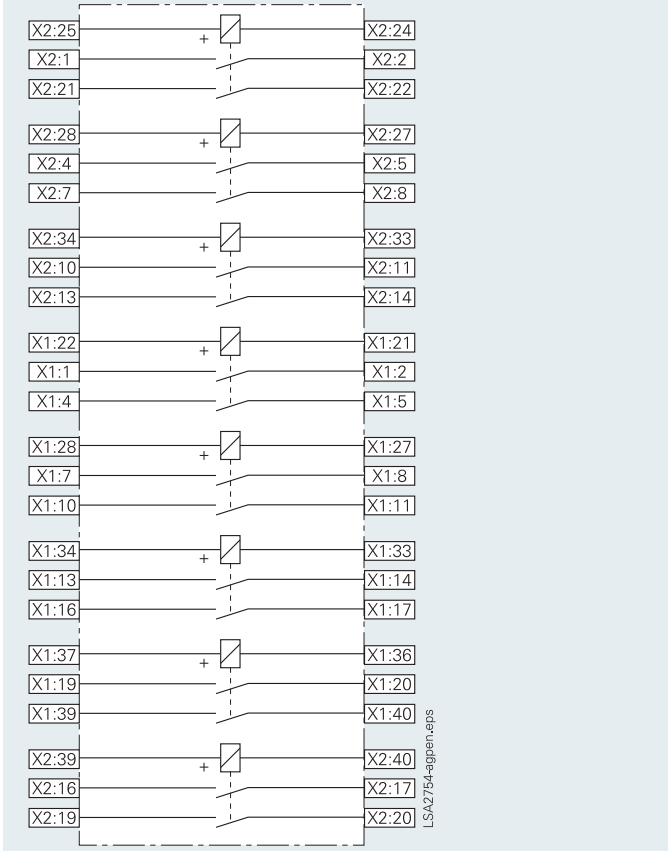

Fig. 9/16 Connection diagram for 7TS720

Connection diagram

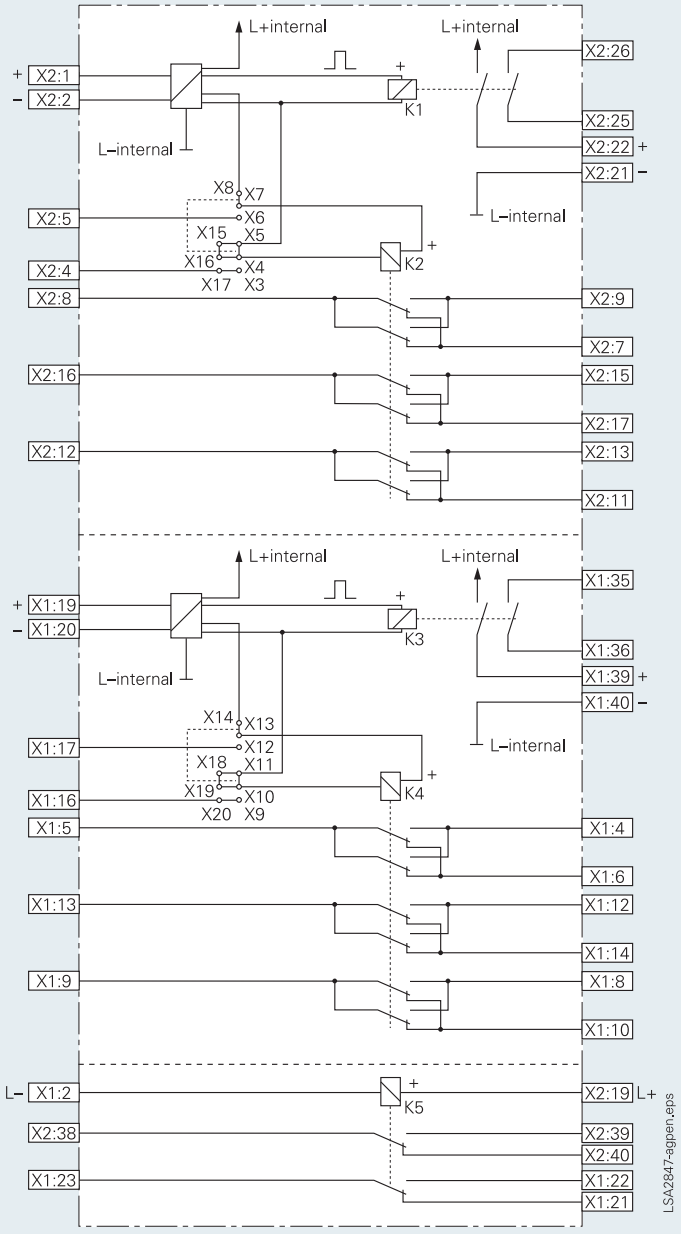

Fig. 9/17 Block diagram of 7TR710