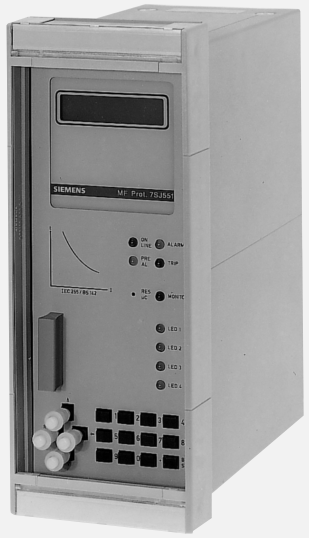
7SJ551 multi–function protection relay



Scope of functions

27, 49R, 59
37, 50, 86
46, 50G
48, 51
49, 51G

Fig. 1
7SJ551 multi–functional protection relay

General

- The numerical multi–function protection relay is a fully microprocessor based relay of the 7S–relay family.
- The relay can be integrated into station control systems like the LSA system via a serial communication interface with an internationally standardized protocol.

Application

- Multi–function protection relay for rotating electric machines, especially asynchronous motors
- Thermal overload, overcurrent and earth–fault protection for transformers and cables
- Back–up protection for differential and distance relays in high voltage feeder protection schemes
- Earth–fault direction protection for isolated, compensated and high–ohmic earthed networks
- Directional overcurrent and earth–fault protection in combination with external connected directional unit like 7SP20

Implemented functions/features

- Thermal overload protection of rotating devices:
  - seperate thermal replica for stator and rotor based on True RMS current measurement
  - up to 2 heating time constants for the stator thermal replica
  - seperate cooling time constants for stator and rotor thermal replica
  - ambient temperature biasing of thermal replica
  - incorporation of additional heating effects of asymmetrical currents.
- Thermal overload protection of non–rotating devices:
  - up to 2 heating time constants with extremely wide setting ranges for optimal thermal protection of cables and transformers
  - externally adjustable time constant
  - ambient temperature biasing of thermal replica.
- Connection of up to 8 RTD sensors.
- Multi–curve overcurrent and earth–fault protection:
  - insensitive for transients and DC components
  - separate two stage tripping characteristics for phase and earth elements
  - four selectable internationally standardized (BS 142, IEC 255–4) tripping characteristics for phase elements: Normally Inverse, Very Inverse, Extremely Inverse and Definite Time
  - two additional tripping characteristics for the earth element: Long Time Earth–fault and Residual Dependent Time
  - customized curves instead of standard curves can be programmed to offer optimal flexibility for both phase and earth elements
- Curve Switch and Blocking functions offer an adaptive feature to change the relay characteristics according to prevailing system conditions
- Separate setting tables for the protection of rotating and non–rotating network components
- Equiped with highly sophisticated protection algorithms which offer optimal flexibility in grading with other protection relays and with the thermal limit curves of primary components
- Software matrix for signalling and tripping relays
- Real Time Clock: last 3 events are stored with real time stamps of alarm and trip data
- Fault recording

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Thermal overload (ANSI 49/49R)

The relay uses a thermal memory to resemble the remaining thermal capacity of the protected device. This is a measure for the allowed heating of the protected device. The thermal capacity can be obtained from the True RMS phase currents, taking into account the effect of asymmetrical current.
A pre–alarm signal is issued when the thermal memory reaches the warning level.

Start inhibit (ANSI 86)

The start inhibit function permits starting of the motor only when the thermal reserve of the motor is sufficient for a complete start.

Emergency restart

To override the start inhibit condition it is possible to activate an input for the emergency restart function, which leads to a discharge of the thermal memory.

Ambient temperature biasing

The thermal capacity available can be adjusted according to the actual ambient temperature as monitored by an RTD–sensor.

Overtemperature

Up to 8 RTD sensors (Pt–100, Ni–100 or Ni–120) can be used to monitor the temperature of the protected device.

Undercurrent (ANSI 37)

This function is normally used to detect a decrease in current flow caused by a loss of, or decrease in, motor load. This is especially useful for indication of loss of suction of pumps, loss of airflow for fans, or a broken belt for conveyors.

Low set overcurrent (ANSI 51/51G/51N) and high set overcurrent (ANSI 50/50G/50N)

The ”low set overcurrent function” protects against short circuits. The Low Set Overcurrent function can be configured with six different tripping characteristics, which can be set for phase and earth elements independently. The time dependent characteristics are standardized according to IEC 255 and BS 142.

The ”high set overcurrent function” protects devices against immediate short–circuits and mechanical jams. Phase and earth elements can be selected independently.

Unbalance (ANSI 46)

This function protects a device against overheating caused by unequal phase loading. Also breaks, short–circuits and reversed phase current connections can be detected. The sequence of connections can be externally chosen either clockwise or counterclockwise.

Locked rotor (ANSI 48) and zero speed

To protect a motor with a ”locked rotor” the maximum allowable time between a motor start attempt and the beginning of normal running operation can be protected.

When the permissable locked rotor time is less then the starting time the ”zero speed” input detects if the rotor is locked during the start attempt.

Undervoltage (ANSI 27) and overvoltage (ANSI 59/64)

The ”undervoltage function” protects devices against operating on too low voltage.

The ”overvoltage function” protects devices against operating under too high phase, line or zero sequence voltage.

External command and breaker failure trip

An external command (e.g. emergency stop button) can issue an immediate or delayed trip command.

The ”breaker–failure trip function” is able to issue a second trip command as a back–up facility, when the issued trip command, either by the relay itself or by an other externally connected protection relay, does not lead to a decrease of the measured current flow.

Directional earth fault (ANSI 67G)

This functions is able to detect the direction of the earth fault in those networks where the starpoint is isolated, high–ohmic grounded or grounded by a Petersen coil.

Curve switch

This function makes it possible to switch from one set of Low Set/High Set Overcurrent setpoints to another when the system conditions have changed.

Block

Individual trip elements, such as ”undercurrent”, ”undervoltage”, ”low set and high set overcurrent” can be blocked temporarily.

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Technical data

Power supply	Supply voltage		
	24/60 V DC		19.2 to 88 V
	110/250 V DC		88 to 300 V
	Supply voltage		
	110/230 V AC		88 to 256 V
	Battery drain	quiescent	15 W
		energized	20 W
Energizing input circuits	Rated current I_N		1 or 5 / 1 A
	Rated frequency f_N		50 / 60Hz
	Thermal withstand	continuously	6 x I_N / 4 A
		for 1 sec	100 x I_N / 75 A
		for 10 sec	30 x I_N / 20 A
		half cycle	250 x I_N / 200 A
	Maximum c.t. burden at I_N		0.1 / 0.2 VA
	Rated voltage V_N		100 or 110 V
	Rated frequency f_N		50 /60 Hz
	Thermal withstand	continuously	1.2 x V_N
	Maximum c.t. burden at V_N		0.1 VA
External control inputs	Control voltage		
	24 to 250 V DC		19.2 to 300 V DC
	110 to 230 V AC		88 to 256 V AC
	Control current		typical $\leq$3 mA
	Detection time		10 msec
Output contacts	2 NO		Output 1
	1 NC		Monitor
	1 NO (5 x)		Output 2 to 6
	Switching voltage, max.		300 /250 V AC
	Make and carry		max. 30 A/0.5 sec
	Permissible current	continuous	5 A
	Switching capacity	make	max. 1 000 W
		break	30 W/50 VA
LED displays	Ready for operation	green	ON LINE
	Internal fault	red	MONITOR
	Thermal overload	yellow	PRE ALARM
	Protection functions	yellow	ALARM
	Trip	red	TRIP
	Marshallable LEDs	yellow	LED 1 to 4
Serial interface	Protocol		according to IEC 870–5
	Transmission speed		2 400/4 800/9 600/19 200/38 400 baud
	Safety		Hamming distance d = 4
	RS485 transmission distance		1 200m
	Fibre optic interface		
	Transmission distance		2 km
	Optical wave length		820 nm
	Permissible attenuation		max. 8 dB
Temperature sensors	Suitable for		Pt 100/Ni 100/Ni 120
	Number		2 or 8
	Connection terminals		3 for each sensor
	Connection cable (to be ordered separately)	max. resistance	<25 Ω

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Technical data

Thermal overload	Full load current I_{flc} No load current I_{noload} Start current I_{start} Safety factor k Unbalance factor k_{inv} Cold starts n_{cold} Warm starts n_{warm} Thermal time τ_1, τ_2 Start time t_{start} Weight factor p_{weight} Accuracy of I_{flc} Accuracy trip time	0.05 to 28 I_N 0.05 to 1 I_N 0.05 to 28 I_N 1 to 1.5 0 to 10 1 to 15 1 to 15 1 sec to 999 min 1 to 200 sec 0 to 1 ±5 % ±2 %
Overtemperature	Alarm level T_{alarm} Trip level T_{trip} Accuracy	0 to 200 °C 0 to 200 °C 1 °C
Undercurrent	Alarm level $I<$ Dead time t_{bypass} Trip time $t\ I<$ Accuracy of $I<$ Accuracy trip time Drop off/pick up ratio	0.05 to 28 I_N 0 to 100 sec 0 sec to 166 min ±5 % ±2 % 0.95 ±0.01
Low set overcurrent on phase and earth		
Definite time	Alarm level $I>$ Alarm level $I_E>$ sensitive Time $t\ I>$ and $t\ I_E>$	0.05 to 28 I_N 0.003 to 1.4 A 0 sec to 166 min
Inverse time	Characteristics Alarm level I_p Alarm level I_{ep} sensitive Time factor t_p and t_{ep}	NI, VI, EI, LTE, RD BS 142 – 1966 0.05 to 28 I_N 0.003 to 1.4 A 0 to 10
Custom curve	Number of points Alarm level I_x Alarm level I_{ex} sensitive Trip time $t\ I_x$ and $t\ I_{ex}$ Accuracy $I>/ I_p$ / I_x Accuracy trip time Drop off/pick up ratio	2 to 15 0.05 to 28 I_N 0.003 to 1.4 A 0 sec to 166 min ±5 % ±2 % 0.95 ±0.01
High set overcurrent on phase and earth	Alarm level $I>>$ Alarm level $I_E>>$ sensitive Time $t\ I>>$ and $t\ I_E>>$ Accuracy of $I>>$ Accuracy trip time Drop off/pick up ratio	0.05 to 28 I_N 0.003 to 1.4 A 0 sec to 166 min ±5 % ±2 % 0.95 ±0.01
Unbalance		
Extremely inverse	Alarm level I_{2p} Dead time t_{bypass} Time factor t_{2p} Accuracy of I_{2p} Accuracy trip time Drop off/pick up ratio	0 to 1 I_N 0 to 100 sec 0 to 25 ±5 % ±2 % 0.95 ±0.01
Locked rotor	Delay time t_{lr} Accuracy trip time	0 to 200 sec ±2 %
Undervoltage	Alarm level $V<$ Trip time $t\ V<$ Accuracy of $V<$ Accuracy trip time Drop off/pick up ratio	0.05 to 1.2 V_N 0 sec to 166 min ±5 % ±2 % 0.95 ±0.01

7SJ551 multi–function protection relay

Technical data

Overvoltage	Alarm level $V>$ Trip time $t\ V>$ Alarm level $V>>$ Trip time $t\ V>>$ Accuracy of $V>$, $V>>$ Accuracy trip time Drop off/pick up ratio	0.05 to 1.2 V_N 0 sec to 166 min 0.05 to 1.2 V_N 0 sec to 166 min ±5 % ±2 % 0.95 ±0.01
Breaker failure trip	Alarm level I_{bf} Trip time t_{bf} Accuracy of I_{bf} Accuracy trip time Drop off/pick up ratio	0.05 to 28 I_N 0 sec to 166 min ±5 % ±2 % 0.95 ±0.01
Directional earth fault	Setting range Alarm level $I_{\phi}>$, $I_{\phi p}$, $I_{\phi}>>$ Alarm level V_{STRT} Trip time $t\,I_{\phi}>$, $t\,I_{\phi}>>$ Time factor $t_{\phi p}$ Angle ϕ_e	$I_{\phi}\cos\phi$ or $I_{\phi}\sin\phi$ 0.003 to 1.4 A 0.05 to 1.2 V_N 0 sec to 166 min 0 to 10 – 45 to + 45°
Reference conditions	Temperature Power supply Line frequency 3rd harmonic 5th harmonic	–10 to +55 °C 0.8 to 1.15 x V_N 0.9 to 1.1 x f_N 10 % (phase 0/180°) 10 % (phase 0/180°)
Construction of unit	Case: dimensions (standard metal housing for flush mounting) Weight Degree of protection acc. to EN 60529	7XP20 approx. 4 kg IP51
Connections	Energizing input circuits, modular terminal blocks Each terminal features: 1 snap–on connection 1 screw connection External control inputs, output contacts Each terminal features: 1 snap–on connection 1 screw connection	Heavy duty terminals with shorting facilities 2.5 mm^2 (# 12 AWG appr.) 4 mm^2 (# 10 AWG appr.) 1.5 mm^2 (# 14 AWG appr.) 1.5 mm^2 (# 14 AWG appr.)
Dielectric tests, electrical environment immunity	Insulation test IEC 255–5 Impulse voltage IEC 255–5 Insulation resistance IEC 255–5	2 kV, 50 Hz, 1 min Test voltage 500 V DC, withstand test ≥100 MΩ 1.2/50 µs, 0.5 J / 5 kV, Ri = 500 Ω, 5 kV CM, 5 kV DM
Disturbance tests	High frequency disturbance (surge withstand capability SWC) IEC–255–6, IEC 255–22–1, Class 3 Electrostatic discharge IEC 801–2, Class 3 Radiated electromagnetic field test IEC 801–3, Class 3 Fast transient test Repetition rate Burst duration Burst period Test duration IEC 801–4, Class 4 Spike test as recommended by KEMA	1 MHz CM, 2.5 kV DM, 1 kV 150 pF, 150 Ω, 8 kV 0.15 to 300 MHz, 10 V/m 5/50 nsec, Ri = 50 Ω 5 kHz 15 msec 300 msec 10 sec, 4 kV CM 0.15/50 µsec, Ri = 5 Ω, DM 1 kV
Radio interference	EN 55011	0.15 to 30 MHz line interference 30 MHz to 1 GHz radiation

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Climatic conditions	Permissible ambient temperature	in service during transport during storage	–10 to +55 °C –25 to +55 °C –25 to +70 °C
	Humidity class according to IEC 68–2–30		6 cycles/12 hrs, +25/+55 °C, humidity 95 %
	Relative humidity		annual average ≤75 % relative humidity on 30 days of the year up to 95 % relative humidity Condensation not permissible
Vibration	IEC 68–2–6, DIN 40 048–8		10 – 55 Hz, 2 g, 20 sweeps, 3 directions
KEMA type test	The relay 7SJ551 has been type tested by KEMA – laboratories in Arnhem, The Netherlands. Type test results are laid down in the reports No. 37469–KCS/LB–93–1017 and 37469–KCS/LB–1036.		

Selection and ordering data

7SJ551 multi–function protection relay	Order–No. **7SJ551 □ – □ □ A 0 0 – □ □**
Nominal current/frequency	
R, T, e 1/5 A, 50/60 Hz	**1**
R, S, T, e 1/5 A, 50/60 Hz	**2**
R, T 1/5 A, e sensitive 1 A, 50/60 Hz	**3**
R, S, T 1/5 A, e sensitive 1 A, 50/60 Hz	**4**
Auxiliary supply voltage	
24–60 V DC	**1**
110–250 V DC/110–230 V AC	**2**
Construction	
horizontal module	**A**
vertical module	**B**
Option A: Connections	
no option	**0**
extended I/O: 3 extra inputs, 2 extra outputs, 4 extra LEDs, output 1 doubled	**1**
extended I/O + voltage functions (single phase)	**2**
extended I/O + voltage functions (single phase) + directional earth-fault protection (only in combination with e sens. 1 A)	**3**
Option B: Interfaces	
no option	**A**
RS–485 + optical interface	**B**
RS–485 + optical interface + connection for 2 RTD sensors	**C**
RS–485 + optical interface + connection for 8 RTD sensors	**D**

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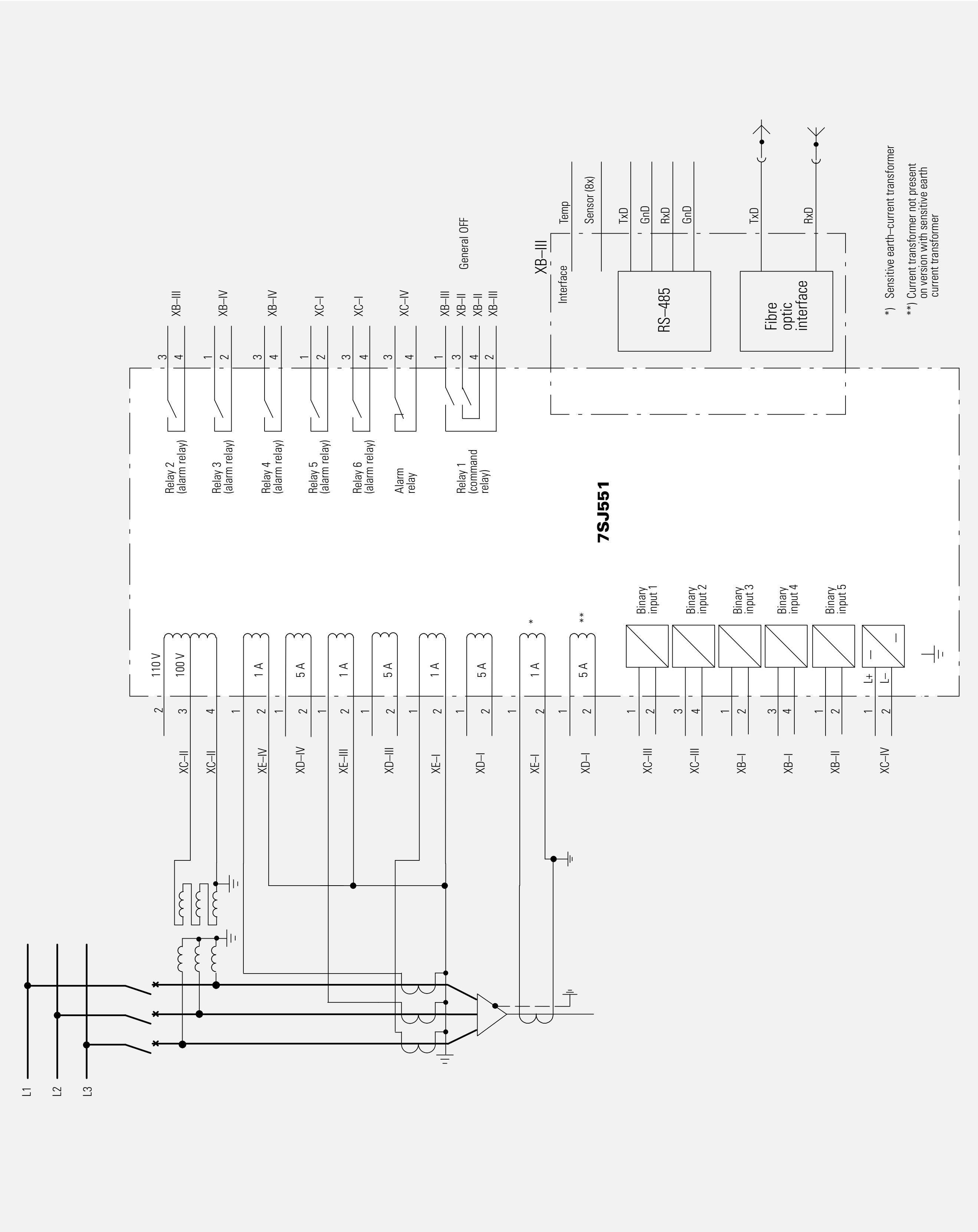

Fig. 2
Application feeder protection

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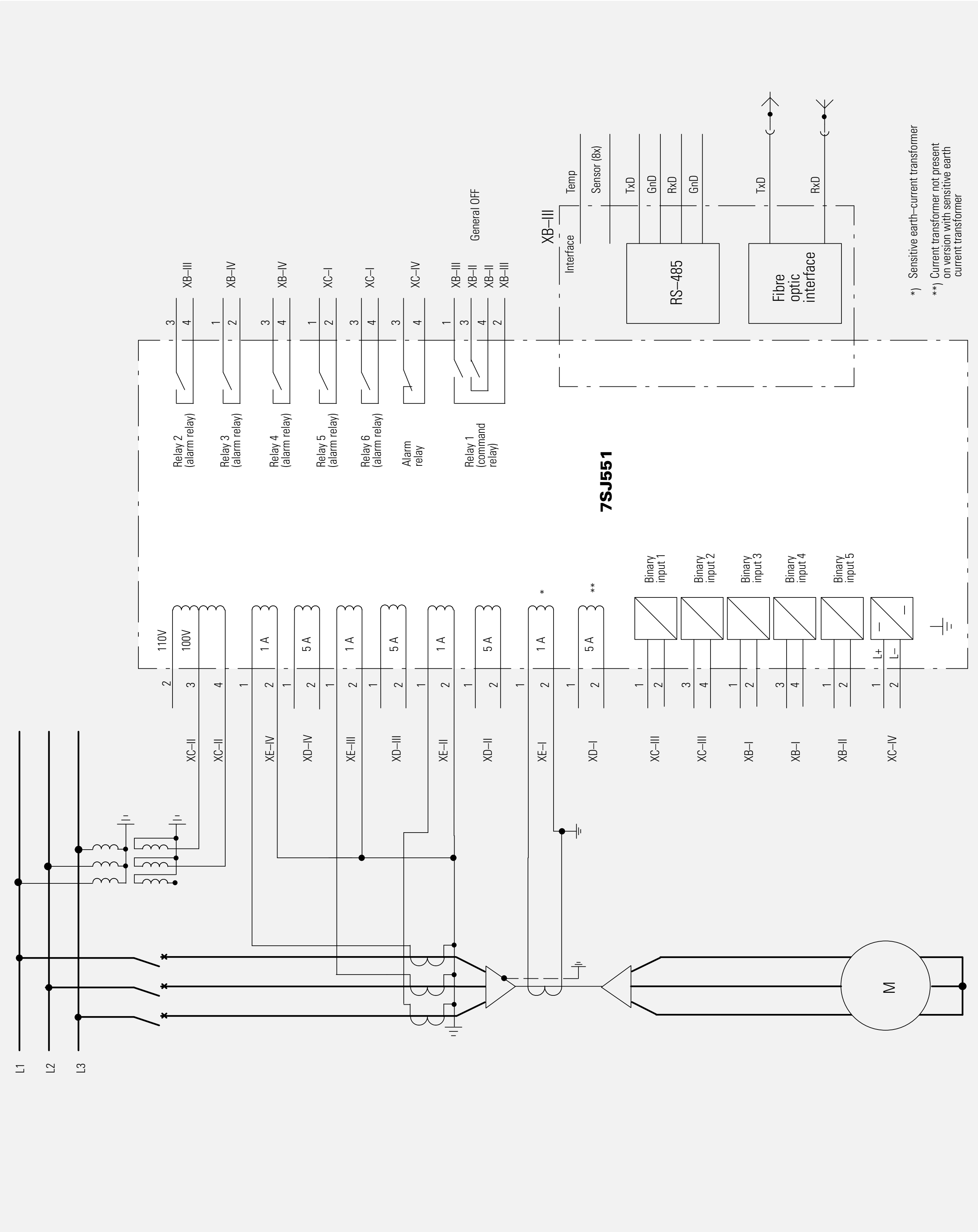

Fig. 3
Application motor protection

7SJ551 multi–function protection relay

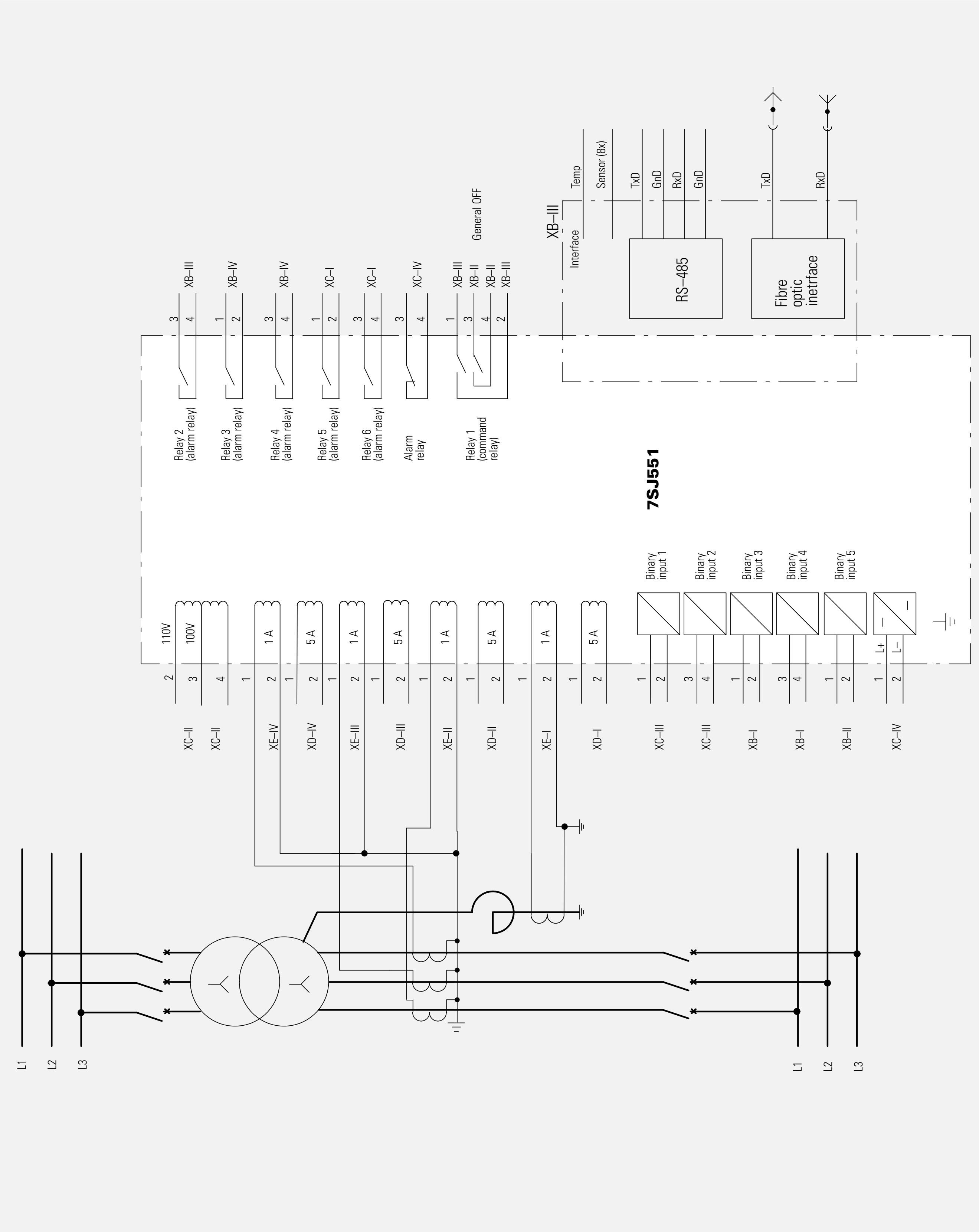

Fig. 4
Application transformer protection

Dimension drawings in mm

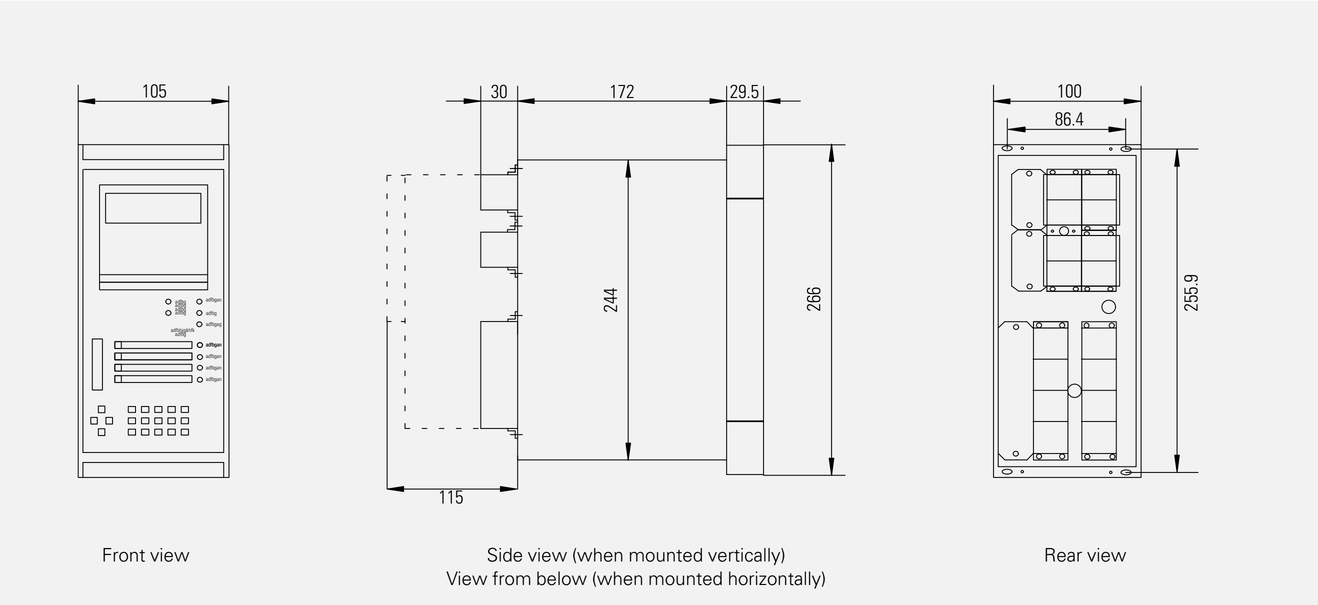

Fig. 5
7SJ551 in 7XP20 housing

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