

7VK512 numerical auto-reclose/check-synchronism relay



Fig. 1
7VK512 numerical auto-reclose/check-synchronism relay

Application

The 7VK512 is a highly flexible single and/or three-pole auto-reclose relay, with or without a check-synchronism function. The 7VK512 can also be used as a check-synchronism relay only.

This relay is used for the automatic reclosure of a circuit-breaker, after this circuit-breaker has tripped due to a fault. The check-synchronism function ensures that the two circuits being reconnected by closing the circuit-breaker, meet the desired requirements before the close command is issued.

Construction

Within its compact construction, the device contains all the components required for:

- Measured-value acquisition and evaluation
- Operator panel with display
- Event/alarm and command outputs
- Binary inputs
- Serial interfaces
- Power supply converter.

The device can be supplied in three housing versions. The version for flush mounting, or mounting in a cubicle, has rear connection terminals. The model for surface mounting is supplied with two-tier terminals accessible from the front.

Implemented functions/features

The following functions are available:

- Single and/or three-pole auto-reclose
- Up to 10 auto-reclose "shots"
- Independently settable "dead" times and "reclaim" time
- Sequential fault recognition
- Check-synchronism with live line/dead bus, dead line/live bus, dead line/dead bus and synchronism conditions (live line/live bus)
- Issue of close command taking the closing time of the circuit-breaker into account
- Circuit-breaker closing supervision, e.g. circuit-breaker not ready facility
- Manual close function independently settable for auto-reclose and check-synchronism
- Changeover on-line between 4 complete sets of parameters
- Event and fault recording for the voltage inputs
- Event and status reports.

Mode of operation

With its powerful microprocessor, digital filtering and processing of the measured values, the relay is reliable, accurate and flexible. The harmonics and transients in the voltage inputs and other external sources are eliminated. The flexible software package allows the user to define the auto-reclose cycle, e.g. type of auto-reclose (single-pole/three-pole); number of auto-reclose "shots" (up to a maximum of 10 shots); with or without check-synchronism.

Serial interfaces

The relay includes two serial interfaces.

The operator interface is provided on the front panel of the relay for connection to an IBM compatible PC (utilizing the operator program DIGSI). This allows convenient parameter setting, transfer and evaluation of fault operation details for the last three faults and the voltage wave forms stored during the last fault and relay commissioning.

The system interface is available as a fibre optic interface for connection to either the substation control system SINAUT LSA or to a central data protection unit.

Settings

All setting parameters can be input via the integrated operator panel and display, or via a PC under user control. The parameters are stored in a non-volatile memory, so they are secure even during interruption of the supply voltage.

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Self monitoring

All important hardware and software components are monitored continuously. Any irregularities in the hardware or in program sequence are immediately detected and alarmed. As a result, the security, reliability and availability of the relay are significantly improved.

Auto-reclose function

This function enables the reclosure of a circuit-breaker after this circuit-breaker has tripped due to a fault. The type of auto-reclose cycle initiated by the relay is determined by the type of fault for which the circuit-breaker was tripped. This can be seen on page 3, where these different cycles are customer settable. The first 4 auto-reclose dead times are freely settable and can be arranged in the different combinations shown.

Up to 10 auto-reclose "shots" are possible with the 4th until the 10th "shot" using the dead time T 3-pole 3 DAR.

Normally, the first auto-reclose cycle has a short dead time thus allowing for a fast auto-reclosure. Hence this auto-reclose (for single or 3-pole reclosing) is referred to as a "fast" or rapid (RAR) auto-reclose. The second and further cycles are therefore referred to as "slow" or delayed (DAR) auto-reclosures.

By using the "action time" it is possible to differentiate between different fault locations because of the time delay between fault detection and tripping of the protection relays. Therefore, with the "action time", or via binary input, the first shot (rapid) can be overridden allowing the first cycle to start with the slow cycle, e.g. with 3 DAR dead time on page 3. The detection of sequential faults, together with what action should be taken for these conditions is also settable.

In the 7VK512, a facility exists for the connection of a contact showing the readiness of the circuit-breaker to perform an auto-reclose, i.e. spring charged. Where a multi-shot auto-reclose cycle is required, this allows for a pause in the cycle to enable the circuit-breaker to charge its spring/closing mechanism.

Various monitoring times exist, which ensure the correct response, if a particular part of the auto-reclose cycle is not completed within a certain time; e.g. spring-charging monitoring time.

Check-synchronism function

This function ensures that the correct conditions exist between the two circuits to be connected, before the close command is output. The conditions for which closing is allowed can be: a live line and a dead busbar, a dead line and a live busbar, a dead line and a dead busbar, or both line and busbar live (i.e. synchronism).

The facility also exists for the closing time of the circuit-breaker to be set. This ensures a closing of the circuit-breaker exactly at the point of synchronism.

All the relevant setting possibilities are available to implement these functions, together with the supervision of the time within which check-synchronism must be attained.

Manual closing

With this function, the action of the relay, is specified upon receipt of a manual close command, i.e. manual close:

- With live line/dead bus,
- With dead line/live bus,
- With synchronism.

Parameter changeover

Four complete sets of parameters (settings) are available. The parameter set valid for the relay can be changed on-line, if necessary, allowing for the change of settings in accordance with, for example the change in the system or network. The parameter set required can be selected via the operator panel or via binary inputs.

Fault reports

The 7VK512 provides detailed data for the analysis of operations, as well as the recording of all relay operational status changes (e.g. relay blocked/ready). All these data are stored in a non-volatile memory.

• Real-time clock

A battery-backed clock is available, which is synchronized via a digital input or the system serial interface to supply time/date information or fault reports.

• Relay operation reports

Summarized fault data for the last three relay operations are always available. Each new recording overwrites the oldest data.

• Service status reports

All relay service status changes are recorded in a ring buffer. In addition, it is possible to view the on-line input voltage values via the front panel LCD display.

• Operating statistics

The number of single or three-pole rapid auto-recloses and three-pole delayed auto-recloses is indicated.

Event recording

The digital measured values for the 2-phase voltages are stored for a period of 100 ms before fault inception until 100 ms after the trip-command however for a maximum of 3 sec. This data can be transferred either to the co-ordinated substation control system SINAUT LSA or to a PC for analysis. This stored information is overwritten when another network fault occurs, so that the most recent fault data is always available.

Marshalling of command and alarm/event relays, LEDs and binary inputs

All input/output relays and indicating LEDs may be functionally allocated according to the user's requirements.

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Example of selectable auto-reclose cycles

Type	No	1st shot	2nd shot	3rd shot	4th shot and further shots (up to a maximum of 10)
1. Single-phase faults					
	a	1-pole auto-reclose with T 1-pole dead time	3-pole delayed auto-reclose with T 3-pole, 2 DAR dead time	3-pole delayed auto-reclose with T 3-pole, 3 DAR dead time	3-pole delayed auto-reclose with T 3-pole, 3 DAR dead time
2. Multi-phase faults					
Either b or c may be selected	b	3-pole rapid auto-reclose with T 3-pole RAR dead time	3-pole delayed auto-reclose with T 3-pole, 2 DAR dead time	3-pole delayed auto-reclose with T 3-pole, 3 DAR dead time	3-pole delayed auto-reclose with T 3-pole, 3 DAR dead time
	c	3-pole delayed auto-reclose with T 3-pole, 1 DAR dead time	3-pole delayed auto-reclose with T 3-pole, 2 DAR dead time	3-pole delayed auto-reclose with T 3-pole, 3 DAR dead time	3-pole delayed auto-reclose with T 3-pole, 3 DAR dead time

Notes:

- Cycle 2b (for multi-phase fault) may be enabled when the fast dead time is blocked. Therefore only slow dead times are available.
- RAR = Rapid auto-reclose
DAR = Delayed auto-reclose

Technical data

Input circuits	Rated voltage V_N Rated frequency f_N Control range in voltage path Thermal overload capability in voltage path Power consumption in voltage path at 100V	80 to 125 V 50 or 60 Hz 1 to 140 V_{rms} 200 V_{rms} continuous approx. 0.5 VA per input
Auxiliary voltage	Rated auxiliary voltage V_{aux} /permissible tolerance Power consumption quiescent energized Max. backup time during voltage supply failure	24/48 V DC / 19 to 56 V DC 60/110/125 V DC / 48 to 144 V DC 220/250 V DC / 176 to 288 V DC approx. 6 W approx. 12 W ≥ 50 ms at $V_{aux} \geq 110$ V DC
Binary input	Number Voltage range Switching threshold Current consumption, energized	15 24 to 250 V DC 18 of 69 V DC via shunt approx. 2.5 mA
Alarm/event contacts	Number Contacts per relay Switching capacity make/break Switching voltage Permissible current continuous	15 1 C/O or 1NO 20 W/VA 250 V AC/DC 1 A
Command contacts	Number of reclosing relays Contacts per relay Switching capacity make break Switching voltage Permissible current continuous for 0.5 s	2 2 NO 1000 W/VA 30 W/VA 250 V AC/DC 5 A 30A
LED displays	Ready indication Blocked indication Marshalling LEDs	1 green 1 red 6 red

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Technical data (continued)

Serial interface	<p>Operator interface</p> <p>Connection</p> <p>Baud rate</p> <p>Floating interface for data transmission between control centre or other protection equipment</p> <p>Standard</p> <p>Baud rate</p> <p>Transmission reliability</p> <p>Fibre optic connection</p> <p>Optical wave length</p> <p>Permissible attenuation</p> <p>Distance</p> <p>No character</p>	<p>Not isolated</p> <p>On the front panel 25-pole subminiature Plug ISO 2110 for the connection of a PC/hand-held terminal</p> <p>Min. 1200 Bd; max. 19200 Bd 1200 Bd</p> <p>Protocol according to DIN 19 244 min. 4800 Bd; max 19200 Bd default setting: 9600 Bd Hamming distance $d = 4$</p> <p>Integrated F-SMA plug-in connector for direct FO: connection with ceramic pin, on flush-mounted housing: at the rear on surface-mounted housing: at the bottom of housing</p> <p>820 nm</p> <p>max. 8 dB with glass fibre 62.5/125 μm max. 1.5 km with glass fibre 62.5/125 μm default setting "light off"</p>
Construction of unit	<p>Housing</p> <p>surface mounting</p> <p>flush mounting/cubicle mounting</p> <p>Weight (dimensions)</p> <p>in housing for surface mounting</p> <p>in housing for flush mounting/cubicle mounting</p> <p>Degree of protection according to EN 60529</p> <p>Housing</p> <p>Terminals</p>	<p>7XP2030-1 7XP2030-2</p> <p>approx. 11 kg approx. 9.5 kg</p> <p>IP 51 IP 21</p>
Insulation tests	<p>Voltage tests (100% test): V_{aux} DIN VDE 0435 part 303 and IEC 255-5 or IEC 255-6</p> <p>Impulse voltage tests (100% test) or other circuits DIN VDE 0435 part 303 and IEC 255-5 or IEC 255-6</p> <p>Impulse voltage tests (type test) DIN VDE 0435 part 303 and IEC 255-5 or IEC 255-6</p>	<p>2.8 kV DC; 30 s per polarity</p> <p>2 kV (rms), 50 Hz, 1 min</p> <p>5 kV (peak); 1.2/50 μs; 0.5 J; 3 positive and 3 negative shots at intervals of 5 s</p>
Disturbance tests	<p>High frequency test (type test) IEC 255-22-1 class III</p> <p>Electrostatic discharge test (type test) IEC 255-22-2 class III</p> <p>Electromagnetic field test (type test) IEC 255-22-3 class III</p> <p>Fast transient test (type test) IEC 255-22-4 class III</p>	<p>2.5 kV (peak); 1 MHz; $\tau = 15 \mu\text{s}$ duration 2 s</p> <p>8 kV (peak); 5/30 ns; 10 positive discharges</p> <p>Test with handheld receiver; 68 MHz; 165 MHz; 460 MHz</p> <p>2 kV (peak); 5/50 ns; 5 kHz; 4 mJ per impuls</p>
Radio interference	<p>DIN VDE 0878 part III, limit class B</p>	
Mechanical stress tests	<p>According to IEC 68 basic specification and IEC 255-21 device specification</p> <p>during transport</p>	<p>10 to 60 Hz: 0.035 mm amplitude; 60 to 500 Hz: 0.5 g acceleration</p> <p>5 to 8 Hz: 7,5 mm amplitude; 8 to 500 Hz: 2 g acceleration</p>
Climatic conditions	<p>Test procedure to IEC 68</p> <p>Condition of use to IEC 255 and IEC 870</p> <p>Permissible ambient temperature</p> <p>in service</p> <p>during storage</p> <p>during transport</p> <p>Storage and transport, packed as supplied by factory</p> <p>Humidity rating</p>	<p>- 5 to +55 °C -25 to +55 °C -25 to +70 °C</p> <p>Annual average $\leq 75\%$ relative humidity; on 30 days/year up to 95% relative humidity; condensation not permissible</p>

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Technical data (continued)

<p>Auto reclose function</p>	<p>Number of auto reclosures in RAR Mode in DAR Mode</p> <p>Type of auto-reclosures for RAR for DAR</p> <p>ARC programs RAR programs</p> <p>DAR programs</p> <p>ARC times: RAR action time DAR action time RAR dead time 1 and 3-pole DAR dead time 3-pole Discrimination times for sequential faults Reclaim time Blocking duration for manual closure Blocking duration for dynamic blocking Circuit-breaker monitoring time Close command duration</p>	<p>1x RAR + 9x DAR 9x DAR</p> <p>Single pole, 3-pole, 1-3 pole, always 3 pole</p> <p>3-pole: 3-pole RAR for all fault types 1-pole: With single-phase faults a single-pole RAR, with multiple-phase faults a three- pole lockout if no DAR is permitted in the first ARC cycle 1/3 pole: With single-phase faults a single-pole, with multiple-phase faults a three-pole RAR</p> <p>DAR only after RAR: A DAR is only possible after an unsuccess- ful RAR DAR also without RAR: In accordance with the fault distance or parameterization, a DAR can be performed directly in the first ARC cycle No DAR: No DAR can be performed, maximum one RAR</p> <p>0.01 to 320s and ∞ (steps of 0.01 s) 0.01 to 320s and ∞ (steps of 0.01 s) 0.01 to 320s (steps of 0.01 s) 0.01 to 1800s (steps of 0.01 s) 0.01 to 320s (steps of 0.01 s) 0.5 to 320s (steps of 0.01 s) 0.5 to 320s (steps of 0.01 s) 0.5 to 320s and ∞ (steps of 0.01 s) 0.01 to 32s and ∞ (steps of 0.01 s) 0.01 to 320s (steps of 0.01 s)</p>
<p>Check-synchronism function</p>	<p>Programs: Check programs for automatic reclosure</p> <p>Check programs for manual reclosure</p> <p>Voltages: V< for no voltage V< for voltage present</p>	<p>Synchronism check (with or without con- sideration of the CB operating time) Dead line and live busbar Live line and dead busbar Dead line and dead busbar Forced tripping or combinations thereof</p> <p>Synchronism check (with or without con- sideration of the CB operating time) Dead line and live busbar Live line and dead busbar Dead line and dead busbar Forced tripping or combinations thereof</p> <p>1 to 60 V (steps of 1 V) 20 to 125 V (steps of 1 V)</p>

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Technical data (continued)

<p>Check-synchronism (continued)</p>	<p>Measurement: ΔV measurement Setting range Limits of error of operating value $\Delta\varphi$ measurement Setting range Limits of error of operating value Δf measurement Setting range for asynchronous switching Setting range for synchronous switching Limits of error of operating value Min. working voltage</p> <p>Measuring times: Minimum measuring time for existing synchronism Minimum measuring time at point of synchronism</p> <p>Times Monitoring time</p>	<p>1 to 50 V (steps of 1 V) $\pm 2\%$ of setting value or ≤ 2 V</p> <p>1 to 60° (steps of 1°) $\leq 1.5^\circ$</p> <p>0.03 to 1 Hz (steps of 0.01 Hz) 0.03 to 1 Hz (steps of 0.01 Hz) ≤ 15 mHz $<$ setting range for dead or live</p> <p>≤ 20 ms ≤ 80 ms</p> <p>0.01 to 320 s (steps of 0.01 s)</p>
<p>Additional functions</p>	<p>Measurement of operational values Operational measured values for voltages Operational measured values for frequencies Voltage difference Frequency difference Angular difference Tolerances</p> <p>Fault logging Storage of the indication of the last three network faults</p> <p>Realtime assignment and backup battery Resolution for operational indications Resolution for fault indications Maximum time deviation Backup battery</p> <p>Storage time (from excitation), at max. 50 Hz</p> <p>Timebase at 50 Hz</p>	<p>V_1 V_2 (secondary in Volt und primary in kV) f in Hz ΔV in V secondary Δf in Hz $\Delta\varphi$ in degrees $\leq 2\%$ from the appropriate rated value</p> <p>1 min 1 ms 0.01 % Lithium battery 3 V/1 Ah. type CR 1/2 AA Discharge time $>$ 5 years -100 to +2900 ms for operating interface and -60 to 600 ms for LSA interface 1 instantaneous value per ms</p>

Selection and ordering data

<p>7VK512 numerical auto-reclose/check-synchronism relay</p>	<p>Order No. 7VK512 □ - □ □ A 0 □ - 0 □ A 0</p>
<p>Check-synchronism function without check synchronism function with check synchronism function</p>	<p>↑ 1 ↑ 2</p>
<p>Rated auxiliary supply voltage V_{aux} for the built-in DC/DC converter 24, 48 V DC 60, 110, 125 V DC 220, 250 V DC</p>	<p>↑ 2 ↑ 4 ↑ 5</p>
<p>Construction for panel surface mounting for panel flush mounting or cubicle mounting for panel flush mounting or cubicle mounting, without glass cover</p>	<p>↑ B ↑ C ↑ E</p>
<p>Real-time clock, non-volatile annunciation memory without with</p>	<p>↑ 0 ↑ 1</p>
<p>Serial interface (for coupling to LSA systems) without serial interface with serial interface for fibre optic connection</p>	<p>↑ A ↑ C</p>

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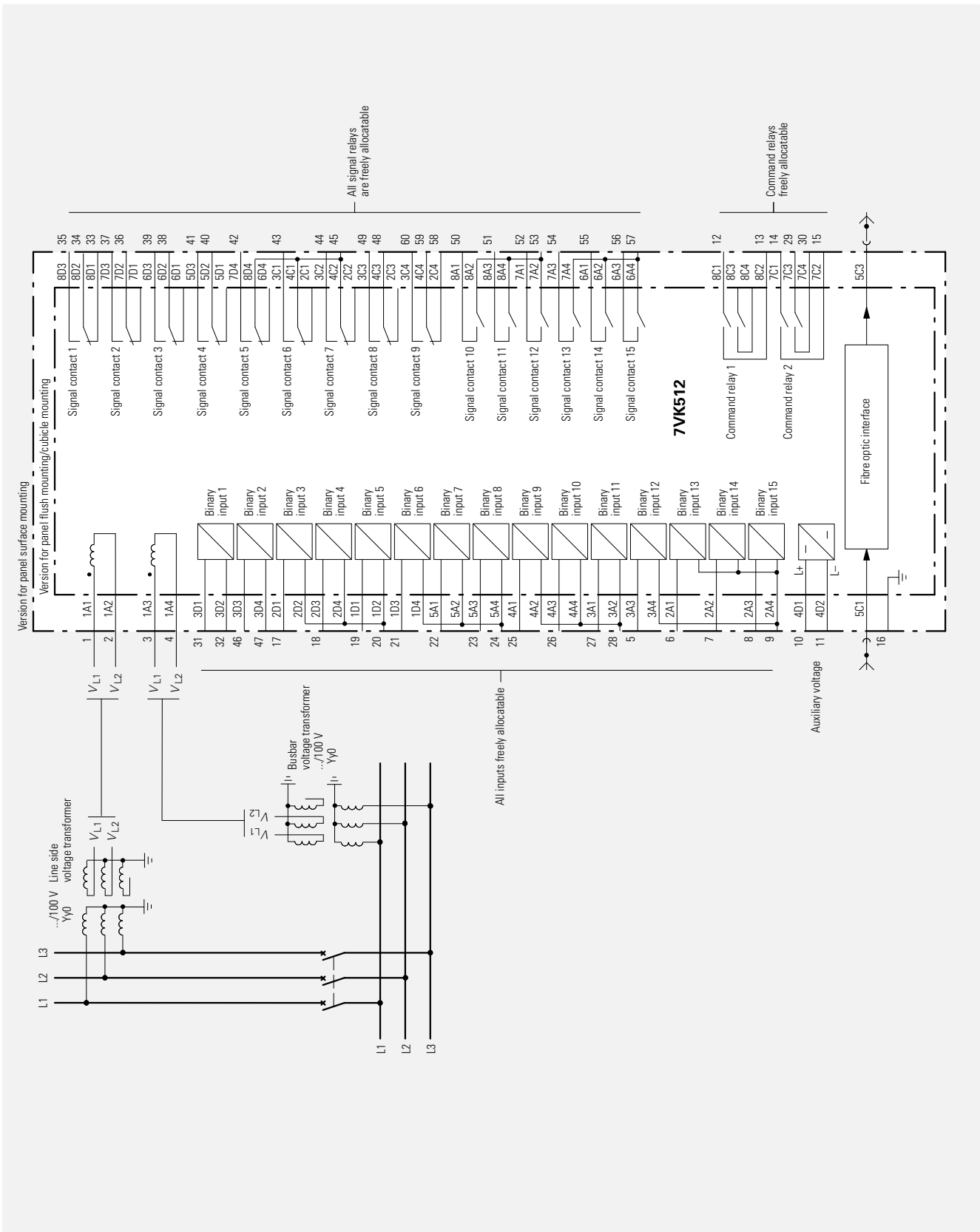


Fig. 2 Connection diagram for 7VK512 numerical auto-reclose/check-synchronism relay (1 and 3-pole)

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Dimension drawings in mm

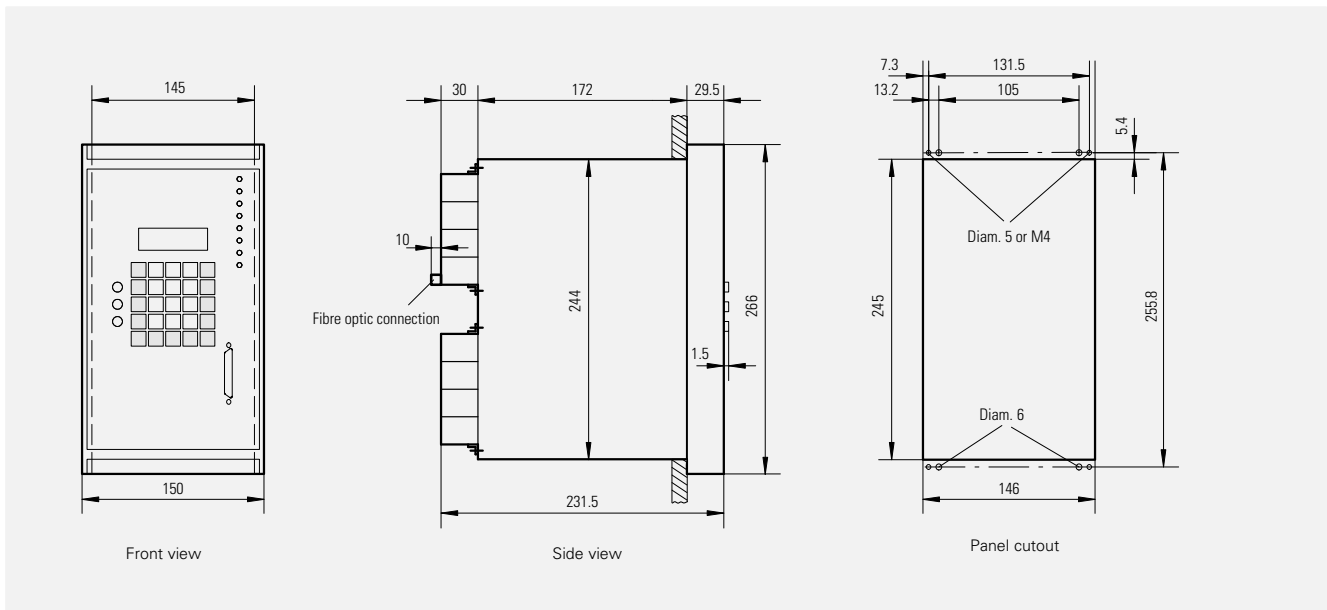


Fig. 3
7VK51 with housing 7XP2030-2 (for panel flush mounting or cubicle mounting)

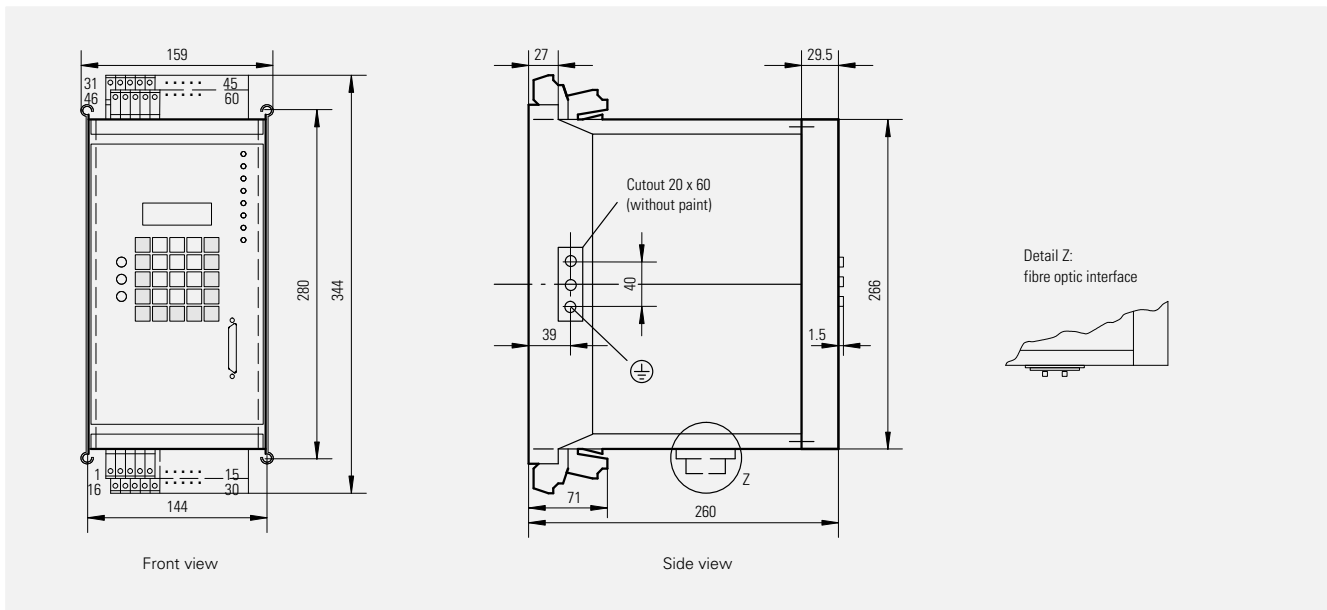


Fig. 4
7VK51 with housing 7XP2030-1 (for panel surface mounting with two-tier terminals)

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Dimensions

All dimensions in this catalog are given in mm

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