SIEMENS

Digital auto-reclose/check-synchronism relay 7VK511/512
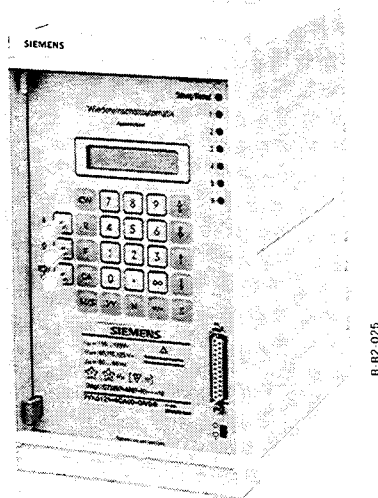

Fig. 1
Digital auto-reclose/check-synchronism relay 7VK51

Application

The 7VK51 is a highly flexible single and/or three-pole auto-reclose relay, with or without a check-synchronism function. The 7VK51 can also be used as a pure check-synchronism relay.

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 requirements before the close command is issued.

Construction

Within its compact construction, the device contains all the components required for:
- Capture and evaluation of measureands
- Operator panel with display field
- Event/alarm and command outputs
- Binary input options
- Serial interfaces
- Power supply converter.

The device can be supplied in two case variations. The variant 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
- Evolving fault recognition
- Check-synchronism with live line/dead bus, dead line/live bus, dead line/dead bus and synchronism conditions
- 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 recording showing the voltage inputs
- Event and status reports.

Mode of operation

With the application of a powerful microprocessor with digital filtering and processing of the measured values, a reliable, accurate and flexible relay is achieved. The influences of harmonics and transients from the voltage inputs and other external sources are thus 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 of an AT compatible PC (utilising an operator program). 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 LSA 678 or to a central data protection unit.

Settings

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

Self monitoring

All important hardware and software components are monitored continuously. Any irregularities in the hardware or in any program sequence are immediately detected and alarmed. As a result, the security, reliability and availability of the protection 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 in Table 1 (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.
Single-pole reclosing is only possible with the 7VK512 relay. 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 2nd and further cycles are thus referred to as "slow" or delayed (DAR) auto-reclosures.

The possibility exists by using the "action time" to differentiate between different fault locations due to 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 over-ridden allowing the 1st cycle to start with the slow cycle, e.g. 1c or 2c in Table 1 (page 3). The detection of evolving faults, together with what action should be taken for these conditions is also settable.

In the 7VK51 the facility exists for the connection of a contact showing the availability 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 supervisory times exist, which ensure the correct reaction should a particular part of the auto-reclose cycle not be completed within a certain time; e.g. spring-charging supervision time.

Check-synchronism function

This function ensures that the correct conditions exist between the two circuits to be connected, before the close command is issued. 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 should 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

4 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/network. The parameter set required can be selected via the operator panel or via binary inputs.

Fault reports

The 7VK51 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 back-up clock is available, which is synchronized via a digital input or the system serial interface to supply time/date information for fault reports.
- Relay operation reports
Summarized fault data for the last three relay operations are always available. A 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.

Event recording

The digital measured values for the 2-phase voltages are stored for a period of 100 ms before fault inception until 1.4 s after fault inception. This data can be transferred either to the co-ordinated substation control system LSA 678 or to a PC for analysis. This stored information will be overwritten upon occurrence of a new network fault, so that the most recent fault data is always available.

Marshalling of command and alarm/event relays, LED's and binary inputs

All input/output relays and indicating LED's 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					
Either a, b or c may be selected	a	1-pole auto-reclose with T 1-pole dead time	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
	b	3-pole rapid auto-reclose with T 3-pole RAR dead time	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
	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
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 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
	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

Table 1 Selectable auto-reclose cycles in the 7VK51 relay

Note: 1. Cycles 1c (for single-phase faults) or 2b (for multi-phase faults) may be enabled when the fast dead time is blocked. Therefore only the slow dead times are available.

2. Cycle 1a (for single-phase faults) is only available in the 7VK512.

3. RAR = Rapid auto-reclose
DAR = Delayed auto-reclose

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Technical data

Input circuits (7VK512 only)	Rated voltage, can be parameterized	50 to 125 V AC
	Rated frequency	50/60 Hz
	Burden in voltage path $U_N = 100$ V	< 0.4 VA
	Thermal overload capability in voltage path	140 V AC
Voltage supply via integrated DC/DC converter	Rated auxiliary voltage U_H/permissible tolerance	24, 48 V DC or / 19 to 56 V DC 60, 110, 125 V DC or/ 48 to 144 V DC 220, 250 V DC or / 176 to 288 V DC
	Max. ripple at rated voltage	≤ 12 %
	Power consumption, quiescent	approx. 5 W
	energized	approx. 10 W
	Max. bridging time during loss of voltage supply	≥ 50 ms at U_H ≥ 110 V DC
Binary inputs		7VK511 7VK512
	Number	6 (marshallable) 15 (marshallable)
	Voltage range	24 to 69 V DC and 70 to 250 V DC
	Current consumption independent of operating voltage	approx. 2.5 mA
Alarm/event contacts		7VK511 7VK512
	Number of relays, each having 1 C/O contact	9 (marshallable) 15 (marshallable)
	Switching capacity, make/break	20 W/VA
	Switching voltage	250 V AC/DC
	Permissible current, continuous	1 A
Command contacts (trip duty)	Number of relays, each having 2 NO contacts	2 (marshallable)
	Switching capacity, make	1000 W/VA
	break	30 W/VA
	Switching voltage	250 V AC/DC
	Permissible current, continuous	5 A
	0.5 s	30 A
LED displays	Ready indication green	1
	Blocked indication red	1
	Marshallable LED's red	6
Serial interfaces	Operator interface	not isolated
	Connection	on the front panel, 25-pole subminiature plug ISO 2110 for the connection of a PC
	Fibre optic protocol	Integrated FSMA connectors for fibre optic connection
	Optical wave length	820 nm
	Permissible attenuation	max. 8 dB with glass fibre 62.5/125 μm
	Distance	max. 2 km
Construction of unit	Case, dimensions	7XP20, see dimension drawings
	Weight flush mounting/cubicle mounting	approx. 9.5 kg
	surface mounting	approx. 11 kg
	Degree of protection according to DIN 40050	IP 51
Standards	DIN VDE 0435, Part 303 and IEC 255-5 or IEC 255-6	
Insulation tests	High voltage test	2 kV (rms), 50 Hz; 1 min or alternatively 2.8 kV DC; 1 min
	Impulse voltage 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 (1 MHz test) IEC 255-22-1, Class III	2.5 kV (peak); 1 MHz, τ = 15 μs, 400 shots per second, duration 2 s
	Electrostatic discharge test (ESD test) IEC 255-22-2, Class III	8 kV (peak); 5/30 ns, 10 positive discharges
	Electromagnetic field test (Radiated electr. magn. field test) IEC 255-22-3 (Report), Class III	Frequency 27 MHz to 500 MHz, 10 V/m
	Fast transient test IEC 41B (CO) 53 (draft), Class III	2 kV (peak), 5/50 ns; 5 kHz, 4 mJ per impulse; 1 min per polarity
Radio interference	DIN VDE 0871, limit class B	

Technical data (continued)

Climatic conditions	Permissible ambient temperature	in service during storage during transport	– 5° to +55°C –25° to +55°C –25° to +70°C
	Humidity rating		Code letter F to DIN 40040, condensation not permitted
Mechanical stress tests according to DIN 40046	Permissible mechanical stress	in service	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
Setting ranges **Auto-reclose**	Rapid auto-reclose dead time	1-pole 3-pole	0.01 to 320 s 0.01 to 320 s
	Action time,	for rapid auto-reclose for delayed auto-reclose	0.01 to 320 s 0.01 to 320 s
	Number of delayed auto-reclose shots	1/3-pole faults	0 to 9
	Delayed auto-reclose dead time	3-pole (DAR T3-pole 1) 3-pole (DAR T3-pole 2) 3-pole (DAR T3-pole 3)	0.01 to 1800 s 0.01 to 1800 s 0.01 to 1800 s
	Close command duration Reclaim time Discimination time for evolving faults Dynamic blocking time Block time with manual close CB ready supervision time CB aux. contact supervision time		0.01 to 32 s 0.5 to 320 s 0.01 to 320 s 0.5 to 320 s or infinity 0.5 to 320 s 0.01 to 320 s 0.01 to 32 s
	Tolerances 　Pick-up value 　Time		< 5% ± 1%
Check-synchronism	Rated voltage Voltage phase angle difference correction Voltage setpoint	for "live" condition for "dead" condition	50 to 125 V AC 0 to 360 degrees 20 to 125 V AC 1 to 60 V AC
	Sync. voltage difference Sync. frequency difference Sync. angle difference Closing time of circuit-breaker CB closing time active for freq. diff. Check-synchronism supervision time	ΔU Δf $\Delta \varphi$	1 to 50 V AC 0.01 to 1 Hz 1 to 60 degrees 0.01 to 0.50 s 0.01 to 0.1 Hz 0.01 to 32 s
	Tolerances 　Pick-up value 　Time 　Reset time		< 5% ± 1% of set value or ≤ 10 ms < 15 ms
Event recording	Measured values Starts recording on Recording duration		V_1, V_2 Fault detection, binary input – 100 ms to 1400 ms (at 50 Hz)
Additional functions	On-line display of 　Voltage/frequency 　Tolerance		V_1, V_2 / f_1, f_2 ≤ 2% of corresponding rated value

Selection and ordering data

Digital auto-reclose/check-synchronism relay	Order No.
	7VK51 ☐☐ – ☐☐ A0 ☐-0 ☐
	▲ ▲ ▲ ▲ ▲ ▲
Auto-reclose function	
With only 3-pole auto-reclose function	1
With 1 and 3-pole auto-reclose function	2
Check-synchronism function	
Without check-synchronism function	1
With check-synchronism function (only with 7VK512)	2
Rated auxiliary supply voltage U_H for the built-in DC/DC converter	
24/48 V DC	2
60/110/125 V DC	4
220/250 V DC	5
Constuction	
For panel surface mounting	B
For panel flush mounting/cubicle mounting	C
Real-time clock, non-volatile annunciation memory	
Without	0
With	1
Serial interface (for coupling to LSA systems)	
Without serial interface	A
With serial interface for fibre optic connection	C

6

All signal relays
freely selectable

eg.
to circuit breaker
close coil

All command relays
freely selectable

| 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 |
| 8D3 | 8D2 | 8D1 | 7D3 | 7D2 | 7D1 | 6D3 | 6D2 | 6D1 | 5D3 | 5D2 | 5D1 | 7D4 | 8D4 | 6D4 | 3C1 | 14C1 | 3C1 | 3C2 | 4C2 | 2C2 | 3C3 | 4C3 | 2C3 | 3C4 | 4C4 | 2C4 |

| 12 | 27 | 28 | 13 | 14 | 29 | 15 | 30 |
| 8C1 | 8C3 | 8C4 | 8C2 | 7C1 | 7C3 | 7C4 | 7C2 |

5C3

Signal contact 1
Signal contact 2
Signal contact 3
Signal contact 4
Signal contact 5
Signal contact 6
Signal contact 7
Signal contact 8
Signal contact 9

Command relay 1
Command relay 2

Fibre optic interface

7VK511

Version for panel surface mounting
Version for panel flush mounting / cubicle mounting

Binary input 1
Binary input 2
Binary input 3
Binary input 4
Binary input 5
Binary input 6

| 3D1 | 3D2 | 3D3 | 3D4 | 2D1 | 2D2 | 2D3 | 2D4 | 1D1 | 1D2 | 1D3 | 1D4 |
| 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 8 | 9 |

4D1	4D2
L+	L−
10	11

Power supply

5C1

16

3/S0268/014
R–2783

Inputs from plant
and circuit breaker

All inputs freely
selectable

L1 L2 L3

L1
L2
L3

Close coil
From command relay 1

Trip coil

Trip from protection relay

Fig. 2
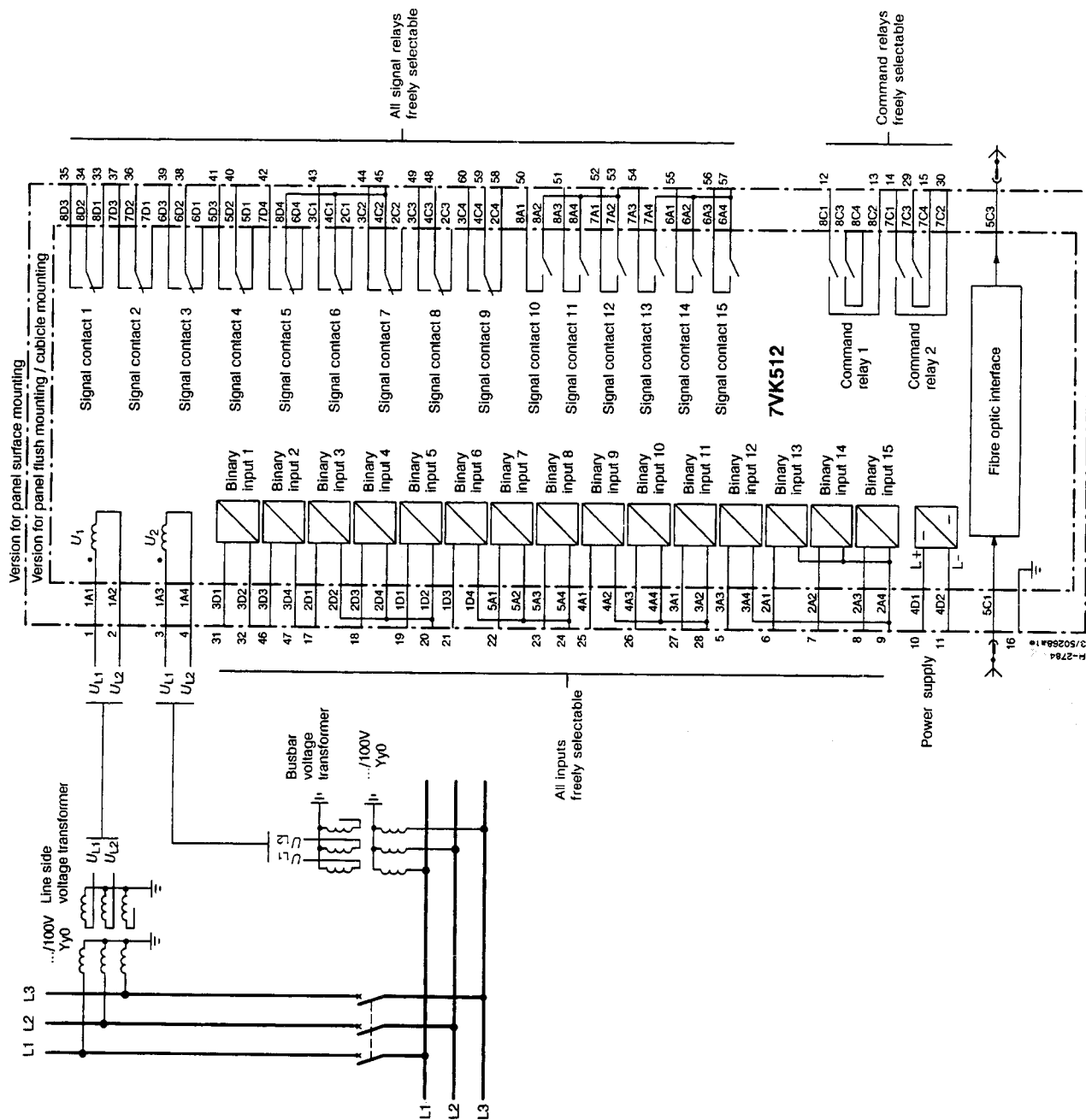Connection diagram for digital auto-reclose relay 7VK511 (3-pole without check-synchronism)

Fig. 3
Connection diagram for digital auto-reclose/check-synchronism relay 7VK512 (1 and 3-pole)
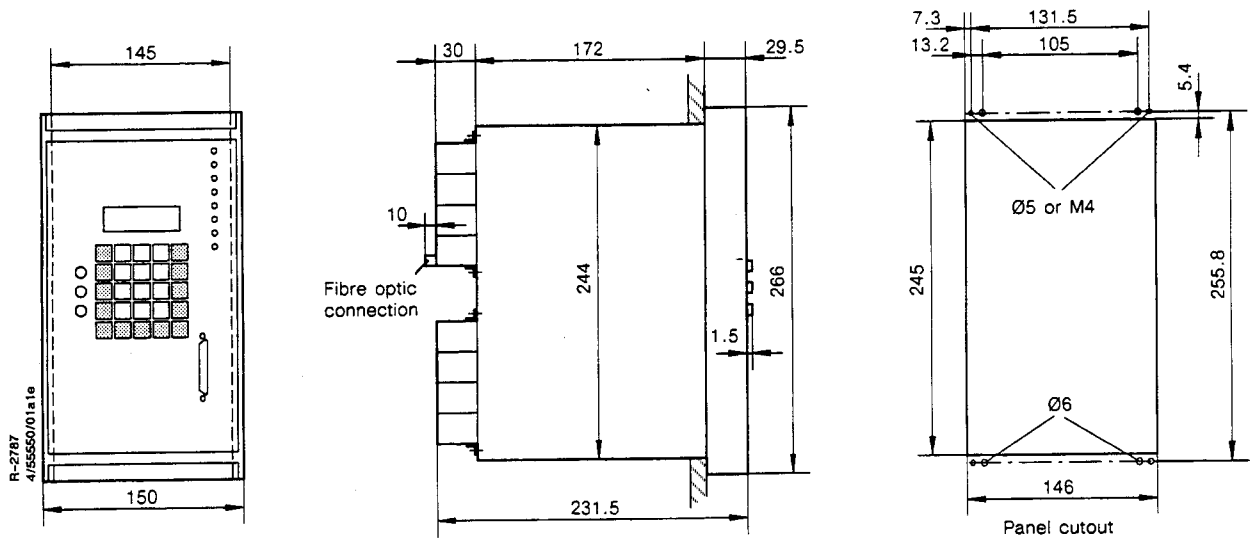
Dimension drawings (in mm)

Fig. 4
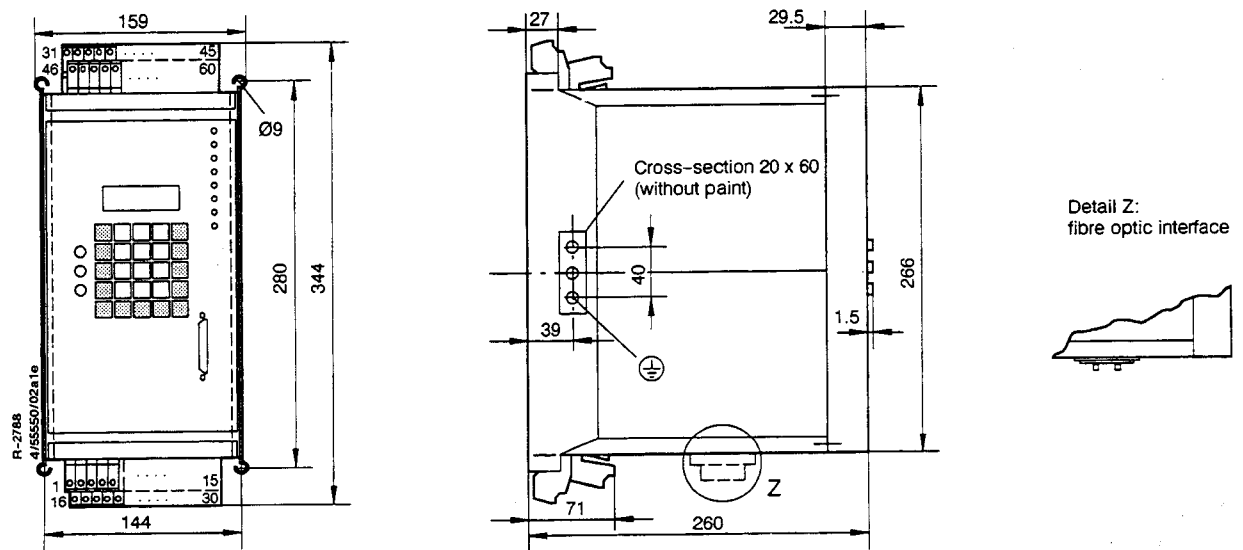7VK51 with housing 7XP2030-2 (for panel flush mounting/cubicle mounting)

Detail Z:
fibre optic interface

Fig. 5
7VK51 with housing 7XP2030-1 (for panel surface mounting with two-tier terminals)

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Conditions of Sale and Delivery

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