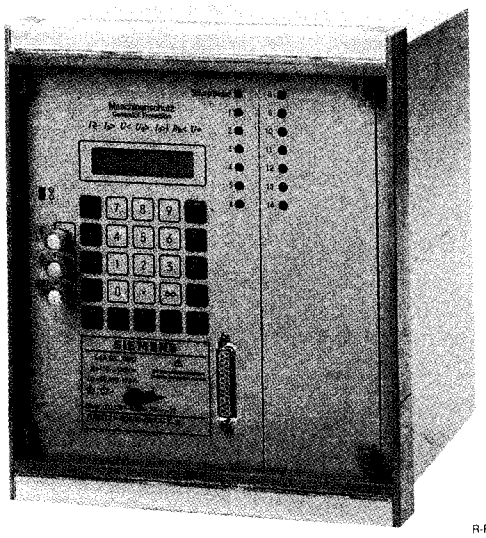
SIEMENS

Generator protection relay 7UM512



R-R2.2-001

Fig. 1
Generator protection relay 7UM512

Application

The 7UM512 is a digital generator protection relay that incorporates specific protection functions for medium and large scale high-voltage generators. Although it can be applied on its own, it supplements the protection functions of the basic device 7UM511. The combination of these 2 devices along with the differential protection 7UT51 will, for example, provide, within the usual scope, the complete protection for industrial machines, medium-sized hydro-generators as well as for generators in thermal plants.

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 option
- 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 50 screw terminals accessible from the front.

Implemented functions/features

The following standard functions are implemented:

- Definite-time overcurrent protection
- Overcurrent/undercurrent protection
- Unbalanced load protection (negative phase sequence)
- Overvoltage/undervoltage protection
- Stator earth-fault protection (residual voltage or directional residual current detection)
- Rotor earth-fault protection, two-stage.

With the application of a powerful microprocessor and filtering and processing of digital values, the influence of starting and load currents, high frequency transients, transient DC current components and differing CT saturation can be suppressed to a large degree.

To ensure the operational readiness and correct measurement during frequency deviations (starts and stops) the device independently controls the sampling rate for the frequency range from 6 to 70 Hz.

Serial interface

The service interface on the front can be used for connecting a PC. An additional isolated interface is provided for coupling to the substation control system LSA 678 or a protection central device.

A service program DIGSI is available for AT-compatible PCs.

Settings

All the settings can be input by means of the integrated operator panel and display field or a PC under user control. The settings are stored in a non-volatile memory, so that they cannot get lost even during interruption of the supply voltage.

Self diagnostics

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

Definite-time overcurrent protection

This protection function is normally used as back-up short-circuit protection where the primary protection consists of differential or distance protection. The chosen algorithms ensure that the device is immune to harmonic currents and saturation of the primary CTs.

An additional feature is the option of maintaining the excitation by means of an undervoltage setting when the voltage collapses sufficiently after a short-circuit (close-up faults). In the case of generators with self-excitation taken off their own terminals the short-circuit current drops below the overcurrent threshold within a few seconds. The undervoltage function referred to must maintain the excitation in this case.

The possibility exists to provide the undervoltage criterium for the maintenance of the excitation as a binary input from an external device.

For this purpose, for example, the undervoltage function of the 7UM511 can be used, which monitors the positive-sequence component of the voltage.

The latching by the undervoltage function is reset automatically after the retention time has elapsed.

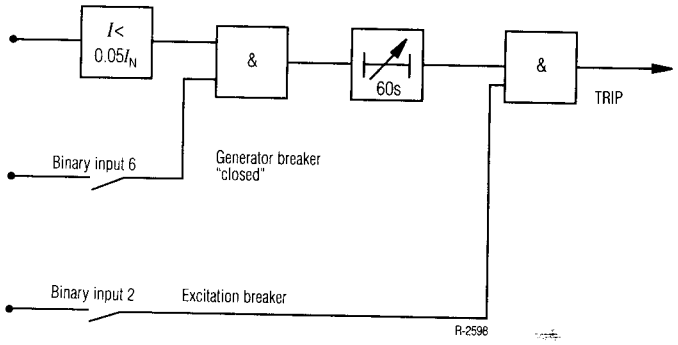


Fig. 2
Example: Automatic shutdown of idling generator

Overcurrent/undercurrent protection

There are multiple applications for this function. Disconnected, interrupted lines or small load currents are recognized. It can likewise be used to indicate certain operating conditions. A simplified breaker failure protection can also be implemented with this function.

This current function can be combined with a binary input using a logical AND respectively OR function. Thus dependence on other protection functions may be realized (for examples refer to Fig. 2 and Fig. 3).

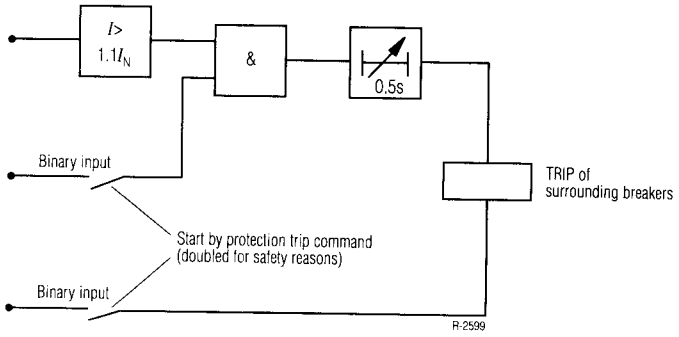


Fig. 3
Example: Circuit-breaker failure protection

Unbalanced load protection

This protection function recognizes the unsymmetrical loading of three-phase machines. The unit's functioning is based on symmetrical component resolution and only evaluates the negative-phase sequence component of the current.

A sensitive alarm stage $I_2>$ and a coarse stage $I_2\gg$ are provided as settings. In addition, the negative-phase sequence component of the current is fed into a thermal replica where the relevant rise in temperature of the generator rotor surface can be modelled (Fig. 4). For alarm purposes an alarm relay may be set to operate before the tripping characteristic of the thermal replica is reached.

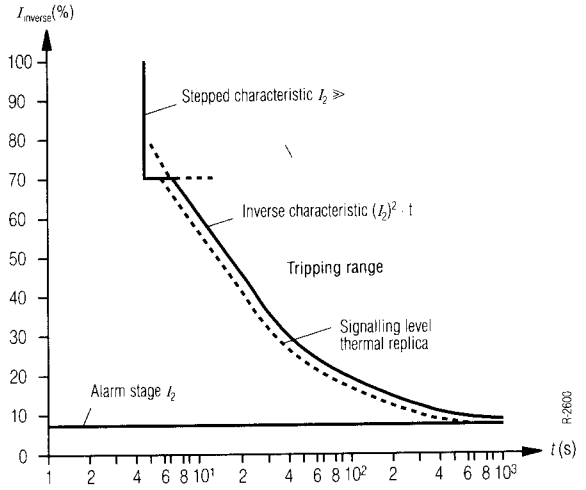


Fig. 4
Unbalanced load protection

Overvoltage/undervoltage protection (can be combined with frequency)

This protection function can, for example, be used as undervoltage protection in industrial networks (islanding) with self-generation.

A severe fault is characterized by a voltage drop and/or a drop in frequency. As long as full voltage is present, no danger exists for the plant and the consumers are not disrupted up to this point of time.

Motors will even keep running after a slight voltage reduction. The threshold torque for induction motors is in most cases 2 to 2.5 times the nominal torque. It is reduced with the square of the voltage.

Only when the voltage is below 60 to 70 % of the nominal voltage, the motor torque drops below its nominal value and the motor starts pole slipping. Thus, a voltage of 60 to 70 % of the nominal voltage is a critical threshold in all plants. Load shedding relays have a voltage setting in this range.

A drop in frequency is a second important indicator for the plant that it is threatened by a shortage of energy. This can, for example, take place when the transmission network fails and the plant's energy requirements cannot be met by self-generation. In this case, the voltage regulator of the own machine will attempt to maintain the voltage. Since the power is not sufficient, the frequency will drop even though the voltage may be maintained.

These two indicators of a system fault, a drop in voltage and/or frequency, can be advantageously combined in one measuring function.

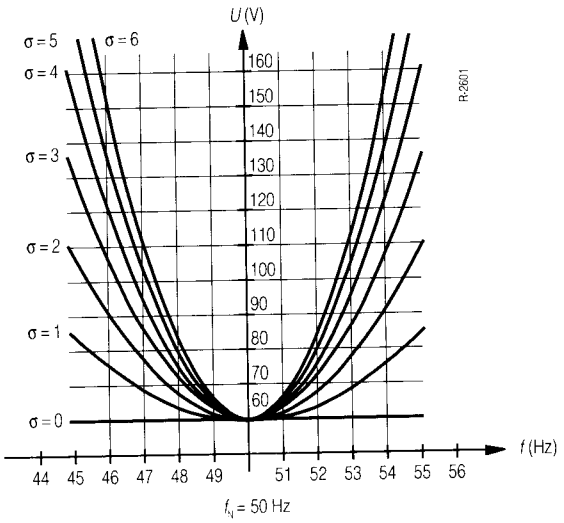


Fig. 5
Frequency-dependent undervoltage function

Fig. 5 shows the collection of settable curves. If characteristic $\sigma = 0$ is selected, only horizontal tendencies are taken into account, i. e. the device reacts only to the set undervoltage threshold independently of the frequency.

When the collection of curves for $\sigma = 1$ to 6 is selected, the protection becomes frequency-dependent. This corresponds to the increasing threat to operating stability in case of frequency deviation.

Characteristic $\sigma = 3$ can be taken as standard. (When the nominal frequency is set to 60 Hz, the characteristic curves are shifted accordingly to the range of 55 to 63 Hz).

This protection function may optionally be set as overvoltage protection. In this case, a frequency-dependent setting would not make sense. Therefore, when using overvoltage protection, the only voltage setting possibility is $U> (\sigma = 0)$.

Generator protection relay 7UM512

Technical data

Pick-up tolerances under rated conditions according to VDE 0435	Current values Voltage values Unbalanced load	≤ 3 % of set value ≤ 3 % of set value ≤ 5 % of set value
	Thermal replica Rotor earth resistance in the range up to $R_E \leq 10\,k\Omega$ DC voltage	≤ 5 % ≤ 10 % ≤ 3 %
	Time values Frequency	≤ 1 % or 10 ms ≤ 100 mHz
Operational measurement	Display of values for – current – voltage – rotor earth resistance	 IL1, IL2, IL3, I0, IRE UL1-L2, U0, URE RE
	– frequency – DC voltage – unbalanced load	F U = I2, I2 thermal replica, 5th harmonic content
Contacts	Potential-free trip contacts Switching capacity Make Break Permitted current, continuous 0.5 s	2 NO (total of 5 trip relays) 1000 W/VA 30 W/VA 5 A 30 A
	Switching voltage	250 V DC
	Alarm contacts Switching capacity Make/Break Permitted current Switching voltage	total of 13 alarm relays 20 W/VA 1 A 250 V DC
Displays	LED displays at the front of the unit	16
Inputs	Optocoupler, for 24 to 250 V DC operating voltage (interference suppression and pick-up threshold in auxiliary unit, Order No. 7XR84 00-0)	6
	Current consumption independent of voltage range	approx. 2.5 mA
Construction of unit	For panel surface mounting Weight approx.	Order No. 7XP20 40-1 11.5 kg
	For panel flush mounting, cubicle mounting Weight approx.	Order No. 7XP20 40-2 10 kg
	Degree of protection acc. to DIN 40 050	IP51

Selection and ordering data

Generator protection module	Order No. **7UM512 □ - □□ A00-0 □**
Rated current at 50 to 60 Hz, 100 to 125 V AC 1 A 5 A	 **1** **5**
Rated auxiliary voltage 24 V, 48 V DC 60 V, 110 V, 125 V DC 220 V, 250 V DC	 **2** **4** **5**
Construction Panel surface mounting Panel flush mounting or cubicle mounting	 **B** **C**
Serial interface Isolated, hard-wired Integrated optical fibre connection	 **B** **C**

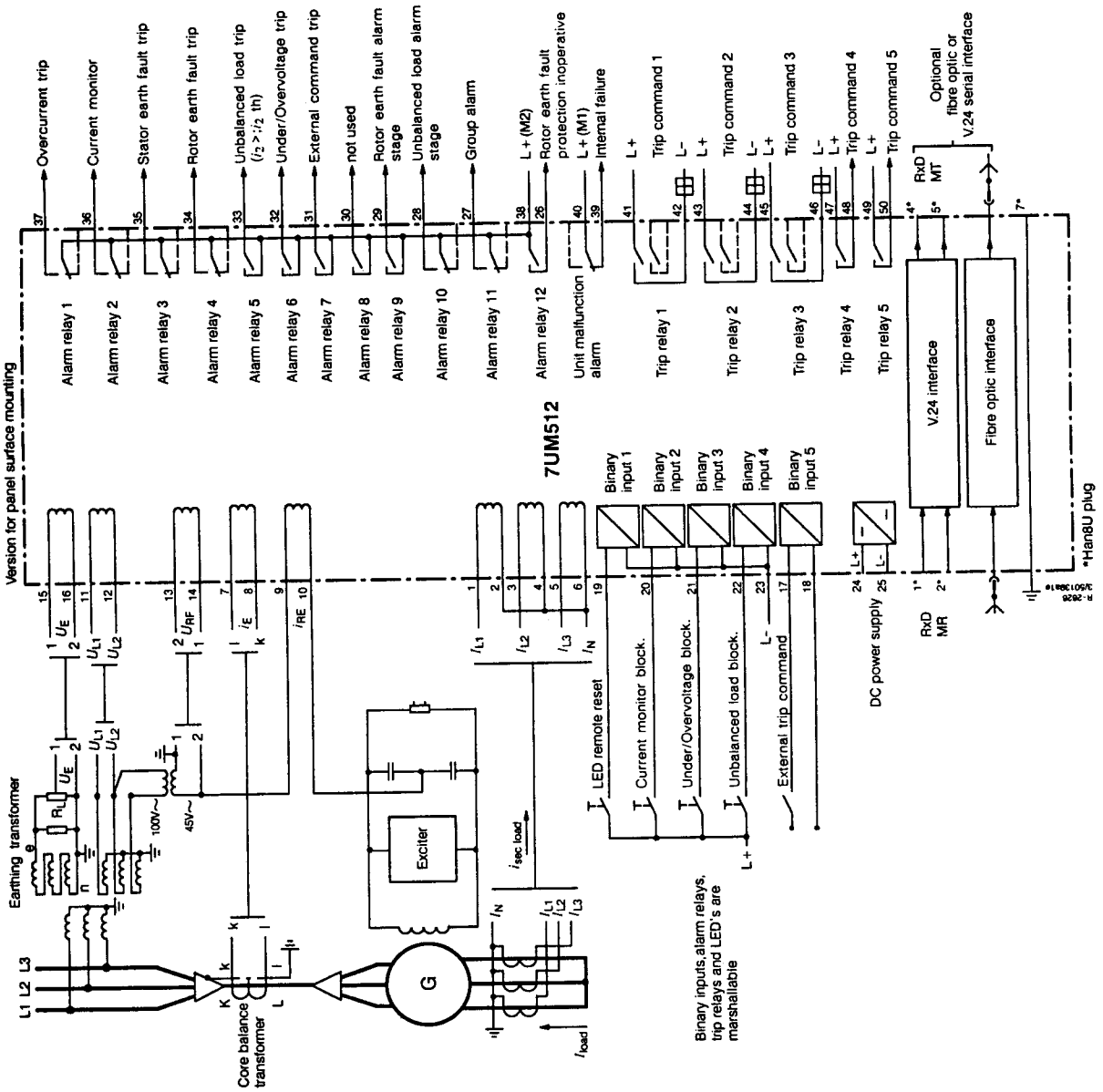


Fig. 6
Version for panel surface mounting

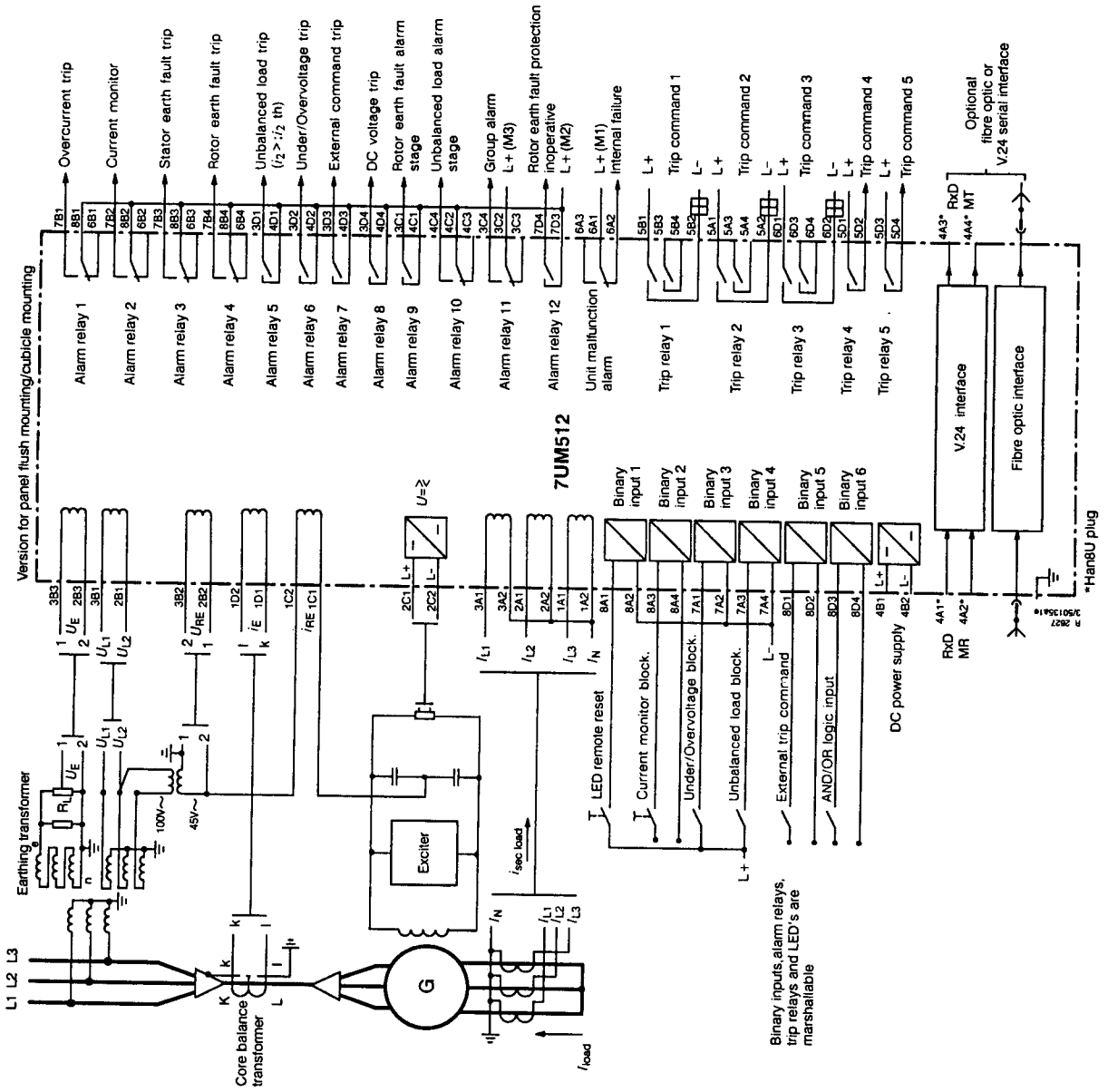


Fig. 7
Version for panel flush mounting, cubicle mounting

Dimension drawings in mm

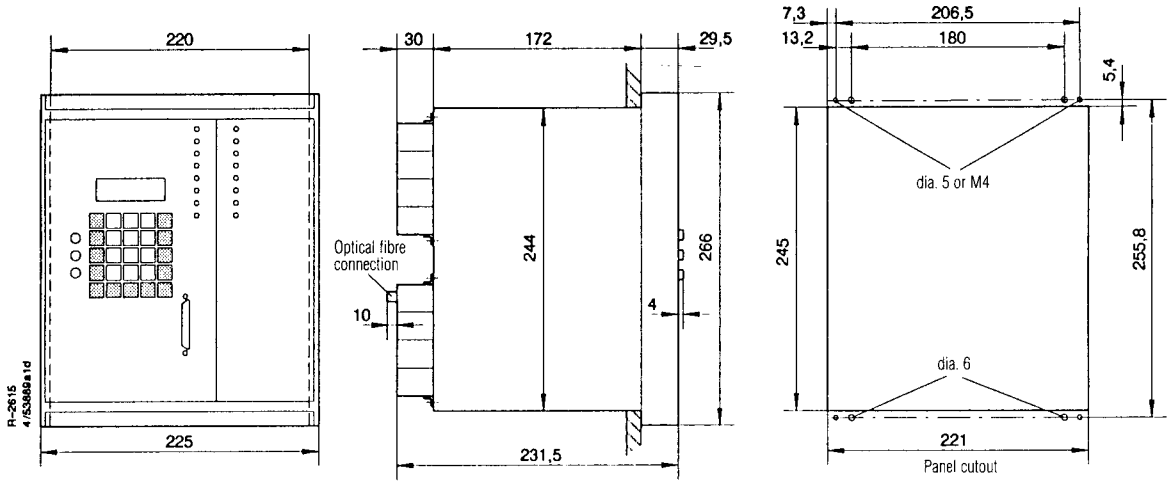


Fig. 8
Panel flush mounting, cubicle mounting

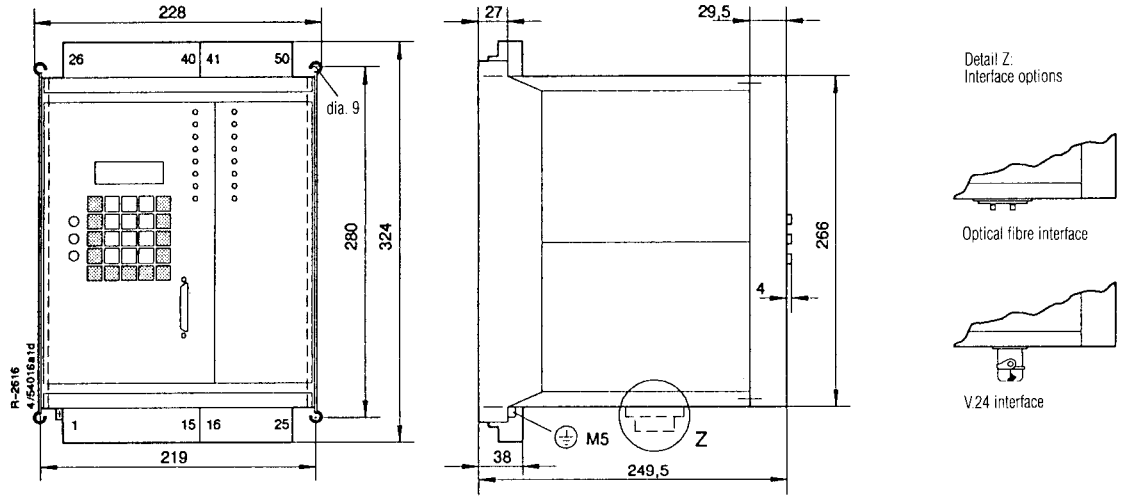


Fig. 9
Panel surface mounting

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