

GENERATION & NETWORK

Digital Protections with Autoreclose Facilities for Distribution Systems

RMSR7000



PROCOM

The optimum performance of electrical power systems depends particularly upon the reliability and the availability of the protection, measuring and automation devices and the ability shown by these devices to communicate the information in their possession.

PROCOM, CEE's modular system, satisfies these criteria by providing the possibility of using either separately or in an integrated system all of the intelligent functions of an electrical cubicle: Protection, Measurement, Automation, Communication.

CEE's exceptional experience in the fields of powers systems protection using static relays (more than 400,000 units in operation throughout the world) enabled our engineers to define, develop and manufacture PROCOM to the standards of quality and concepts of technical innovation which have been the foundation of CEE's reputation over the past 30 years.

PRINCIPLES AND APPLICATIONS

The function of the devices in the RMSR7900 series is to provide protection to three-phase electrical distribution networks against any form of short circuit between phases or between phase and earth. They are modular in design and can be fully integrated into the PROCOM structure, or just as easily be used entirely independently in any other classical protection scheme.

PRINCIPLE OF MEASUREMENT

Using microprocessor technology, the RMSR7900 devices operate on the principle of sampling the applied signals to calculate their respective modules and phase angles. The resulting numerical filtering enables the third harmonic component of the earth fault current to be eliminated.

For this reason, they carry out separate measurements of the three phase currents, the residual current and the residual voltage. They incorporate two current operating levels with wide setting ranges:

- The “low-set” level with a multicurve type of operating characteristic, which can be programmed on site, choosing between inverse time, very inverse time, extremely inverse time or definite (independent) time types.
- The “high-set” level, which has a definite (independent) time characteristic.

Independent settings and characteristic curve selection can be made for the earth-fault unit and for the overcurrent unit.

APPLICATIONS

The RMSR7991 meets the technical requirements of radial outgoing feeder protection in distribution networks.

To complement the traditional three-phase overcurrent protection, the RMSR7991 makes use of a sensitive earth-fault unit and integrated auto reclose device to reduce supply interruption times resulting from transient faults.

- **Automatic reclose function**

Where the distribution network incorporates overhead lines, the “reclose” function is generally activated.

The reclose cycles (trip, interruption “dead” time, close) are activated upon the detection of phase and/or earth faults as selected by the operator who can, in addition, use the high set overcurrent and earth fault threshold levels. (The high set earth fault level is not normally used for this function). The number of reclose cycles is adjustable up to 4.

This comprises:

- 0 or 1 rapid cycle (short interruption time)
- followed by 0 to 3 slow cycles (long interruption time)
- followed by one final “lock-out” trip.

The trip commands are time-delayed when only the low set overcurrent and/or low set earth fault are involved in the fault, or, if the case arises, instantaneous when the high set levels are exceeded (as in the rapid cycle).

The interruption (“dead”) time of each cycle is programmable. Each cycle is blocked for 10 seconds after a closing command which results in circuit breaker closing, ordered by this cycle or any other successive cycle.

The temporary block is also active following the manual operation of the circuit breaker.

If a fault arises during one of these temporary blocking periods, the period is extended by the duration of the fault. The reclose function is safeguarded by monitoring information relating to the position of the circuit-breaker (circuit breaker auxiliary contacts), its service position (plugged in...) and any fault conditions (SF6 pressure, or others...). In addition, the “reclose” function can be blocked by an external switch.

- **Earth-fault (zero sequence) unit**

The protection provided by the earth fault unit is adaptable to all neutral earthing systems and to all types of network (overhead lines or underground cables).

In fact, the operator can select a non directional mode of operation using I_0 current measurement or a directional mode of operation using $I_0 \cos \varphi_0$ measurement or $I_0 \sin \varphi_0$ (φ_0 = phase angle between the earth fault current and voltage).

Furthermore, the RMSR7991 can be fed from the residual connection of line CTs or a core balance CT around the 3 phases.

In the case of solidly earthed or resistive earthed systems with relatively high levels of fault currents, the user will normally select the residual CT connection and the non-directional I_0 mode of operation.

In the case of an isolated or high resistance system of neutral earthing, the user will normally select a core-balance CT connection and the directional $I_0 \sin \varphi_0$ mode of operation.

Finally, in the case of Petersen coil earthing, the user will normally select a core-balance CT connection and the directional $I_0 \cos \varphi_0$ mode of operation.

The RMSR7992 is specially designed to protect incoming feeders in distribution system substations.

The protection functions in the RMSR7992 allow selective operation with all types of protection installed downstream on the outgoing feeders (inverse or definite time).

Used in conjunction with the RMSR7991, this relay can help increase the security in an electrical substation. In fact, by exchanging information with the RMSR7991 relays, the RMSR7992 can:

- Reduce the operating time for a fault on the bus-bars,
- Provide fast backup protection, in the case of the failure of a downstream circuit-breaker.

MAJOR ADVANTAGES

The RMSR7900 devices provide three main sets of advantages as follows:

Reliability and availability

The design and construction of this equipment meet the same standards of reliability and safety used by CEE for the manufacture of conventional static protection devices:

- Compliance with IEC 255 recommendations and standards,
- Mechanical, fool-proof fouling pins on cases and bases,
- Debugging and individual testing of certain critical components,
- Component selection based upon not only thermal withstand but also overvoltages considerations, etc...
- Withstand to severe environmental conditions: heat/humidity, 56 days, 40°C, 93% relative humidity.

In addition to these basic construction details, the RMSR7900 devices incorporate an automatic self-supervision system which, together with the plug-in case facility, optimises their availability.

The automatic self-supervision system intervenes at three different levels:

- Detection of loss of auxiliary supply,
- Detection of a microprocessor failure using a "watchdog",
- Detection of a breakdown in a microprocessor peripheral (such as RAM, EEPROM, etc.) by executing microdiagnostic programs.

The user is notified that the automatic self-supervision system has operated by the closure of a clean contact brought out to terminals and/or, if the case arises, by the interruption of the digital communication channel.

Power and flexibility of the communications

The RMSR7900 series communicates with the external world in three major ways:

• Local communication

Dialogue between the user and the equipment is ensured by means of a keyboard on the device itself, which may be used to set up and read back all of the quantities, recorded, calculated or measured by the RMSR7900.

An easy LED display unit enables the user to have direct readout of the electrical quantities in true primary values.

Two lamps "Alarm" and "Trip" indicate when the low set thresholds are exceeded and when a trip occurs.

• Communication by digital channels

The RMSR7900 contains RS-232-C/DB9 and current loop (0-20 mA) digital serial communication channels.

Switching to the automatic RS232 channel can be used for direct connection (either by copper wire connection or via fibre optics) to a PC (micro-computer).

The current loop sockets (0 - 20 mA) may be used to incorporate the unit into a communications network controlled by a PC or other STAT8 device*.

All data available locally, whether measured or introduced as an input, may be transmitted to a remote location. When there is an event such as the relay operating, the "rms" values of phase and earth fault (zero sequence) currents, calculated during the 3 seconds prior to the event and 2 seconds after it, are made available to the centralised system.

• Communication by "all or nothing" channels

The RMSR7900 relays are fitted with electromagnetic output units to provide self-supervision, alarm, trip or close signals:

- self-supervision = by clean contact of the "watchdog" device (unit W),
- alarm = via the operation of any of the three relays A, B, C commanded by the threshold levels, time delays or auto reclose,
- trip/close = two high closing current capacity relays E and D for circuit breaker control.

Adaptability and autonomy

As they are mounted in modular, plug-in, metallic type R cases, devices in the RMSR7900 series may be used either:

- as independent modules,
- as modules integrated into a rack incorporating conventional static relays in the 7000 series,
- as modules integrated into a rack as an element of the PROCOM system.

This flexible presentation means that the RMSR7900 devices may be easily adapted to the user's actual technical and economic requirements and can, for example, be inserted into existing schemes and installations.

The RMSR7900 autonomous and flexible nature is further reinforced by the fact that it can, without the use of special devices, be connected to a source of AC or DC auxiliary supply having a very wide operating range (38 to 250 V or 20 to 66 V).

(*Please consult us)

GENERAL CHARACTERISTICS

<p>1. Input and output quantities</p> <p>Current circuits</p> <ul style="list-style-type: none"> Rated current Burden Overload withstand Recommended current transformers, including a loop resistance of 0.1 Ω (5A) or 2 Ω (1A) <p>Residual (zero sequence) voltage circuit</p> <ul style="list-style-type: none"> Rated voltage Burden Overload withstand <p>Auxiliary voltage</p> <ul style="list-style-type: none"> Burden <p>Logic inputs</p> <ul style="list-style-type: none"> Burden <p>Output contacts</p> <ul style="list-style-type: none"> Maximum voltage Maximum continuous current Closing capacity (0.2 s) Rupturing capacity on DC (L/R = 40 ms) on AC (Cos φ = 0.4) 	<p>FN = 50 Hz or 60 Hz</p> <p>INP = 1A or 5A / IN₀ = 1A or 5A</p> <p>< 0.2VA at IN</p> <p>80 IN / 1 s - 20 IN / 3 s - 3 In perm.</p> <p>5VA 5P20</p> <p>VNo = 100/√3 V - 110/√3 V - 100/3 V - 110/3 V</p> <p>< 1 VA at 3 VNo</p> <p>3.5 VNo permanently</p> <p>20 - 66 Vac / Vdc or 38 - 250 Vac / Vdc</p> <p>approx 11 W DC - approx 18 VA AC</p> <p>< 5 mA</p> <p>600 V (D-E-W) / 250 V (A-B-C)</p> <p>5 A (D-E-W) / 2.5 A (A-B-C)</p> <p>10 A (D-E-W) / 2.5 A (A-B-C)</p> <p>50 W (1 A / 48 Vcc - 0.5 A / 110 Vcc) (D-E-W)</p> <p>25 W (0.5 A / 48 Vcc - 0.25 A / 110 Vcc) (A-B-C)</p> <p>1250 VA / I < 3 A (D-E-W)</p> <p>625 VA / I < 1.5 A (A-B-C)</p>
<p>2. Influencing quantities nominal ranges</p> <ul style="list-style-type: none"> Temperature Frequency 	<p>-10°C / +55°C</p> <p>FN ± 5 Hz</p>
<p>3. Measuring units</p> <p>Overcurrent units</p> <ul style="list-style-type: none"> Low-set unit High-set unit Accuracy <p>Earth fault units</p> <ul style="list-style-type: none"> Low-set unit High-set unit Accuracy <p>Residual (zero sequence) voltage</p> <p>Reset ratio</p> <p>Measurement unit characteristic</p> <ul style="list-style-type: none"> Operating time Reset time Overshoot 	<p>RMS of IA, IB, IC</p> <p>IP > 0.25 to 2.5 INP (0.05 INP steps)</p> <p>IP >> 0.25 to 25 INP (0.05 or 0.5 INP steps)</p> <p>5% of the setting value with a minimum of 5% INP</p> <p>RMS of I_o or I_o Cos φ₀ or I_o Sin φ₀</p> <p>I_o > 0.01 to 0.1 IN_o (0.01 IN_o steps)</p> <p>I_o >> 0.01 to 1 IN_o (0.01 or 0.1 IN_o steps)</p> <p>5% of the setting value with a minimum 5% INP</p> <p>RMS of V_o voltage</p> <p>V_o < 0.01 to 0.2 VNo</p> <p>95% ± 3%</p> <p>Using D output unit and injected current = 2 times the setting</p> <p>70 ms ± 15 ms</p> <p>< 50 ms</p> <p>< 40 ms</p>
<p>4. Time delays</p> <p>Low set protection TP> / To></p> <p>Characteristics curves</p> <ul style="list-style-type: none"> Independent (definite) time CT Dependent (inverse) time <ul style="list-style-type: none"> inverse NI very inverse VI extremely inverse EI 	<p>0.1 - 3 s (0.05 s steps) for dependent (inverse) time - at 10 times the setting</p> <p>0.1 - 99.5 s (0.05 or 0.25 s steps) for independent (definite) time</p> <p>according to IEC 255-4</p> $t = \frac{T}{(I/I >)^\alpha - 1}$ <p>T = 0.047 s α = 0.02</p> <p>T = 9 α = 1</p> <p>T = 99 α = 2</p>

GENERAL CHARACTERISTICS

High-set unit protection TP>> / To>>	0.1-99.5s (0.05 or 0.5 s steps) definite time
Accuracy	5% or ± 30 ms
Accelerated trip (RMSR7992) T>> ACC	7.5% or ± 30 ms for the extremely inverse curve
Trip in progress (RMSR7992) Temerg	0.1 - 0.3 s (0.05 s steps)
5. Automatic reclose	
Selection	on phase and/or earth faults 0 or 1 rapid cycle (trip, dead time, close), followed by 0 to 3 slow cycles (trip, dead time, close), followed by a trip and lock-out
Rapid cycles	
• Tripping	IP> : delayed by TPF lo> : delayed by ToF IP>> : if routed to unit D lo>> : if routed to unit D
• Time delays	delay TPF : 0 to 1 s in 0.05 s step ToF : 0 to 1 s in 0.05 s step dead time TF : 0.2 s to 1 s in 0.1 s step
Slow cycles	
• Tripping	TP> : with a maximum of TPS To> : with a maximum of ToS TP>> : if routed to unit D To>> : if routed to unit D
• Time delays	delay TPS : 0.5 to 5 s in 0.25 s step ToS: 0.5 to 5 s in 0.25 s step dead time TS : 2 to 100 s in 1 s step
Blocking	10 s fixed, following each cycle or manual operation of the circuit breaker
Accuracy	5%
6. Communication - Supervision	
• Local indications and displays	2x8 characters LED display, indicating settings and type of fault: ."Alarm" lamp signalling the passage of an IP > or lo> setting. ."Trip" hand reset lamp signalling a trip due to a fault.
• Digital communication	. Protocol: on demand Master/Slave to J-BUS or other standards. . Speed: 1200, 2400 or 4800 Bauds . Support: current loop 0-20mA at the rear, DB9/RS232-C at the front.
• Supervision	. "Watchdog" output from a relay energised in the quiescent state (contact open), resets in the event of an abnormal condition (contact closed) interrupting the current loop link.
7. Insulation to IEC 255-5	
• Dielectric withstand all terminals together/frame and between galvanically isolated groups DB/RS 232-C socket	2 kV - 50 / 60 Hz - 1 min 500 V - 50 / 60 Hz - 1 min
• Insulation resistance at 500 V	> 10 000 M Ω
• Impulse voltage withstand (except DB9 socket)	5 kV - 1.2/50 μ s
8. High frequency disturbance withstand to IEC 255-22-1 (except DB9)	2.5 kV and 1 kV - 1 MHz class III
9. Case	R4
10. Weight	4.5 kg approx.
11. Identifying drawings	RMSR7991 : 13A2 RMSR7992 : 13A3

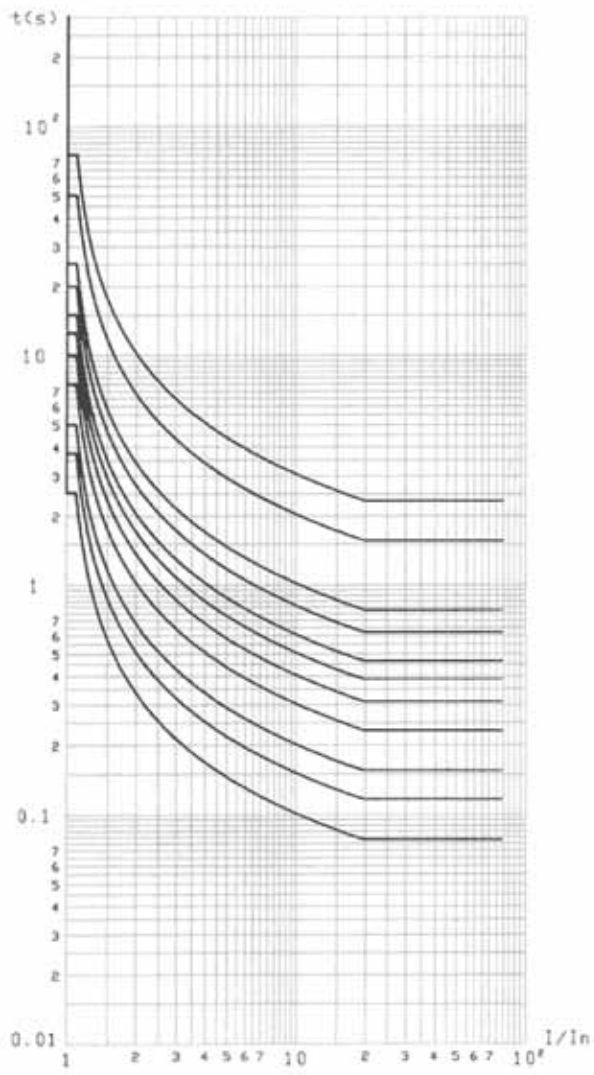


Fig. 1 - Inverse time curves to IEC 255-4

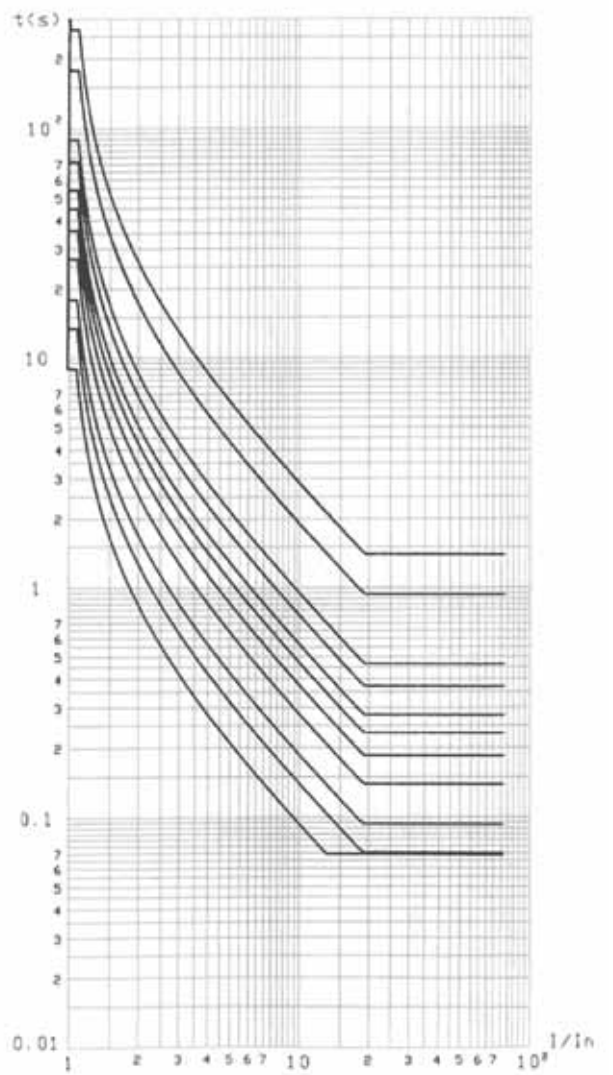


Fig. 2 - Very inverse time curves to IEC 255-4

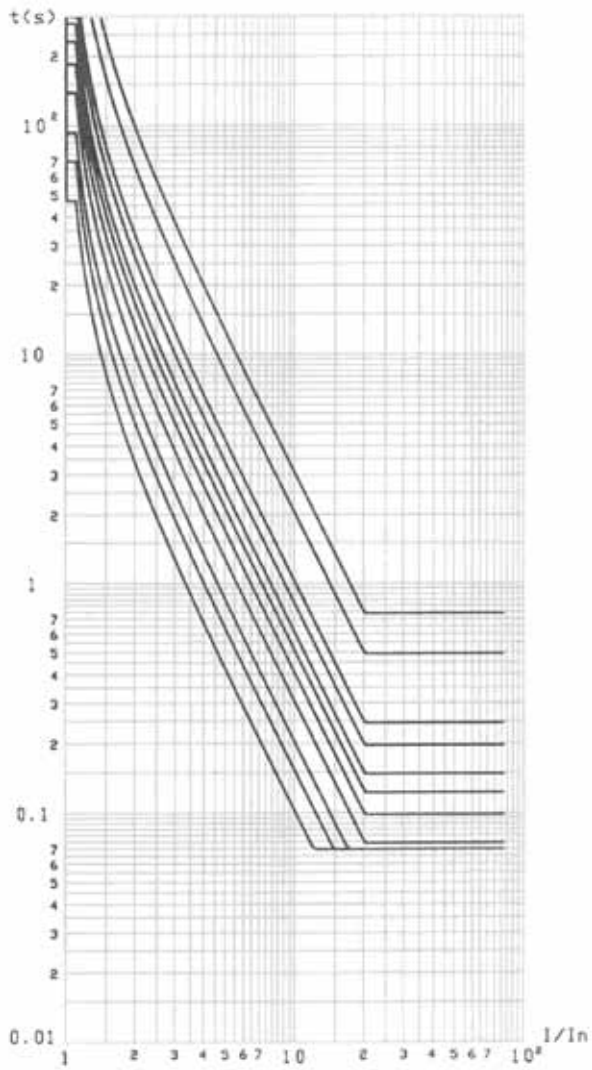


Fig. 3 - Extremely inverse time curves to IEC 255-4

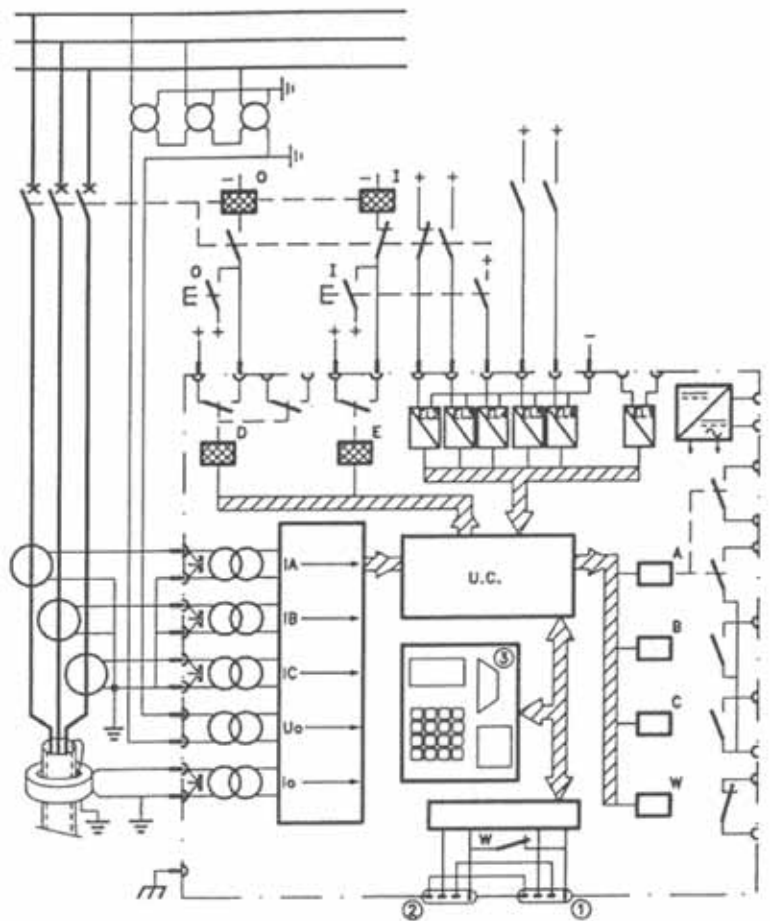


Fig. 4 - RMSR7991 Example of simplified and connection diagram

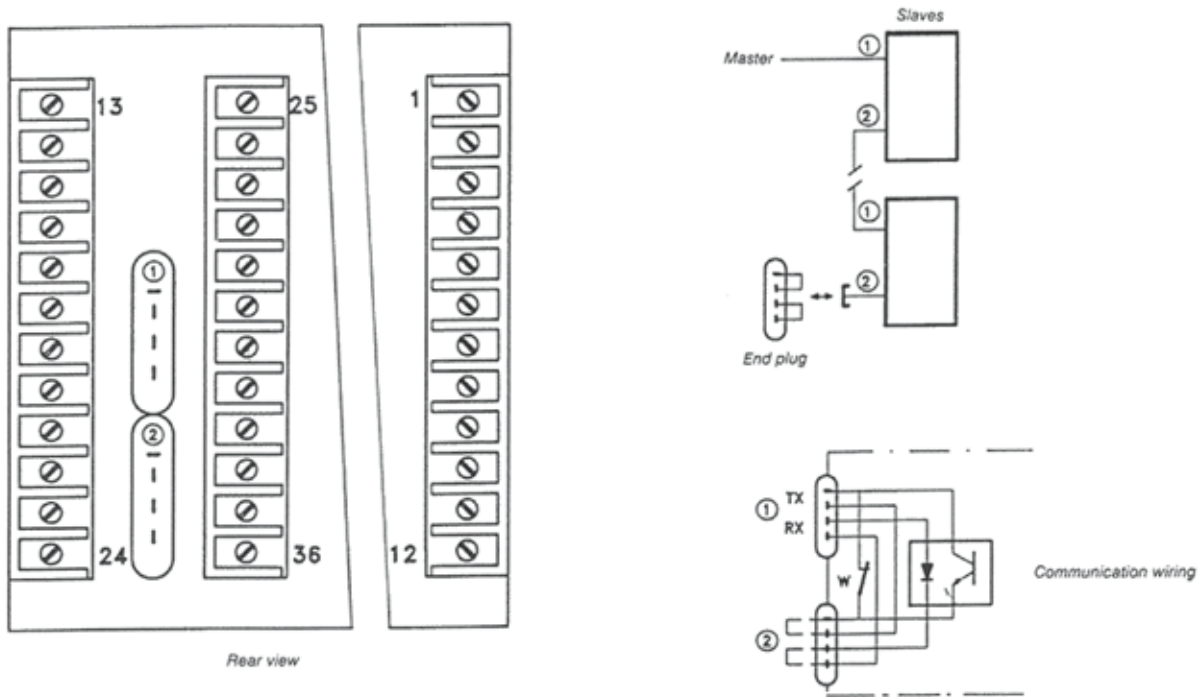


Fig. 5 - Communication diagram

CASE TYPE R4

		projecting front connection	projecting rear connection	flush rear connection
CASE DIMENSIONS	CONNECTING SCREWS Ø M4			
R4	CASE DIMENSIONS			
	DRILLING AND CUT OUT			

The specifications and drawings given are subject to change and are not binding unless confirmed by our specialists.