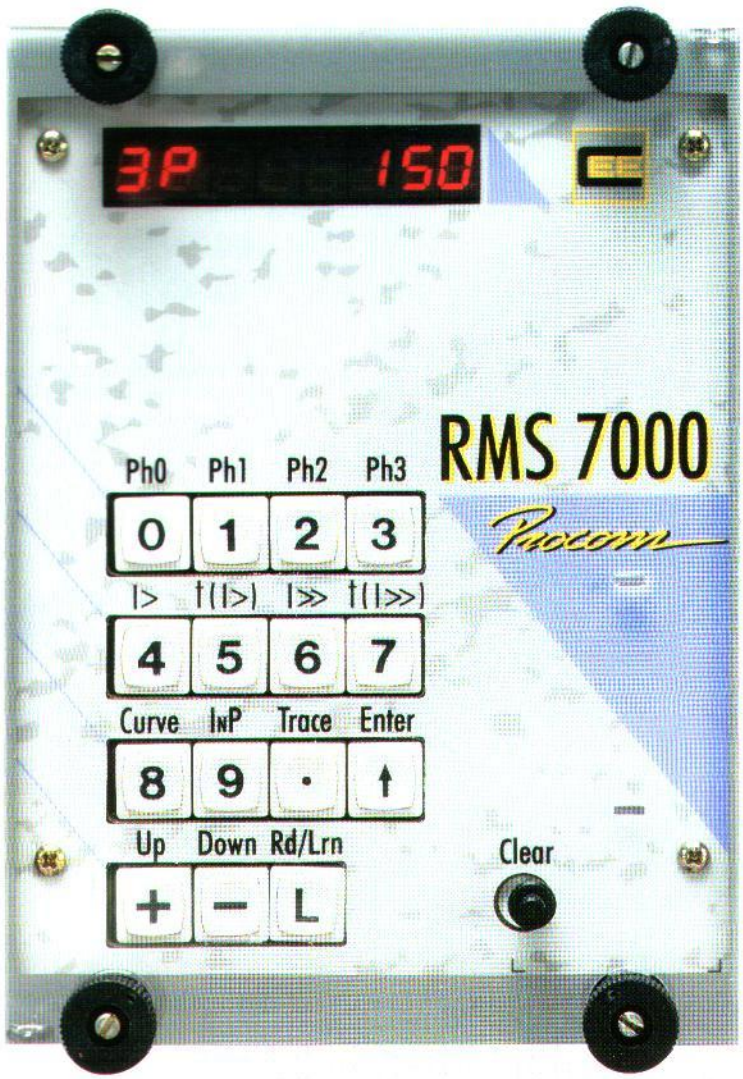
RMS/RMST 7000

Procom



DIGITAL MULTICURVE R.M.S. OVERCURRENT PROTECTIONS

The ultimate in power network supervision

Digital multicurve r.m.s. overcurrent relay with communications capability RMS/RMST 7992

PROCOM

The optimum operation of an electrical network depends particularly on the reliability and the avaibility of the protection, measuring and automation devices, and the manner in which these devices can communicate the information in their possession.
PROCOM, CEE's new 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 field of network 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 object of devices in the RMS 7992 series is to provide protection of three-phase electrical networks against any form of short-circuit between phases or between phase and earth. They are modular in design and can be totally integrated into the PROCOM structure, or just as easily they may be used entirely independently in any other classical protection scheme.
Using microprocessors and digital technology, the RMS 7992 devices operate on the principle of signal sampling and calculate the harmonic spectrum of the input currents up to the seventh harmonic using a Fast Fourier Transform (FFT).
The powerful principles and methods of measurement provide the possibility of evaluating phase by phase the harmonic "pollution" of currents in three-phase networks and establishing operating criteria on the basis of the true "rms" or root - mean - square value of the input quantities recreated by a quadratic combination of the harmonics:

$$Irms = \frac{1}{\sqrt{2}} \sqrt{I_1^2 + I_2^2 ..... + I_7^2}$$

where: I_1 represents the amplitude of the fundamental
I_2 to I_7 are the amplitudes of the harmonics.

The user also has the possibility, by on-site programming, of choosing to eliminate one or more harmonics which he considers to be undesirable. In this manner the influence of third harmonics can be eliminated from the evaluation carried out by the relay of the zero sequence component.
The RMS 7992 relays have been designed for the protection of all types of electrical power equipment, but most specifically transformers and plain feeders. For this reason they carry out 4 distinct measurements of current, the three phases and the residual. 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 the inverse time, very inverse time, extremely inverse time and definite (or independent) time types.
. the "high-set" level, which has an independent time characteristic. Settings and choice of characteristic can each be programmed independently, both on the earth-fault detection unit and on that used for phase faults.

Optionally the RMS 7992 relays may be fitted with an alarm unit "C" operating on the phase or earth fault instantaneous elements.
Also the RMST 7992 relay has a thermal image measuring unit designed for power transformer and feeder overload protection. In this relay, an alarm adjustable at a proportion of the thermal unit setting is available on the "C" output unit. This unit retains, if required, the functions of the phase or earth fault instantaneous elements of the RMS 7992.

RELAYS IN THE RMS 7992 SERIES

PROTECTION	FUNCTIONS	RELAY
Multicurve, overcurrent, 3 phases + earth fault with 2 output units + 1 optional alarm unit which may be operated by instantaneous elements I>, Io>, I>>, Io>>	I> - tI> - I>> - tI>> Io> - tIo> - Io>> tIo>> ANSI codes : [50] [51] - [50N] - [51N]	RMS 7992
Multicurve, overcurrent, 3 phases + earth fault + thermal image, with 2 output units + 1 optional alarm unit which may be operated by instantaneous elements I>, Io>, I>>, Io>> or by the thermal alarm unit	I> - tI> - I>> - tI>> Io> - tIo> - Io>> - tIo>> - tItH> - t α ItH> ANSI codes: [50] - [51] - [50N] - [51N] - [49]	RMST 7992

Major advantages

The RMS 7992 devices provide three main series of advantages as follows:

– Reliability and availability
The design and construction of these equipments respect the same standards of reliability and safety used by CEE for the manufacture of conventional static protection devices:
. conforming to the recommendations and standards of IEC 255,
. mechanical, fool-proof fouling pins on cases and bases,
. debugging and individual testing of certain critical components,
. component selection as a function not only of the thermal withstand but also of the withstand to overvoltages, etc...
. withstand to severe environmental conditions: heat/humidity - 56 days, 40°C, 93% relative humidity.

In addition to these basic construction details, the RMS 7992 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 of a microprocessor periferal (such as RAM, EEPROM, etc.) by executing microdiagnostic programs.

The user is warned of the operation of the automatic self-supervision system by the closure of a dry contact brought out to terminals and/or as required by the interruption of the digital communication channels.

— Power and flexibility of the communications

The RMS 7992 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 in memory, or those calculated or measured by the RMS 7992.
An easily readable LED display unit enables the user to have direct readout of the electrical quantities in true primary values.

Communication by digital channels

The RMS 7992 contains two digital serial communication channels of the RS-232-C/DB 25 or current loop (0 - 20 mA). The choice is at the user's disgression, simply using a switch.
*The RS-232-C/DB 25 outlet can be used for direct connection (either by galvanomic connection or via fibre optics) to a PC (microcomputer).**
The current loop terminals (0 - 20mA) may be used to incorporate the unit into a communications network controlled by a PC or other device. All data available locally, whether measured or introduced as an input, may be transmitted to a remote location if the relay operates or when the operator presses on the "Trace" key. In this way the "rms" values of the phase and zero sequence currents are made available to the centralised system.*

. Communication by "all or nothing" channels

The RMS 7992 relays are fitted with electromagnetic output units to provide supervision, alarm, trip or load shedding signals:
— supervision : by dry contact of the "watchdog" device (unit W).
— alarm : by instantaneous operation of the "C" unit, indicating that an operating level has been exceeded
. RMS 7992 : high-set or low-set unit(s)
. RMST 7992 : high-set or low-set unit(s) or thermal alarm level
— trip or load shedding: two high-power output units A and B which can directly control the power circuit breaker or contactor. Functions such as high-set, low-set, phase-fault or earth-fault are programmable to one or other unit by the user.
The operation of the relay is automatically indicated by flashing of the LED display, and a mechanical (flag) operation indicator is fitted to the "B" output unit. The phase(s) involved in the fault are indicated by the display unit.

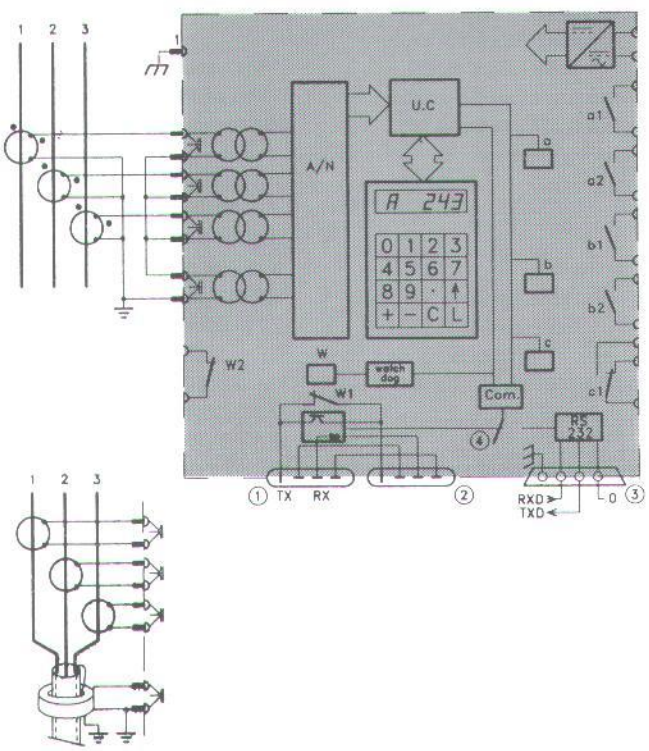
— Adaptability and autonomy

As they are mounted in modular, plug-in, metallic cases type R, devices in the RMS 7992 series may be used either:
. as independent modules
. as modules integrated into a rack cradle incorporating conventional static relays in the 7000 series
. as modules integrated into a rack cradle as an element of the PROCOM structure.
This flexible presentation means that the RMS 7992 devices may be easily adapted to the user's real technical and economic requirements and can, for example, be inserted into existing schemes and installations.
The RMS 7992's 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 range of tolerance (38 to 250V, or 20 to 66V).

** Please consult us.*

Operation

Fig. 1 - RMS 7992 - Example of simplified operation and connection diagram



General characteristics

1. Input and output quantities

• Nominal current (In)	In = 1 or 5A Fn = 50 Hz or 60 Hz
• Auxiliary supply	20 – 66 Vdc 38 – 250 Vdc or Vac 50/60 Hz
• Burden	
– on phase input circuit	< 0.2 VA at In
– on earth-fault input circuit	< 1 VA at In
– on auxiliary supply	8 W/dc, 13 VA/ac
• Recommended current transformers, including a loop resistance of 0.1 Ω (5A) or 2Ω (1A)	5VA 5P20
• Output contacts	
– Output units A and B	2NO or 1NO + 1NC or 2NC per output unit
– Output unit C	1 changeover
– Output unit W	1NC watchdog relay picked-up in normal operation
– Maximum operating voltage	600 V (A, B and W) / 250V (C)
– Maximum permanent current	5 A (A, B and W) / 2.5A (C)
– Closing current (0.2s)	10 A (A, B and W) / 5A (C)
– Rupturing capacity	
on D.C. (L/R = 40 ms)	50 W (1A/48Vdc - 0,5A/110Vdc) (A, B and W) 25 W (0.5A/48Vdc - 0.25A/110Vdc) (C)
on A.C. (Cosφ = 0.4)	1250 VA; I < 3A (A, B and W) 625 VA; I < 1.5A (C)
• WATCHDOG condition	normally picked up in the quiescent state drop out in the event of an abnormal condition.
• Mechanical operation indicator	hand-reset flag on the "B" unit.
• Signalling and display	an 8 digit LED numerical unit, giving visual output of the settings and adjustments, as well as differenciation of the types of fault.

2. Nominal ranges of the influencing factors

• Temperature	–10°/+55°C
• Frequency	Fn ± 5 Hz

3. Measurements

3.1. Overcurrent protection	
• Characteristic quantity	"rms" values of the currents
• Operating values	110% of setting (dependent time low-set units) 100% of setting (high-set and definite time low-set)
– Current ranges	
phases low-set I>	0.5 to 4 In (steps of 0.1 In)
high-set I>>	2 to 25 In (steps of 0.5 In)
zero sequence low-set Io>	0.05 to 0.4 In (CTs) (steps of 0.01 In) 5 to 40A prim. (CBCT) (steps of 1A)
high-set Io>>	0.2 to 2.5 In (CTs) (steps of 0.05 In) 20 to 250A prim. (CBCT) (steps of 5A)
– Time-delay settings (at 10 times setting for inverse time units)	
low-sets tI> - tIo>	0.1 - 3 s (see curves) (steps of 0.05 s) 3 - 30s (independent time only) (steps of 0.5s)
high-sets tI>> - tIo>>	0.1 - 3 s (steps of 0.05s)
• Resetting value	approx. 95% for all units
• Overshoot	< 40 ms
• Overload withstand on inputs	
– phases	80 In/1s - 20 In/3s - 3 In permanent
– zero sequence	40 In/1s - In permanent
• Precision	
– operating level	5% of level value with 5% of In min.
– time-delay	5% or ± 30 ms 7.5% or ± 30 ms for extremely inverse curve
3.2. Thermal protection (RMST 7992)	
• Characteristic quantity	"rms" values of the currents
• Time/current characteristic	thermal image per phase

General characteristics (continued)

• Thermal levels thermal level Ith> thermal alarm level α Ith>	 0.5 to 1.2 In (steps of 0.05 In) 0.8 to 1 Ith (steps of 0.05 Ith)
• Operating level of the thermal unit k	1.07 times the displayed level Ith (corresponds to a thermal state of 114% of the operating level)
• Resetting values	approx. 95%
• Time constant setting	4 to 180 min. (steps of 1 min.)
• Operating time of the thermal unit	according to cold and hot characteristic curves (figure 5)
• Thermal state	in %V of the nominal thermal state, may be displayed on each phase
• Precision – operating levels – time delays	 5% of setting with 5% of In min. 10% for I = 2 Ith

4. Curves

4.1. Overcurrent protection
- independent time : according to IEC 255-4
- inverse (see figure 2)
- very inverse (see figure 3)
- extremely inverse (see figure 4)

$$t(s) = \frac{T}{[I/I>]\alpha - 1} \times \text{setting } t(I>)$$

$T = 0.0466 \quad \alpha = 0.02$
$T = 9 \quad \alpha = 1$
$T = 100 \quad \alpha = 2$

4.2. Thermal protection (RSMT 7992)
- Operating curves according to IEC 255-8 (see figure 5)

$$t(s) = \tau \, Ln \frac{(I/Ith)^2 - (Ip/Ith)^2}{(I/Ith)^2 - k^2}$$

with
τ = time constant in seconds
I = measured current
Ith = relay current setting
Ip = prior loading current
k = relay operating level (fixed and egal to 1.07 Ith)

5. Digital communication

• Support	2 switchable channels, each equipped with outputs – current loop / 0-20 mA – DB 25 / RS-232-C
• Information exchange protocol	Master/Slave, as required J.BUS or other standard
• Programmable operating speed	1200 Baud or 2400 Baud or 4800 Baud

6. Insulation to IEC 255-5

• Dielectric withstand all terminals together/frame and between galvanically isolated groups DB 25/RS 232 output	 2 kV-50/60 Hz-1 mn 500V-50/60 Hz-1 mn
• Insulation resistance at 500 V	> 10.000 MΩ
• Impulse voltage withstand (except DB 25/RS-232-C socket)	5 kV-1.2 / 50 µs

7. High frequency disturbance withstand to IEC 255-22-1 (except DB 25/RS-232-C socket) — 2.5 kV and 1 kV 1 MHz class III

8. Case — R3

9. Weight — 3.9 kg

10. Identifying drawings — 08A5 : RMS 7992
10A3 : RMST 7992

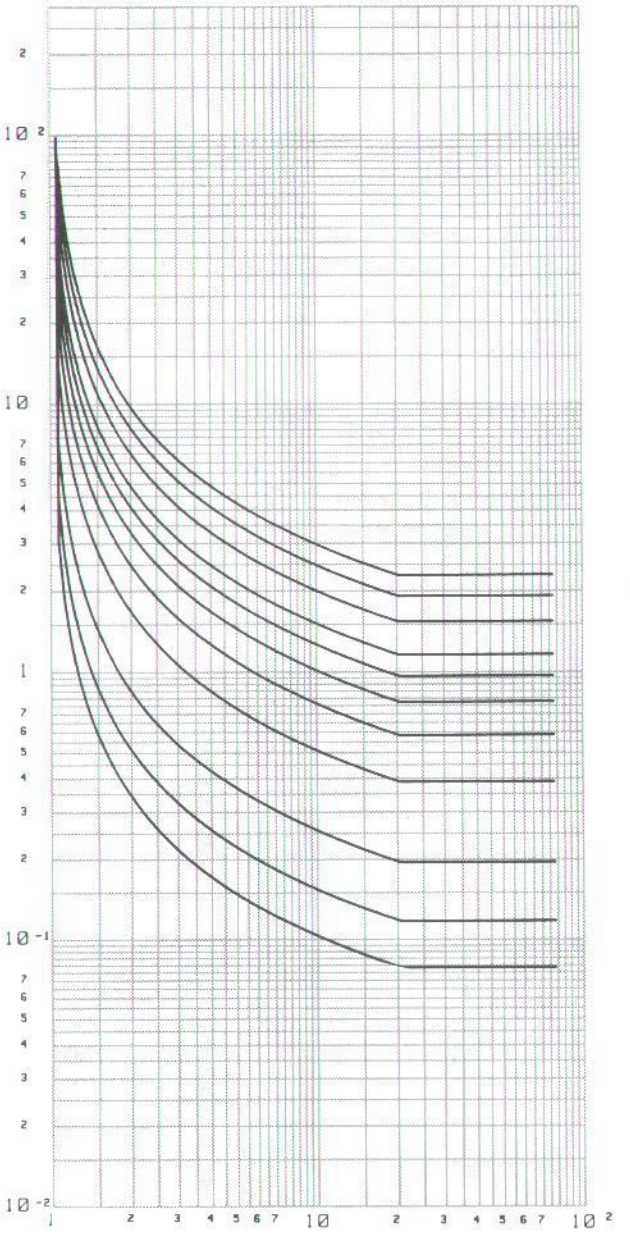


Fig. 2 - RMS 7992 - Inverse time curves to IEC 255-4

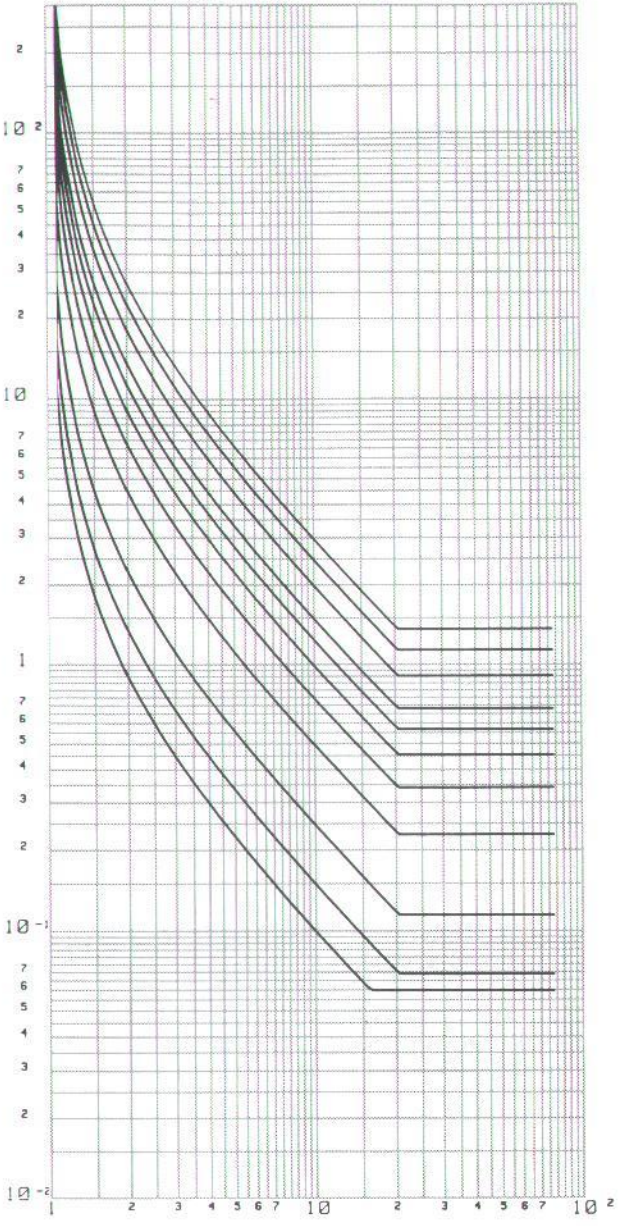


Fig. 3 - RMS 7992 - Very inverse time curves to IEC 255-4

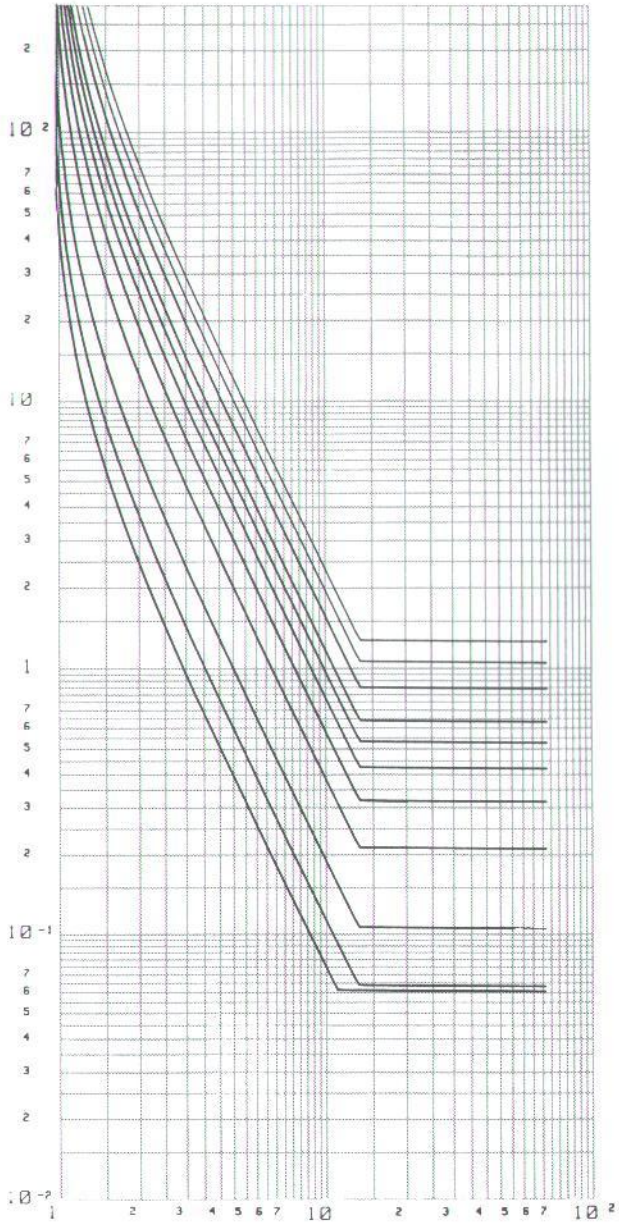


Fig. 4 - RMS 7992 - Extremely inverse time curves to IEC 255-4

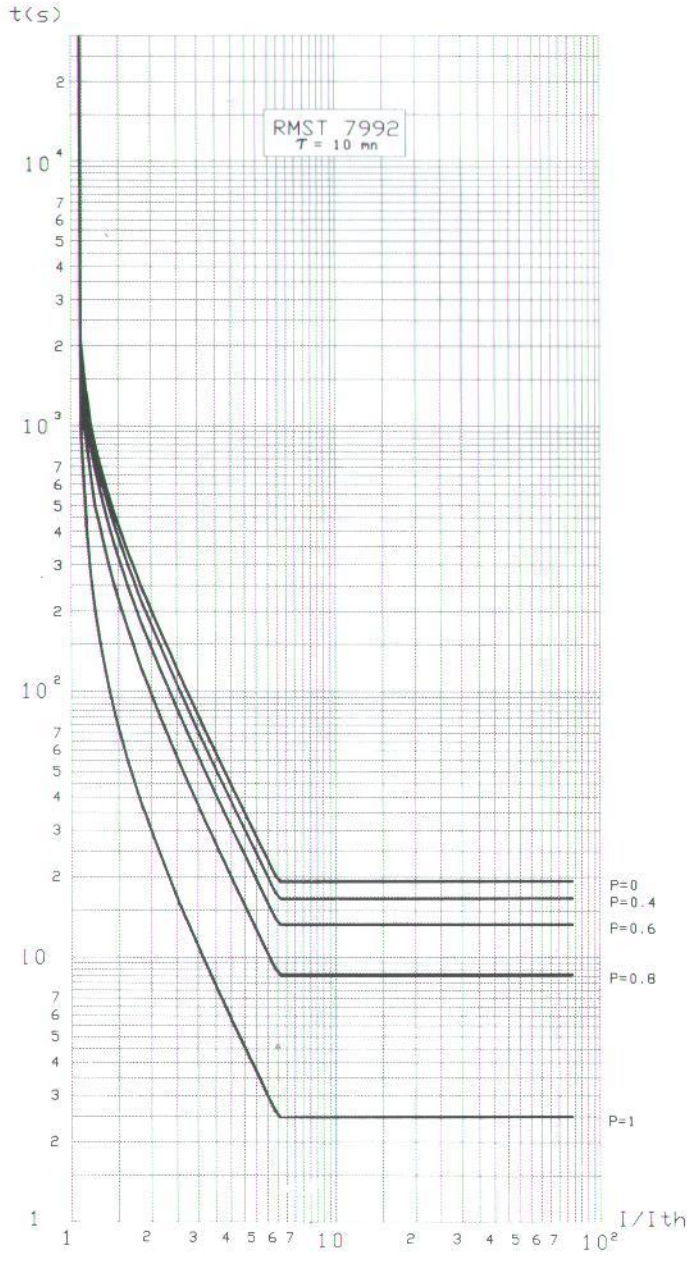
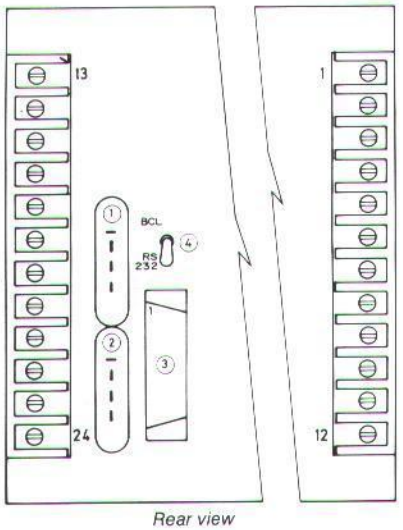
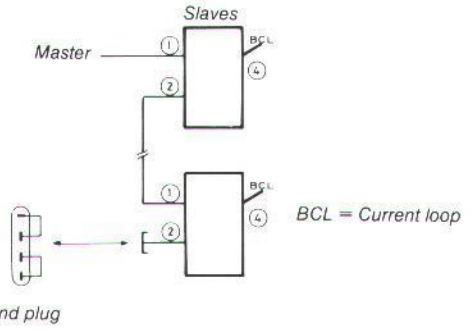
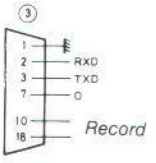


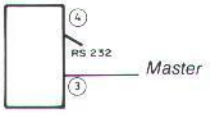
Fig. 5 - RMST 7992 - Thermal unit curve - IEC 255-8

Communication network wiring diagram

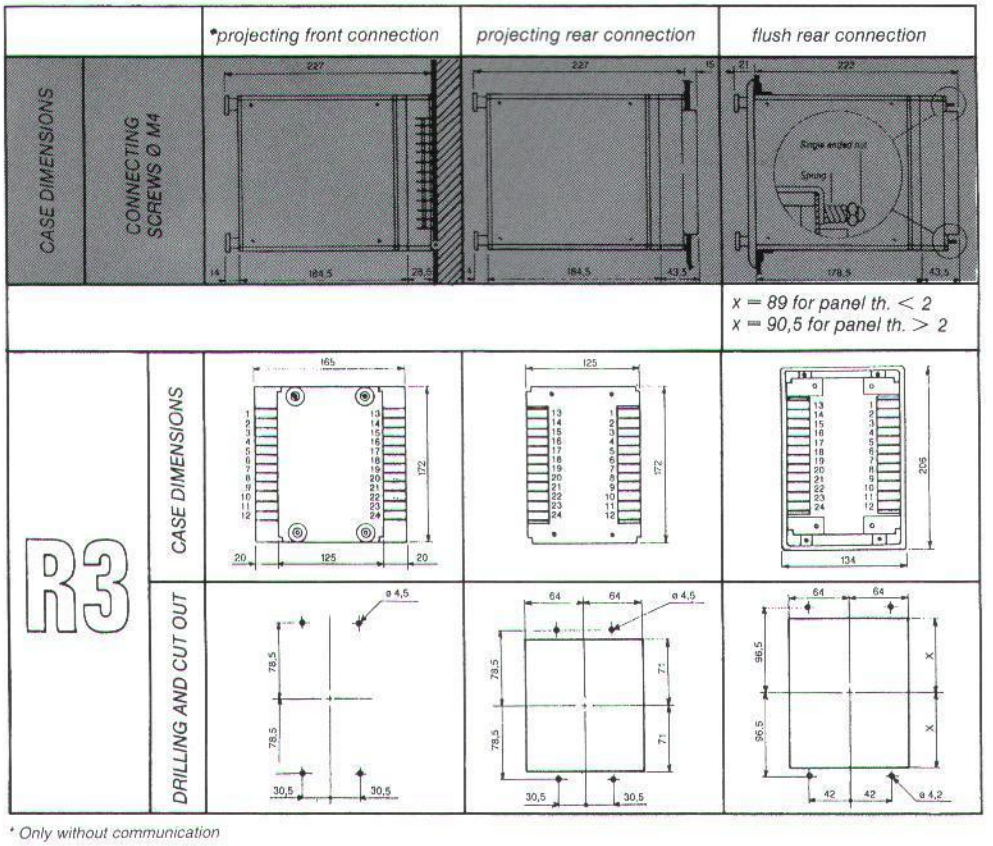








Case type R3



* Only without communication

CEE Relays Ltd
87C Whitby Road, Slough, Berks, SL1 3DR (Registered Office)
Telephone: (01753) 576477 Fax: (01753) 825661
Website: www.ceerelays.co.uk