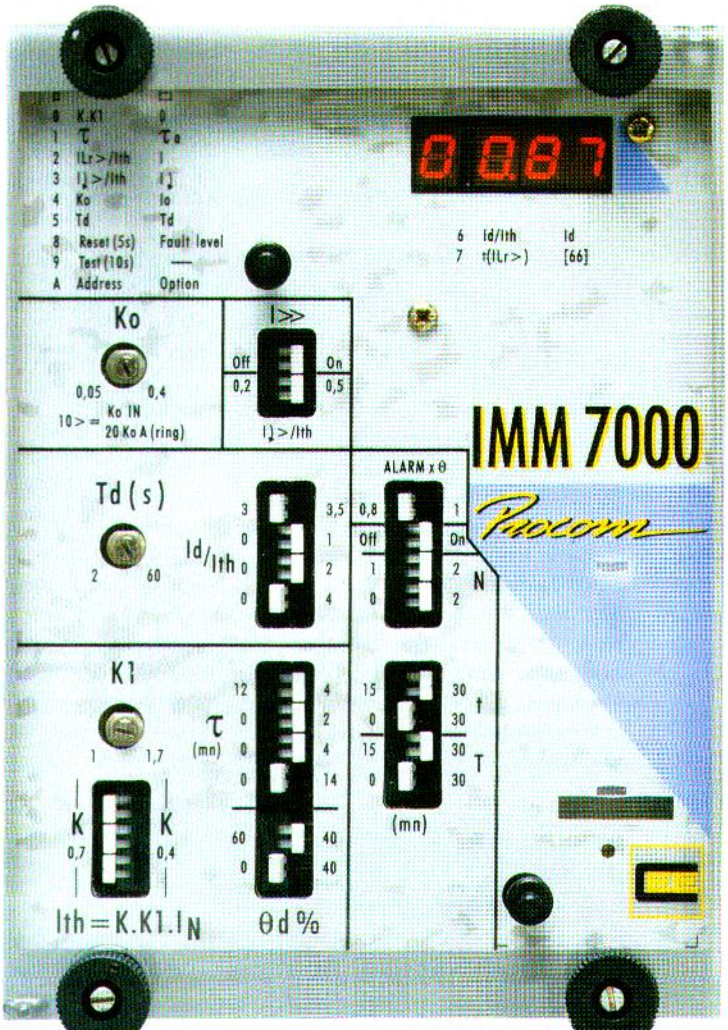
IMM 7000

Procom



DIGITAL
MOTOR
PROTECTIONS

The ultimate in power network supervision

DIGITAL CONVERSATIONAL MOTOR PROTECTION RELAYS IN MODULAR CASE IMM 7000

IMM 7960 and IMM 7990 relays have been specifically designed to provide electrical protection for high and medium voltage motors, as well as high power motors at low voltage.

Of modular conception, they form an overall system with PROCOM architecture or can be used separately in all other classic protection schedule by transmitting all the data they possess (alarms and trips, together with operating quantities, and on request from the operator both operating quantities and relay settings) and on the other hand, they can receive specific instructions during starting or reacceleration sequences.

These devices incorporate in one small plug-in case all the functions necessary for sophisticated protection of all types of ac motors.

The main principles are those of the ITM series of relays which protect tens of thousands of high and medium voltage motors and have proved their worth for more than 20 years.

Their design, based on integrated circuit technology around a microprocessor, provides:

- the incorporation of additional functions,
- higher precision and ease of adjustment as well as assistance to the user by giving, via a digital display, the following information:
  - the setting values,
  - the real start characteristics of the motor,
  - the thermal state and the load current,
  - the type and amplitude of a fault which has caused a trip

IMM 7960 has a trip output and a start authorisation output.

IMM 7990 has in addition an alarm output.

• Protection functions

- Thermal overload (49), with two time-constants
- Thermal pre-alarm (IMM 7990 only))
- Start authorisation by detection of the thermal state (θd)
- Limitation of number of starts (66) (IMM 7990 only)
- Too long start
- Locked rotor (51 LR)
- Short-circuit (50)
- Unbalance - Loss of one phase (46)
- Earth/ground fault (50N/51N)
- Detection of pump un-priming (37)

• Options

C.E.E.'s unique experience in the field of motor protection has enabled us to define all of the standard protection functions described above as well as more than 20 special functions to provide the correctly adapted solution to specific problems.

These special functions are chosen when ordering from the options given in figure 1.

• Major advantages

- The very wide current setting ranges, together with a low burden can ensure protection of a very varied range of motors with a limited number of different current transformer ratios.
- Perfect protection of the machine during the starting period (a special unit with an extremely inverse curve).
- Possibility of motor reacceleration after a network fault, as the relay takes account of short-duration network loss.
- Start-up authorised only when the thermal state of the machine will allow it, and the relay auxiliary supply is present.
- Highly sensitive earth/ground fault unit when used with a core-balance CT.
- Easily mounted: small dimensions and well-proven plug in system.
- Simple high-precision settings: adjustments by switches and potentiometers (thus avoiding any risk of loss of information) and direct read-out on the digital display.
- Read-out on the relay of the type of fault and its amplitude after a trip.
- Permanent load current indication if required.
- Able to communicate via a serial digital link.
- Professional electronic components.

• Description of the protection functions

Thermal overload (49)

The IMM 7000 relays create a thermal image of the motor from an appropriate blend of the positive and negative sequence components of current to take into account the increased thermal effects, particularly in the rotor, under unbalanced supply conditions.

This thermal image has two time-constants:

• the first, τ, adjustable from 4 to 32 minutes on the relay faceplate, comes into effect as soon as the motor is connected to the network,

• the other, τ F, may be fixed on request at 1, 2, 4 or 6 times the values of τ.

Time-constant τ F comes into operation in the thermal image as soon as the current absorbed by the machine drops below 15% of nominal, thus indicating that the motor is disconnected from the network. Under these conditions, as the motor slows the cooling system becomes less efficient and causes an apparent increase in the motor's timeconstant. Figure n° 5 shows the curves corresponding to different preload conditions for one particular time-constant τ (12 minutes). It will be noted that the curves show a discontinuity at approximately 3 times setting. This is in order to produce a true thermal protection for overload situations, whilst avoiding false tripping under starting conditions.

Thermal pre-alarm unit (IMM 7990 only)

A separate output unit (A) provides an alarm as soon as the thermal state of the motor is above 80% or 100% of nominal state.

It should be noted that under balanced supply conditions, the thermal unit set at Ith will trip for a permanent current of 1.07 Ith which corresponds to 114% of the nominal thermal state.

Start authorisation unit

Whenever the thermal state of the motor is such that its protection would not allow a further start sequence to be carried out, it would be detrimental to the machine to switch it on, only to have the relay follow this with a tripping signal.

To avoid such manœuvres, the IMM 7000 relays contain a unit (D) whose contact may be inserted into the closing coil-chain. This unit will prevent the closing order being carried out whilst the thermal state of the motor is above that which would allow a successful starting sequence (40, 60, 80 or 100% of the nominal thermal state).

Unit to limit the number os starts (66) (IMM 7990 only)

This function uses a counter to control the number of starts in a certain time: a chosen number of starts is permitted during a chosen reference period (t). If this number of starts is attained, any new start is prevented for a further period (T)

This function operates the output unit D mentioned in the paragraph "Start authorisation unit".

Too long start and locked rotor whilst running (51LR)

As well as being covered by the thermal protection, each starting sequence is individually monitored in order to check that the heating effect is not significantly above that defined by the parameters Id and Td set on the relay.

To do this, the relay incorporates an extremely inverse time unit ensuring efficient protection of the motor against abnormally long starting periods, which is in dependent of the network voltage.

After the starting period, the locked rotor or stalling situation is covered by an independent (or definite) time overcurrent unit.

Short circuit protection (50)

Protection against short-circuits or very heavy phase-to-phase faults is ensured by the high speed positive sequence unit. The adjustment of this unit is derived automatically from the settings used for the starting characteristics.

It may be put out of service (by a switch on the faceplate) whenever the motor is controlled by a fuse/contactor unit.

Protection against unbalance and loss of phase (46)

This unit operates on the negative sequence component of current. Its operating curve (figure n° 6) is of the dependent time type, thus avoiding maloperation on unbalance which could be caused by the CTs during starting or reacceleration periods, whilst at the same time ensuring adequate protection. Its minimum operating time makes it compatible with fuse/contactor control.

Protection against earth/ground faults (50N/ 51N)

This unit may be connected to a core-balance CT or used in the residual connection of the 3 line CT's. In the latter case, the transient inaccuracy of the line CT's during the starting or the reacceleration periods may lead to "inadvertent" trippings of the protection. To solve such problems, it is highly recommended to connect a stabilising resistor in series with the relay input (consult us). Connection of the core-balance CT provides the very sensitive operating levels required to ensure protection in networks with high impedance earthing/grounding. The operating time is automatically increased when the positive sequence component is put out of service, which makes it compatible with fuse/contactor control.

Protection against pump un-priming (37)

This undercurrent unit, driven from the positive sequence component, comes into operation when the motor current stabilizes at a value between 15% and 40% of nominal for more than 3 seconds, indicating a no-load condition characteristic of a pump becoming un-primed.

• *Data management*

A major characteristic of the IMM 7000 is its ability to communicate with the outside world. It can in fact exchange information, both locally and to a remote location, in three main ways:

- a local digital display unit,
- a sophisticated arrangement of output units,
- a serial digital link which may be incorporated into a communication network PROCOM.

• *Digital display unit*

The IMM 7000 are equipped with a digital display unit, giving local read-out of:

- the various relay setting adjustments,
- measured or calculated values: thermal state, positive, negative and zero sequence components of line current,
- starting quantities, memorised during the last start sequence,
- the type of fault having caused a trip,
- when relevant, the address of the relay in the communication network (see "Digital Communication Network"),
- the option according to which the relay has been manufactured (see figure 1).

• *Ouput units*

The IMM 7000 incorporate several output relays giving all-or-nothing output signals:

- an electromechanical relay "T" with high-power contacts, operates for the tripping signals coming from each of the IMM 7000 protection functions. It has two output contacts, one of which is a change-over type, and a mechanical operation indicator visible on the front of the relay. This unit, which is self-reset in the standard version, may be electrically held in and/or trip in a differentiated manner (see "Options").
- an electromagnetic relay "A" with one output contact indicating a thermal pre-alarm (IMM 7990 only),
- an electromagnetic relay "D" with one output contact authorising motor starting according to settings defined by the operator.

The IMM 7990 has also an intemal relay which can indicate presence of the auxiliary supply via the digital communication network.

• *Digital communication network*

The IMM 7000 may be integrated into the digital data exchange network.

Each communication channel has two pairs, one for transmission, the other for reception. Data is exchanged via a 0-20 mA current loop at 1200 bauds on J-Bus®/Modbus® (consult us).

OPTIONS

Negative sequence unit I↓ > out of service.
Locked rotor unit IL_r > out of service.
Thermal unit out of service.
Manual reset for all units.
Manual reset for all units except the thermal unit.
Zero sequence unit time delay tI0 = 0.5 sec.
Zero sequence unit time delay tI0 = 0.25 sec.
Negative sequence unit time delay tI > multiplied by 2 for 2 times the starting time Td.
Negative sequence unit time delay tI > multiplied by 2
I↓ > + IL_r > out of service.
Manual reset for all units + I↓ out of service.
Zero sequence alarm with or without thermal alarm.
Manual reset for all units + IL_r > out of service.
Manual reset for all units except the thermal unit + I↓ > out of service.
Manual reset for all units except the thermal unit + L_r > out of service.
tI_0 = 0.25 sec. + I↓ > out of service.
tI_0 = 0.25 sec. + IL_r out of service.
tI_0 = 0.25 sec. + manual reset for all units except the thermal unit
tI↓ x 2 during 2 Td + IL_r > out of service.
tI↓ x 2 during 2 Td + manual reset for all units except the thermal unit.
tI↓ x 2 + IL_r > out of service.
tI↓ x 2 + manual reset for all units except the thermal unit.

Fig. 1 - Options table

GENERAL CHARACTERISTICS

1 Input/Output quantities

• Current	
- Nominal values	In = 1 A or 5 A. Fn = 50 Hz or 60 Hz.
- Burden	< 0.5 VA at In.
- Thermal withstand limits	15 In for the operating time. 80 In for 1 sec.
- Recommended transformers	5 VA 5P10 (including 20 m of 4 mm2 cable at In = 5 A). On residual connections: 3 CTs. On core-balance CT: 2 CTs + CEE core-balance CT.
• Auxiliary supply DC	• 24 V (operating range 19 to 26.5 V). • 48 V (operating range 40 to 58 V) burden 3.5 W (48 V). • 110-125 V (operating range 80 to 140 V) burden 8W (110V). • 220-240 V (operating range 160 to 275 V) burden 17 W (220 V). (Please consult us for ac auxiliary supply).
• Outputs:	
- Local signalling	By digital display, read-out of: • setting values, • measured or calculated quantities, • type and value of fault having caused a trip.
- Electromechanical units automatic reset contact	T: trip 1c/o + 1No. A: Alarm 1No (IMM 7990 only). D: start 1No.
• Possibility of hand-reset contacts for some units (see " Options ")	
• Hand-reset mechanical operation indicator	On "T" Unit
• Contacts:	
- maximum voltage	600 V.
- maximum permanent current	5A.
- closing capacity (0.2 sec.)	10A.
- breaking capacity:	
- dc (L/R = 40 ms)	50 W (1 A/48 V/DC-0.5 A/110 V/DC).
- ac (cos φ = 0.4)	1250 VA (I < 3A).

2 Measuring units

- Thermal overload .... Ith = 0.4 - 1.2 In = K.K 1 IN. Continuous adjustement using switch K and potentiometer K1.
  - Operating level .... 1.07 Ith.
  - Time constants .... τ = 4 - 32 min.; cooling: τ F = 1-2-4-6 on request.
  - Operating time .... See figures n° 4 and 5.
  - Thermal alarm .... θ > 80% or 100%, nominal thermal state.

- Start authorisation .... By normally open contact of the "D" unit in series with the closing coil chain.
  - By check on the thermal state
    Authorization for θ < θ d .... θ d = 40 - 60 - 80 - 100%, of nominal thermal state.
  - By check on the number of starts (IMM 7990 only)
    Authorized .... N = 1 to 4 starts during t = 15 to 60 min.
    Prevented .... During T = 15 to 60 min. if N attained during t.

- Protection against too long starts .... In service for a period of 2 Td from start initiation.
  - Operating time .... Extremely inverse time curve (I^2t = const) defined by: Td = 2 - 60 sec. Id = 3 - 10.5 Ith.

- Locked rotor protection .... Brought into operation 2 Td after start initiation.
  - Operating level .... 2.5 Ith or 4 Ith Fixed, on request
  - Operating time .... 1 sec. or 4 sec. Fixed, on request

- Short-circuit (positive sequence) .... Brought into operation by switch I > > in "ON" position.
  - Operating level .... 1.4 Id (limited to 12.5 Ith)
  - Operating time .... 0.08 sec. (at twice setting).

- Unbalance and loss of phase (negative sequence)
  - Operating level .... I↓ > = 0.2 or 0.5 Ith.
  - Operating time .... Curve figure n° 6

- Zero sequence:
  - Operating level (Ko) .... 0.05 - 0.4 In (on line CTs). 1 - 8 A primary (on CEE core-balance CT).
  - Operating time .... 0.1 sec. (switch I > > "ON"). 0.25 sec. (switch I > > "OFF")

- Protection against pump unpriming: .... Operational on request.
  - Operating level .... 0.15 Ith < I < 0.4 Ith; fixed.
  - Time-delay .... 3 sec., fixed.

3 Nominal operating ranges:

- Temperature .... -10 to + 50°C.
- Frequency .... Fn ± 2.5 Hz.
- Auxiliary supply .... See paragraph "Auxiliary supply".
- Storage range .... - 30 to + 70° C.

4 Insulation:

- Dielectric withstand .... 2 kV - 1 min. to IEC 255-5 serie B.
- Impulse withstand .... 5 kV peak - 1.2/50 µs to IEC 255-5.

5 High frequency interference .... 2.5 and 1 kV/1 MHz to class III.

IEC 225-22-1.

6 Cases

IMM 7960 .... R2
IMM 7990 .... R3
+ external resistor for auxiliary supply > 48 V.

7 Weight .... 3.5 kg.

8 Drawings to be used when odering

IMM 7960 .... 25A4.
IMM 7990 .... 9987.

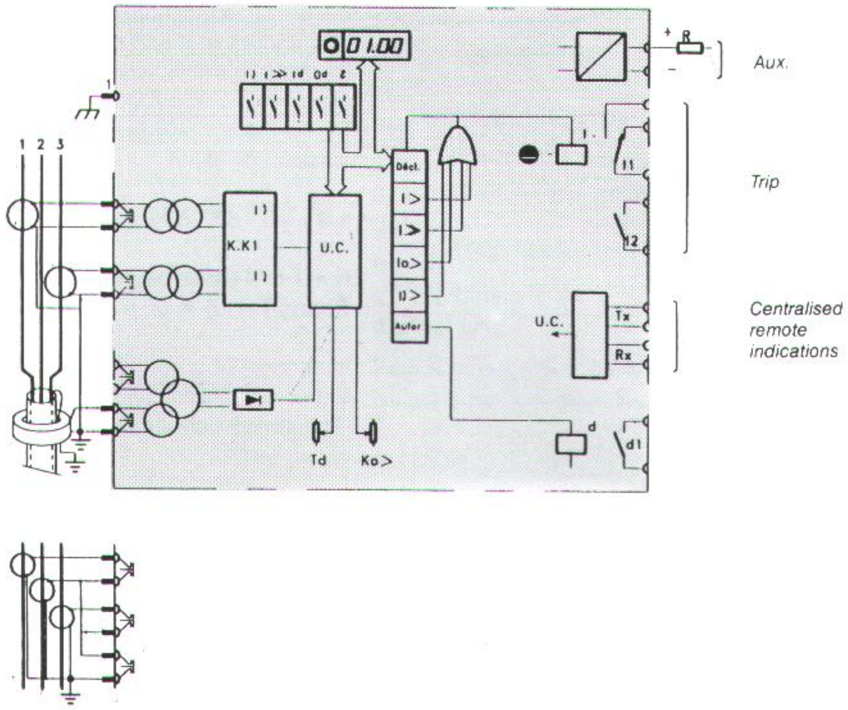


Fig. 2 - IMM 7960 : Simplified operation and connection diagram

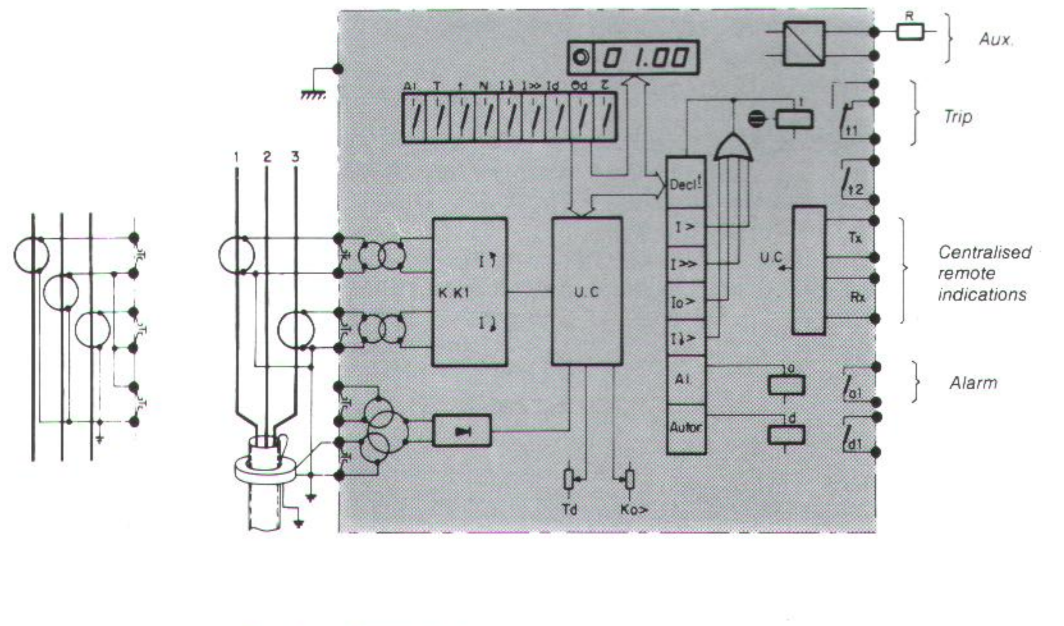
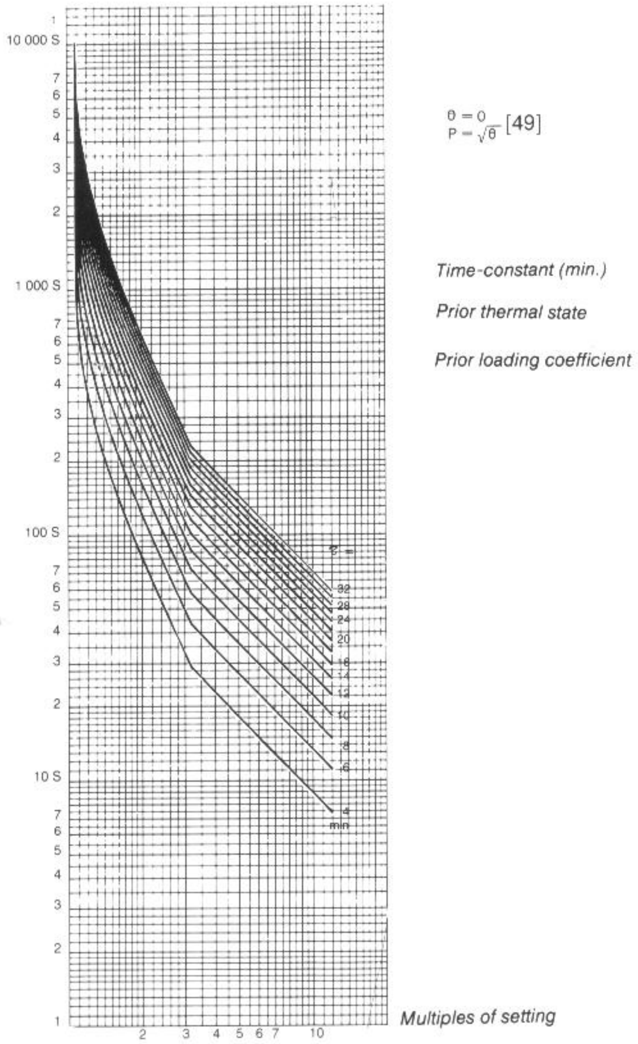
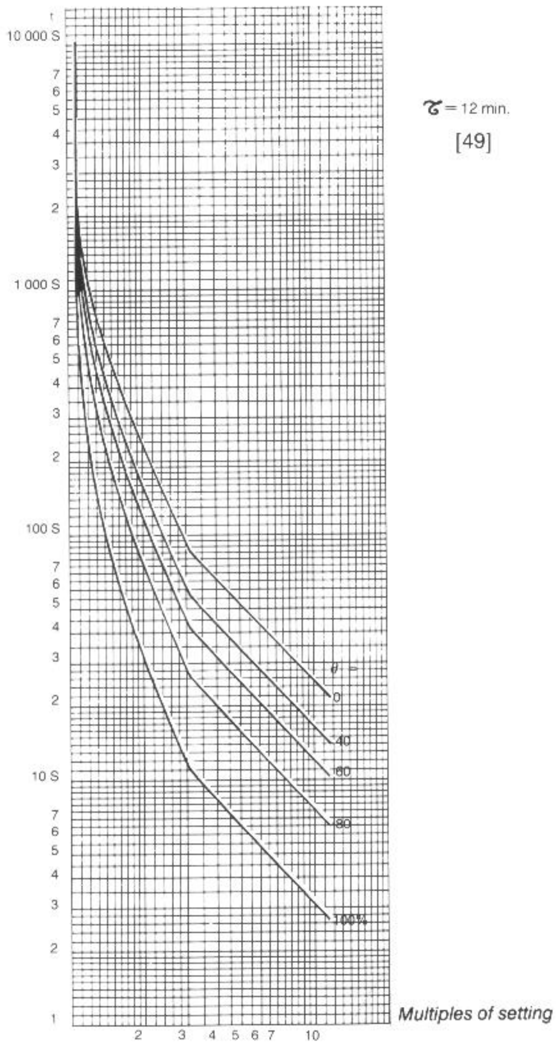


Fig. 3 - IMM 7990 : Simplified operation and connection diagram



– Cold characteristics for different time constants.

Fig. 4 - Thermal unit



– 12 min time constant with different prior thermal states.

Fig. 5 - Thermal unit

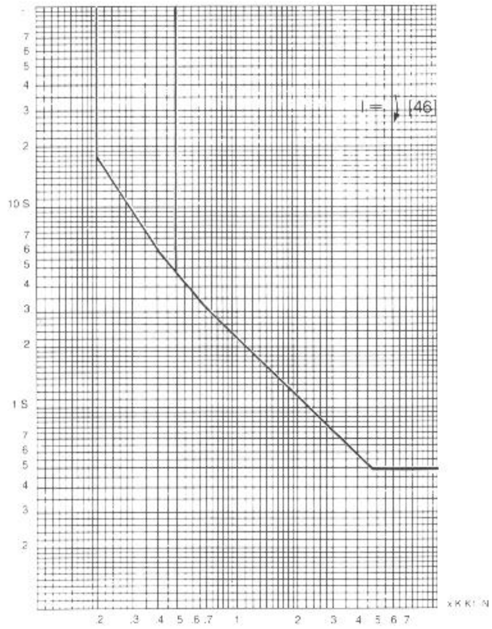
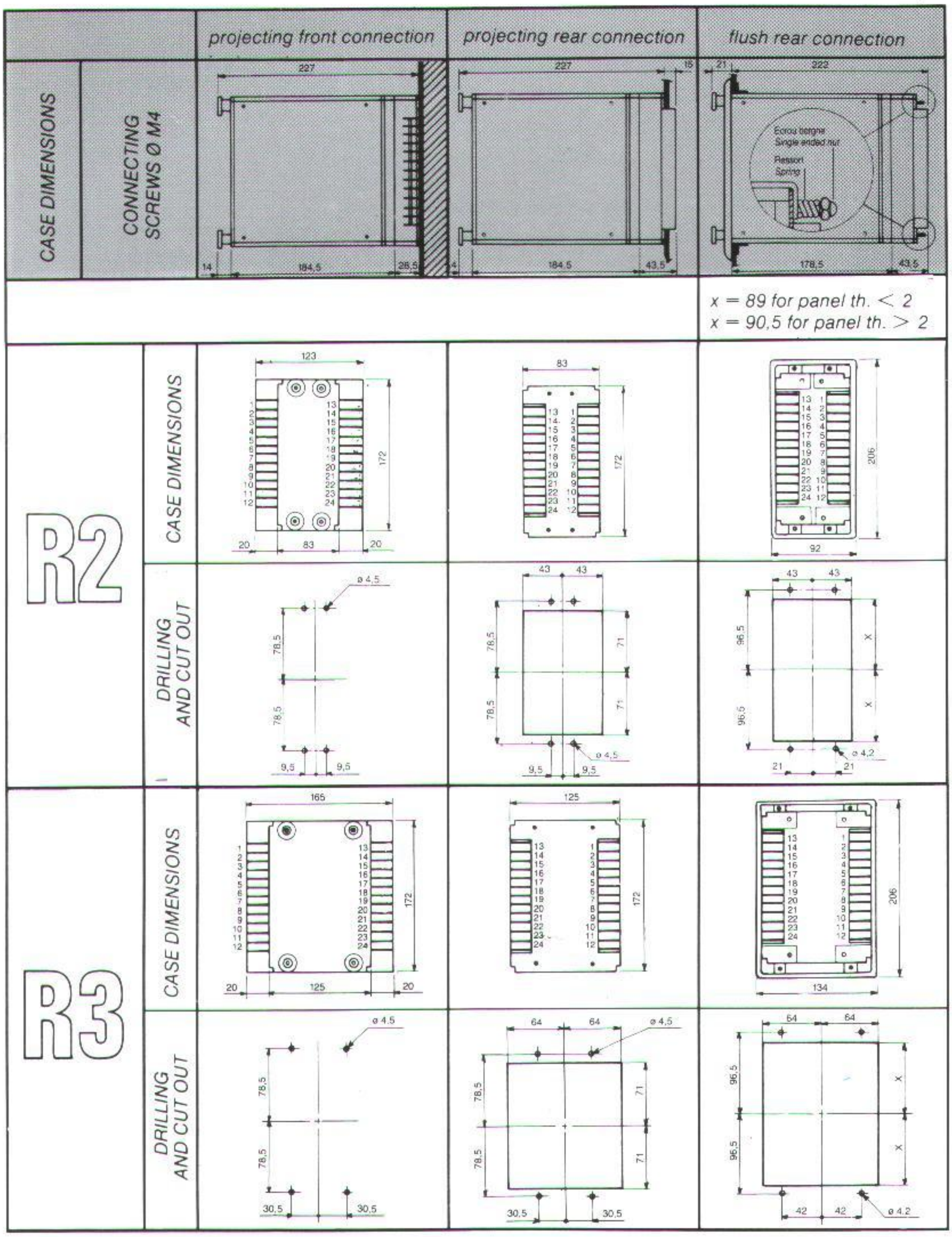


Fig. 6 - Negative sequence unit

CASES TYPE R2 / R3



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