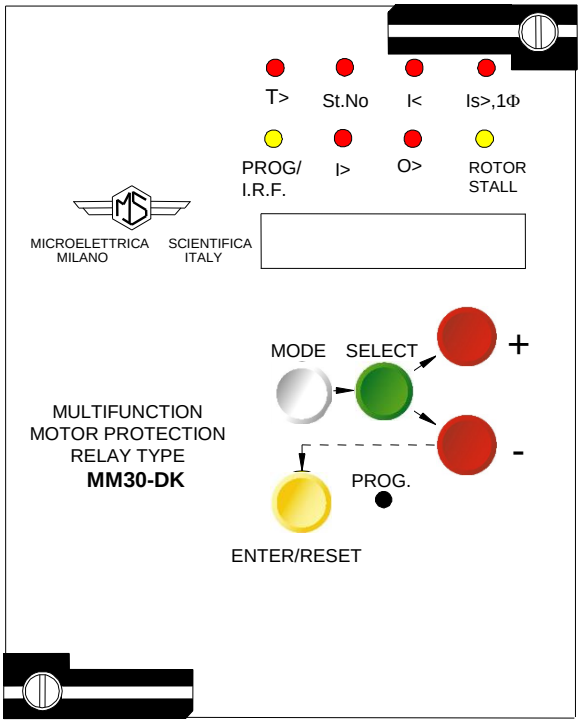
MICROPROCESSOR
MOTOR PROTECTION RELAY
WITH DIRECTIONAL EARTH FAULT ELEMENT

TYPE
MM30-DK

OPERATION MANUAL



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INDEX

1. General utilization and commissioning directions

Always make reference to the specific description of the product and to the Manufacturer's instruction. Carefully observe the following warnings.

1.1 - STORAGE AND TRANSPORTATION,

must comply with the environmental conditions stated on the product's instruction or by the applicable IEC standards.

1.2 - INSTALLATION,

must be properly made and in compliance with the operational ambient conditions stated by the Manufacturer.

1.3 - ELECTRICAL CONNECTION,

must be made strictly according to the wiring diagram supplied with the Product, to its electrical characteristics and in compliance with the applicable standards particularly with reference to human safety.

1.4 - MEASURING INPUTS AND POWER SUPPLY,

carefully check that the value of input quantities and power supply voltage are proper and within the permissible variation limits.

1.5 - OUTPUTS LOADING,

must be compatible with their declared performance.

1.6 - PROTECTION EARTHING

When earthing is required, carefully check its effectiveness.

1.7 - SETTING AND CALIBRATION

Carefully check the proper setting of the different functions according to the configuration of the protected system, the safety regulations and the co-ordination with other equipment.

1.8 - SAFETY PROTECTION

Carefully check that all safety means are correctly mounted, apply proper seals where required and periodically check their integrity.

1.9 - HANDLING

Notwithstanding the highest practicable protection means used in designing M.S. electronic circuits, the electronic components and semiconductor devices mounted on the modules can be seriously damaged by electrostatic voltage discharge which can be experienced when handling the modules. The damage caused by electrostatic discharge may not be immediately apparent but the design reliability and the long life of the product will have been reduced. The electronic circuits reduced by M.S. are completely safe from electrostatic discharge (8 KV IEC 255.22.2) when housed in their case; withdrawing the modules without proper cautions expose them to the risk of damage.

a. Before removing a module, ensure that you are at the same electrostatic potential as the equipment by touching the case.

b. Handle the module by its front-plate, frame, or edges of the printed circuit board. Avoid touching the electronic components, printed circuit tracks or connectors.

c. Do not pass the module to any person without first ensuring that you are both at the same electrostatic potential. Shaking hands achieves equipotential.

d. Place the module on an antistatic surface, or on a conducting surface which is at the same potential as yourself.

e. Store or transport the module in a conductive bag.

More information on safe working procedures for all electronic equipment can be found in BS5783 and IEC 147-OF.

1.10 - MAINTENANCE

Make reference to the instruction manual of the Manufacturer ;
maintenance must be carried-out by specially trained people and in strict conformity with the safety regulations.

1.11 - FAULT DETECTION AND REPAIR

Internal calibrations and components should not be altered or replaced.
For repair please ask the Manufacturer or its authorised Dealers.

Misapplication of the above warnings and instruction relieves the Manufacturer of any liability.

2. GENERAL

Input currents are supplied to 3 current transformers: - two measuring phase current (the third current is computed as vector summation of the two others) - one measuring the earth fault zero-sequence current.
Phase current rated input can be 1 or 5A (Selectable by movable bridges on relay card)
Zero sequence rated input is 1A.
Zero sequence voltage input is supplied to one voltage transformer.
Rated input voltage 100V – 50/60Hz.
Make electric connection in conformity with the diagram reported on relay's enclosure.
Check that input currents are same as reported on the diagram and on the test certificate.
The auxiliary power is supplied by a built-in interchangeable module fully isolated an self protected.

2.1 POWER SUPPLY

The relay can be fitted with two different types of **power supply** module :

a) - { **24V(-20%) / 110V(+15%) a.c.** ; **24V(-20%) / 125V(+20%) d.c.** }

b) - { **80V(-20%) / 220V(+15%) a.c.** ; **90V(-20%) / 250V(+20%) d.c.** }

Before energising the unit check that supply voltage is within the allowed limits.

2.2 – Operation and Algorithms

2.2.1 – Reference input variables

Display	Description	Setting Range	Step	Unit
NodAd 1	Identification number for connection serial communication	1 - 250	1	1
Fn 50 **Hz**	Mains frequency	50 - 60	10	Hz
In 500**Ap**	Rated primary current of the phase C.Ts.	1 - 9999	1	A
On 500**Ap**	Rated primary current of the C.Ts. or of the tore C.T. detecting earth fault current	1 - 9999	1	A
Im 1.0**In**	Motor full-load current (p.u. of phase C.Ts. rated current)	0.1 – 1.5	0.01	In
Ist 6**Im**	Motor starting current (p.u. of motor full load current)	0.5 – 10	0.1	Im
tst 5**s**	Motor starting time	1 – 120	1	s
Itr0.5**Ist**	Switch-over current for control of two-step motor starter (p.u. of motor starting current)	Dis – 0.1 – 1	0.1	Ist
tTr 6**s**	Max switch-over time from start-up	0.5 – 50	0.1	s

2.2.2 – Input quantities

2.2.2.1 – Mains Frequency

The relay can operate either in 50Hz or 60Hz systems.
The rated Mains Frequency " Fn " must be set accordingly.

2.2.2.2 – Phase Current inputs

The relay directly displays the r.m.s. value of the Phase Currents " **IA** ", " **IB** ", " **IC** " flowing in the Primary of the input Current Transformers and refers all its measurements to that value.
To make the relay properly working with any C.T., when programming the relay settings we have to input the value of the Rated Primary Current " In " of the phase C.Ts.

For the Phase Current inputs, 1A or 5A configuration can be selected by moving the jumpers J1 and J2 provided on the C.T. input card (See § 19).

Example :

- Phase CTs 1500/5A and Core Balance CT 100/1A
- Set In = 1500A and On = 100A
- Configure CT input card with jumpers J1, J2 in the 5A position.

Only phase A and C currents are measured, whereas the current of the phase B is computed as vector summation of the currents of the other two phases.
The algorithm is based on the following considerations coming from well-known vector relations among the three-phase currents and the zero sequence current.

- In any circumstance – currents balanced or not, sinusoidal or not – it is always true that:

$$(1) \quad \overline{I_A} + \overline{I_B} + \overline{I_C} + \overline{I_0} = 0$$

- When no Earth Fault exists ($I_0 = 0$)

$$(2) \quad \overline{I_A} + \overline{I_B} + \overline{I_C} = 0 \quad \Rightarrow \quad \overline{I_B} = \left(\overline{I_A} + \overline{I_C}\right)$$

The earth fault protection element is independently supplied by the residual current coming either from the residual connection of the 3 system C.Ts. or from the core balance C.T.

If any Earth Fault is experienced ($I_0 \neq 0$) the Earth Fault Protection Element trips independently from the phase current measuring elements.

If no Earth Fault is present ($I_0 = 0$), the equation (2) is valid, no matter if currents are balanced or not, sinusoidal or not.

The third phase current is calculated, in real time, as vector summation of the other two-phase currents.

Similarly, the Positive Sequence Current Component " **Id** " and Negative Sequence component " **Is "**, with no Earth Fault, are computed according to the normal equations of the system symmetrical components, using two currents only:

$$\begin{cases} \overline{I_A} = \overline{Id} + \overline{Is} \\ \overline{I_C} = \alpha\,\overline{Id} + \alpha^2\,\overline{Is} \end{cases} \Rightarrow \begin{cases} \overline{I_C} - \alpha\,\overline{I_A} = Is\left(\alpha^2 - \alpha\right) \\ \overline{I_C} - \alpha^2\,\overline{I_A} = \overline{Id}\left(\alpha - \alpha^2\right) \end{cases} \Rightarrow \begin{cases} \overline{Is}\sqrt{3} = \left|\overline{I_C} - \overline{I_A}e^{j120}\right| \\ \overline{Id}\sqrt{3} = \left|\overline{I_C} - \overline{I_A}e^{j120}\right| \end{cases}$$

In case of Earth Fault the Earth Fault Element trips before tripping of the unbalance element.

- During Faults

A) Single phase to earth Fault

Trip of the earth fault element directly measuring the Residual Current.

B) Two Phase Fault

In any case one of the currents directly measured is involved, so the relay trips correctly.

C) Two Phase to Earth Fault

Same as A + B

D) Three Phase Fault

All the three currents are correctly measured (in any case two directly).

2.2.2.3 – Earth Fault Current and Voltage Inputs

The real-time measurement of the r.m.s. Earth Fault Current is displayed as percent of the rated current of the Zero sequence Current measuring C.T. (Io= xxxx %On).

The input of the Earth Fault element is supplied by a separated Core Balance C.T., with 1A rated Secondary Current.

The Earth Fault element can operate as a normal Zero Sequence O/C element or as a Directional Zero Sequence O/C element.
In this case to discriminate the direction the relays uses as polarizing quantity the Zero Sequence Residual voltage supplied by the Open-Delta windings of the system P.Ts.
The display directly gives the measurement " Uo " of the Secondary Zero sequence voltage and the measurement " φo " of the phase displacement of the Zero Sequence Current Fasor from the Zero Sequence Voltage Fasor.

2.2.3 – Functions and Settings

2.2.3.1 – F49 – Thermal Image (See curves § 20)

The current " **I** " producing motor warming-up is computed as a conventional composition of Positive Sequence " **Id** " and Negative Sequence " **Is** " components of the motor current.

- Computed current: $I = \sqrt{Id^2 + 3Is^2}$

- *Allowed overloading time* (See Curve § 19)

  The trip time delay " **t** " of the thermal element, depends on the warming-up time constant " **tm** " of the motor, on the previous thermal status (Ip), on the admissible continuous overload (Ib) and, of course, on the actual load (I)

$$t = tm \ ln\left[\frac{(I/Im)^2 - (Ip/Im)^2}{(I/Im)^2 - (Ib/Im)^2}\right]$$

tm	=	(1-60)min.	
I	=	computed current	
Ip	=	preheating current	
Ib	=	continuously admissible current	(1-1.3)Im, step 0.01Im
Im	=	motor rated current	(0.1-1.5)In, step 0.1In

- Steady motor *cooling-down* time constant: **to** = (1-10)tm, step 1tm

  The cooling-down time constant of the motor when running is "**tm**"; it is automatically changed to " **to** " when the motor current drops below 0.1 Im (running/steady motor discrimination level).

- *Thermal prealarm* : **Ta/n** = (50-110)%Tn, step 1%Tn

  An alarm signal is issued when the simulated warming exceeds the set percentage of the motor rated temperature Tn.
  Automatic 1% drop out percentage.

- *Restart inhibition*: **Ts/n** = (40-100)%Tn, step 1%Tn

  To inhibit a new motor starting before cooling down to 99% Ts/n, reset after tripping of the thermal element takes places when T< 0.99[Ts].

2.2.3.2 – F51LR – Locked Rotor Protection (Rotor jam)

At motor starting this function is disabled for the set time " **2tSt "** : when this time has elapsed, if current exceeds the set level " **ILR** ", the relay trips with a delay of " **tLR** " sec.

- *Current level* :

  ILR = (1-5)Im, step 0.1Im. If **ILR** = DIS. the function is disactivated.
  tLR = (1-25)s, step 1s

- *Inhibition time of the locked rotor function*:

  2tSt
  tSt = (1-120)s, step 1s = motor start-up time

2.2.3.2 - F46 - Current Unbalance (Negative Sequence Current) protection (See curve 21)

Besides its contribution to the thermal image algorithm, current unbalance also controls another inverse time element

-Minimum Negative Sequence current operation level

Is> = (0.1-0.8)Im, step 0.1Im. If **Is>** = DIS. the function is disactivated.

- *Time current curve*

  tIs> = (1-8)s, step 1s

  Actual trip time delay is given by: $t = \frac{0.9}{Is/Im - 0.1}\ tIs>$ (tIs >= trip time at Is = Im)

  " **Is** " is the actual Negative Sequence Current

2.2.3.4 – F47 – Single Phasing

When the relay detects the loss of the current of one phase while the currents of the other two phases are present, the Single Phasing element " **1Φ** " is tripped with a fixed 3 sec. time delay.

2.2.3.5 - F37 - No-Load Running protection

This function performs the protection against no-load running: it is activated by motor under current.

- *Under current level*

  I< = (0.15-1)Im, step 0,01Im. If **I<** = DIS. the function is disactivated.

  When current is below 0.1Im in all phases the function is activated.

- *Trip time delay* = 3 sec.

2.2.3.6 - F51 - Overcurrent protection

- *Minimum Pick-up Current level in at least one phase* :

  I> = (1-5)Ist, step 0.1 Ist (limited to 20 times In)
  Ist (motor locked rotor current) = (0.5-10)Im, step 0.1Im
  If **I>** = DIS. the function is disactivated

- *Trip time delay*

  tI> = (0.05-1)s, step 0,01s.

  Any of the output relays can be associated to the time delayed element "**tI>**" as well as to the instantaneous element "**I>**" of this function for signalling or for blocking other relays. The output relay controlled by the I> level remains energized for the time tI> + tBO.
  After this delay the relay it is anyhow reset.

  tBO = (0.05-0.5)s, step 0.05s.

2.2.3.7 - F64 - Earth Fault protection

- *Minimum Pick-up Zero Sequence Residual Current l*evel :

  O> = (0.1 - 4)%On, step 0.1%On. If **O>** = DIS. the function is disactivated.

- *Trip time delay*:

  tO> = (0.05-5)s, step 0.01s.

- *Minimum Residual Voltage level to enable the operation of the Zero Sequence O/C element when in the Directional mode:*

  Uo> = (2-25)secondary V, step 1V.

- *Max torque angle in the Directional operation mode (see § 2.3):*

  α = (0-359-Dis)°, step 1°.

  When " α " is set to Dis, the Earth Fault element works as normal non directional Overcurrent relay and the " **Uo** " level is disregarded.

  As for function F51, any of the output relays can be associated to the instantaneous element of "**O>**" as well as to the time delayed element " **tO>** ".

2.2.3.8 - Limitation of the Starts Number

- *Allowed Number of startings:*

  St No = (1-60), step 1 If **St No** = DIS the number of startings is unlimited.

- Time interval in *which the StNo is counted:*

  tStNo = (1-60)min. step 1 min.
  If during the time "**tStN**" the "**StNo**" is attained, a new start is inhibited for the time tBst.

- *Restart Inhibition time*:

  tBst = (1-60)min., step 1min.

  On the set tBst= 0 the inhibition is disactivated
  On the set tBst= Rm the inhibition is permanent until the RESET key is operated.

2.2.3.9 - Starting Sequence Control

During start-up of the motor, the unit can control an output relay used to operate the switch-over of motor starter (star-delta, resistance or impedance, autotransformer, etc...) thus allowing to automatically manage the starting transition by controlling the following parameters:

- *Switch-over (transition) current*:

  ITr = (0.1-1)Ist, step 0.1Ist

- *Maximum switch-over (transition) time delay*:

  tTr = (0.5-50)s, step 0.1s.

At motor start counting of " **tTr** " begins. If during " **tTr** " the motor current drops below " **Itr** ", switching-over is operated; if motor current stays above " **Itr** " longer than " **tTr** ", the Locked Rotor element is activated.

2.2.3.10 - Autosetting

The complexity of properly set a motor protection, frequently produces undesired tripping or non-operation of some of the functions.
The relay MM30-DK can automatically select the best setting of the parameters according to motor and system basic data. These data are:

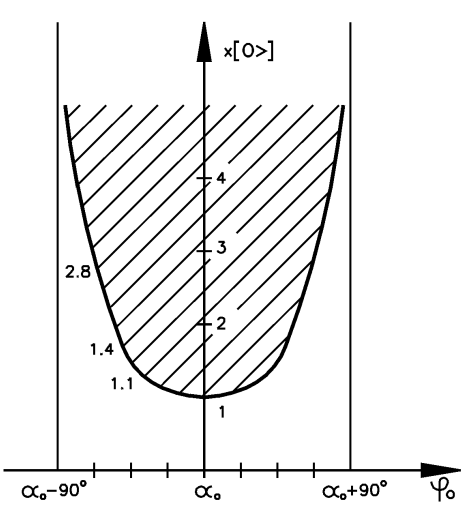
-	*System frequency*	=	**Fn**	=	50 o 60	Hz	
-	*Rated primary current of phase C.Ts.*	=	**In**	=	0-9999	A	step 1A
-	*Rated primary current of earth fault C.*T	=	**On**	=	0-9999	A	step 1A
-	*Motor rated current*	=	**Im**	=	0.1-1.5	In	step 0.01In
-	*Motor starting current*	=	**Ist**	=	0.5-9.9	Im	step0.1 Im
-	*Starting time*	=	**tst**	=	1-120	s	step 1s
-	*Transition current level*	=	**ITr**	=	0.11	Ist	step 0.1 Ist
-	*Transition time*	=	**tTr**	=	0.5-50	s	step 0,1s

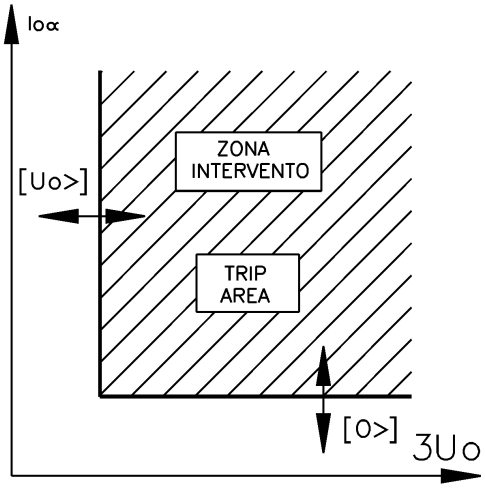
Once these settings have been programmed, the “AUTOSET” function can be activated by the key "ENTER" and all the parameters are computed and automatically set at values suitable for a normal duty of the motor.
Particularly the motor warming-up time constant “tm” is computed so that the motor, when stopped after having run continuously at Rated Power (Rated current Im), can be immediately restarted at least one time.
The parameters can anyhow be manually modified if different setting is needed.

2.3 - OPERATION OF THE DIRECTIONAL EARTH FAULT ELEMENT

It is assumed :

O>	=	Set minimum pick-up residual current : (3Io)
Uo>	=	Set minimum residual voltage (3Uo) to enable Is pick-up
αo	=	Set characteristic angle (max. torque displacement of residual current 3Io from residual voltage 3Uo).
3Io	=	Actual earth fault relay's input current
3Uo	=	Actual earth fault relay's input voltage
φo	=	Displacement of 3Io from 3Uo
$Io\alpha$	=	Component of 3Io in the direction α $Io\alpha = 3Io \cos(\varphi o - \alpha o)$





The relay measurement is:

3Io x cos(φo -αo) = $Io\alpha$

The relay trips (3Uo>[Uo>]) when **<u>$Io\alpha$>[O>]</u> (fig.2)** i.e, when the component of the input current in the measuring direction of the relay exceeds the set trip level Is. [O>]

Operation is enabled only if the input zero-sequence voltage 3Uo is above the set level [Uo>].

The sensitivity of the relay is then proportional to cos(φo -αo), it is maximum when φo **=** αo
and its operation field is limited within the range:

(αo - 90°) < φo < (α + 90) (fig.1)

The characteristic angle of the relay must be selected according to the kind of earthing of the installation which has to be protected against earth fault; typical setting are:

- **UNEARTHED NEUTRAL** **αo = 90°**
- **NEUTRAL EARTHED VIA RESISTOR** **αo = 0°**
- **SOLIDLY EARTHED NEUTRAL** **αo = 60°**

2.4 - CLOCK AND CALENDAR

The unit features a built in clock calendar with Years, Months, Days, Hours, Minutes, Seconds, Tenths of seconds and Hundredths of seconds.

2.4.1 - Clock synchronization.

The clock can be synchronized via the serial communication interface.
The following synchronization periods can be set: 5, 10, 15, 30, 60 minutes.
Synchronization can also be disabled, in which case the relay ignores the serial broadcast signal.
In case synchronization is enabled, the unit expects to receive a sync signal at the beginning of every hour and once every T_{syn} minutes. When a sync signal is received, the clock is automatically set to the nearest expected synchronization time.
For example: if T_{syn} is 10min and a sync signal is received at 20:03:10 January the 10th, 98, then the clock is set to 20:00:00 January the 10th, 1998.
On the other hand, if the same sync signal were received at 20:06:34, the clock would be set to 20:10:00, January the 10th 98.
Note that if a sync signal is received exactly in the middle of a T_{syn} period, the clock is set to the previous expected synchronization time.

2.4.2 - Date and time setting.

When the PROG/SETTINGS menu is entered, the current date is displayed with one of the groups of digits (YY, MMM or DD) blinking.
The DOWN key operates as a cursor. It moves through the groups of digits in the sequence YY => MMM => DD => YY => …
The UP key allows the user to modify the currently blinking group of digits.
If the ENTER button is pressed the currently displayed date is set.
Pressing the SELECT button the current time is displayed which can be modified using the same procedure as for the date.
If synchronization is enabled and the date (or time) is modified, the clock is stopped until a sync signal is received via the serial port. This allows the user to manually set many units and have them to start their clocks in a synchronized fashion.
If synchronization is disabled the clock is never stopped.
Note that the setting of a new time always clears 10ths and 100ths of sec.

2.4.3 - Time resolution.

The clock has a 10ms resolution. This means that any event can be time-stamped with a 10ms accuracy, although the information concerning 10ths and 100ths of sec. can be accessed only via the serial communication interface.

2.4.4 - Operation during power off.

The unit has an on board Real Time Clock which maintains time information for at least 1 hour in case of power supply failure.

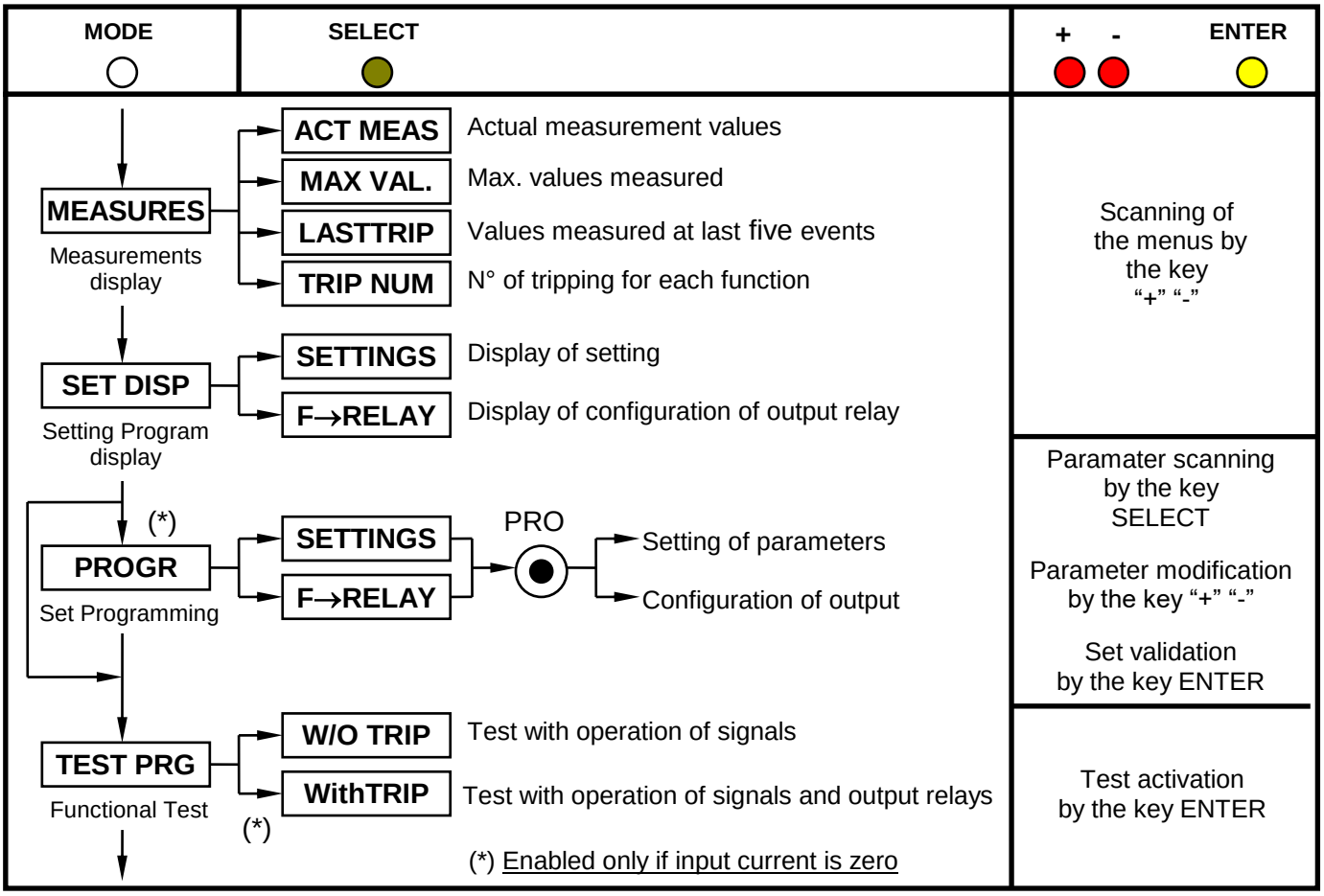
2.4.5 - Time tolerance.

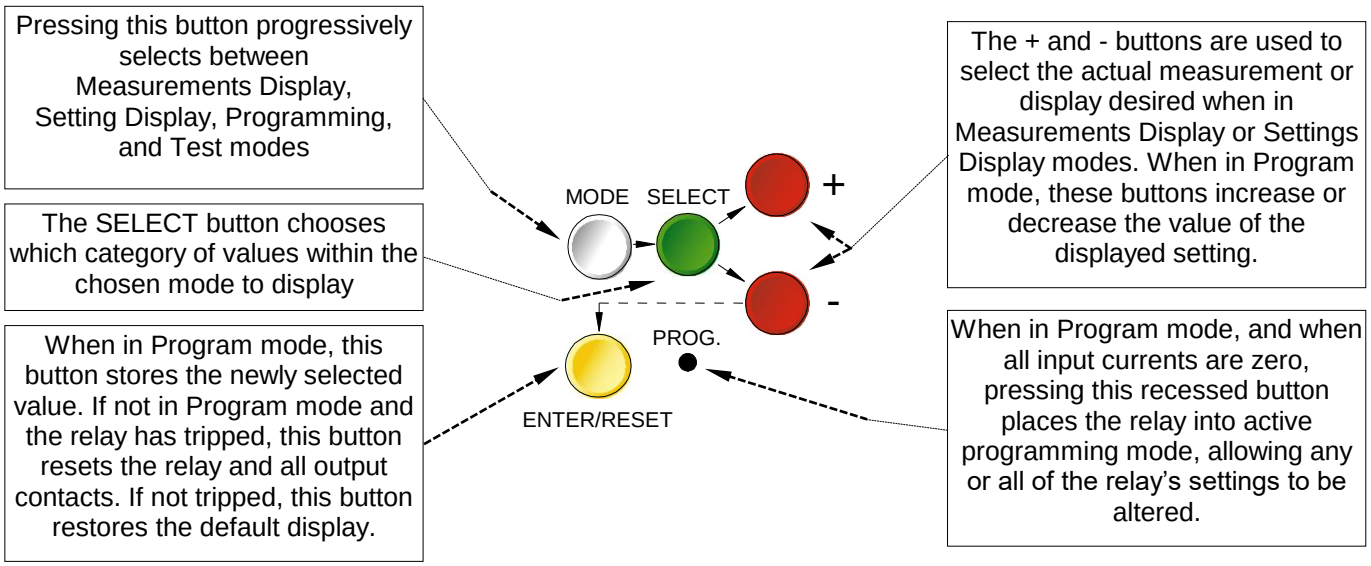
During power on, time tolerance depends on the on board crystal (+/-50ppm typ, +/-100ppm max. over full temperature range).
During power off, time tolerance depends on the RTC's oscillator (+65 /–270 ppm max over full temperature range).

3. CONTROLS AND MEASUREMENTS

Five key buttons allow for local management of all relay's functions.
A 8-digit high brightness alphanumerical display shows the relevant readings **(xxxxxxxx)**
(see synoptic table fig.1)

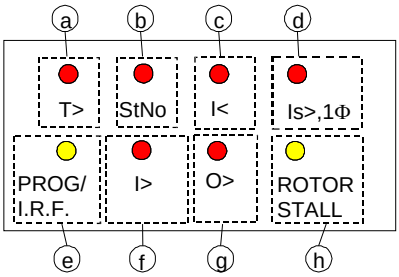
FIG.1





4. SIGNALIZATIONS

Eight signal leds (normally off) are provided:



a)	Red LED	**T>**	❑ Flashing when the motor heating "T" exceeds the set alarm level [Ta]. ❑ Illuminated on over-temperature trip. – Also illuminated on activation of RTD input.
b)	Red LED	**St No**	❑ Flashing on tripping of the element for limitation of the number of consecutive startings. ❑ Illuminated at the end of [tBSt].
c)	Red LED	**I<**	❑ Flashing as soon as motor current drops below the set level [I<] ❑ Illuminated at the end of trip time delay.
d)	Red LED	**Is>,1Φ**	❑ Flashing as soon as motor unbalance exceeds the set level [Is>] ❑ Illuminated on trip after [tIs>] time delay or on tripping of the single phasing element.
e)	Yellow LED	**PROG/ I.R.F.**	❑ Flashing when in PROGRAM MODE ❑ Illuminated when relay internal fault is detected.
f)	Red LED	**I>**	❑ Flashing when motor current exceeds the set level [I>] ❑ Illuminated on trip after [tI>] time delay.
g)	Red LED	**O>**	❑ Flashing when earth fault current exceeds the set level [O>] ❑ Illuminated on trip after [tO>] time delay.
h)	Yellow LED	**ROTOR STALL**	❑ Illuminated on trip of the Locked Rotor element (I>ILR) and/or on activation of the Speed Control input SpC.

The reset of the leds takes place as follows:

❑ Leds	a	❑ From flashing to off automatically when motor heating drops below the alarm level [Ta]. ❑ From steady light to off by the Reset control (front button or serial command) provided motor heating is below the restart temperature [Ts].
❑ Leds	b	❑ From flashing to off by the Reset control (front button or serial command) only when the restart inhibition time is set to "manual": [tBSt]=Rm. ❑ From illuminated to off when [tBSt] has expired.
❑ Leds	c,d,e,f,g	❑ From flashing to off, automatically when the lit-on cause disappears. ❑ From ON to OFF, by "ENTER/RESET" push button only if the tripping cause has disappeared.
❑ Leds	h	❑ From flashing or illuminated to off, automatically when the lit-on cause disappears.

In case of auxiliary power supply failure the status of the leds is recorded and reproduced when power supply is restored.

5. OUTPUT RELAYS

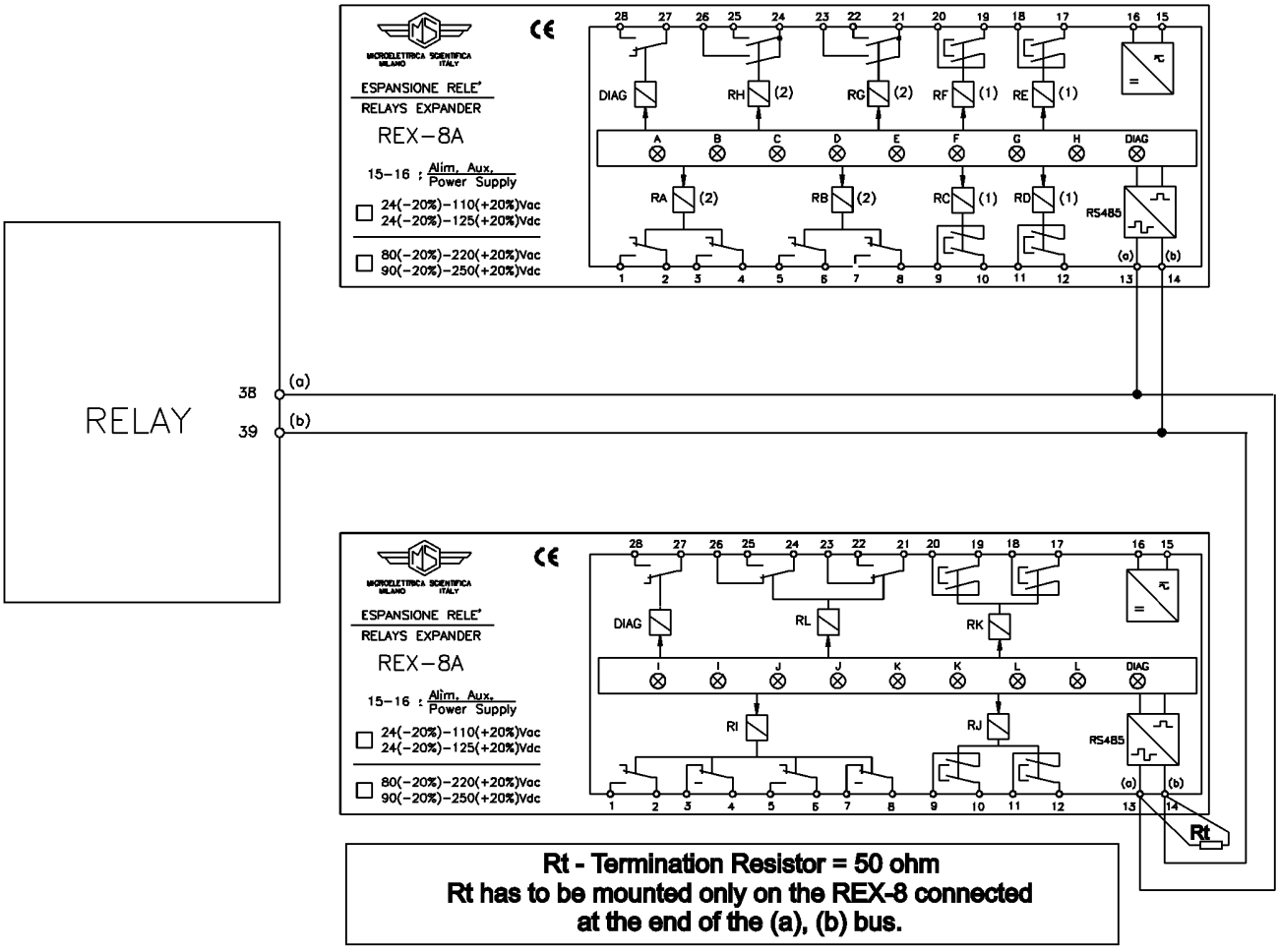
The unit MM30-DK includes four (R1, R2, R3, R4) user programmable plus one diagnostic (R5) output relays.
In the version MM30-DKX the number of output relays can be increased by the addition of one or two optional Relay Expansion modules REX-8.
The modules REX-8 are for protruding mounting and are controlled by the master module MM30-DKX via a screened twisted pair of cables connecting dedicated RS485 serial ports (see diagram herebelow).
The module REX-8 includes eight (RA, RB, RC, RD, RE, RF, RH, RG) user programmable plus one (R-Diag) diagnostic output relays
The master module MM30-DK can control altogether up to sixteen output relays

- 4 internal R1 – R2 – R3 – R4

- 8 from the first optional REX-8 module RA – RB – RC – RD – RE – RF – RG – RH

- 4 from a second optional REX-8 module RI(RA+RB) – RJ(RC+RD) – RK(RE+RF) – RL(RG+RH)

This second unit REX-8 is configured (by internal Dip-Switch) to operate the eight relays two by two in parallel (only four user programmable outputs with double number of available contacts)



Any of the functions featured by the MM30-DK can be programmed to control up to four out of the sixteen user programmable output relays

The user programmable relays (all but R5, RDIAG) are normally deenergized, i.e. energized on trip. These relays pick-up as soon as the tripping cause appears (relays controlled by the instantaneous functions) or at the end of the set trip time delay (relays controlled by time delayed functions).

The reset after trip takes place automatically as soon as the relevant tripping cause has been cleared.

The relays R5, R DIAG are not user programmable; they are normally energized and get deenergized on :

R5
- internal fault of MM30-DK
- MM30-DK power supply failure
- during the programming

R DIAG
- Internal fault of REX-8
- REX-8 power supply failure
- Interruption/fault on the serial control communication

6. SERIAL COMMUNICATION

The relays fitted with the serial communication option can be connected via a cable bus or (with proper adapters) a fiber optic bus for interfacing with a Personal Computer (type IBM or compatible).
All the operations which can be performed locally (for example reading of measured data and changing of relay's settings) are also possible via the serial communication interface.
Furthermore the serial port allows the user to read the demand recording data.
The unit has a RS232 / RS485 interface and can be connected either directly to a P.C. via a dedicated cable or to a RS485 serial bus, thus having many relays to exchange data with a single master P.C. using the same physical serial line. A RS485/232 converter is available on request.
The communication protocol is MODBUS RTU (only functions 3, 4 and 16 are implemented).
Each relay is identified by its programmable address code (NodeAd) and can be called from the P.C.
A dedicated communication software (MSCOM) for Windows 95/98/NT4 SP3 (or later) is available.
Please refer to the MSCOM instruction manual for more information Microelettrica Scientifica.

7. DIGITAL INPUTS

The relay is fitted with three digital inputs activated when the relevant terminals are shorted by a cold contact :

- R.T.	(terminals 1-2)	Remote Trip control. Activation of the input R.T. (Terminals 1-2 shorted) produces the following operation : ❑ The output relay associated to the function R.T. is energized ❑ The Trip Number Counter R.T. is incremented by 1 unit ❑ The event recording is activated and shows “CAUSE: RT”
- S.p.C.	(terminals 1-3)	Switch speed Control. The Speed Control input is connected to an external N/O contact which closes as soon as the motor is running. If the contact does not close within the set start time [tst] from the moment the motor is energised, the Locked Rotor function is tripped. The relay and the signal led associated to ILR are energised, the recording on Last Trip will show cause SpC and trip N° LR will be increased. If the Speed Control function is not used, it must be disactivated by programming the variable [Spc] = OFF (see § 12.1)
- RTD	(terminals 1-14)	Thermal probe. This function is enabled by programming the variable [RTD] = ON (see § 12.1) If the function is enabled, the input RTD is activated when the resistance connected to the terminals 1-14 exceeds the limits $50\Omega > R_{1\text{-}14} > 2900\Omega$. This limits respectively correspond to “Shorted Probe” ($<50\Omega$) or to “Overtemperature” ($R>2900\Omega$) The activation of the input 1-14 produces the following operation: ❑ The relay associated to R.T. is energized ❑ The Led T> is lit-on. ❑ The counter of Trip Number of the function T> is incremented LastTrip recording shows : "CAUSE RTD"

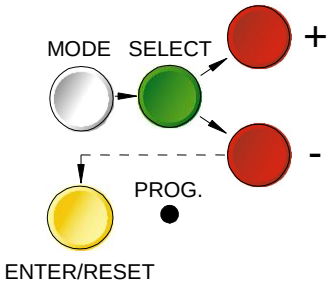
8. TEST

Besides the normal "WATCHDOG" and "POWERFAIL" functions, a comprehensive program of self-test and self-diagnostic provides:

- ❑ Diagnostic and functional test, with checking of program routines and memory's content, run every time the aux. power is switched-on: the display shows the type of relay and its version number.
- ❑ Dynamic functional test run during normal operation every 15 min. (relay's operation is suspended for less than 10 ms). If any internal fault is detected, the display shows a fault message, the Led "PROG/IRF" illuminates and the relay R5 is deenergized.
- ❑ Complete test activated by the keyboard or via the communication bus either with or without tripping of the output relays.

9. KEYBOARD AND DISPLAY OPERATION

All controls can be operated from relay's front or via serial communication bus.
The keyboard includes five hand operable buttons **(MODE) - (SELECT) - (+) - (-) - (ENTER/RESET)** plus one indirect operable key **(PROG)** (see synoptic table a fig.1):



a) - White key	**MODE**	:	when operated it enters one of the following operation modes indicated on the display :
	MEASURES	=	Reading of all the parameters measured and of those recorded in the memory
	SET DISP	=	Reading of the settings and of the configuration of the output relays as programmed.
	PROG	=	Access to the programming of the settings and of relay configuration.
	TEST PROG	=	Access to the manual test routines.
b) - Green key	**SELECT**	:	When operated it selects one of the menus available in the actual operation MODE
c) - Red key	"**+**" AND "**-**"	:	When operated they allow to scroll the different information available in the menu entered by the key SELECT
d) - Yellow key	**ENTER/RESET**	:	It allows the validation of the programmed settings ❑ the actuation of test programs ❑ the forcing of the default display indication ❑ the reset of signal Leds.
e) - Indirect key	●	:	Enables access to the programming.

10. READING OF MEASUREMENTS AND RECORDED PARAMETERS

Enter the MODE "MEASURE", SELECT the menus "ACT.MEAS"-"MAX VAL"-"LASTTRIP"-
-"TRIP NUM", scroll available information by key "+" or "-" .

10.1 - ACT.MEAS

Actual values as measured during the normal operation.
The values displayed are continuously refreshed.

Display	Description
xxXXXxx	Date : Day, Month, Year
xx:xx:xx	Hour : Hours, Minutes, Seconds
T/Tnxxx**%**	Actual temperature rise displayed as % of the motor full load temperature rise (0 - 999%)
IAxxxxx**A**	True R.M.S. value of the current of phase A displayed as primary Amps. (0 - 99999)
IBxxxxx**A**	As above, phase B.
ICxxxxx**A**	As above, phase C.
Iox.xx**%n**	As above, earth fault current.
Id/mxxx**%**	Positive sequence component of motor current displayed as % of motor full load current. (0 - 999)%
Is/mxxx**%**	Negative sequence component of motor current displayed as % of motor full load current. (unbalance degree) (0 - 999)%
Uo xxxxx**V**	RMS Voltage displayed as primary volts (0 – 65000)
φo xxx**°**	Phase displacement
h xxxxx	Operation hours (0 – 65000)

10.2 - MAX VAL

Highest values recorded during motor run after the starting time (refreshed at each higher value) plus highest values recorded during the starting time (refreshed at each new starting).

Display	Description
T/Tnxxx**%**	Highest temperature recorded since the start of the run. (0 - 99,9)%
IAxxxxx**A**	Current of phase A measured during run after starting time (0-99999)
IBxxxxx**A**	As above, phase B.
ICxxxxx**A**	As above, phase C.
Iox.xx**%n**	As above, zero sequence current.
Id/mxxx**%**	Positive sequence component of motor current.
Is/mxxx**%**	Negative sequence component of motor current
SAxxxxx**A**	Current of phase A during the starting time.
SBxxxxx**A**	As above, phase B.
SCxxxxx**A**	As above, phase C.
Soxxxx**%n**	As above, earth fault current.
Sd/mxxx**%**	Positive sequence current component during starting time.
Ss/mxxx**%**	Negative sequence current component during starting time.
tStxxxx**s**	Measurement of the Motor Starting time.
SUoxxxx**V**	Zero sequence voltage during the starting time.

10.3 - LASTTRIP

Recording of the last 5 trippings of the relay and values of the parameters at the moment of tripping.
The memory buffer is refreshed at each new relay tripping.

Display	Description
LastTr-x	Indication of the recorded event (x= 0 to 4) Example: Last event (LastTr -0) Last but one event (LastTr-1) etc...
xxXXXxx	Date : Day, Month, Year
xx:xx:xx	Hour : Hours, Minutes, Seconds
Causexxx	Function which caused the last tripping: **T>; Is>; I>; O>; I<; LR; StN; ITr; SpC; RTD; RT.**
IAxxxxx**In**	Current of phase A.
IBxxxxx**In**	Current of phase B.
ICxxxxx**In**	Current of phase C.
Ioxxxxx**%n**	Earth fault current.
Id/mxxx**%**	Positive sequence component of current.
Is/mxxx**%**	Negative sequence component of current.
T/Tnxxx**%**	Motor heating
Uoxxxxx**V**	Zero-sequence voltage
φoxxxxx°	Io/Uo phase displacement angle in degrees.

10.4 - TRIP NUM

Counters of the number of operations for each of the relay functions.
The memory is non-volatile and can be cancelled only with a secret procedure.

Display	Description
T> xxxxx	Motor overload.
Is>xxxxx	Current unbalance.
I> xxxxx	Overcurrent.
O>xxxxx	Earth fault.
I< xxxxx	No load running.
LRxxxxx	Locked rotor.
StN>xxxx	No of consecutive startings.
ITr xxxx	Too long starting.
RT xxxx	Remote trip
1ϕ xxxx	Single phasing

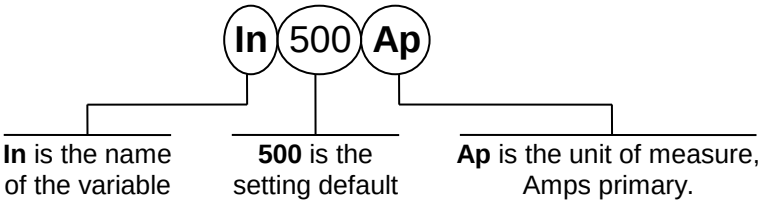
11. READING OF PROGRAMMED SETTINGS AND RELAY'S CONFIGURATION

Enter the mode "SET DISP", select the menu "SETTINGS" or "F→RELAY", scroll information available in the menu by keys "+" or "-".
SETTINGS= values of relay's operation parameters as programmed
F→RELAY= output relays associated to the different functions as programmed.

12. PROGRAMMING

The relay is supplied with the standard default programming used for factory test. [Values here below reported in the " Display " column].
All parameters can be modified as needed in the mode PROG and displayed in the mode SET DISP
Local Programming by the front face key board is enabled only if no input current is detected (main switch open). Programming via the serial port is always enabled but a password is required to access the programming mode. The default password is the null string; in the standard application program for communication "MS-COM" it is also provided an emergency password which can be disclosed on request only.
As soon as programming is enabled, the Led PRG/IRF flashes and the reclosing lock-out relay R5 is deenergized. Enter MODE "PROG" and SELECT either "SETTINGS" for programming of parameters or "F→RELAY" for programming of output relays configuration; enable programming by the indirect operation key PROG.
The key SELECT now scrolls the available parameters. By the key (+) , (-) the displayed values can be modified; to speed up parameter's variation press the key SELECT while "+" or "-" are pressed.
Press key "ENTER/RESET" to validate the set values.

12.1 - PROGRAMMING OF FUNCTIONS SETTINGS



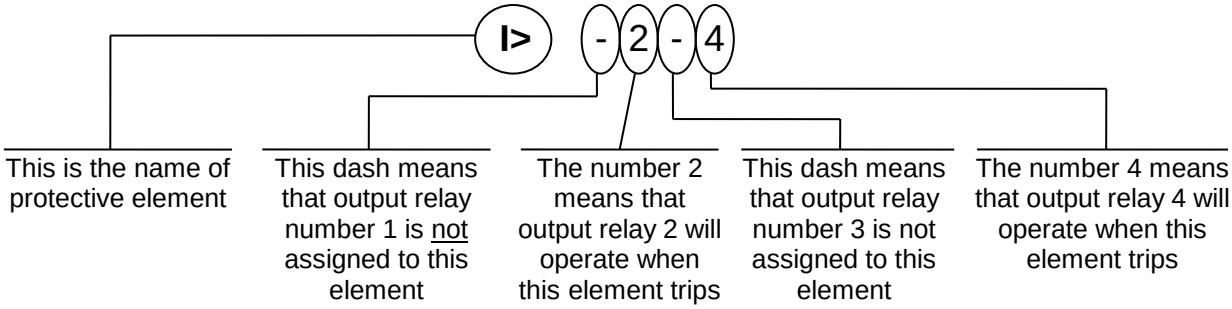
Mode PROG menu SETTINGS. (Production standard settings here under shown).

Display	Description	Setting Range	Step	Unit
xxXXXxx	Current date	DDMMMYY	-	-
xx:xx:xx	Current time	HH:MM:SS	-	-
NodAd 1	Identification number for connection on serial communication bus	1 - 250	1	1
Fn 50 **Hz**	Mains frequency	50 - 60	10	Hz
In 500**Ap**	Rated primary current of the phase C.Ts.	1 - 9999	1	Ap
On 500**Ap**	Rated primary current of the C.Ts. or of the tore C.T. detecting earth fault current	1 - 9999	1	Ap
Im 1.0**In**	Motor full-load current (p.u. of phase C.Ts. rated current)	0.1 – 1.5	0.01	In
Ist 6**Im**	Motor start-up current (p.u. of motor full load current)	0.5 – 10	0.1	Im
tst 5**s**	Motor starting time	1 – 120	1	s
ITr0.5**Ist**	Switch-over current of motor starter (p.u. of motor starting current)	Dis – 0.1 – 1	0.1	Ist
tTr 6**s**	Max switch-over time from reduced to full voltage operation during motor starting.	0.5 – 50	0.1	s

Display	Description	Setting Range	Step	Unit
AUTOSET? + ENTER	Automatic setting of all the following parameters computed on the base of the setting of the previous parameters			
tm 34**min**	Thermal time constant of motor while running ; **tm** is computed to allow at least one restarting with the motor at its rated full load temperature	1 - 60	1	min
to/tm 3	Steady/running motor thermal time constant	1 - 10	1	1
Ta/n 90**%**	Prealarm motor heating level (% of motor full-load temperature rise)	50 - 110	1	%
Ts/n100**%**	Motor restart heating level	40 - 100	1	%
Ib1.05**Im**	Rated maximum continuous motor overload	1 – 1.3	0.01	Im
StNo 6	Max. No of startings allowed within the time tStNo	Dis - 1 - 60	1	-
tStNo60**m**	Time into which the StNo is counted	1 - 60	1	m
tBSt 12**m**	Restart inhibition time after tripping of the function StNo (Rm = restart inhibited until manual RESET is operated)	1 - 60 – Rm	1	min
ILR 2**Im**	Trip level of Locked Rotor function (activated after 2tst from motor start)	Dis - 1 - 5	0.1	Im
tLR 5**s**	Trip time delay of LR element during run	1 – 25	1	s
Is> 0.3**Im**	Trip level of inverse time current unbalance protection element	Dis-0.1-0.8	0.1	Im
tIs> 4**s**	Trip time delay of inverse time current unbalance protection when I2=Im	1 - 8	1	s
I< 0.2**Im**	Trip level of undercurrent (no-load running) element	Dis-0.15-1	0.01	Im
I> 2**Ist**	Trip level of phase overcurrent element	Dis - 1 - 5	0.1	Ist
tI> 0.1**s**	Trip time delay of phase overcurrent element	0.05 - 1	0.01	s
Uo> 20**V**	Minimum level of residual voltage for directional operation of the Earth Fault element.	2 - 25	1	V
αo 90°	Max sensitivity displacement angle of the Earth Fault directional element.	0 – 359 - Dis	1	°
O>0.1%**On**	Trip level of earth fault element	Dis - 0.1 - 4	0.1	%On
tO> 0.2**s**	Trip time delay of earth fault element	0.05 - 5	0.01	s
tBO 0.15**s**	Maximum energization time of the output relays associated to the instantaneous functions I> and/or O> (Blocking output with safety disactivation)	0.05 - 0.5	0.01	s
RTD OFF	Enabling of the input 1 – 14 for operation of RTD function	OFF – ON	-	-
SpC OFF	Enabling of input 1 – 3 for operation of the Speed Control function	OFF – ON	-	-
Tsyn Dis **m**	Clock synchronisation Time Expected time interval between sync. signal.	5 - 60 - Dis	5-10 15-30 60-Dis	m

The setting Dis indicates that the function is disactivated.

12.2 - PROGRAMMING THE CONFIGURATION OF OUTPUT RELAYS



Mode PROG menu F→RELAY (Settings out of production are here under shown).
The key "**+**" operates as cursor; it moves through the digits corresponding to the four relays programmable for any functions in the sequence 4-3-2-1-L-K-J-I-H-G-F-E-D-C-B-A (4=Relay R4 etc.) and makes start flashing the information actually present in the digit. The information present in the digit can be either the number/letter of the relay (if this was already associated to the function actually on programming) or a dot (-) if this place was not yet addressed.

Display		Description		Only for Version **MM30-DKX**
T>	---1	Overload tripping	operates relay R1, R2, R3, R4	RA,RB→RL
Ta	----	Overload prealarm tripping	operates relay R1, R2, R3, R4	RA,RB→RL
ITr	----	Starting switch-over tripping	operates relay R1, R2, R3, R4	RA,RB→RL
StNo	---1	Start No limitation tripping	operates relay R1, R2, R3, R4	RA,RB→RL
ILR	---1	Locked Rotor tripping	operates relay R1, R2, R3, R4	RA,RB→RL
tI2>	---1	Time delayed unbalance tripping	operates relay R1, R2, R3, R4	RA,RB→RL
I<	----	No load running tripping	operates relay R1, R2, R3, R4	RA,RB→RL
I>	----	Instantaneous overcurrent tripping	operates relay R1, R2, R3, R4	RA,RB→RL
tI>	---2	Time delayed overcurrent tripping	operates relay R1, R2, R3, R4	RA,RB→RL
O>	----	Instantaneous earth fault tripping	operates relay R1, R2, R3, R4	RA,RB→RL
tO>	---2	Time delayed earth fault tripping	operates relay R1, R2, R3, R4	RA,RB→RL
RT	----	Remote trip command (input 1-2)	operates relay R1, R2, R3, R4	RA,RB→RL
1ϕ	---1	Time delayed Phase loss tripping	operates relay R1, R2, R3, R4	RA,RB→RL

13. MANUAL AND AUTOMATIC TEST OPERATION

13.1 Mode "TESTPROG" subprogram "W/O TRIP"

Operation of the yellow key activates a complete test of the electronics and the process routines. All the leds are lit-on and the display shows (TEST RUN). If the test routine is successfully completed the display switches-over to the default reading (xx:xx:xx).
If an internal fault is detected, the display shows the fault identification code and the relay R5 is deenergized. This test can be carried-out even during the operation of the relay without affecting the relay tripping in case a fault takes place during the test itself.

13.2 Mode "TESTPROG" subprogram "WithTRIP"

Access to this program is enabled only if the current detected is zero (breaker open).
Pressing the yellow key the display shows "TEST RUN?". A second operation of the yellow key starts a complete test which also includes the activation of all the output relays.
The display shows (TEST RUN) with the same procedure as for the test with W/O TRIP.
Every 15 min during the normal operation the relay automatically initiates an auto test procedure (duration ≤ 10ms). If any internal fault is detected during the auto test, the relay R5 is deenergized, the relevant led is activated and the fault code is displayed.

Further operation of key SELECT instead of the TEST programs gives the indication of the version and production date of the firmware.

WARNING

Running the **WithTRIP** test will operate all of the output relays. Care must be taken to ensure that no unexpected or harmful equipment operations will occur as a result of running this test.
It is generally recommended that this test be run only in a bench test environment or after all dangerous output connections are removed.

14. MAINTENANCE

No maintenance is required. Periodically a functional check-out can be made with the test procedures described under MANUAL TEST chapter. In case of malfunctioning please contact Microelettrica Scientifica Service or the local Authorised Dealer mentioning the relay's Serial No reported in the label on relays enclosure.

WARNING

In case of Internal Relay Fault detection, proceed as here-below indicated :

- If the error message displayed is one of the following “DSP Err”, “ALU Err” ,”KBD Err” ,”ADC Err”, switch off power supply and switch-on again. If the message does not disappear send the relay to Microelettrica Scientifica (or its local dealer) for repair.
- If the error message displayed is “E2P Err”, try to program any parameter and then run “W/OTRIP”.
- If message disappear please check all the parameters.
- If message remains send the relay to Microelettrica Scientifica (or its local dealer) for repair.

15. POWER FREQUENCY INSULATION TEST

Every relay individually undergoes a factory insulation test according to IEC255-5 standard at 2 kV, 50 Hz 1min. Insulation test should not be repeated as it unusefully stresses the dielectrics.
When doing the insulation test, the terminals relevant to serial output must always be short circuited to ground. When relays are mounted in switchboards or relay boards that have to undergo the insulation tests, the relay modules must be drawn-out of their enclosures and the test must only include the fixed part of the relay with its terminals and the relevant connections. This is extremely important as discharges eventually tacking place in other parts or components of the board can severely damage the relays or cause damages, not immediately evident to the electronic components.

15. ELECTRICAL CHARACTERISTICS

APPROVAL: CE – RINA – UL and CSA approval File : E202083
REFERENCE STANDARDS IEC 60255 - EN50263 - CE Directive - EN/IEC61000 - IEEE C37

❑	Dielectric test voltage	IEC 60255-5	2kV, 50/60Hz, 1 min.		
❑	Impulse test voltage	IEC 60255-5	5kV (c.m.), 2kV (d.m.) – 1,2/50μs		
❑	Insulation resistance	> 100MΩ			

Environmental Std. Ref. (IEC 68-2-1 - 68-2-2 - 68-2-33)

❑	Operation ambient temperature	-10°C / +55°C			
❑	Storage temperature	-25°C / +70°C			
❑	Humidity	IEC68-2-3 RH 93% Without Condensing AT 40°C			

CE EMC Compatibility (EN50081-2 - EN50082-2 - EN50263)

❑	Electromagnetic emission	EN55022 industrial environment			
❑	Radiated electromagnetic field immunity test	IEC61000-4-3 ENV50204	level 3	80-1000MHz 900MHz/200Hz	10V/m 10V/m
❑	Conducted disturbances immunity test	IEC61000-4-6	level 3	0.15-80MHz	10V
❑	Electrostatic discharge test	IEC61000-4-2	level 4	6kV contact / 8kV air	
❑	Power frequency magnetic test	IEC61000-4-8		1000A/m	50/60Hz
❑	Pulse magnetic field	IEC61000-4-9		1000A/m, 8/20μs	
❑	Damped oscillatory magnetic field	IEC61000-4-10		100A/m, 0.1-1MHz	
❑	Electrical fast transient/burst	IEC61000-4-4	level 3	2kV, 5kHz	
❑	HF disturbance test with damped oscillatory wave (1MHz burst test)	IEC60255-22-1	class 3	400pps, 2,5kV (m.c.), 1kV (d.m.)	
❑	Oscillatory waves (Ring waves)	IEC61000-4-12	level 4	4kV(c.m.), 2kV(d.m.)	
❑	Surge immunity test	IEC61000-4-5	level 4	2kV(c.m.), 1kV(d.m.)	
❑	Voltage interruptions	IEC60255-4-11			
❑	Resistance to vibration and shocks	IEC60255-21-1 - IEC60255-21-2 10-500Hz 1g			

CHARACTERISTICS

❑	Accuracy at reference value of influencing factors	2% In for phase currents 0.01%On or 1%[O>] whichever greater for Earth Fault 2% +/- 10ms for times
❑	Rated Current	In = 1 or 5A - On = 1A
❑	Current overload	200 A for 1 sec; 10A continuous (5A for neutral)
❑	Burden on current inputs	Phase : 0.01VA at In = 1A; 0.2VA at In = 5A Neutral : 0.05VA at On = 1A
❑	Rated Voltage	Un = 100 – 125V
❑	Voltage overload	2 Un continuous
❑	Burden on voltage input	0,04 VA at Un
❑	Average power supply consumption	8.5 VA
❑	Output relays	rating 5 A; Vn = 380 V A.C. resistive switching = 1100W (380V max) make = 30 A (peak) 0,5 sec. break = 0.3 A, 110 Vcc, L/R = 40 ms (100.000 op.)

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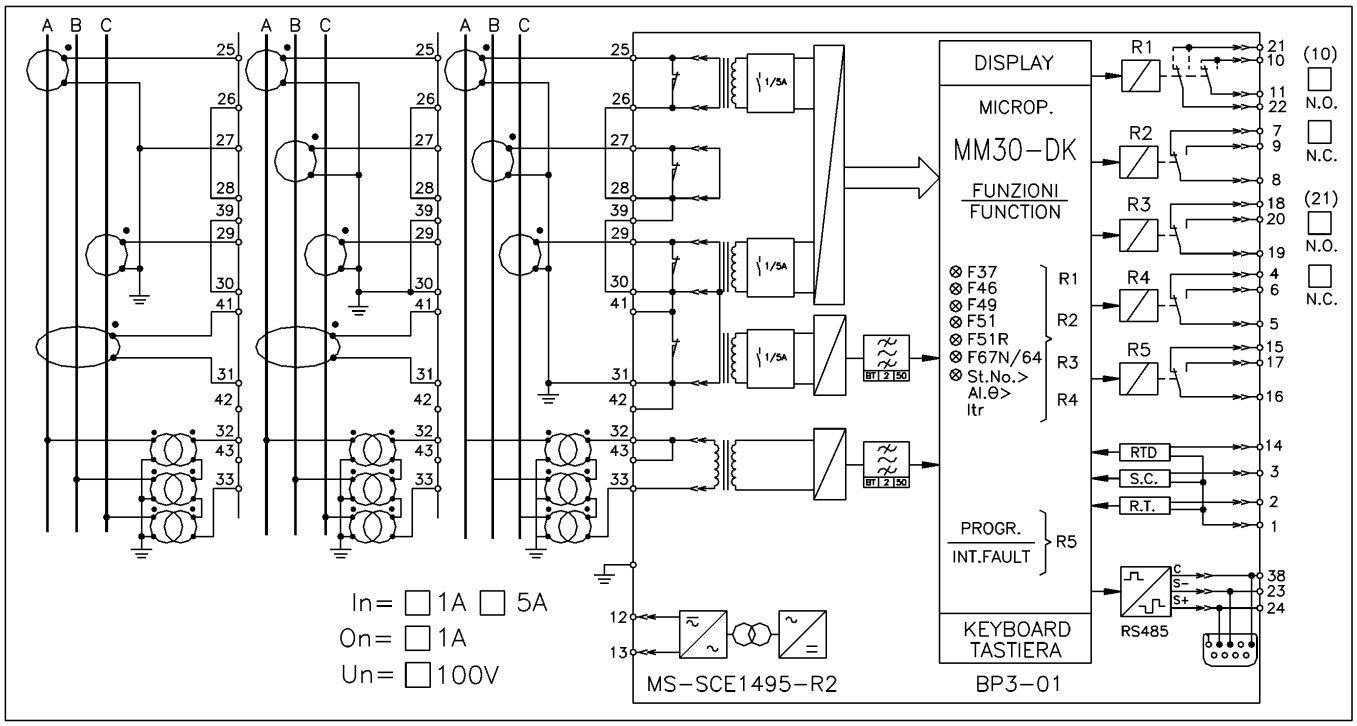
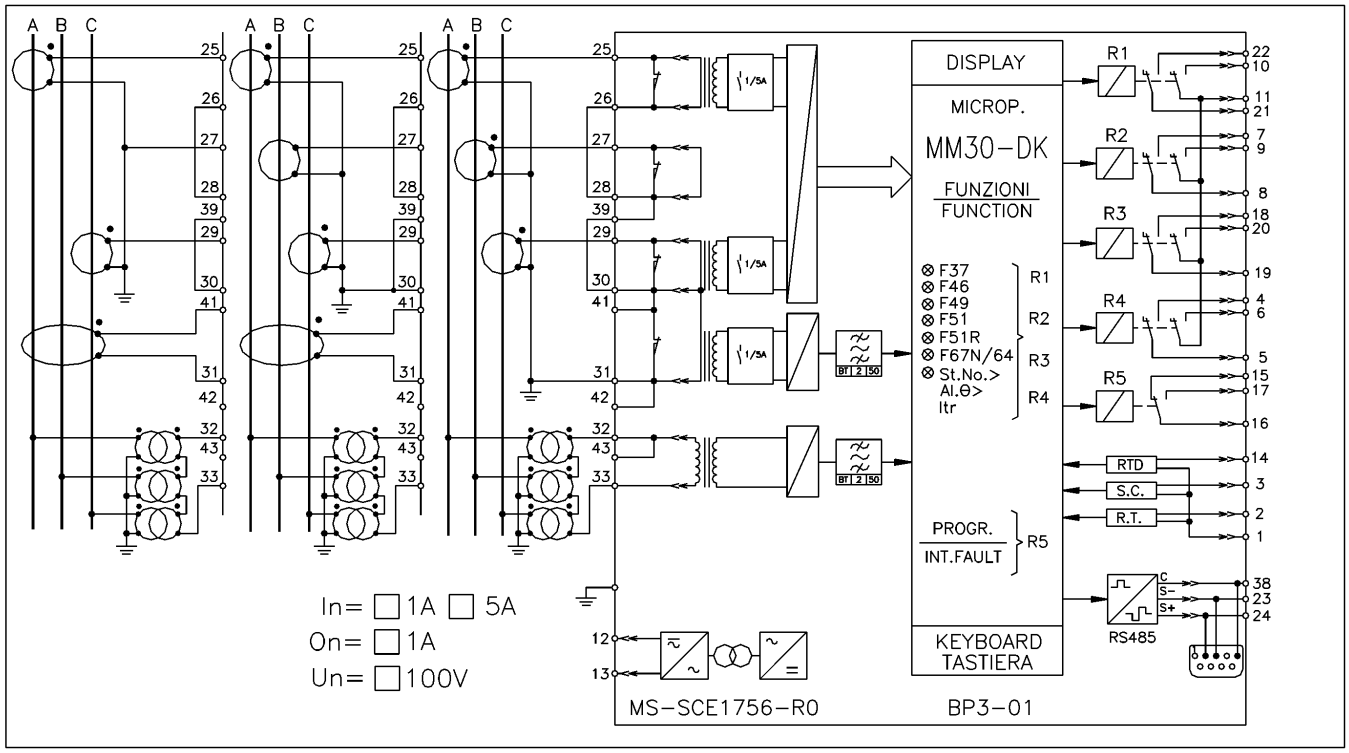
http://www.microelettrica.com **e-mail :** ute@microelettrica.com

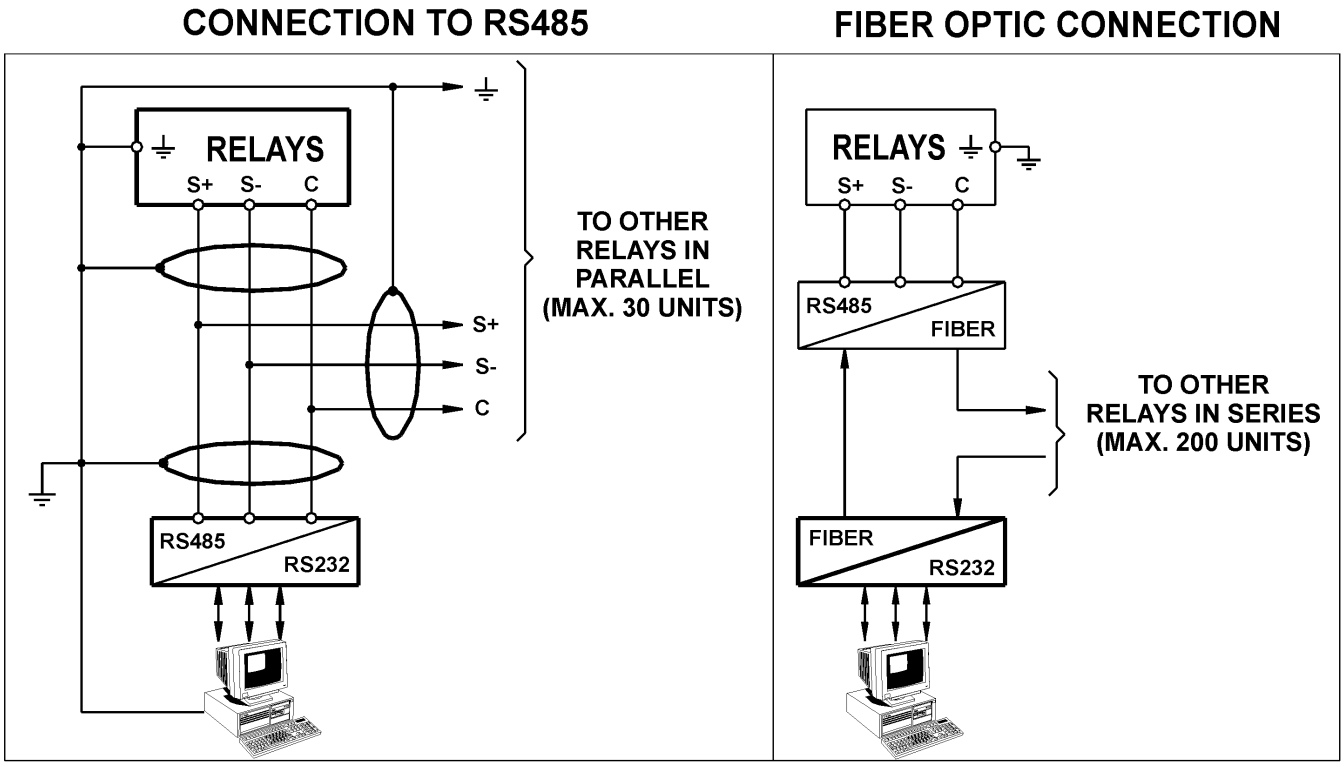
16. CONNECTION DIAGRAM (SCE1495 Rev.2 Standard Output)



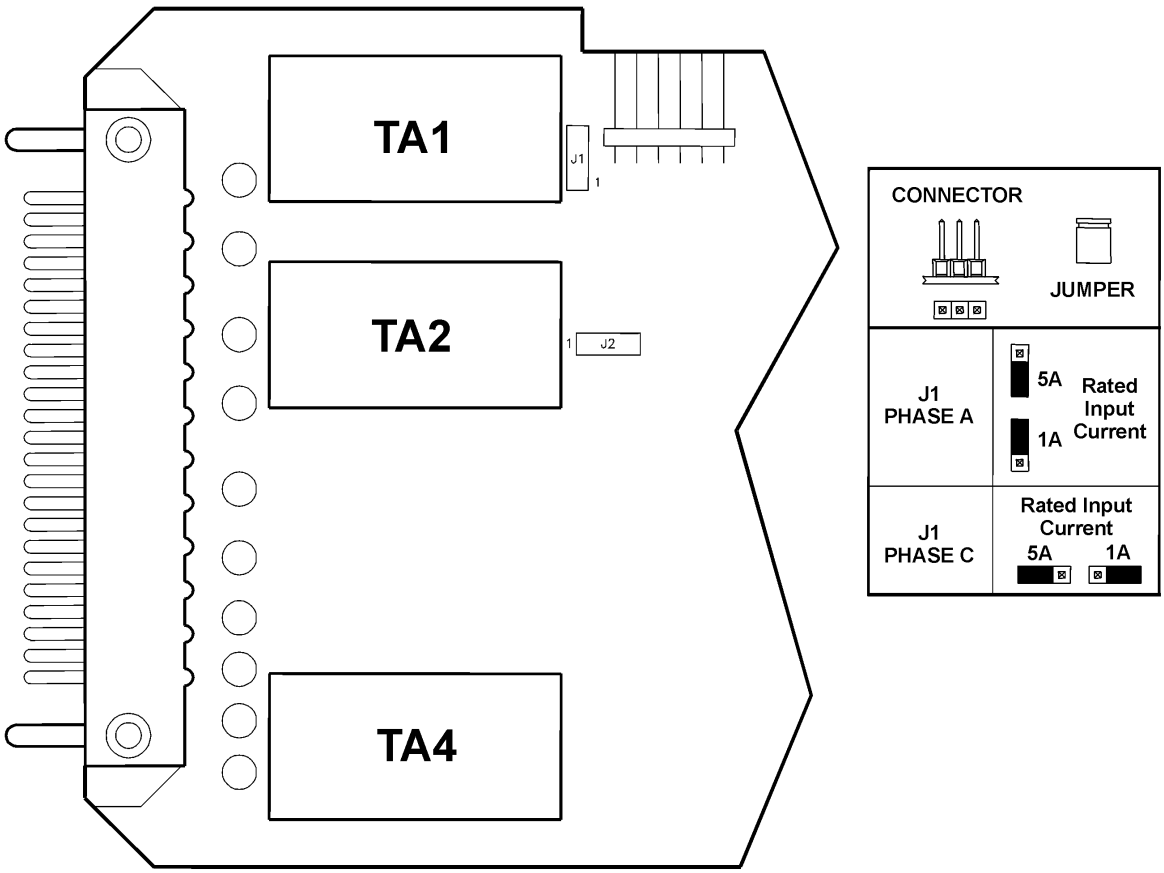
16.1 - CONNECTION DIAGRAM (SCE1756 Rev.0 Double Output)



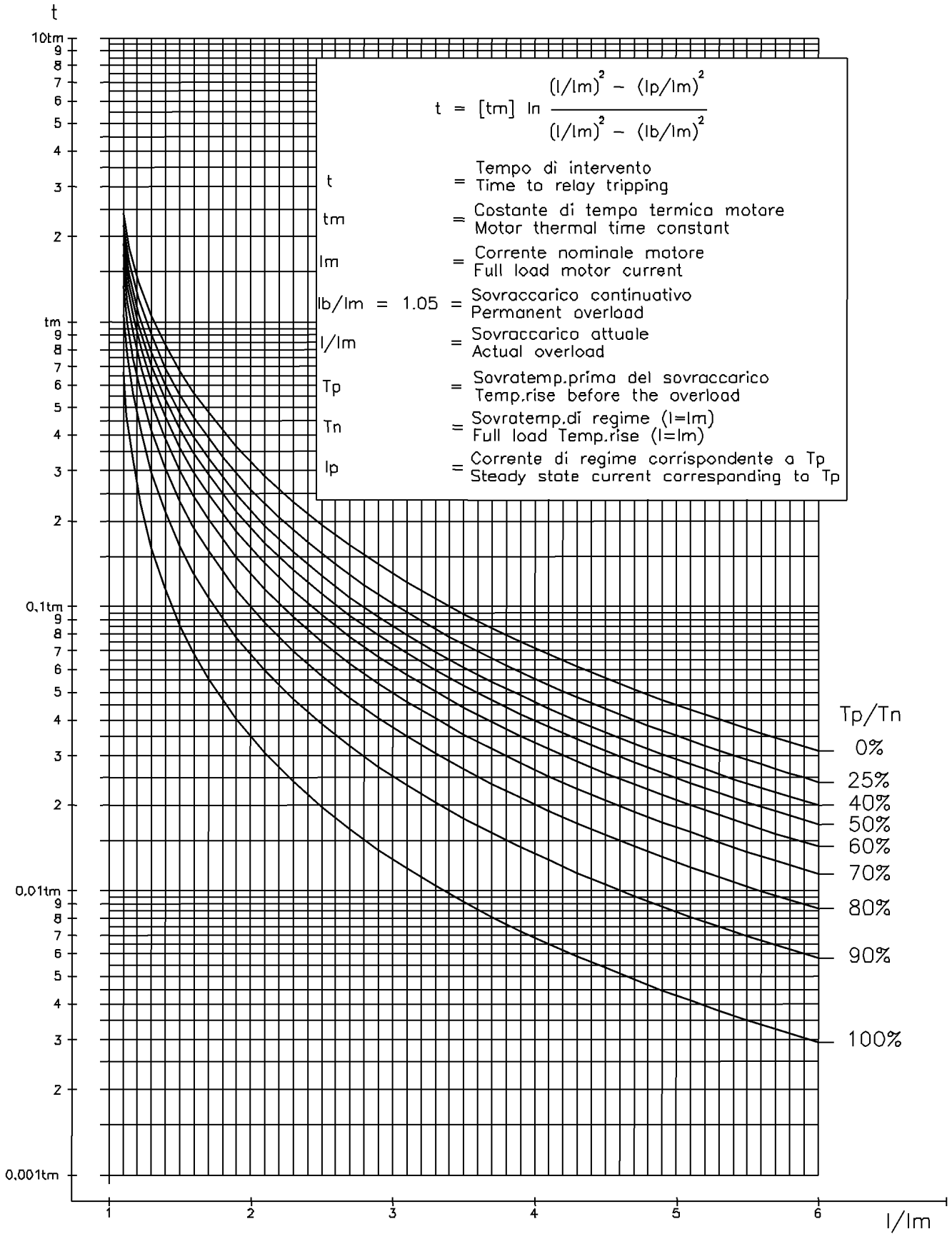
17. WIRING THE SERIAL COMMUNICATION BUS (SCE1309 Rev.0)



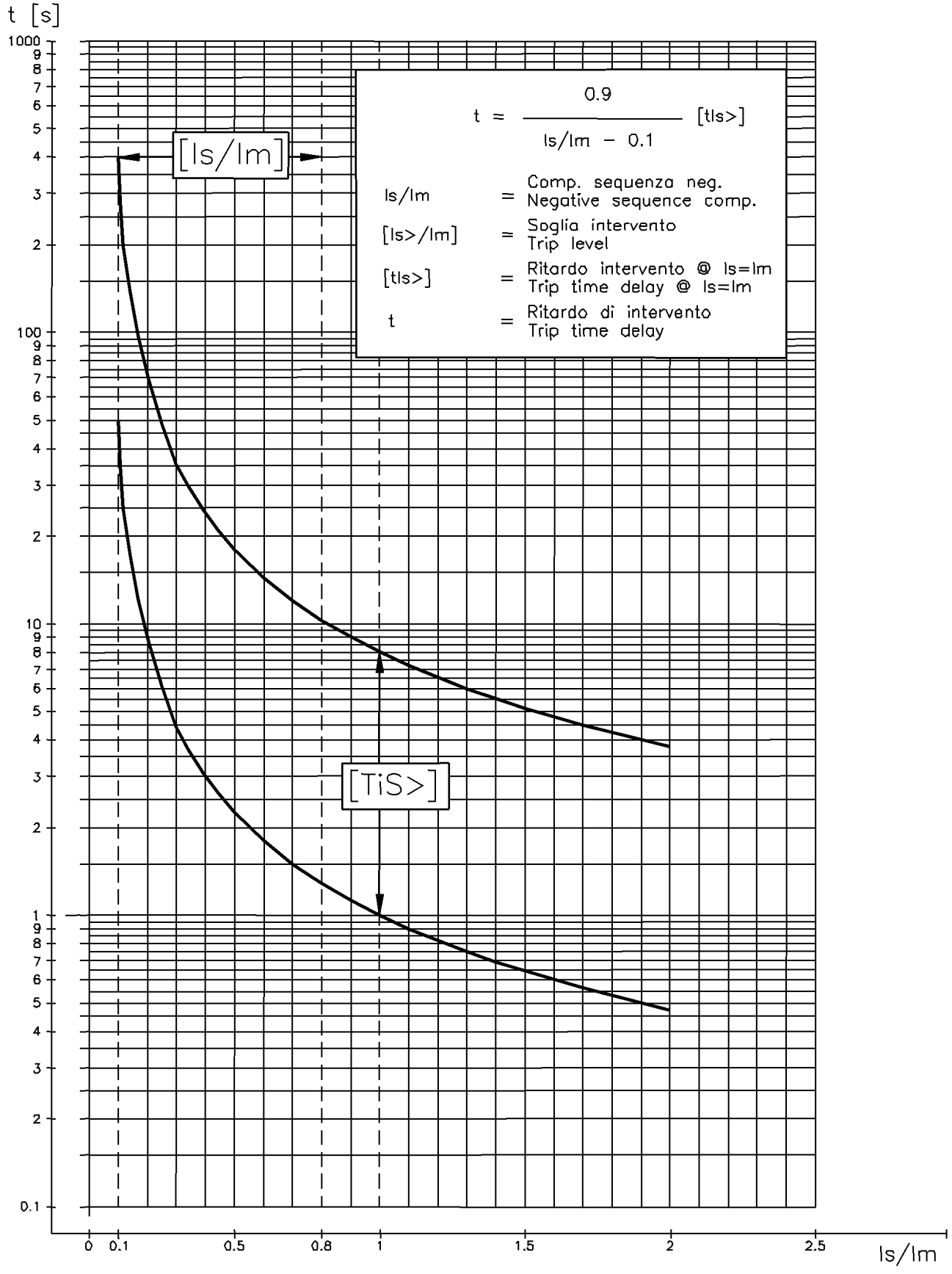
18. CHANGE PHASE CURRENT RATED INPUT 1 OR 5A



19. THERMAL IMAGE CURVES (TU0249 Rev.1)



20. INVERSE TIME UNBALANCE PROTECTION ELEMENT (TU0248 Rev.1)



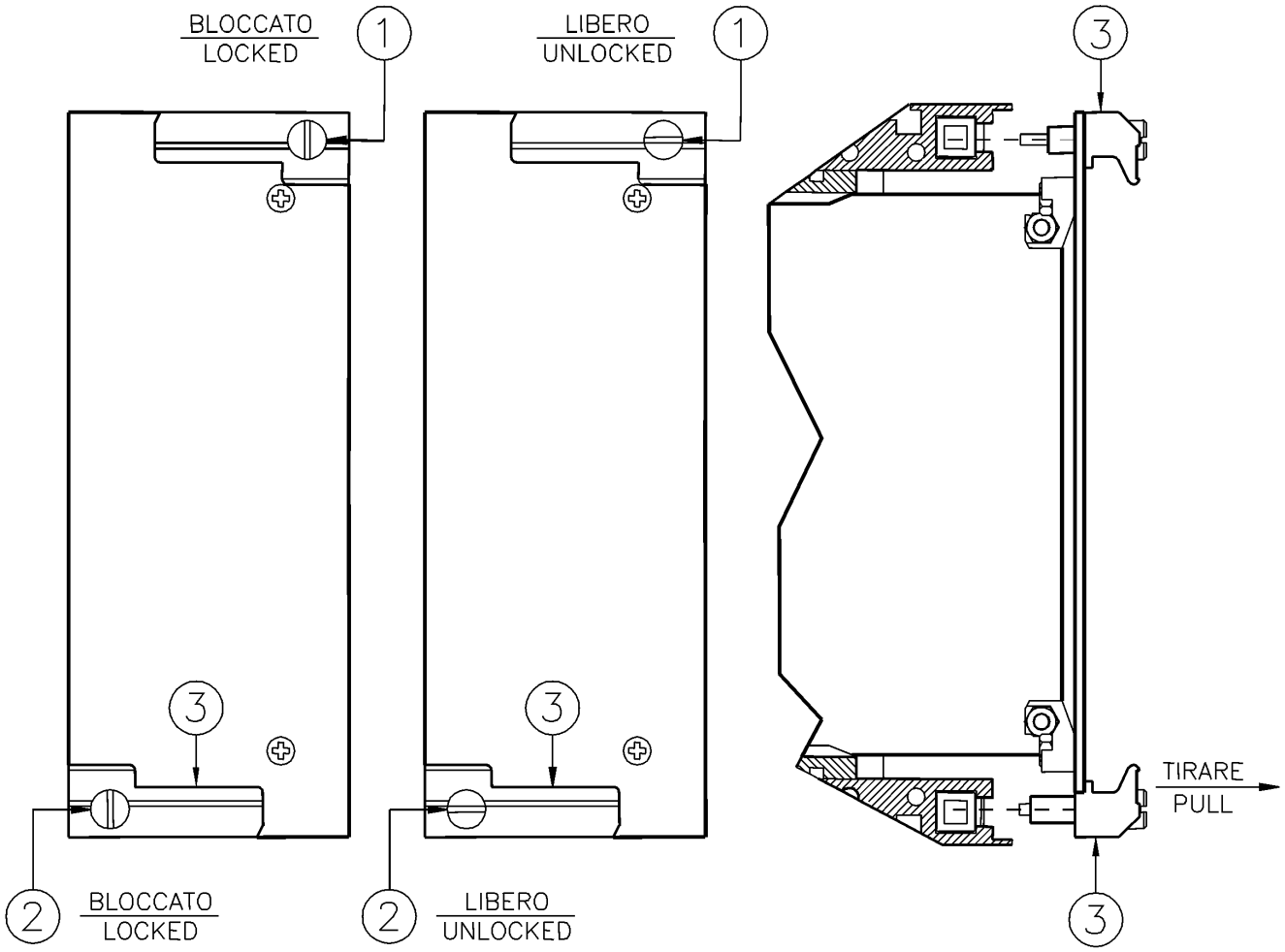
21. DIRECTION FOR PCB'S DRAW-OUT AND PLUG-IN

21.1 Draw-out

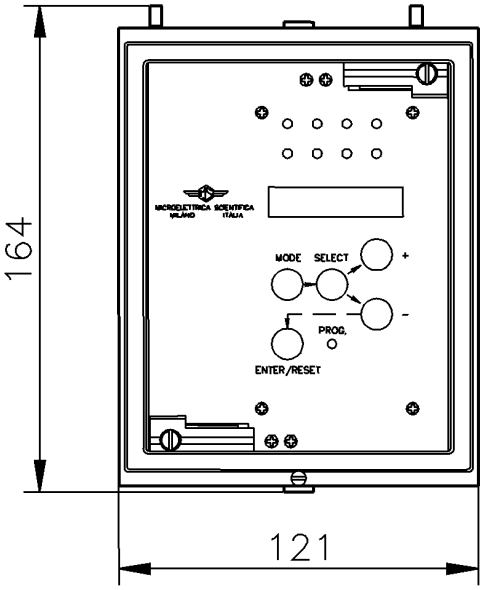
Rotate clockwise the screws ① and ② in the horizontal position of the screws-driver mark.
Draw-out the PCB by pulling on the handle ③

21.2 Plug-in

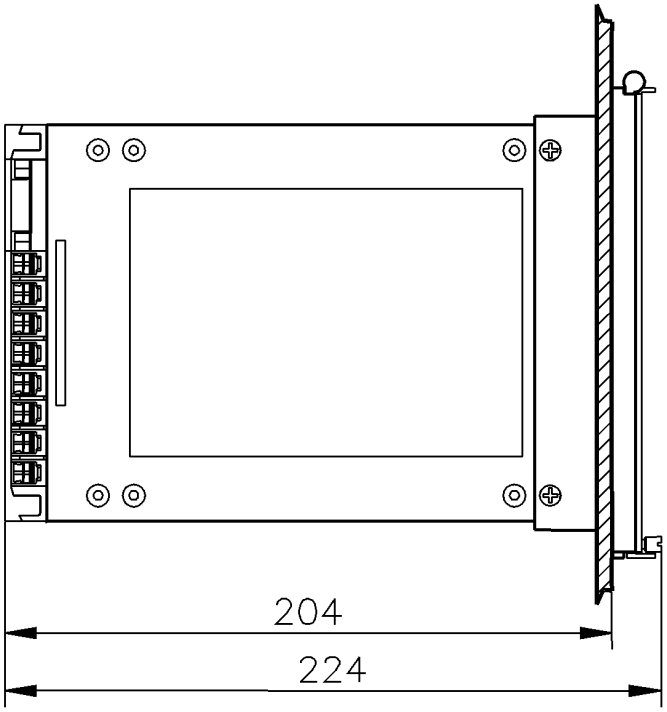
Rotate clockwise the screws ① and ②in the horizontal position of the screws-driver mark.
Slide-in the card on the rails provided inside the enclosure.
Plug-in the card completely and by pressing the handle to the closed position.
Rotate anticlockwise the screws ① and ② with the mark in the vertical position (locked).

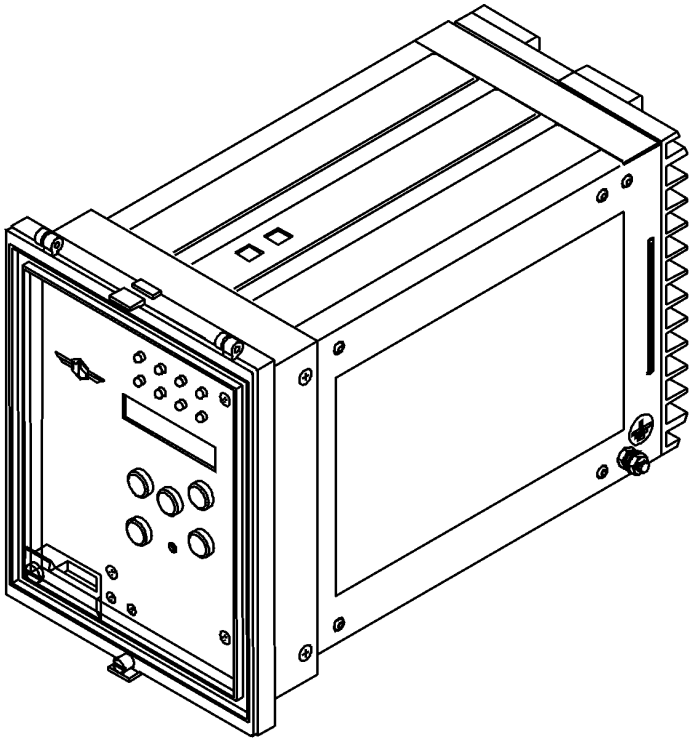


22. OVERALL DIMENSIONS / MOUNTING

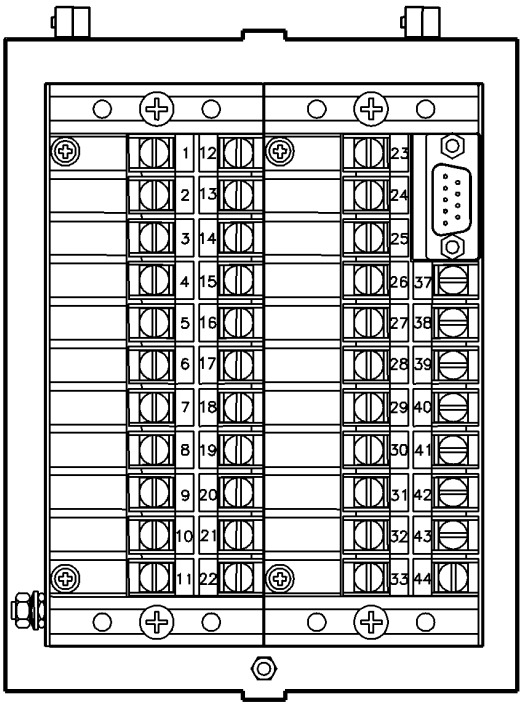


PANEL CŪT OUT 113x142 (LxH)

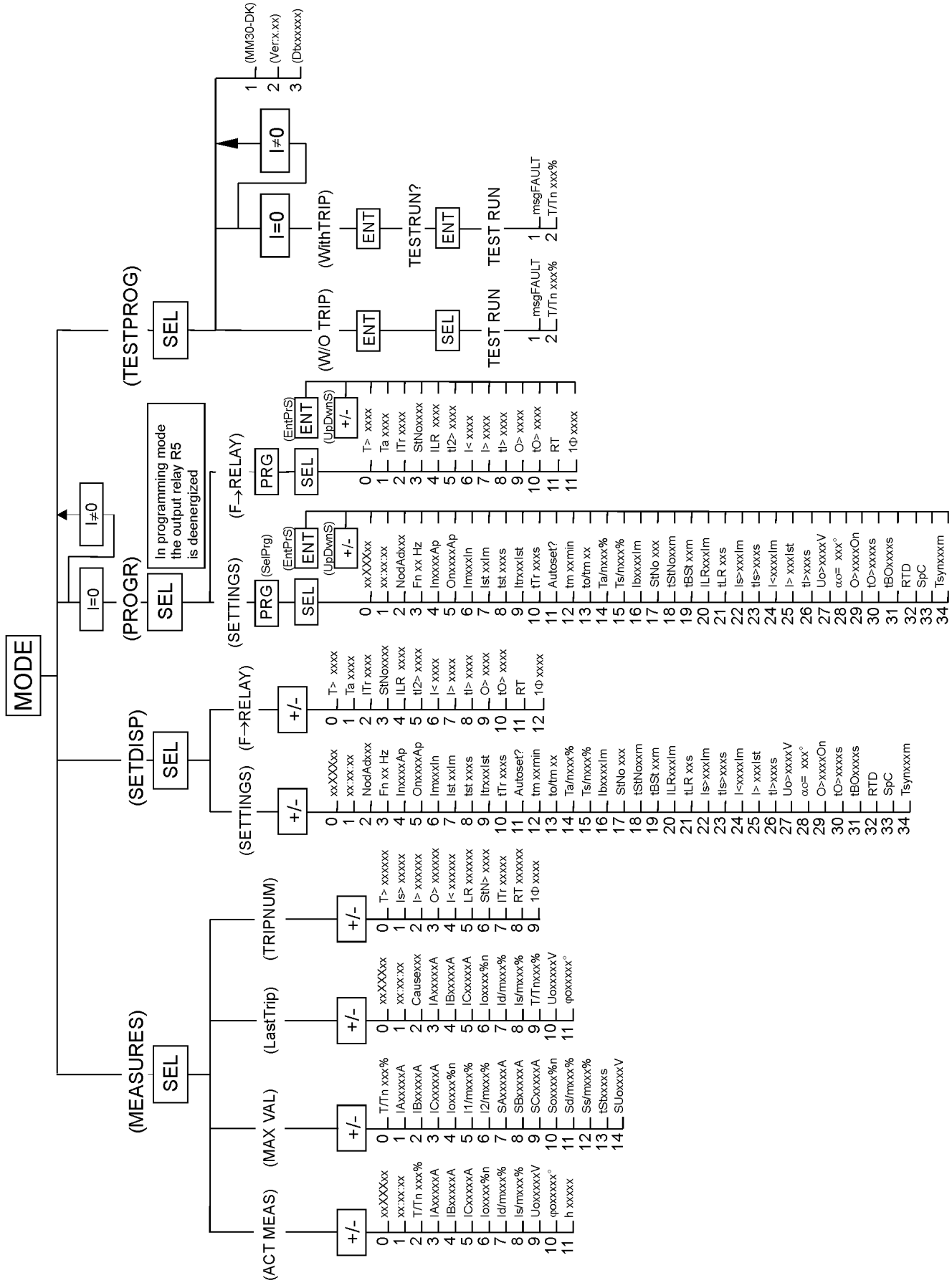




View of Rear Terminal Connection



23. KEYBOARD OPERATIONAL DIAGRAM



24. SETTING'S FORM

Relay Type	**MM30-DK**	**Station :**	**Circuit :**
Date :	**/ /**	**FW Version:**	**Relay Serial Number :**

Power Supply	☐ 24V(-20%) / 110V(+15%) a.c. 24V(-20%) / 125V(+20%) d.c.	**Rated Current In :**	☐ **1A** ☐ **5A**
	☐ 80V(-20%) / 220V(+15%) a.c. 90V(-20%) / 250V(+20%) d.c.	**Rated Current On :**	☐ **1A**
		Rated Voltage :	

RELAY PROGRAMMING

Variable	Description	Setting Range		Default Setting	Actual Setting	Test Result	
						Pick-up	Reset
xxXXXxx	Current date	Random	**-**	DDMMMYY			
xx:xx:xx	Current time	Random	**-**	HH:MM:SS			
NodAd	Identification number for serial communication bus	1	**-**	1 - 250			
Fn	Mains frequency	50	**Hz**	50 - 60			
In	Rated primary current of the phase C.Ts.	500	**Ap**	1 - 9999			
On	Rated primary current of the C.Ts	500	**Ap**	1 - 9999			
Im	Motor full-load current	1.0	**In**	0.1 – 1.5			
Ist	Motor start-up current	6	**Im**	0.5 – 10			
tst	Motor starting time	5	**s**	1 – 120			
ITr	Switch-over current of motor starter	0.5	**Ist**	Dis–0.1–1			
tTr	Max switch-over time from reduced to full voltage operation during motor starting.	6	**s**	0.5 – 50			
AUTOSET? + ENTER	Automatic setting of all the following parameters computed on the base of the setting of the previous parameters						
tm	Thermal time constant of motor while running ; **tm** is computed to allow at least one restarting with the motor at its rated full load temperature	34	**min**	1 - 60			
to/tm	Steady/running motor thermal time constant	3	**-**	1 - 10			
Ta/n	Prealarm motor heating level	90	**%**	50 - 110			
Ts/n	Motor restart heating level	100	**%**	40 - 100			
Ib	Rated maximum continuous motor overload	1.05	**Im**	1 – 1.3			
StNo	Max. No of startings allowed within the time tStNo	6	**-**	Dis-1-60			
tStNo	Time into which the StNo is counted	60	**m**	1 - 60			
tBSt	Restart inhibition time after tripping of the function StNo	12	**m**	1-60-Rm			
ILR	Trip level of Locked Rotor function	2	**Im**	Dis-1-5			
tLR	Trip time delay of LR element during run	5	**s**	1 – 25			
Is>	Trip level of inverse time current unbalance protection element	0.3	**Im**	Dis-0.1-0.8			
tIs>	Trip time delay of inverse time current unbalance protection when I2=Im	4	**s**	1 – 8			
I<	Trip level of undercurrent (no-load running) element	0.2	**Im**	Dis-0.15-1			
I>	Trip level of phase overcurrent element	2	**Ist**	Dis - 1 - 5			
tI>	Trip time delay of phase overcurrent element	0.1	**s**	0.05 - 1			
Uo>	Minimum level of residual voltage for directional operation of the Earth Fault element.	20	**V**	2 - 25			
αo	Max sensitivity displacement angle of the Earth Fault directional element.	90	°	0–359-Dis			
O>	Trip level of earth fault element	0.1	**%On**	Dis-0.1-4			
tO>	Trip time delay of earth fault element	0.2	**s**	0.05 – 5			
tBO	Maximum energization time of the output relays associated to the instantaneous functions I> and/or O>	0.15	**s**	0.05 - 0.5			
RTD	Enabling of the input 1 – 14 for operation of RTD function	OFF	**-**	OFF – ON			
SpC	Enabling of input 1 – 3 for operation of the Speed Control function	OFF	**-**	OFF – ON			
Tsyn	Clock synchronisation Time Expected time interval between sync. signal.	Dis	**m**	5-60-Dis			

CONFIGURATION OF OUTPUT RELAYS											
Default Setting						**Actual Setting**					
Protect. Element	**Output Relays**				**Description**	**Protect. Element**	**Output Relays**				
T>	1	-	-	-	Overload tripping	**T>**					
Ta	-	-	-	-	Overload prealarm tripping	**Ta**					
ITr	-	-	-	-	Starting switch-over tripping	**ITr**					
StNo	1	-	-	-	Start No limitation tripping	**StNo**					
ILR	1	-	-	-	Locked Rotor tripping	**ILR**					
tI2>	1	-	-	-	Time delayed unbalance tripping	**tI2>**					
I<	-	-	-	-	No load running tripping	**I<**					
I>	-	-	-	-	Instantaneous overcurrent tripping	**I>**					
tI>	-	2	-	-	Time delayed overcurrent tripping	**tI>**					
O>	-	-	-	-	Instantaneous earth fault tripping	**O>**					
tO>	-	2	-	-	Time delayed earth fault tripping	**tO>**					
RT	-	-	-	-	Remote trip command (input 1-2)	**RT**					
1ϕ	1	-	-	-	Time delayed Phase loss tripping	**1ϕ**					

Commissioning Engineer : _____ **Date :** _____

Customer Witness : _____ **Date :** _____