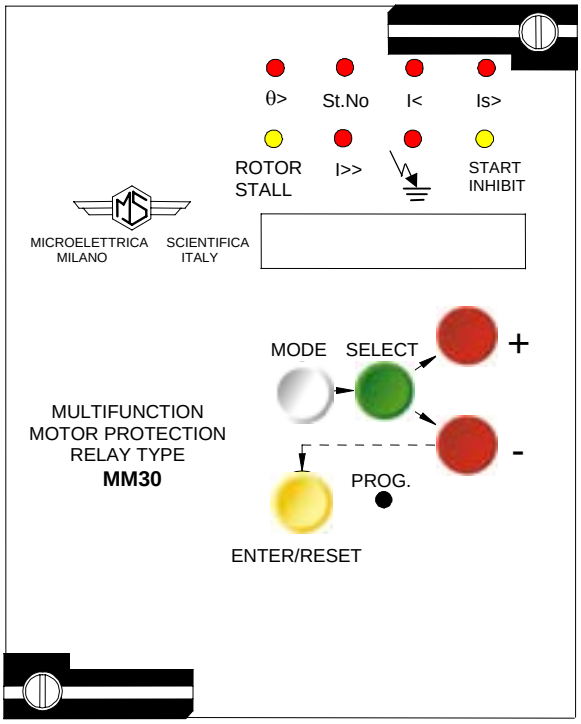
MICROPROCESSOR
MOTOR PROTECTION RELAY

TYPE

MM30

OPERATION MANUAL



CE

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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 efficiency.

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 produced 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 alterated 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 CHARACTERISTICS

Input currents are supplied to 3 current transformers: - two measuring phase current (the third current is computed as vector sum 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 an relay card)
For zero-sequence current taps for 1A and 5A input are provided on relay's terminal board.
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 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 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.
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 Input

Same as for the Phase Currents, the relay directly displays the r.m.s. value of the Zero Sequence Residual Current flowing at the Primary of the Current Transformers.

If the input of the Earth Fault element is supplied by the residual connection of the 3 phase C.Ts., we shall set for "On" the same value as "In".

If the input of the Earth Fault elements is supplied by a separated Core Balance C.T., or by another CT, "On" value will be the Rated Primary Current of this C.T., normally different from "**In**".

The rated Secondary Current of the C.Ts. can be either 1A or 5A.

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).

For the earth Fault current input 1A and 5A taps are provided on relays terminals board: 1A or 5A configuration is obtained connectively to terminals 32-33 or 32-31 (See connection Diagram § 16)

Example :

- Phase CTs 1500/5A and Core Balance CT 100/1A
- Load In = 1500A and On = 100A
- Configure CT input card with jumpers J1, J2 in the 5A position.
- Connect Earth Fault input to terminals 32-33

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 - 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*:

  tI< = (0.1-90)s, step 0.1s.

2.2.3.5 - 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.

2.2.3.6 - F64 - Earth Fault protection

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

  O> = (0.02-2)On, step 0.01On. If **O>** = DIS. the function is disactivated.

- *Trip time delay*:

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

  As for function F51, any of the output relays can also be associated to the instantaneous element of "**O>**" level.

2.2.3.7 - 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.

2.2.3.8 - 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.

2.2.3.9 - Autosetting

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

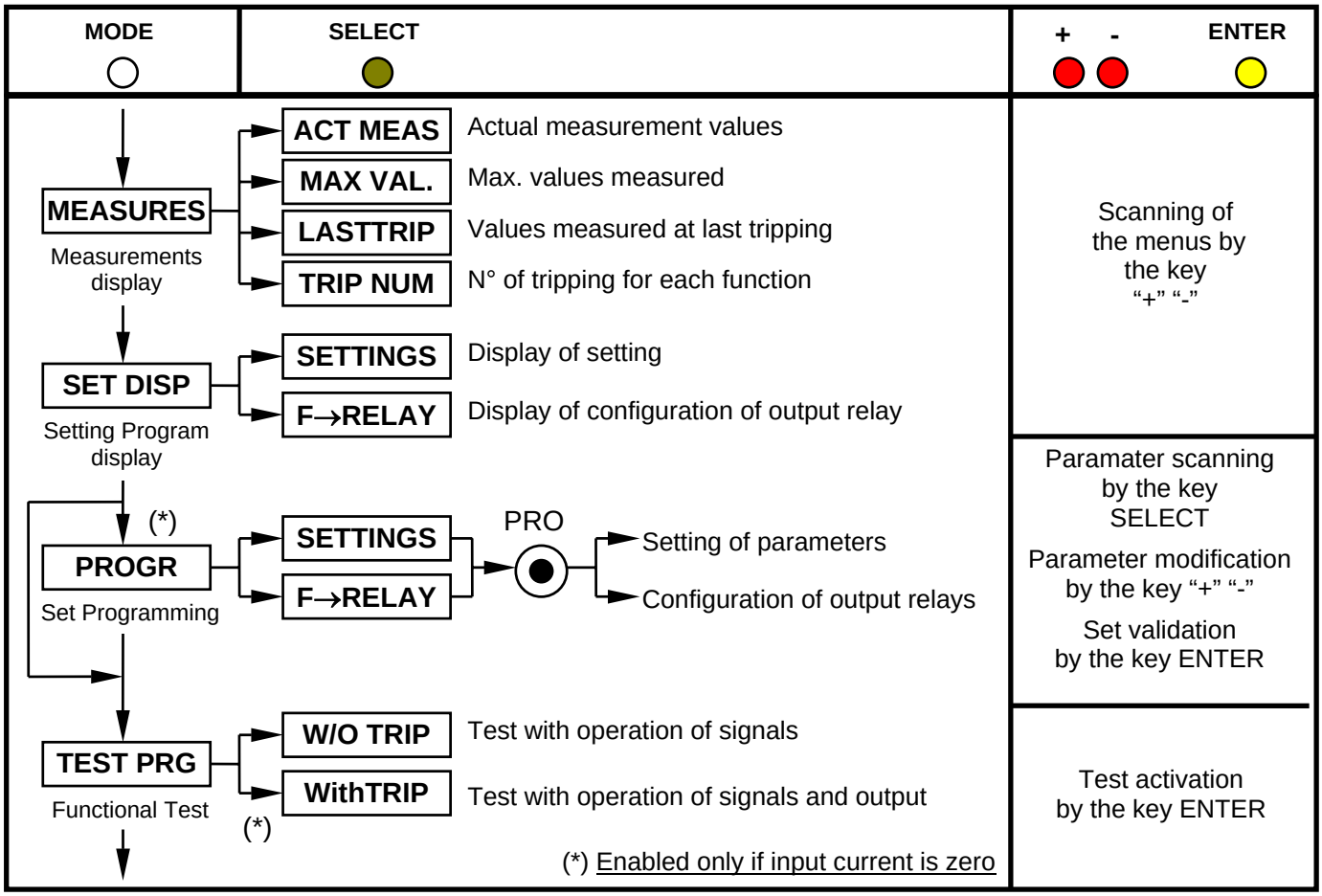
-	*System frequency*	=	**Fn**	=	50 o 60	Hz	
-	*Rated primary current of phase C.Ts.*	=	**In**	=	0-9999	A	step 1A
-	*Rated primary current of earth fault C.*T	=	**On**	=	0-9999	A	step 1A
-	*Motor rated current*	=	**Im**	=	0.1-1.5	In	step 0.01In
-	*Motor starting current*	=	**Ist**	=	0.5-9.9	Im	step0.1 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

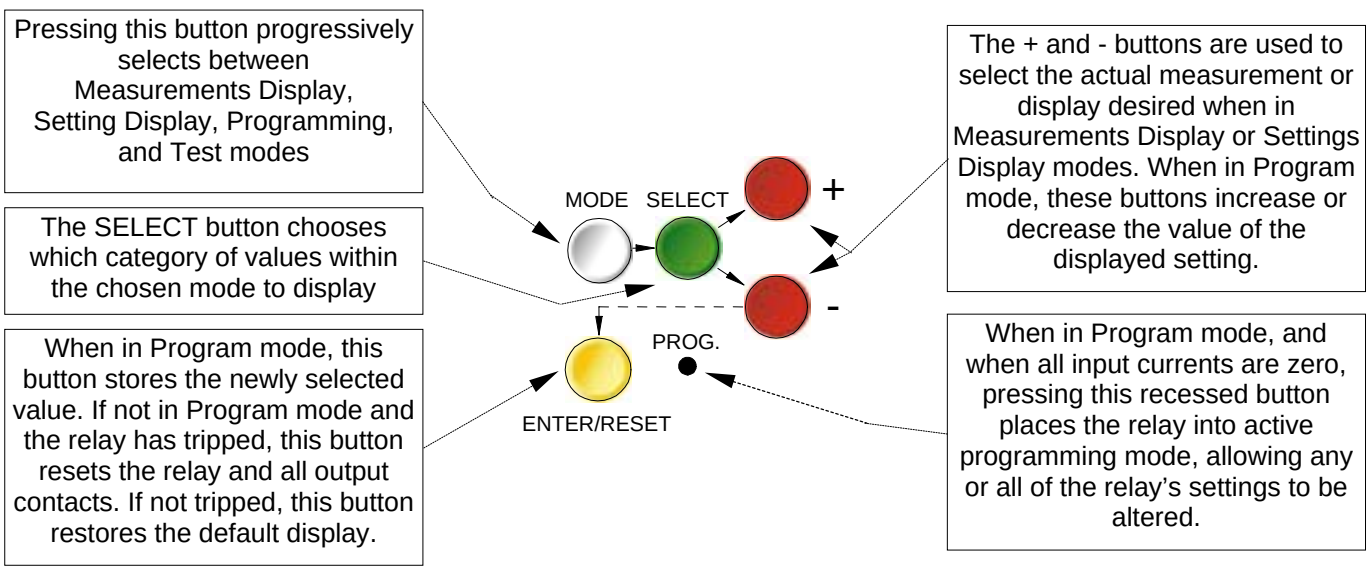
Once these settings have been programmed, the “AUTOSET” function can be activated by the key "ENTER" and all the parameters are computed and automatically set at values suitable for a normal duty of the motor.
Particularly the motor warming-up time constant “tm” is computed so that the motor, when stopped 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.

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)

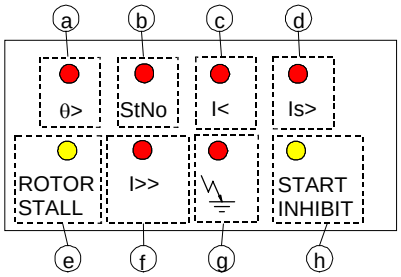
FIG.1





4. SIGNALIZATIONS

Eight signal leds (normally off) are provided:



a)	Red LED	**θ>**	❑ Flashing when the motor heating T overcomes the set alarm level [Ta]. ❑ Illuminated on over-temperature trip. – Also illuminated on activation of RTD input.
b)	Red LED	**St N°**	❑ Illuminated on tripping of the element for limitation of the number of startings.
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>**	❑ Flashing as soon as motor unbalance overpasses the set level [Is>] ❑ Illuminated on trip after delay [tIs>].
e)	Yellow LED	**ROTOR STALL**	❑ Illuminated on trip of the Locked Rotor element (I>ILR) and/or on activation of the Speed Control input SpC.
f)	Red LED	**I>>**	❑ Flashing when motor current is above the set level [I>] ❑ Illuminated on trip after delay [tI>].
g)	Red LED		❑ Flashing when earth fault current is above the set level [O>] ❑ Illuminated on trip after delay [tO>].
h)	Yellow LED	**START INHIBIT**	❑ Flashing when in PROGRAM MODE ❑ Illuminated when relay internal fault is detected.

The reset of the leds takes place as follows:

❑	Leds	a,c,d,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	b,e	❑ 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

Five output relays are available (R1, R2, R3, R4, R5)

a) - The relays **R1,R2,R3,R4** are normally deenergized (energized on trip): these output relays are user programmable and any of them can be associated to one of the MM30's functions.
One relay eventually associated to instantaneous element of the function 51 or 51N(64), after pick-up normally drops-out as soon as the tripping cause is cleared (current below the set trip level).
If the current remains above the trip level longer than the time delay programmed for the same function, the drop-out of the instantaneous relay is anyhow forced after an adjustable waiting time [tBO]. (Breaker failure protection control)
The reset after tripping of the relays associated to the time delayed functions takes place automatically as soon as the pick-up cause is cleared.

b) - The relay **R5**, normally energized, is not programmable and is deenergized on:

- Internal fault
- Power supply failure
- During the programming

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

On request (Optional) are provided three inputs activated when the relevant terminals are shorted:

- **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”

- **SpC** (terminals 1 - 3) : Speed switch
  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” ($R>2900\Omega$) (*)
  In this case activation of the input 1-14 (terminals shorted) 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"

  (*) If Pt100 thermal probes are used, calibrated accordingly.
  Please specify when ordering!

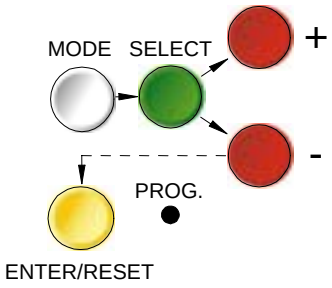
8. TEST

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 $\leq$ 4ms). 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 "MEASURES", 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
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.
Ioxxxxx**A**	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)%

NB: If no key is operated within 60 sec. the display is automatically switched to the default indication

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.
Ioxxxxx**A**	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.
Soxxxxx**A**	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**	Measure of the start time.

10.3 – LASTTRIP – Recording of the last five trippings

Display of the function which caused the tripping 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...
Causexxx	Function which caused the last tripping: **T>; Is>; I>; O>; I<; LR; StN; ITr.**
IAxxxx**In**	Current of phase A.
IBxxxx**In**	Current of phase B.
ICxxxx**In**	Current of phase C.
Ioxxxx**On**	Earth fault current.
Id/mxxx**%**	Positive sequence component of current.
Is/mxxx**%**	Negative sequence component of current.
T/Tnxxx**%**	Motor heating

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.
ITrxxxxx	Too long starting.
RTxxxx	Remote trip

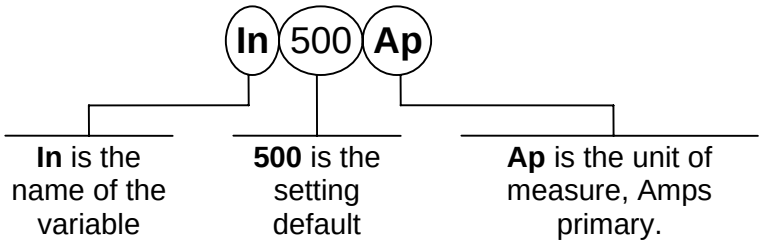
11. READING OF PROGRAMMED SETTINGS AND RELAY'S CONFIGURATION

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 relay 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 **(-----)**].
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



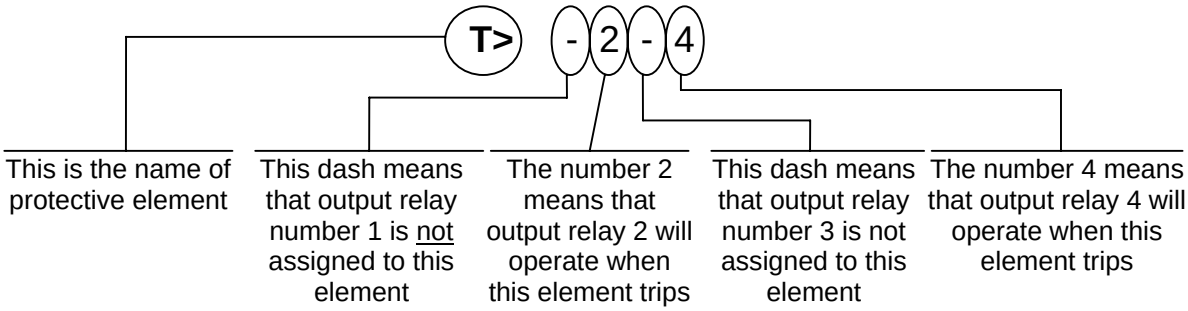
Mode PROG menu SETTINGS. (Production standard settings here under shown).

Display	Description	Setting Range	Step	Unit
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	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 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

Display	Description	Setting Range	Step	Unit
tTr 6**s**	Max switch-over time from start-up	0.5 – 50	0.1	s
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 current of the motor	1.00 – 1.30	0.05	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	Dis - 1 - 5	0.1	Im
tLR 1**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 Is=Im	1 - 8	1	s
I< 0.2**Im**	Trip level of undercurrent (no-load running) element	Dis-0.15-1	0.01	Im
tI< 3**s**	Trip time delay of undercurrent element	0.1 - 90	0.1	s
I> 2**Ist**	Trip level of overcurrent element	Dis - 1 - 5	0.1	Ist
tI> 0.1**s**	Trip time delay of overcurrent element	0.05 - 1	0.01	s
O> 0.1**On**	Trip level of earth fault element	Dis - 0.02 - 2	0.01	On
tO> 0.2**s**	Trip time delay of earth fault element	0.05 - 5	0.01	s
tBO 0.15**s**	Reset time delay of the blocking output relay	0.05 - 0.5	0.01	s
RTD OFF	Input from external thermal probe	ON - OFF	-	-
SpC OFF	Speed switch control	ON - OFF	-	-

The setting Dis indicates that the function is disactivated.

12.2 - PROGRAMMING THE CONFIGURATION OF OUTPUT RELAYS



Mode PROG menu F→RELAY (Production standard settings here under shown).
The key "**+**" operates as cursor; it moves through the digits corresponding to the four programmable relays in the sequence 1,2,3,4,(1= relay R1, etc.) and makes start flashing the information actually present in the digit. The information present in the digit can be either the number of the relay (if this was already associated to the function actually on programming) or a dot (-) if the relay was not yet addressed.
The key "**-**" changes the existing status from the dot to the relay number or viceversa.
After programming of any function (T>, Ta, etc.), press the key ENTER to validate the configuration selected,

Display		Description	
T>	1---	Overload tripping	operates relay R1,R2,R3,R4.
Ta	-2--	Overload prealarm tripping	operates relay R1,R2,R3,R4.
ITr	----	Starting switch-over tripping	operates relay R1,R2,R3,R4.
StNo	----	Start No limitation tripping	operates relay R1,R2,R3,R4.
ILR	1---	Locked Rotor tripping	operates relay R1,R2,R3,R4.
tIs>	1---	Time delayed unbalance tripping	operates relay R1,R2,R3,R4.
I<	---4	No load running tripping	operates relay R1,R2,R3,R4.
I>	----	Instantaneous overcurrent tripping	operates relay R1,R2,R3,R4.
tI>	1---	Time delayed overcurrent tripping	operates relay R1,R2,R3,R4
O>	----	Instantaneous earth fault tripping	operates relay R1,R2,R3,R4
tO>	1---	Time delayed earth fault tripping	operates relay R1,R2,R3,R4.
RT	----	Remote trip control.	operates relay R1,R2,R3,R4.

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 (T/Tnxxx%).
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.

16. 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 measure 0,2% On 2% +/- 10ms for times
❑ Rated Current	In = 1 or 5A - On = 1 or 5A
❑ Current overload	200 A for 1 sec; 10A continuous
❑ Burden on current inputs	Phase : 0.01VA at In = 1A; 0.2VA at In = 5A Neutral : 0.03VA at On = 1A; 0.2VA at On = 5A
❑ 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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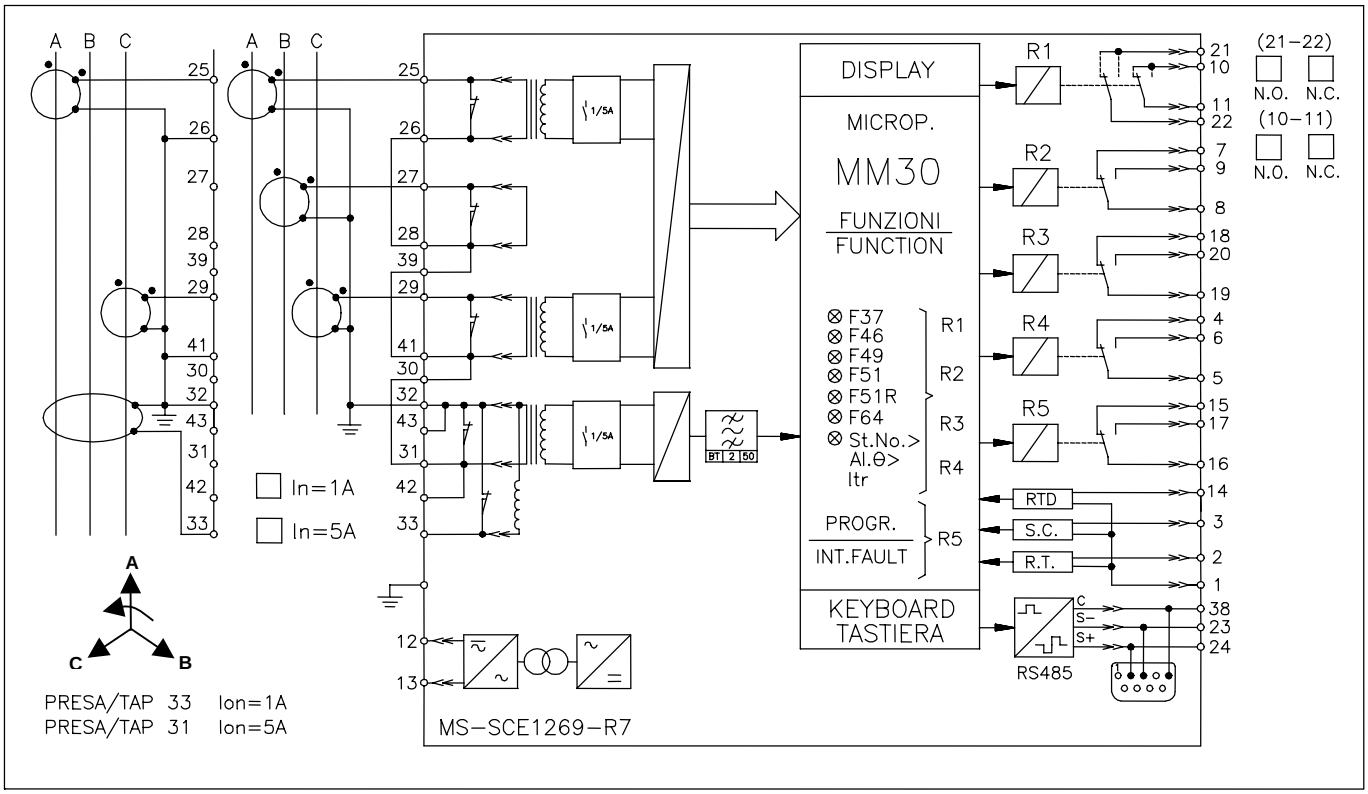
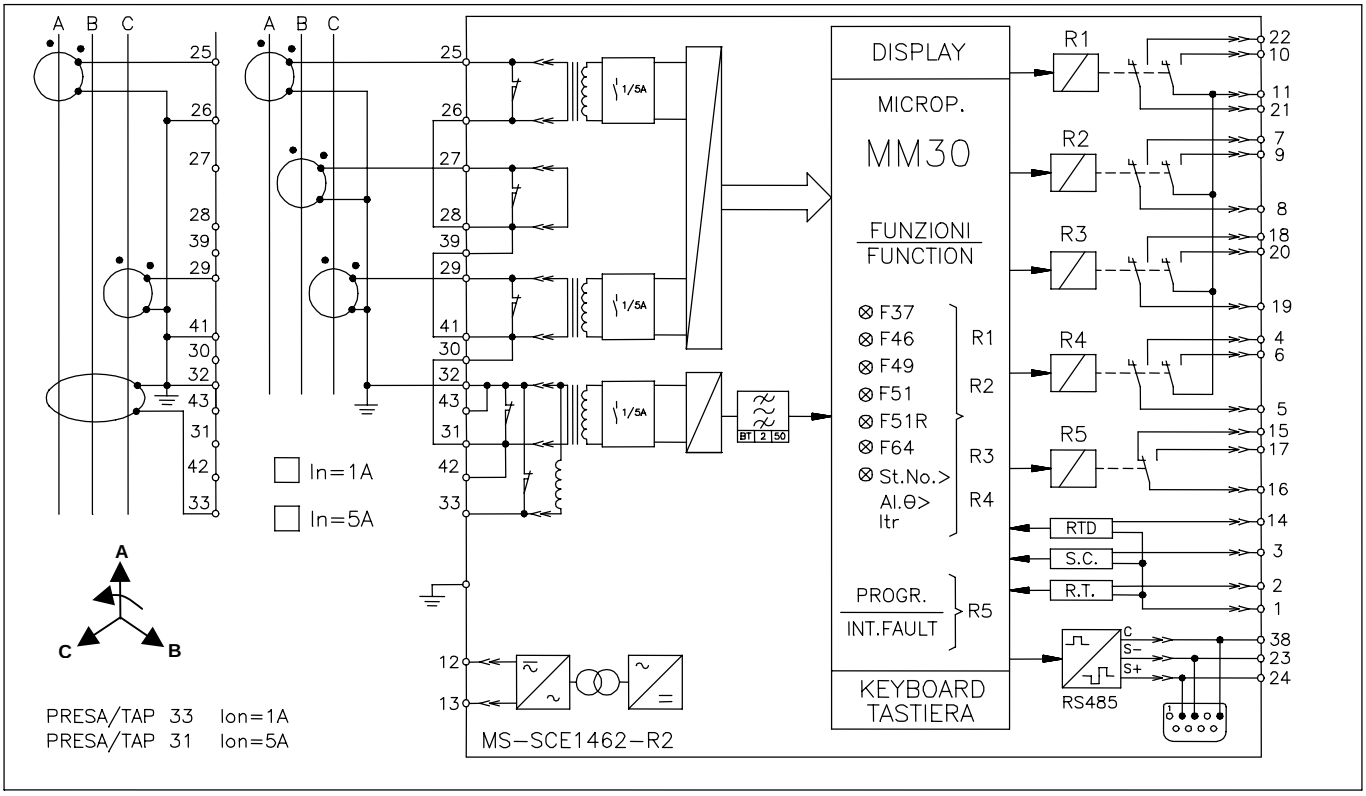
The performances and the characteristics reported in this manual are not binding and can modified at any moment without notice

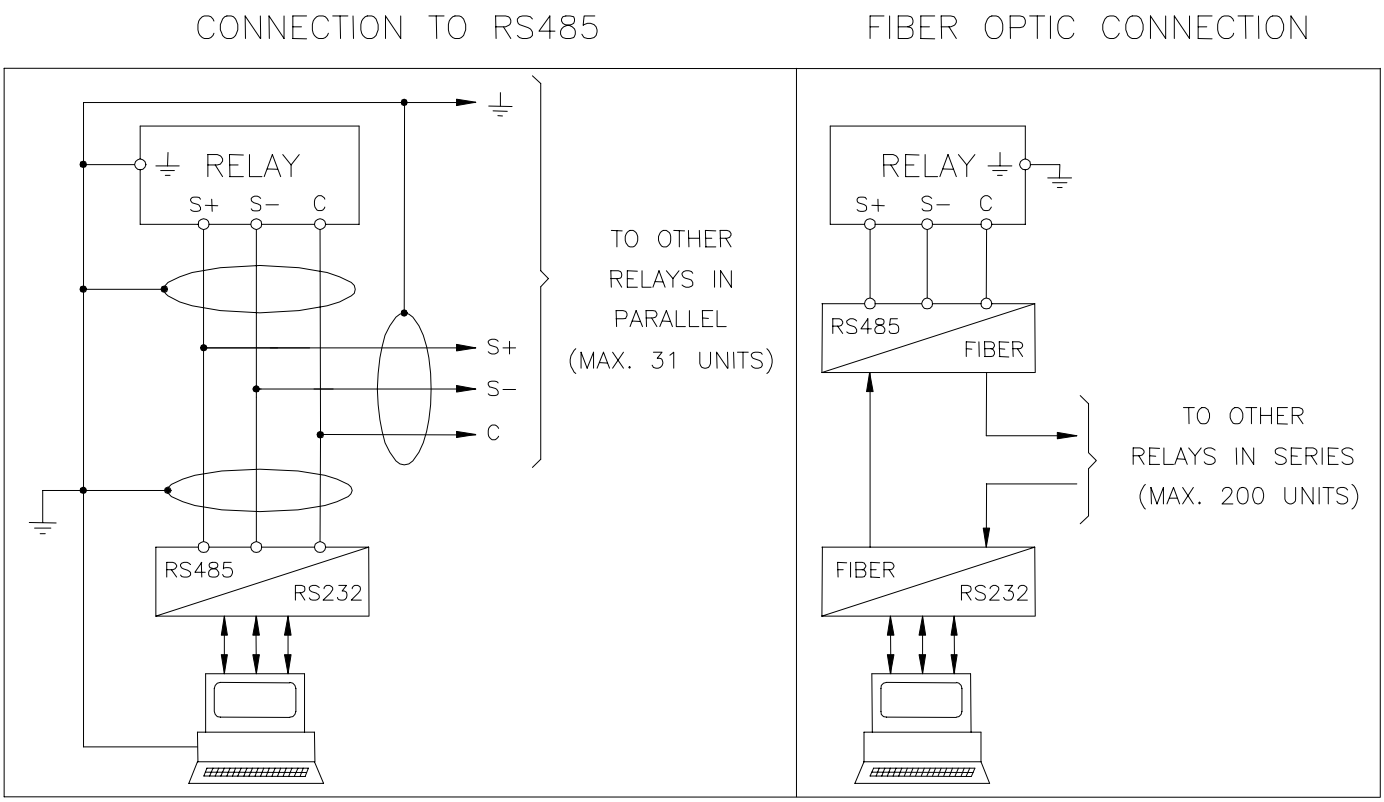
17. CONNECTION DIAGRAM (SCE1269 Rev.7 Standard Output)



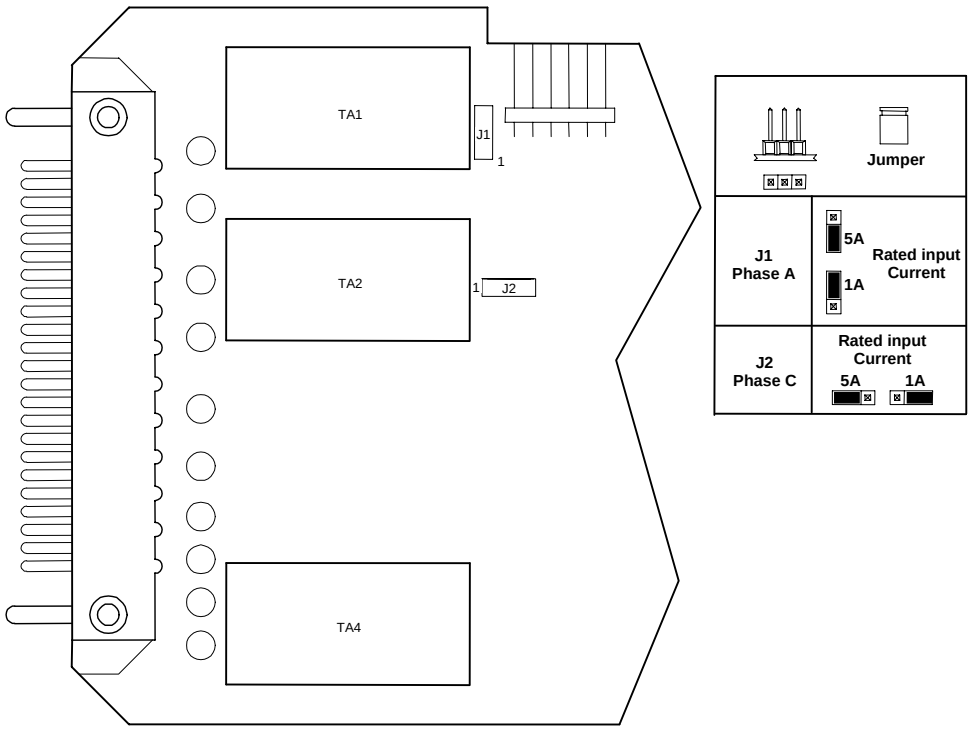
17.1 CONNECTION DIAGRAM (SCE1462 Rev.2 Double Output)



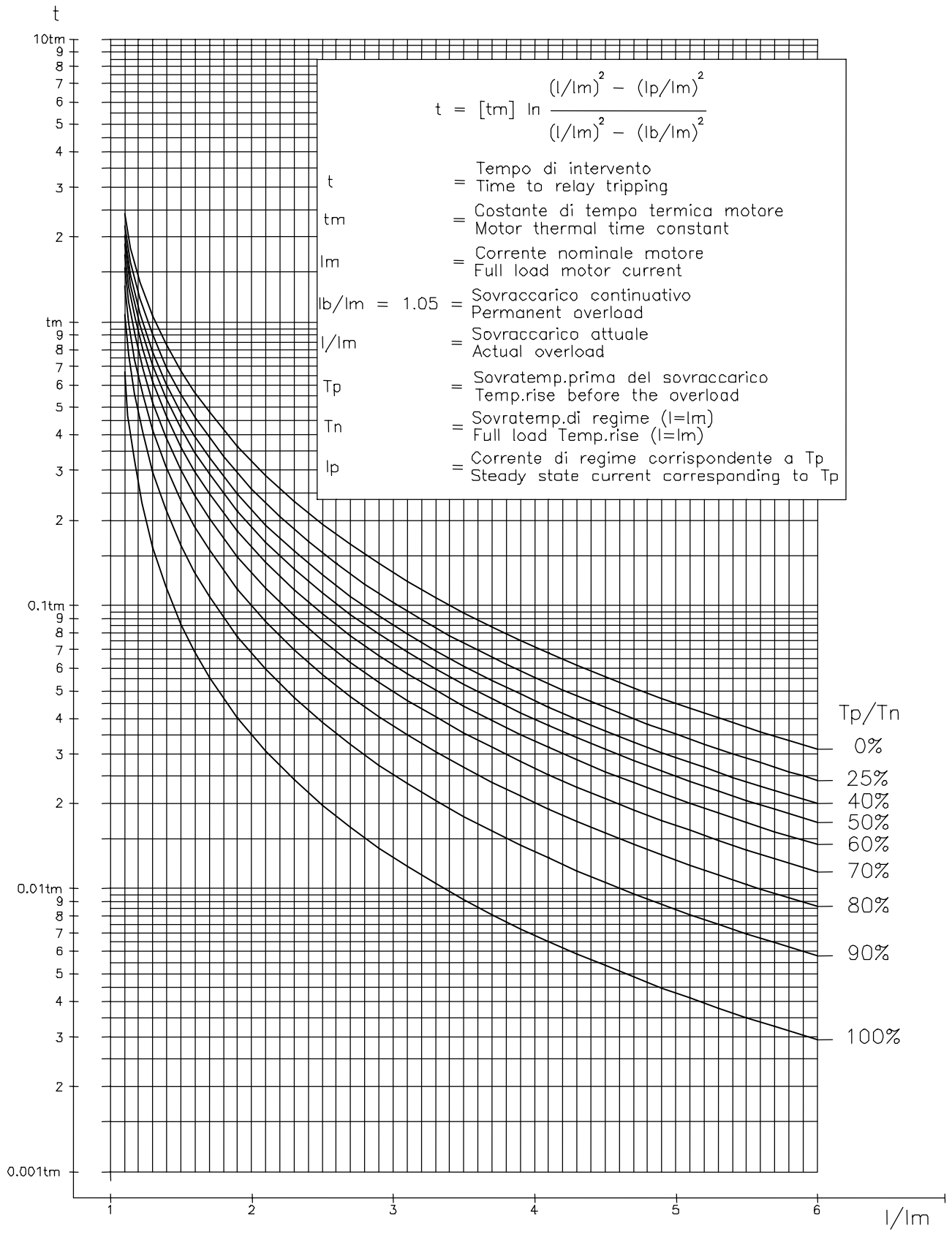
18. WIRING THE SERIAL COMMUNICATION BUS (SCE1309 Rev.0)



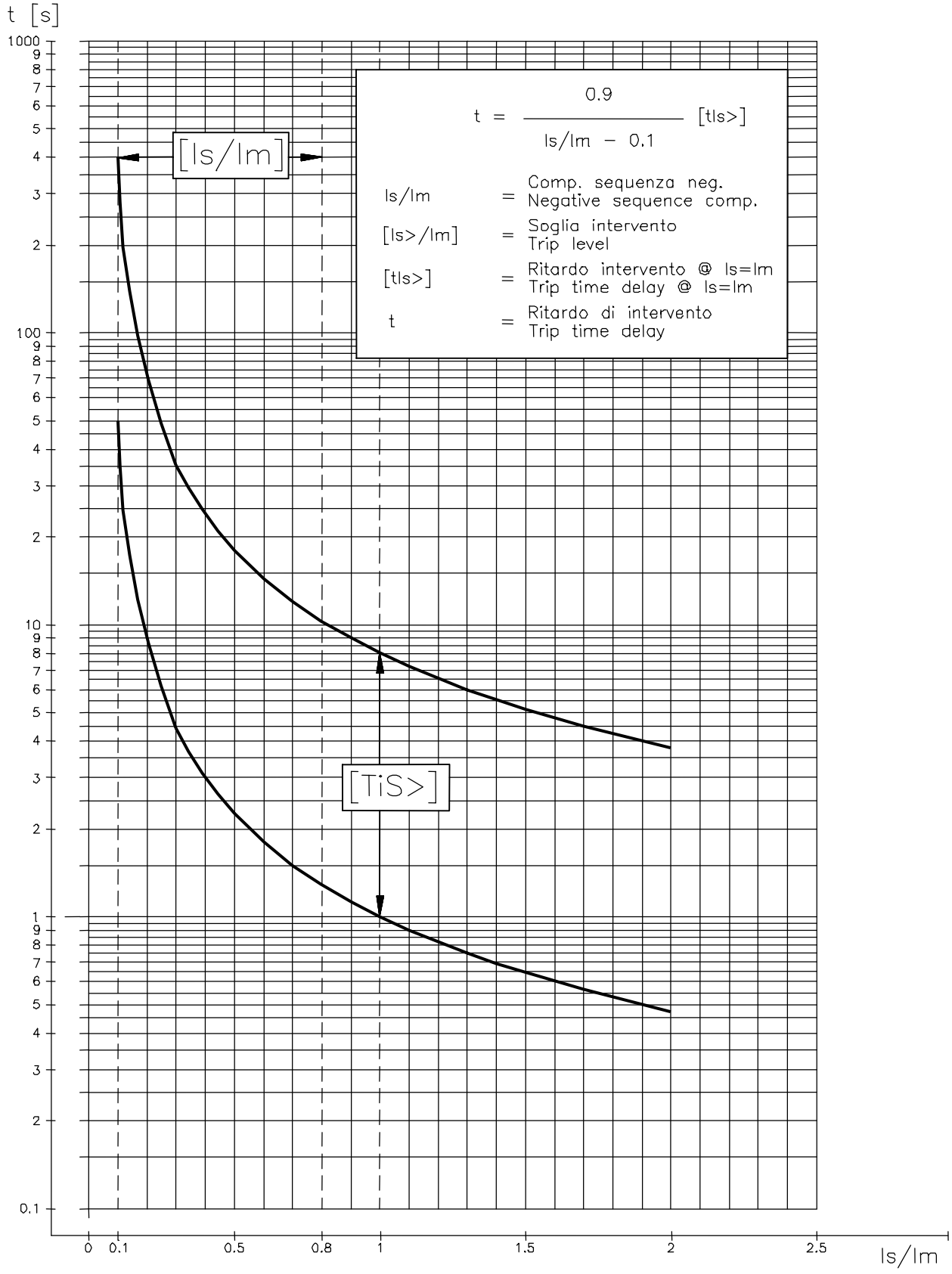
19. CHANGE PHASE CURRENT RATED INPUT 1 OR 5A



20. THERMAL IMAGE CURVES (TU0249 Rev.1)



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



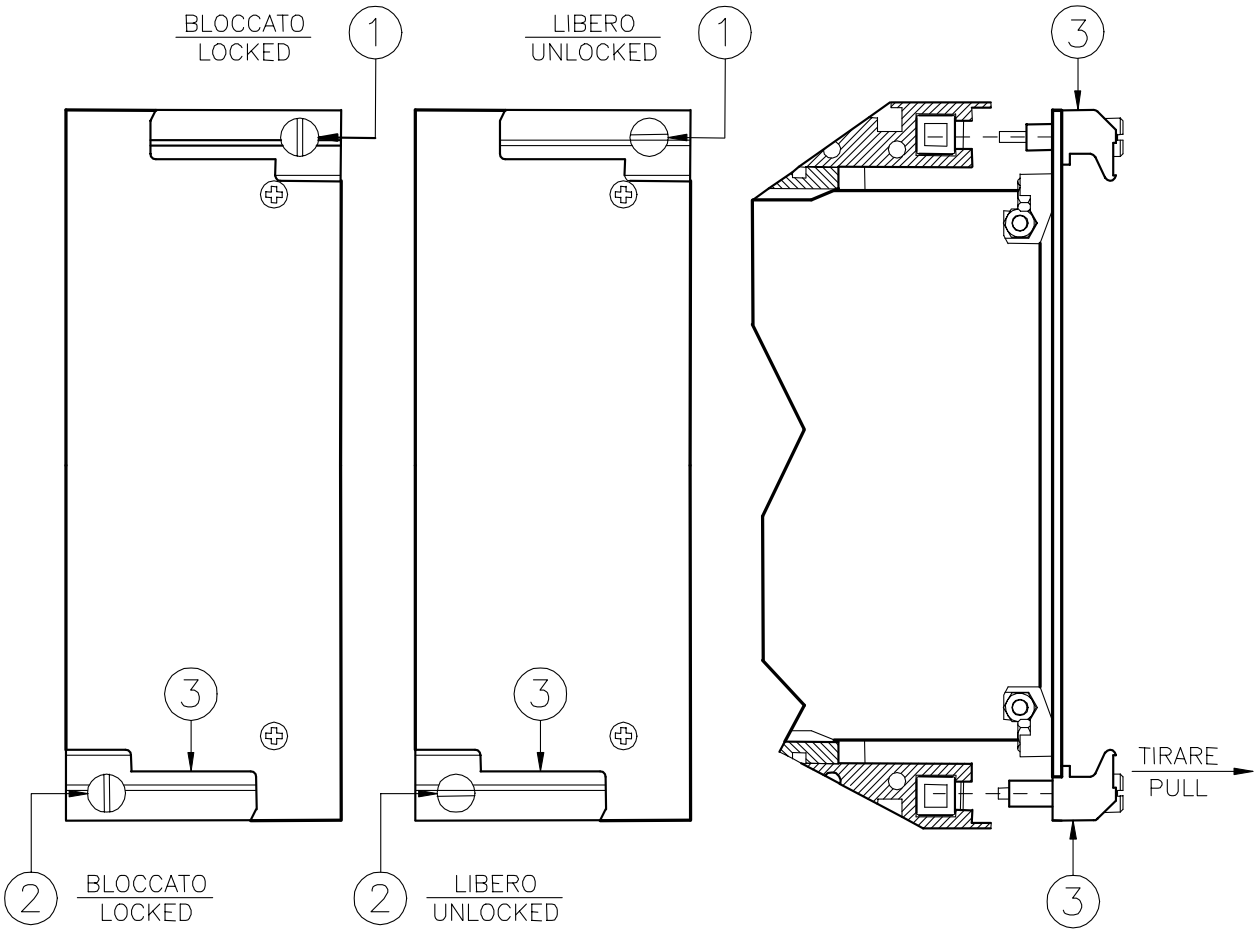
22. DIRECTION FOR PCB'S DRAW-OUT AND PLUG-IN

22.1 Draw-out

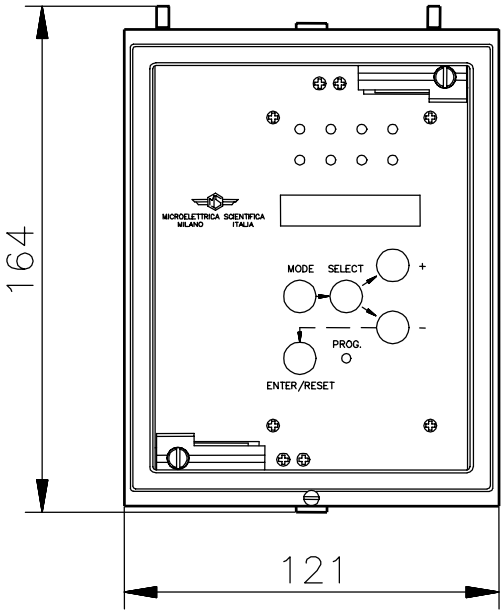
Rotate clockwise the screws ① and ② in the horizontal position of the screws-driver mark.
Draw-out the PCB by pulling on the handle ③

22.2 Plug-in

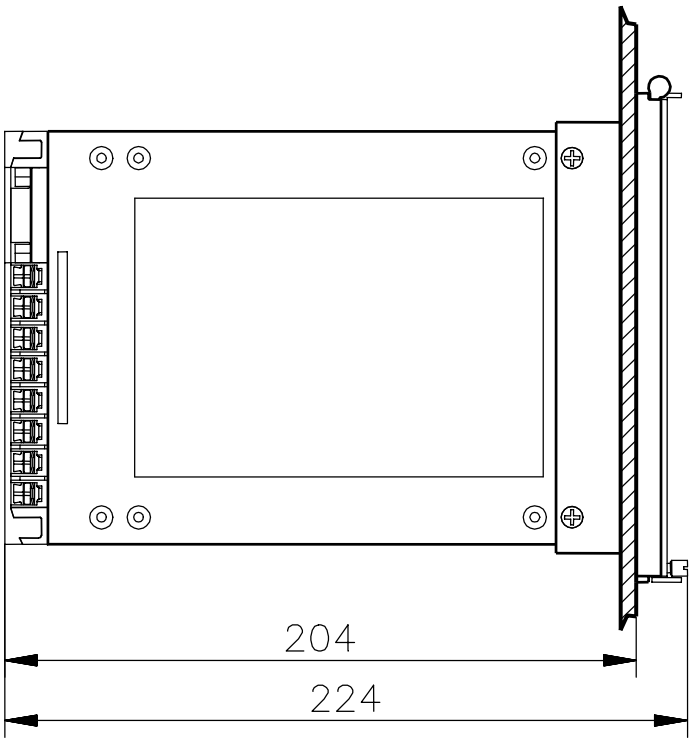
Rotate clockwise the screws ① and ②in the horizontal position of the screws-driver mark.
Slide-in the card on the rails provided inside the enclosure.
Plug-in the card completely and by pressing the handle to the closed position.
Rotate anticlockwise the screws ① and ② with the mark in the vertical position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

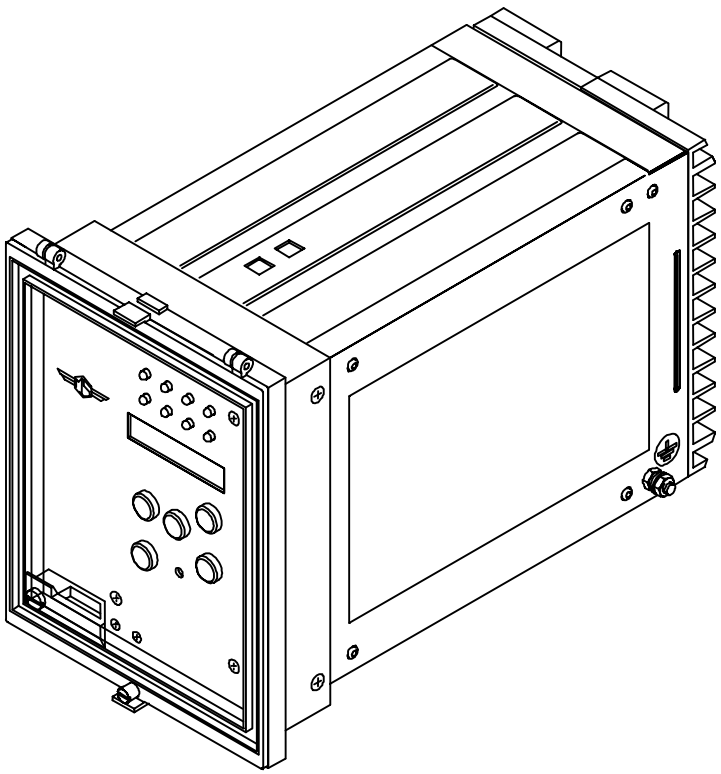


23. MOUNTING

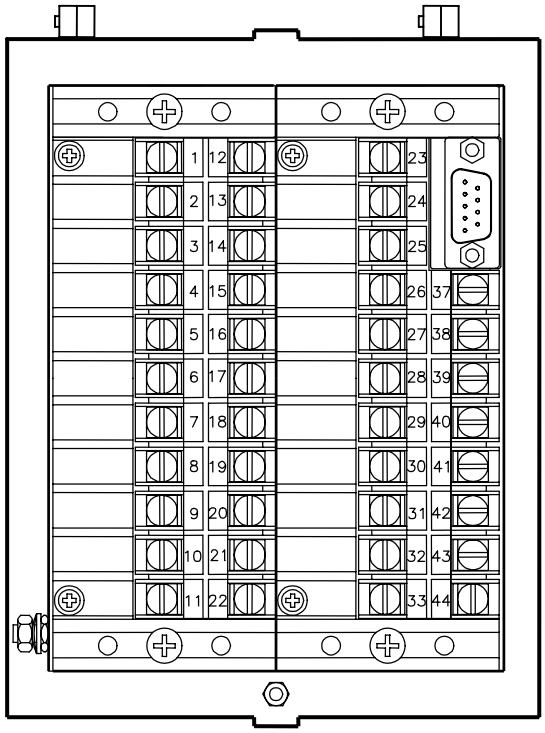


PANEL CUT-OUT 113x142 (LxH)

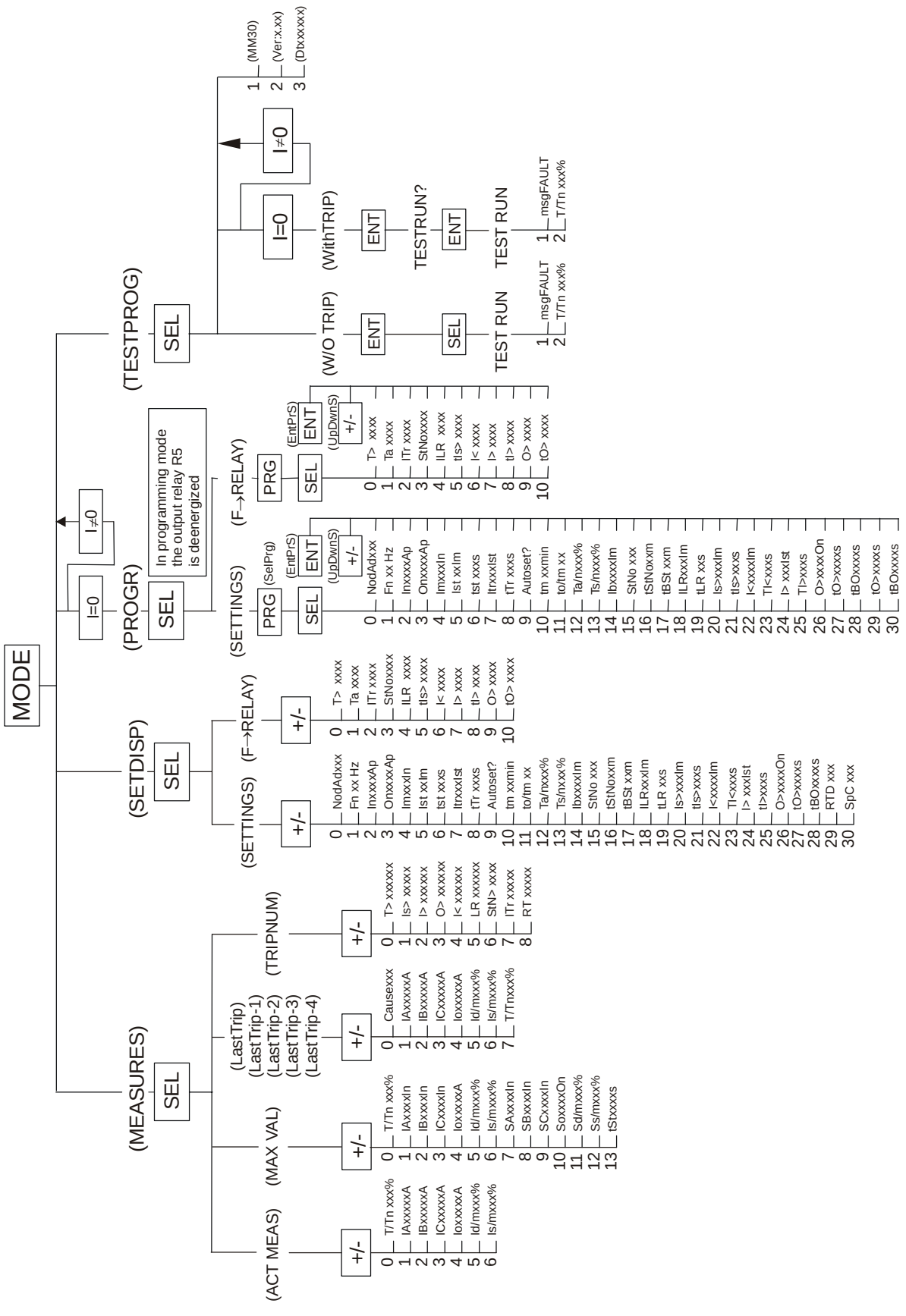




View of Rear
Terminal Connection



24. KEYBOARD OPERATIONAL DIAGRAM



25. SETTING'S FORM

Relay Type	**MM30**	**Station :**	**Circuit :**
Date :	**/ /**		**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 Ion :** ☐ **1A** ☐ **5A**

RELAY PROGRAMMING

Variable	Description	Setting Range		Default Setting	Actual Setting	Test Result Pick-up	Test Result Reset
NodAd	Identif. number for connection on serial comm. bus	1 - 250	-	1			
Fn	Mains frequency	50 - 60	**Hz**	50			
In	Rated primary current of the phase C.Ts.	1 - 9999	**Ap**	500			
On	Rated primary current of the C.Ts.	1 - 9999	**Ap**	500			
Im	Motor full-load current	0.1 – 1.5	**In**	1.0			
Ist	Motor start-up current	0.5 – 10	**Im**	6			
tst	Motor starting time	1 – 120	**s**	5			
Itr	Switch-over current of motor starter	Dis –0.1– 1	**Ist**	0.5			
tTr	Max switch-over time from start-up	0.5 – 50	**s**	6			
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	1 - 60	**min**	34			
to/tm	Steady/running motor thermal time constant	1 - 10	-	3			
Ta/n	Prealarm motor heating level	50 - 110	**%**	90			
Ts/n	Motor restart heating level	40 - 100	**%**	100			
Ib	Rated maximum continuous current of the motor	1.00 – 1.30	**Im**	1.05			
StNo	Max. No of startings allowed within the time tStNo	Dis - 1 - 60	-	6			
tStNo	Time into which the StNo is counted	1 - 60	**m**	60			
tBSt	Restart inhibition time after tripping of the funct. StNo	1 - 60 – Rm	**m**	12			
ILR	Trip level of Locked Rotor function	Dis - 1 - 5	**Im**	2			
tLr	Trip time delay of LR element during run	1 – 25	**s**	1			
Is>	Trip level of inverse time current unbalance protect. element	Dis-0.1-0.8	**Im**	0.3			
tIs>	Trip time delay of inv. time current unbalance prot.	1 - 8	**s**	4			
I<	Trip level of undercurrent (no-load running) element	Dis-0.15-1	**Im**	0.2			
tI<	Trip time delay of undercurrent element	0.1 - 90	**s**	3			
I>	Trip level of overcurrent element	Dis - 1 - 5	**Ist**	2			
tI>	Trip time delay of overcurrent element	0.05 - 1	**s**	0.1			
O>	Trip level of earth fault element	Dis -0.02- 2	**On**	0.1			
tO>	Trip time delay of earth fault element	0.05 - 5	**s**	0.2			
tBO	Reset time delay of the blocking output relay	0.05 - 0.5	**s**	0.15			
RTD	Thermal probe	ON - OFF	**-**	-			
SpC	Speed switch	ON - OFF	-	-			

CONFIGURATION OF OUTPUT RELAYS

Default Setting: Protect. Element	Output Relays				Description	Actual Setting: Protect. Element	Output Relays			
T>	1	-	-	-	Overload tripping operates relay	**T>**				
Ta	-	2	-	-	Overload prealarm tripping operates relay	**Ta**				
Itr	-	-	-	-	Starting switch-over tripping operates relay	**Itr**				
StNo	-	-	-	-	Start No limitation tripping operates relay	**StNo**				
ILR	1	-	-	-	Locked Rotor tripping operates relay	**ILR**				
tIs>	1	-	-	-	Time delayed unbalance tripping operates relay	**tIs>**				
I<	-	-	-	4	No load running tripping operates relay	**I<**				
I>	-	-	-	-	Instantaneous overcurrent tripping operates relay	**I>**				
tI>	1	-	-	-	Time delayed overcurrent tripping operates relay	**tI>**				
O>	-	-	-	-	Instantaneous earth fault tripping operates relay	**O>**				
tO>	1	-	-	-	Time delayed earth fault tripping operates relay	**tO>**				
RT	-	-	-	-	Remote trip control.	**RT**				

Commissioning Engineer : _____ **Date :** _____

Customer Witness : _____ **Date :** _____