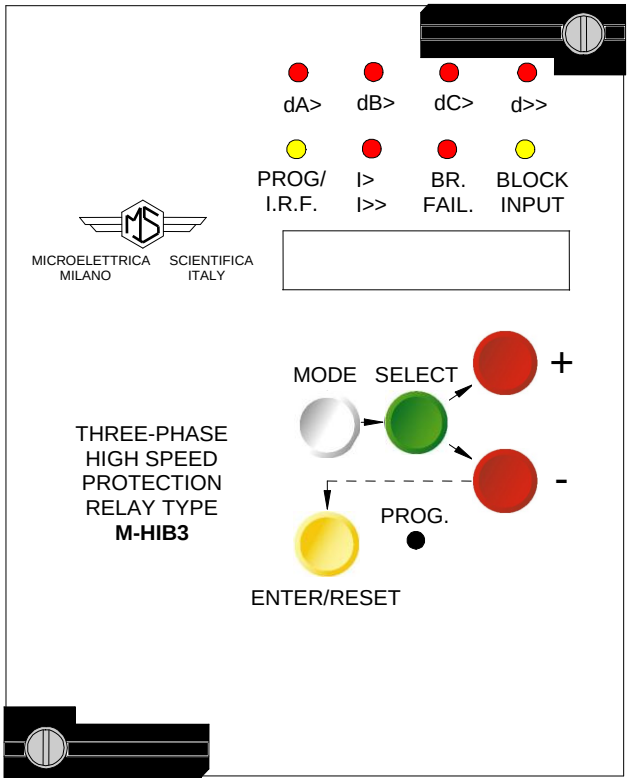
DIGITAL-MULTIFUNCTION HIGH IMPEDANCE BIASED DIFFERENTIAL RELAY

TYPE

M-HIB3

OPERATION MANUAL



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REV.	DESCRIPTION	DATE	PREP.	CONTR.	APPR.
2	Mod. 716	12-06-00	P.Brasca	D.Abad	
1	Mod. 626	20-09-99	*P.Brasca*	*D.Abad*	-
0	EMISSION	12-11-98	*P.Brasca*	*D.Abad*	-

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 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 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 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 from system's CT.s are supplied to two internal sets of 3 CT.s
One set is used to directly measure the difference between the currents on the two sides of the protected zone, the other to measure the summation of the two currents for relay percentage biasing.
Input rated current can be 1A or 5A

2.1 - POWER SUPPLY

The auxiliary power is supplied by a built-in interchangeable module fully isolated an self protected. Two options are available :

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 - Differential Protection 1F87

The relay performs a percentage biased differential protection against faults inside the protected zone

For each phase the relay measures :

- The value of the System Frequency component of the Vector Difference between side 1 and side 2 currents

$$d_x = |\bar{I}_{1x} - \bar{I}_{2x}| \qquad x = A, B, C$$

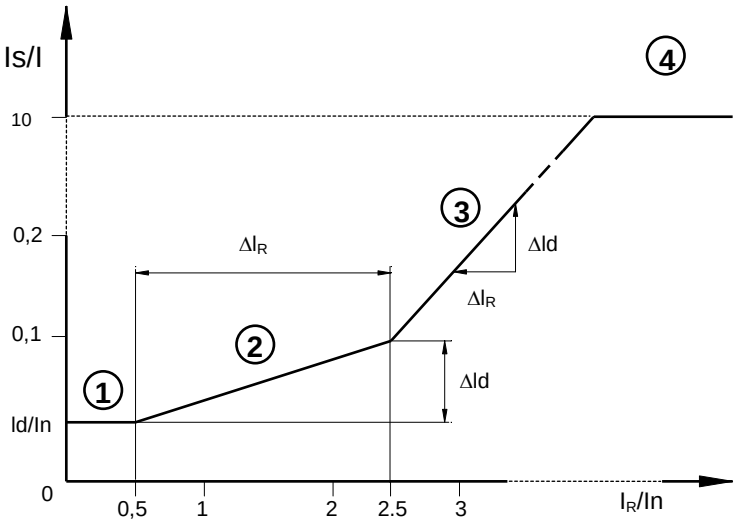
- The R.M.S. value of the zone "Through current" $Ir = \frac{|\bar{I}_1 + \bar{I}_2|}{2}$

The operation is based on the above measurements and on the following programmable levels :

- Basic minimum differential pick-up level : **d>** = (0.10 – 1.00)In, step 0.01In
- Percent bias in the zone $0.5 < \frac{I_R}{In} < 2.5$: **R%** = (10-50)%, step 1%
- Percent bias in the zone $\frac{I_R}{In} > 2.5$: **R%** = (100)%, step 1%

To compensate differential current produced by errors of the CT the actual differential current minimum pick-up level **Is** is dynamically adjusted in function of the actual Through Current **Ir** depending on the set percent bias levels **R%.**

Fig.1



$$R\% = 100\,\frac{\Delta I_d}{\Delta I_R} \qquad I_R = \frac{I1 + I2}{2}$$

① $\frac{Is}{In} = \frac{I_d}{In}$

② $\frac{Is}{In} = \frac{I_d}{In} + (\frac{I_R}{In} - 0{,}5) \cdot \frac{R\%}{100}$

③ $\frac{Is}{In} = \frac{I_d}{In} + \frac{(2.5 - 0{,}5)R\%}{100} + (\frac{I_R}{In} - 2.5)$

④ $\frac{Is}{In} \cong 10$

Is= Effective relay operation differential current
Id= Relay setting differential current
I_R= Relay through current

The low set differential element operates instantaneously (less than 30ms) when the measured differential current $\mathbf{I_{dx}}$ of any phase exceeds the pick-up level **2xIs**.

2.2.1 – Second harmonic restraint

If the value of the second harmonic component " 2H " of the input differential current " d " exceeds a programmable level

2H = (0.1 – 1 – Dis)d

the operation of element F87/1 is blocked.

2.2.2 - Stability on Through Fault

During Through Faults the bias current I_R equals the Through Fault Current $\mathbf{I_F}$

$$I_R = \frac{I_1 + I_2}{2} = \frac{2I_F}{2} = I_F$$

Due to the bias action the ratio of the Through Fault Current I_R to the relay trip level Is variates according to the bias characteristics.
For checking the relay stability on Through Fault it important to notice that the value of

the ratio $\frac{I_F}{I_S} = \frac{I_R}{I_S}$ is maximum when I_R = 2.5: from equation 2 or 3 § 2.2.

$$\frac{I_F}{I_S} = \frac{I_R}{I_S} = \frac{2.5}{I_d + 0.02R\%} = \frac{2.5}{[d>] + 0.02[R]}$$

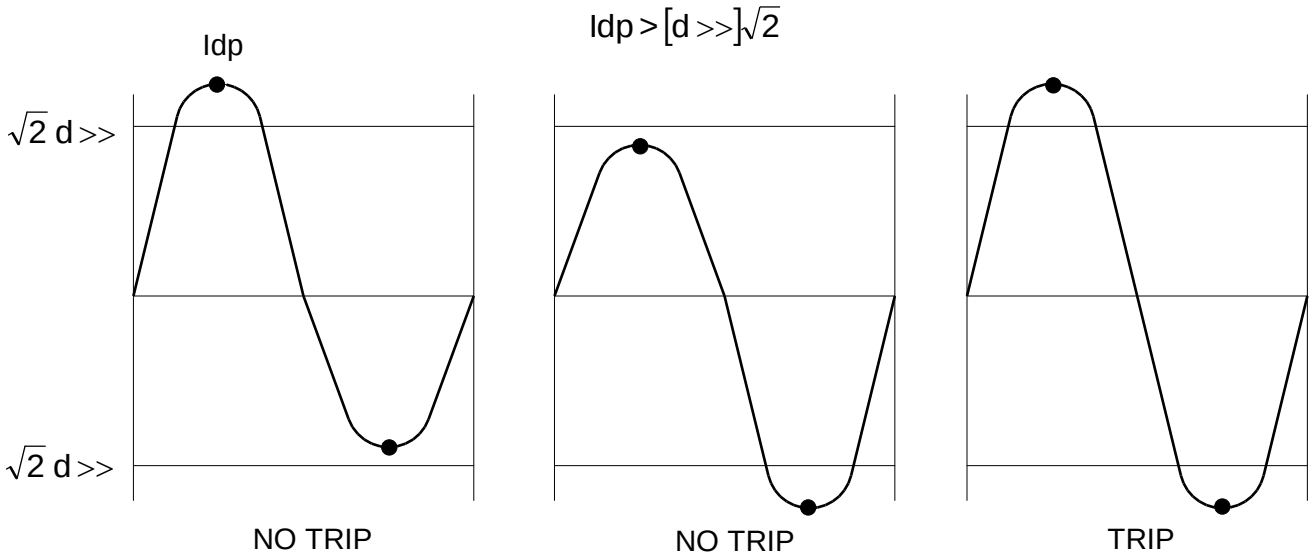
Example : [d>] = 0.1 ; R = 10

$$\frac{I_F}{I_S} = \frac{2.5}{0.1 + 0.02} = 8.33$$

Conditions for stability are reported on next §2.7

2.3 - High set differential level 2F87

For each phase the relay measures the peak value of the positive and negative wave of the differential current. The relay operates instantaneously **if both** the values are above the minimum pick-up level.



This practically avoids spurious tripping on unidirectional current component.

- Basic minimum differential pick-up level : **d>>** = (0.5 – 9.0 - Dis)In, step 0.1In

2.4 – Low-set Overcurrent Element 1F51

Relays measures on each phase the R.M.S. value of the through current $I_R = \frac{|\bar{I}_1 + \bar{I}_2|}{2}$

- Minimum pick-up level : **I>** = (0.50 – 8.00 - Dis)In, step 0.01In
- Trip time delay (Independent Definite time) : **tI>** = (0.05-9.99)s, step 0.01s

2.5 – High-set Overcurrent Element 2F51

- Minimum pick-up level : **I>>** = (0.5 – 8 - Dis)In, step 0.1In
- Trip time delay (Independent Definite time) : **tI>>** = (0.05 – 9.99)s, step 0.01s

2.6 - Breaker Failure Protection

- **tBF** = (0.05-1.00)s, step 0.01s

If within the set time tBF from tripping of the output relay R1 the input current does not drop to zero, a proper output relay is energized to operate the second opening circuit of the Circuit Breaker or a back-up breaker.

2.7 – Characteristic required for C.Ts.

Current transformers must meet the requirements hereunder specified (Class X C.Ts. with 1A secondary are recommended) for stability on through Faults.

- $\mathbf{R_R}$ = Relay Burden = $\begin{cases} 0.02\ \Omega \text{ for In} = 1A \\ 0.01\ \Omega \text{ for In} = 5A \end{cases}$

- $\mathbf{R_C}$ = Resistance of the Cable loop between C.T. and relay
- $\mathbf{R_2}$ = Resistance of C.T's secondary winding
- $\mathbf{I_F}$ = Maximum Through Fault Secondary Current
- $\mathbf{I_S}$ = Relay trip level
- $\mathbf{V_k}$ = C.T's Knee point voltage
- $\mathbf{V_S}$ = Stability voltage = $I_F (R_C + R_2)$
- $\mathbf{R_S}$ = Stabilizing resistor

The conditions for stability on Through Fault are :

- $\mathbf{V_k} \geq 2\mathbf{V_S}$
- $V_S < I_S(R_R + R_S) \Rightarrow I_F(R_C + R_2) < I_S(R_R + R_S) \Rightarrow \frac{I_F}{I_S} < \frac{R_R + R_S}{R_C + R_2} \Rightarrow R_S > \frac{I_F}{I_S}(R_C + R_2) - R_R$

The highest possible value $\frac{I_F}{I_S}$ is (see § 2.2.2)

$$\frac{I_F}{I_S} = \frac{2.5}{[d>] + 0.02[R]} \quad \text{then} \quad R_S > \frac{2.5(RC + R2)}{[d>] + 0.02[R]}$$

It is recommended to set the basic relay's trip level [d>] at approximately ½ of the minimum fault current expected on fault inside the protected Zone.

2.8 - Functions Blocking

Any function can be permanently disactivated setting to **Dis** the relevant variable, or temporarily blocked via the digital inputs B1 and B2
The operation of the blocking inputs can be programmed to block (when activated) any of the relay functions by programming the variables B1, B2

Input **B1** (Terminals 1 – 2) : **dH** = d>>; **dL** = d>

B1	=	-	-	-	-	No Block
B1	=	-	-	-	dL	Only d>
B1	=	dH	-	-	-	Only d>>
B1	=	dH	dL	-	-	d> + d>>

Input **B2** (Terminals 1 – 3) : **IH** = I>>; **IL** = I>

B2	=	-	-	-	-	No Block
B2	=	-	-	-	IL	Only I>
B2	=	IH	-	-	-	Only I>>
B2	=	IH	IL	-	-	I> + I>>

When block B1 or B2 is activated the led 8 goes flashing.

Input **B1** : Block the instantaneous tripping

Input **B2** : Block the pick-up of the time delayed element only

2.9 - CLOCK AND CALENDAR

2.9.1 - Clock synchronization.

The clock can be synchronized via a digital input (terminals 1 – 14) or 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 only way to modify the current date and time is via the front panel keyboard (SETTINGS menu) or the serial communication interface.
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.

2.9.2 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 captured.
On the other hand pressing the SELECT button leaves the current date unchanged and scrolls the SETTINGS menu. Current time can now be modified using the same procedure described above.
If synchronization is enabled and the date (or time) is modified, the clock is stopped until a sync signal is received (via digital input or the serial port). This allows the user to manually set many units and have them to start their clocks in a synchronized fashion.
On the other hand if synchronization is disabled the clock is never stopped.
Note that the setting of a new time always clears 10ths and 100ths of sec.

2.9.3 Time resolution.

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

2.9.4 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.

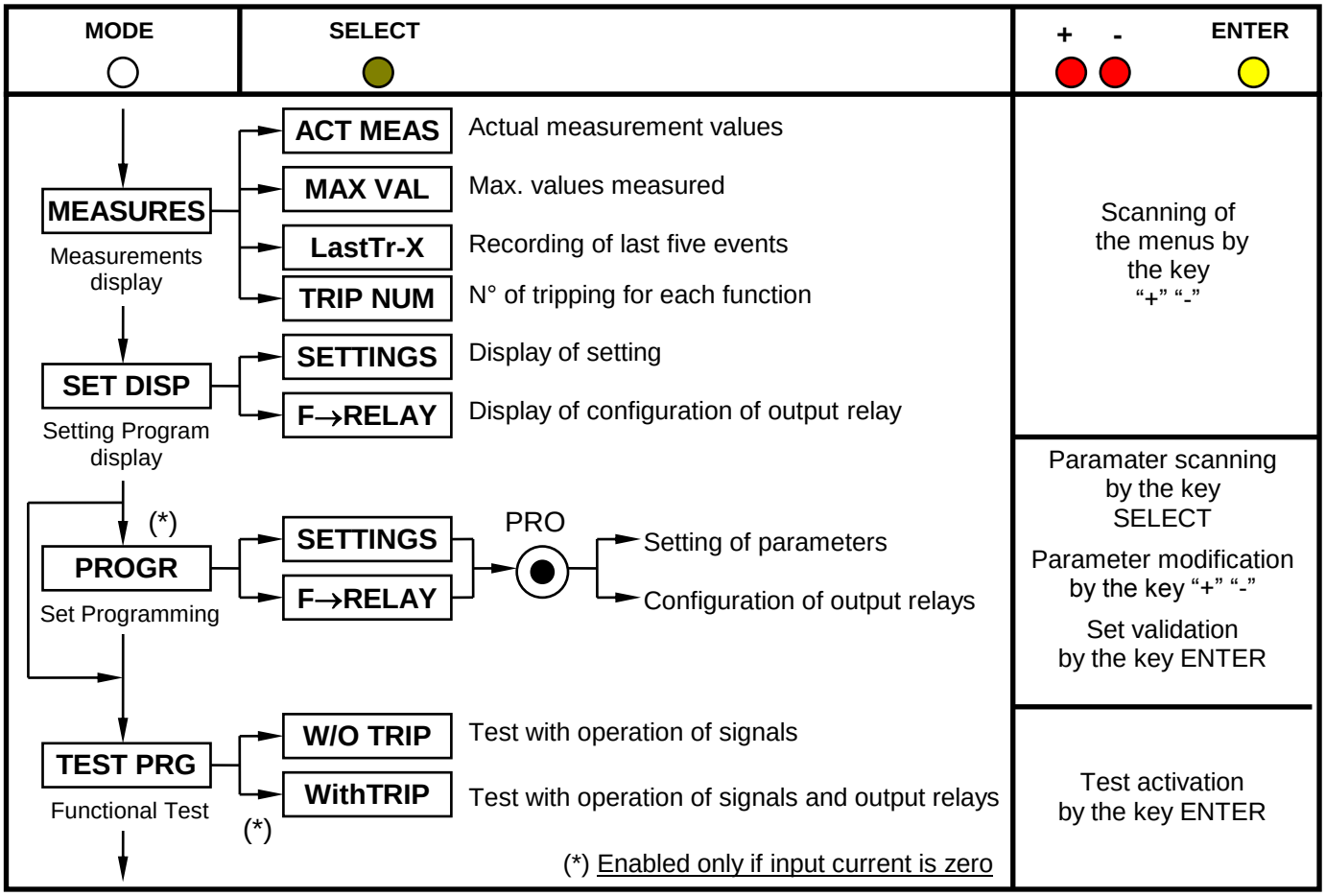
2.9.5 Time tolerance.

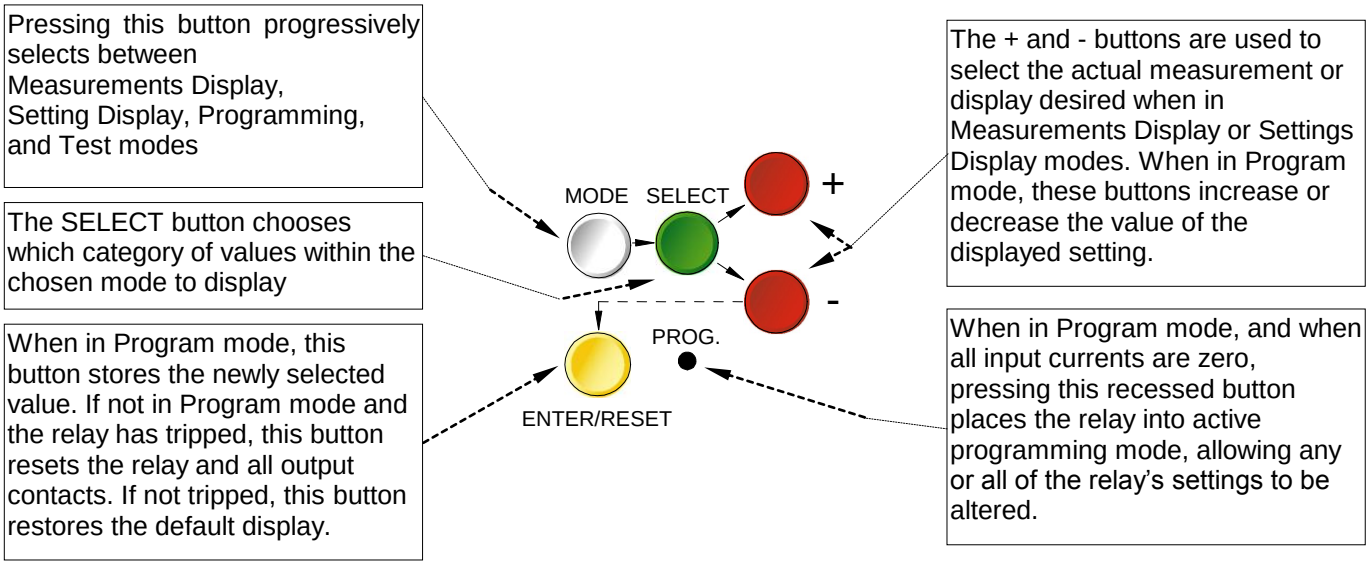
During power on, time tolerance depends on the on board crystal (+/-50ppm typ, +/-100ppm max. over full temperature range).
During power off, time tolerance depends on the RTC's oscillator (+65 –270 ppm max over full temperature range).

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)

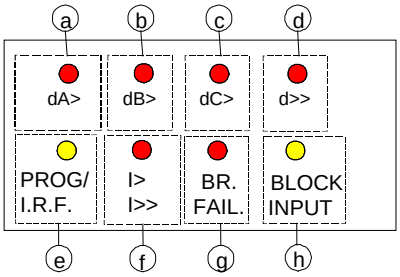
FIG.1





4. SIGNALIZATIONS

Eight signal leds (normally off) are provided:



a) Red LED	**dA>**	❑	Illuminated on tripping of biased differential element of phase A (IdA > [d>])
b) Red LED	**dB>**	❑	Illuminated on tripping of biased differential element of phase B (IdB > [d>])
c) Red LED	**dC>**	❑	Illuminated on tripping of biased differential element of phase C (IdC > [d>])
d) Red LED	**d>>**	❑	Illuminated on tripping of the high-set differential element of any phase I_{dx} > [d>>]
e) Yellow LED	**PROG I.R.F.**	❑	Flashing during the programming of the parameters or in case of Internal Relay Fault.
f) Red LED	**I>, I>>**	❑ ❑	Flashing when the current in any phase exceeds the set level [I>] or [I>>] Illuminated on trip at the end of time delay tI> or tI>>
g) Red LED	**BR. FAIL.**	❑	Illuminated on trip of the Breaker Failure function
h) Yellow LED	**BLOCK INPUT**	❑	Flashing when digital input B1 or B2 is activated

The reset of the leds takes place as follows:

-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.

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)

- 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 any of the M-HIB3's functions.
  For function **I>** and **I>>** both instantaneous and time delayed elements are provided.
  Any relay associated to the instantaneous element of a function picks-up as soon as the measured input value exceeds the set minimum pick-up level.
  The reset after tripping of the relays (when tripping cause has been cleared) can be programmed as Manual or Automatic (Variable FRes=Man/Aut).

  FRes = Aut : Automatic Reset as soon as pick-up cause has been cleared.

  FRes = Man : Reset by ENT/RESET KEY on relay's front or via serial port

- The relay **R5**, normally energised, is not programmable and is deenergized on:
  - internal fault
  - power supply failure
  - during the programming

6. DIGITAL INPUTS

The relay has tree user available inputs that are activated shorting the relevant terminals by a cold contact. Max external resistance $\leq 3\ k\Omega$

B1	Terminals (1 – 2)	:	For blocking functions d>, d>>
B2	Terminals (1 – 3)	:	For blocking functions I>, I>>
B3	Terminals (1 – 14)	:	External trigger for oscillography records

7. SERIAL COMMUNICATION (Optional: see relevant instruction manual)

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 event 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.
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 (or later) is available.
Please refer to the MSCOM instruction manual for more information.

8. OSCILLOGRAPHY RECORDS

The relay continuously records in a buffer the samples of the six input phase currents and the residual zero sequence current.
The buffer contains samples for approximately 16 periods.
Recording is stopped after approximately 8 periods after a trigger signal and the content of the buffer is stored into memory.
Therefore in the memory are stored the wave forms for 8 cycles before and 8 cycles after the trigger instant.
The trigger can be operated either internally on tripping of any function programmed d>, d>>, I>, I>> or externally by activation of the digital input B3.
Selection between the two modes is made by programming the variable **TRG** = EXT, d>, d>>, I>, I>>
The last oscillography record of the six input currents is stored; a second record replaces the first one.

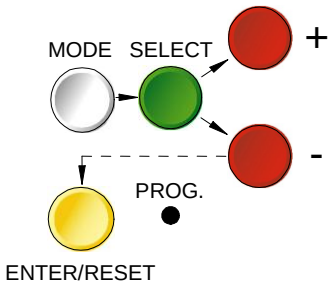
9. TEST

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 and then switches over to the default display.
- Dynamic functional test run during normal operation every 15 min. (relay's operation is suspended for less than ≤4 ms).
- Complete test activated by the keyboard or via the communication bus either with or without tripping of the output relays.
- If any internal fault is detected, the display shows a fault message, the Led "PROG/IRF" illuminates and the relay R5 is deenergized.

10. 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 indirectly 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	=	Real time measurements of input quantities and reading of the data stored in to relay 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 output relays 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 and to increase-decrease the settings when in Prog mode.
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.

11. 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 "-" .

11.1 - ACT.MEAS

Real time measurements during the normal operation. The values displayed are continuously updated.

Display	Description
xxxxxxx	Current date in the DDMMMYY format.
xx:xx:xx	Current time in the HH:MM:SS format.
dAxx.xx**n**	System frequency component of differential current of phase A : (0-99.99) per unit of rated phase input current
dBxx.xx**n**	As above phase B
dCxx.xx**n**	As above phase C
IAxxxxx**A**	R.M.S. value of the through current of phase A : (0-99999) CT's primary Amp
IBxxxxx**A**	As above phase B
ICxxxxx**A**	As above phase C

11.2 - INRUSH

Highest values recorded from Breaker closing, (updated any time the breaker closes).

Display	Description
dAxx.xx**n**	Differential current of phase A : (0-99.99) per unit of rated phase input current
dBxx.xx**n**	As above phase B
dCxx.xx**n**	As above phase C
IAxx.x**n**	Through Current phase A: (0-99.9) p.u. of phase input current
IBxx.x**n**	As above, phase B
ICxx.x**n**	As above, phase C

11.3 - LASTTRIP

Display of the function which caused the tripping of the relay plus values of the parameters at the moment of tripping. The memory buffer contains the records of the last five trippings (FIFO).

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
Cau:xxxx	Function which produced the event being displayed: **dA>,dB>,dC>,dA>>,dB>>,dC>>,I>,I>>**
dAxx.xx**n**	Differential current phase A
dBxx.xx**n**	Differential current phase B
dCxx.xx**n**	Differential current phase C
IAxxxx**n**	Through Current phase A
IBxxxx**n**	As above, phase B
ICxxxx**n**	As above, phase C

11.4 – TRIP NUM

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

Display	Description
dA> xxxx	Low-set Biased Differential element phase A
dB> xxxx	Low-set Biased Differential element phase B
dC> xxxx	Low-set Biased Differential element phase C
dA>>xxxx	High-set Biased Differential element phase A
dB>>xxxx	High-set Biased Differential element phase B
dC>>xxxx	High-set Biased Differential element phase C
I> xxxx	Low-set Overcurrent element
I>> xxxx	High-set Overcurrent element

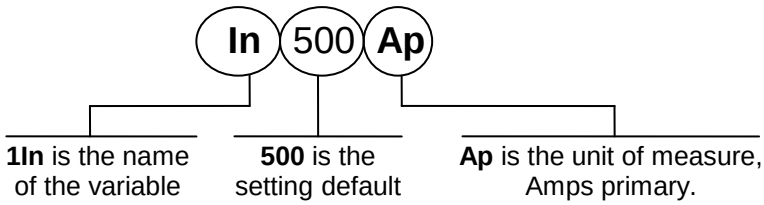
12. READING OF PROGRAMMED SETTINGS AND RELAY'S CONFIGURATION

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.

13. 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 alarm 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.

13.1 - PROGRAMMING OF FUNCTIONS SETTINGS

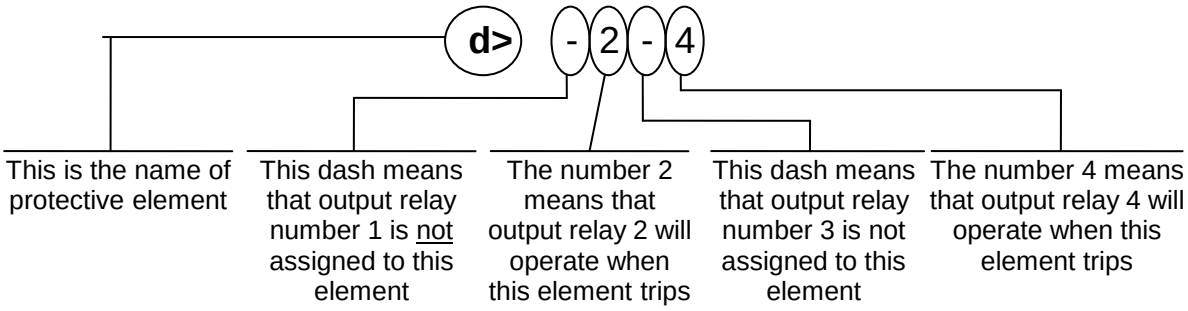


Mode PROG menu SETTINGS. (Production standard settings here under shown).

Display	Description	Setting Range	Step	Unit
xxxxxxx	Current date	DDMMMYY	-	-
xx:xx:xx	Current time	HH:MM:SS	-	-
Fn 50 **Hz**	System frequency	50 - 60	10	Hz
In 500**A**	Rated primary current of CTs	1 - 9999	1	A
d> 0.15**n**	Basic minimum pick-up level of biased phase differential element	0.10-1.00-Dis	0.01	In
R 10**%**	Bias percentage in the zone 0,5<I_R<2.5In	10-50	1	%
2H 0.50**d**	2nd harmonic restraint level (p.u. of measured differential current)	0.10-1.00-Dis.	0.01	d
d>>5.00**n**	High set differential element	0.5-9.0-Dis.	0.1	In
I>5.00**In**	Minimum pick-up level of low set overcurrent element	0.50-8-Dis.	0.01	In
tI>3.00**s**	Time delay of low set overcurrent element	0.05-9.99	0.01	s
I>>5.0**In**	Minimum pick-up level of high set overcurrent element	0.5-8-Dis.	0.1	In
tI>>3.0**s**	Time delay of high set overcurrent element	0.05-3.0	0.01	s
tBF 0.25**s**	Breaker Failure time delay	0.05-1.00	0.01	s
B1 --dL	Digital input B1 blocks the functions selected	dL – dH	any combination	
B2 --IL	Digital input B2 blocks the functions selected	IL – IH	any combination	
Trg: d>	Trigger for oscillography records is Internal or External (via digital input B3)	Ext, d>, d>>, I>, I>>		-
Tsyn Dis**m**	Synchronisation Time Expected time interval between sync. pulse.	5 - 60 - Dis	5-10 15-30 60-Dis	m
NodAd 1	Identification number for connection on serial communication bus	1 - 250	1	-

The setting Dis indicates that the function is disactivated.

13.2 - 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 numbers 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 having programmed all the four relay, press " ENTER " to validate the programmed configuration.

Display		Description
d>	1---	Biased Differential elemen operates relay R1,R2,R3,R4 as programmed(one or more)
d>>	-2--	High set of differential element operates relay R1,R2,R3,R4 as programmed
I>	--3-	Instantaneous Overcurrent low set element operates relay R1,R2,R3,R4 as programmed
tI>	---4	Time delayed Overcurrent low set element operates relay R1,R2,R3,R4 as programmed
I>>	--3-	Instantaneous Overcurrent high set element operates relay R1,R2,R3,R4 as programmed
tI>	---4	Time delayed Overcurrent high set element operates relay R1,R2,R3,R4 as programmed
tBF	----	Breaker Failure function operates relay R2,R3,R4 as programmed
FRes:		Reset of output relays after tripping is: **Aut** = Automatic **Man** = Manually key Enter /Reset or via serial bus

14. MANUAL AND AUTOMATIC TEST OPERATION

14.1 - 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.

14.2 - 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.

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.

15. 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.

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		
❑	Climatic tests	IEC 68-2-1 - 68-2-2 - 68-2-33			

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

❑	Electromagnetic emission	EN55022 IND. ENV.			
❑	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 4	2kV, 5/50ns, 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		200ms	
❑	Resistance to vibration and shocks	IEC60255-21-1 - IEC60255-21-2 – 10-50Hz – 1g			

CHARACTERISTICS

❑	Accuracy at reference value of influencing factors	2% Rated Input for measure 2% +/- 10ms for times
❑	Rated Current	In = 1 or 5A
❑	Current overload	200 A for 1 sec; 10A continuos
❑	Burden on current inputs	Phase : 0.02VA at In = 1A ; 0.4VA at In = 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.)
❑	Operation ambient temperature	-10°C / +55°C
❑	Storage temperature	-25°C / +70°C
❑	Humidity	IEC68-2-3 RH 93% Without Condensing at 40°C

Microelettrica Scientifica S.p.A. - 20089 Rozzano (MI) - Italy - Via Alberelle, 56/68
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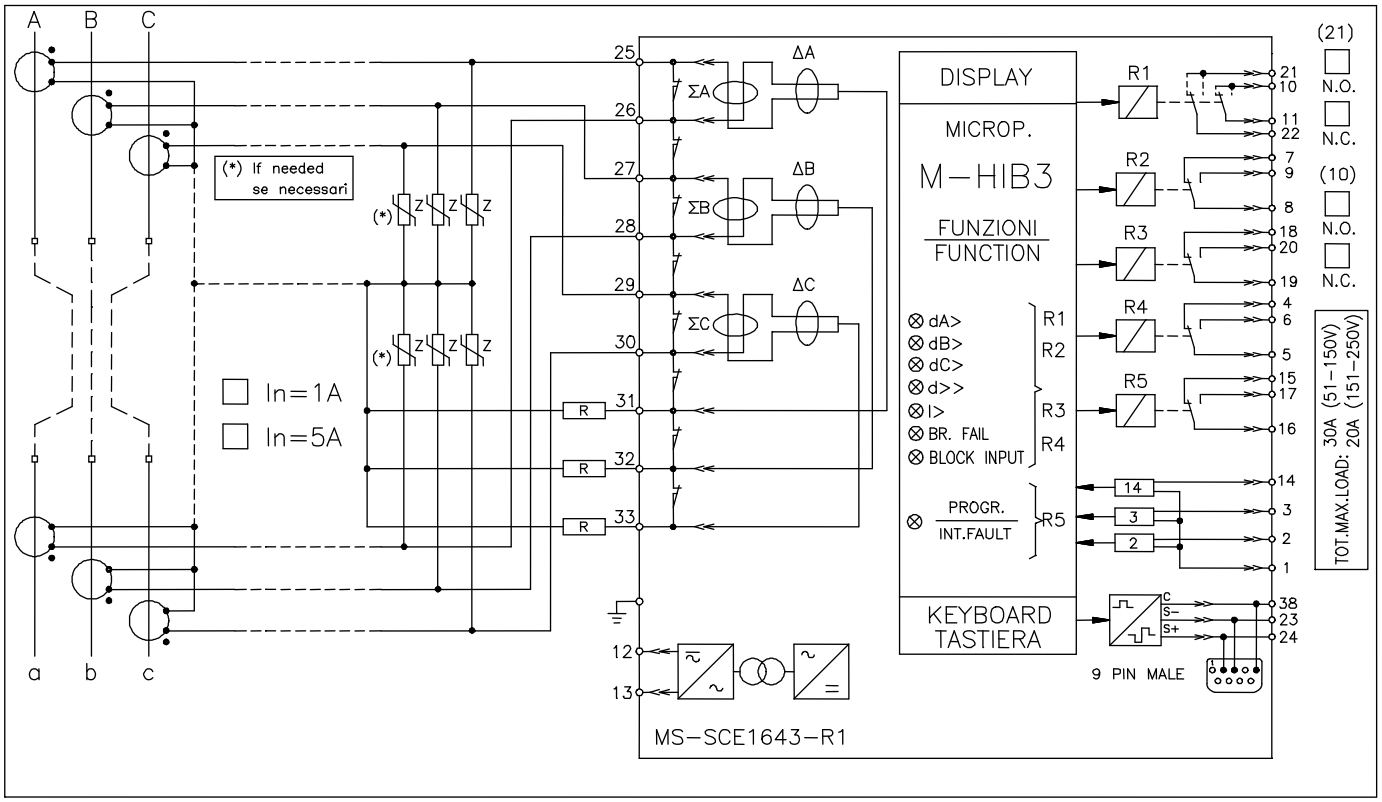
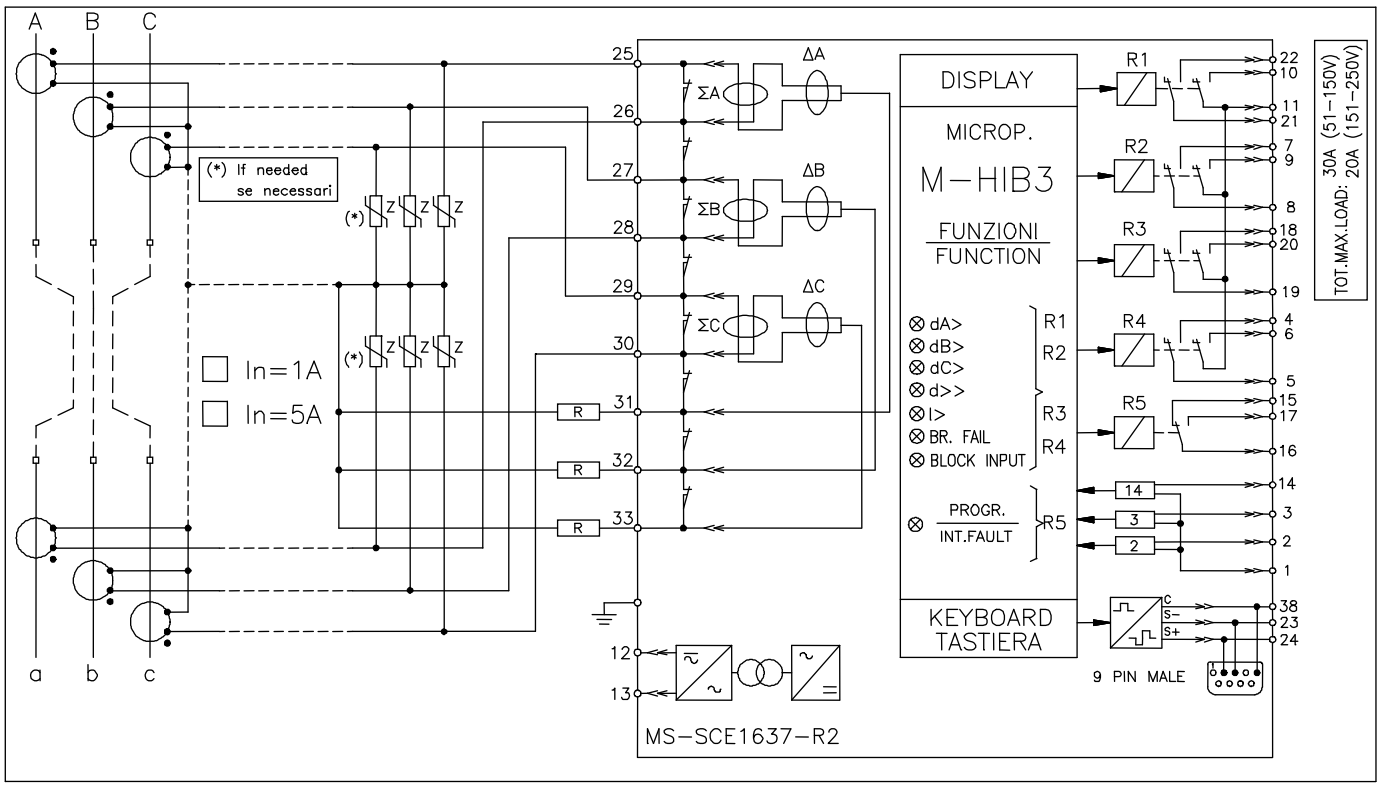
http://www.microelettrica.com **e-mail :** ute@microelettrica.com

The performances and the characteristics reported in this manual are not binding and can modified at any moment without notice

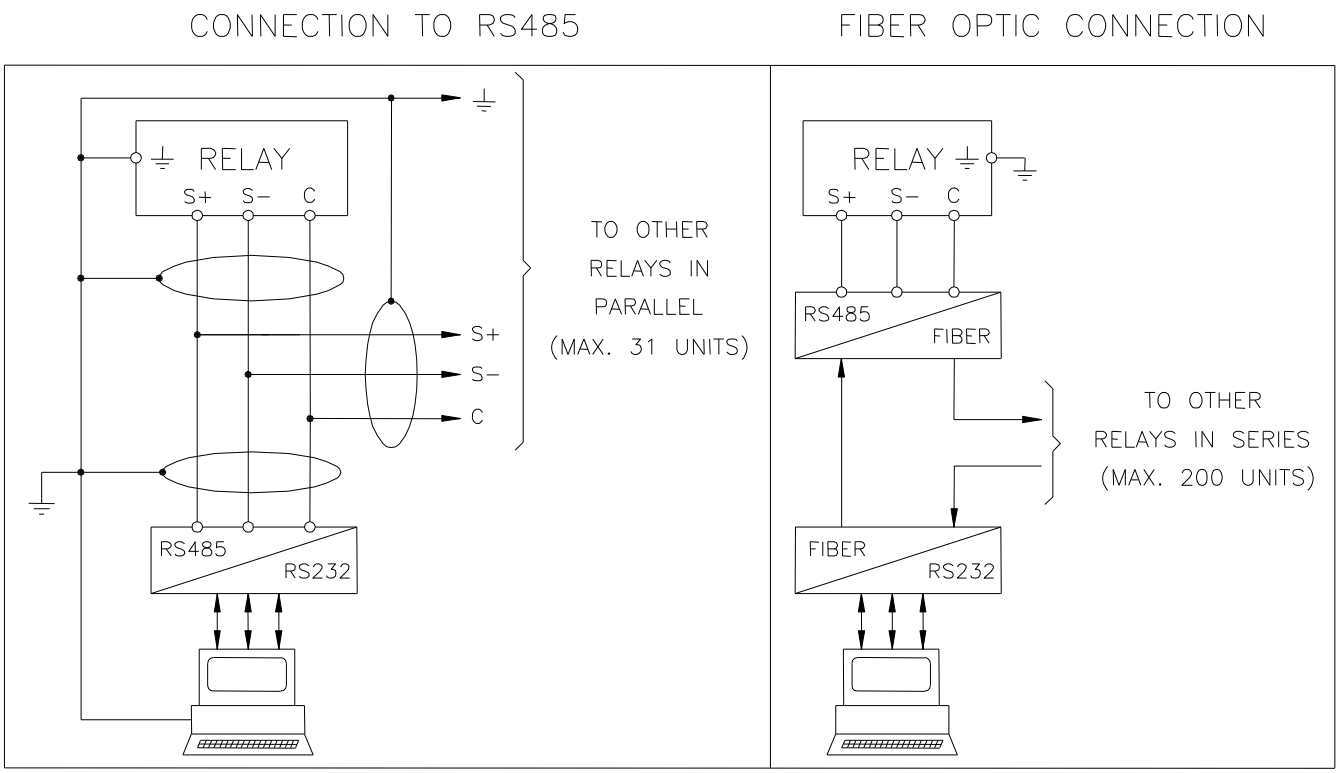
17. CONNECTION DIAGRAM (SCE1643 Rev.1 Standard Output)



17.1 - CONNECTION DIAGRAM (SCE1637 Rev.2 Double Output)



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



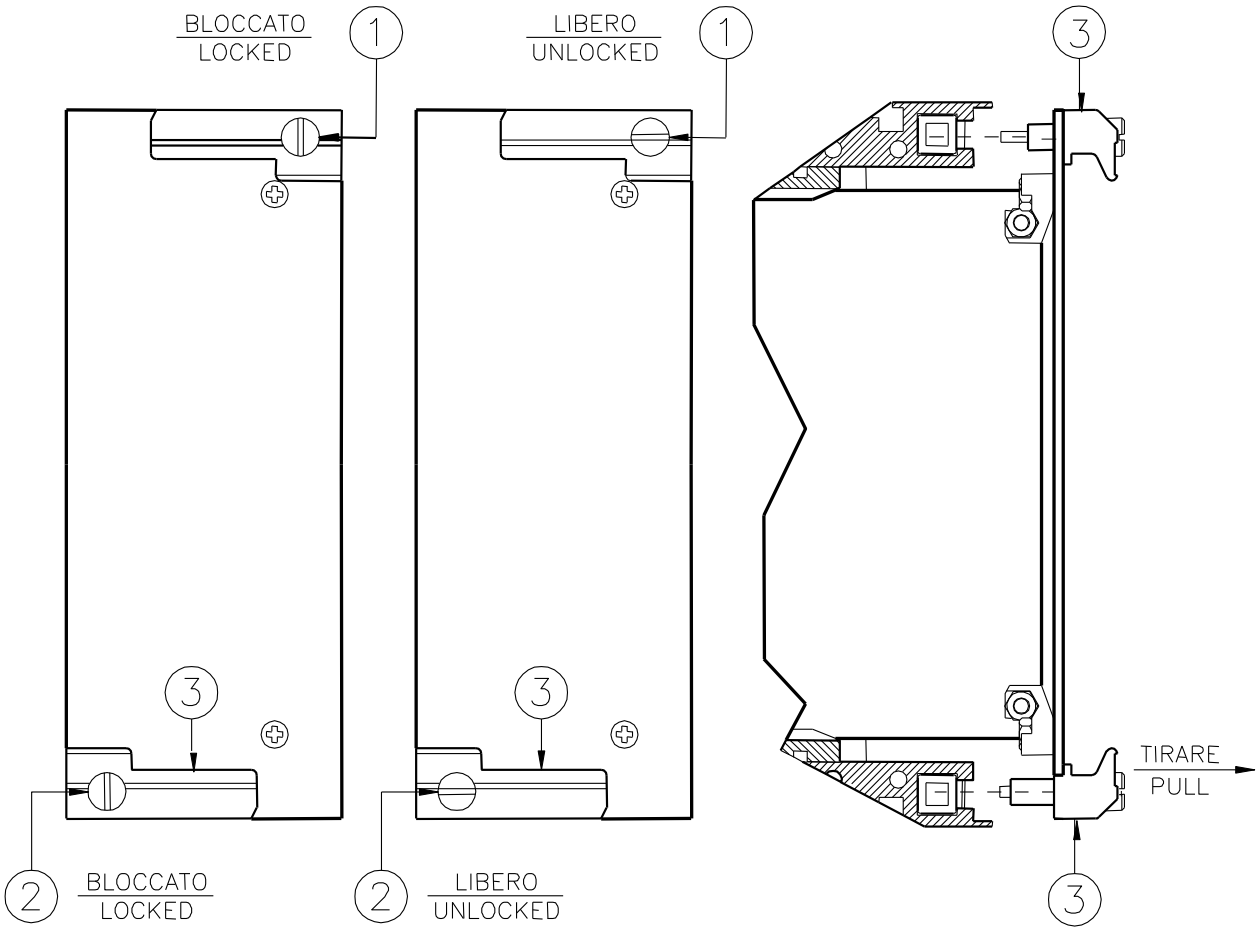
19. DIRECTION FOR PCB'S DRAW-OUT AND PLUG-IN

19.1 Draw-out

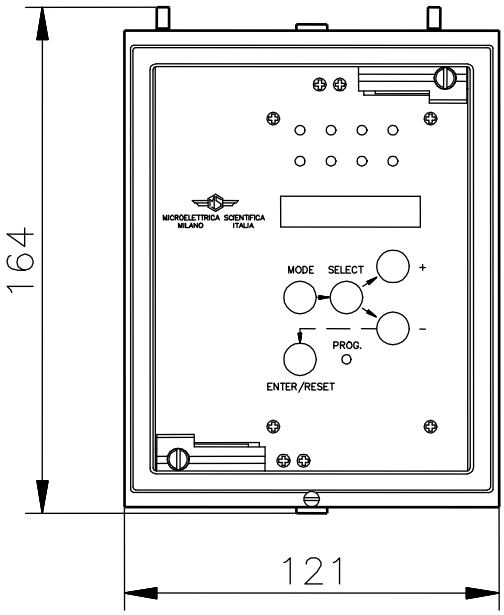
Rotate clockwise the screws ① and ② in the horizontal position of the screws-driver mark.
Draw-out the PCB by pulling on the handle ③

19.2 Plug-in

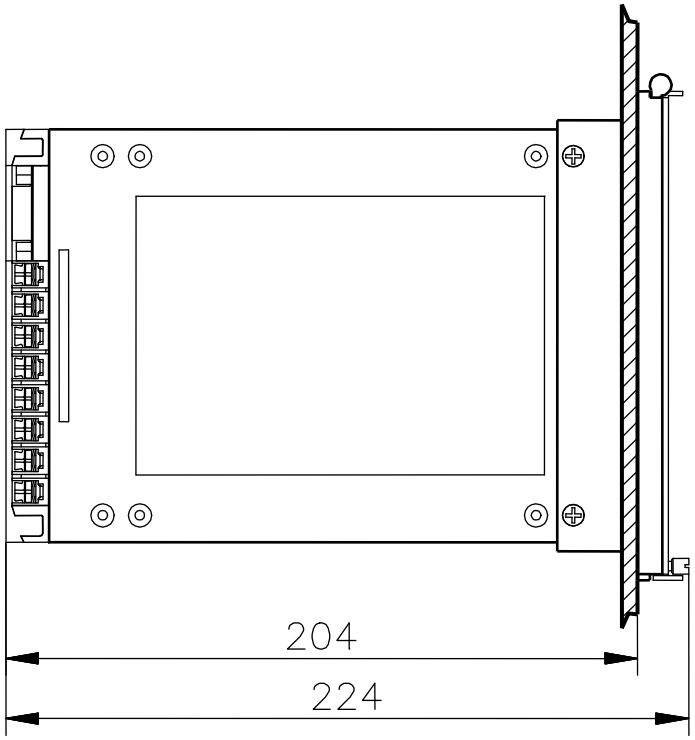
Rotate clockwise the screws ① and ②in the horizontal position of the screws-driver mark.
Slide-in the card on the rails provided inside the enclosure.
Plug-in the card completely and by pressing the handle to the closed position.
Rotate anticlockwise the screws ① and ② with the mark in the vertical position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

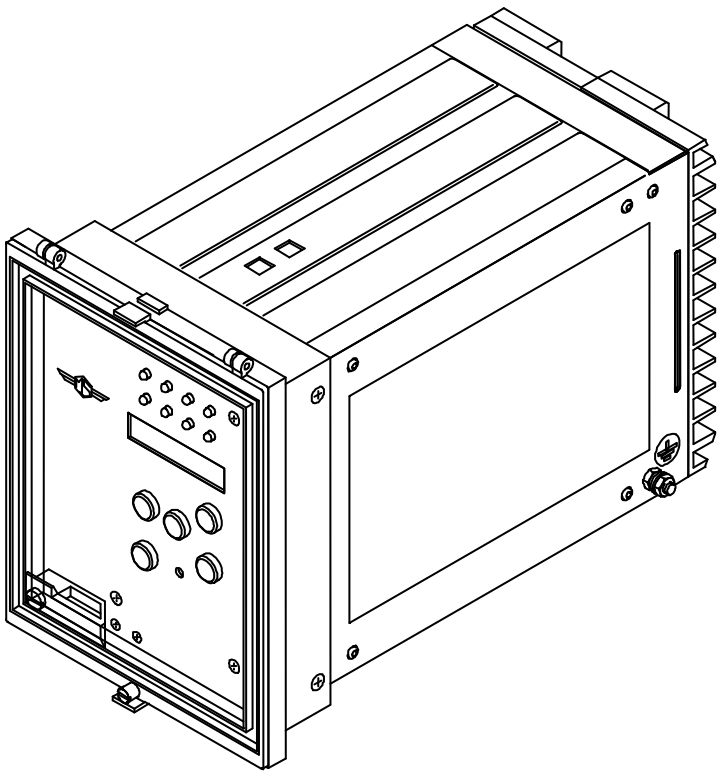


20. MOUNTING

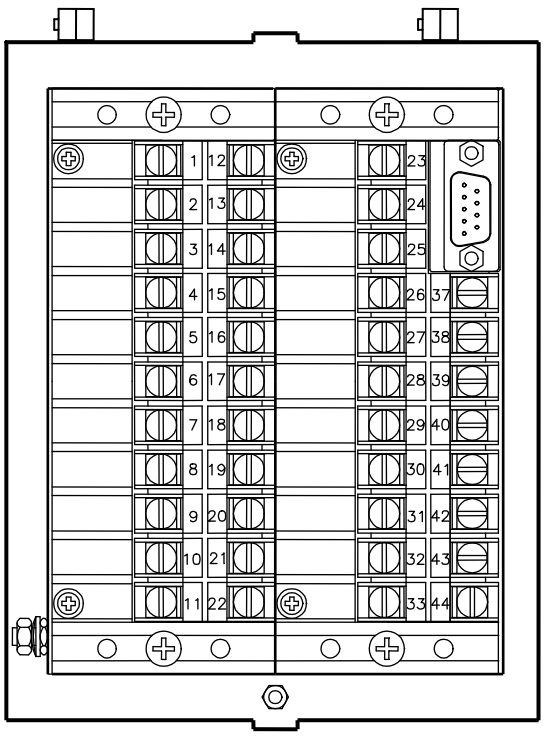


PANEL CUT-OUT 113x142 (LxH)

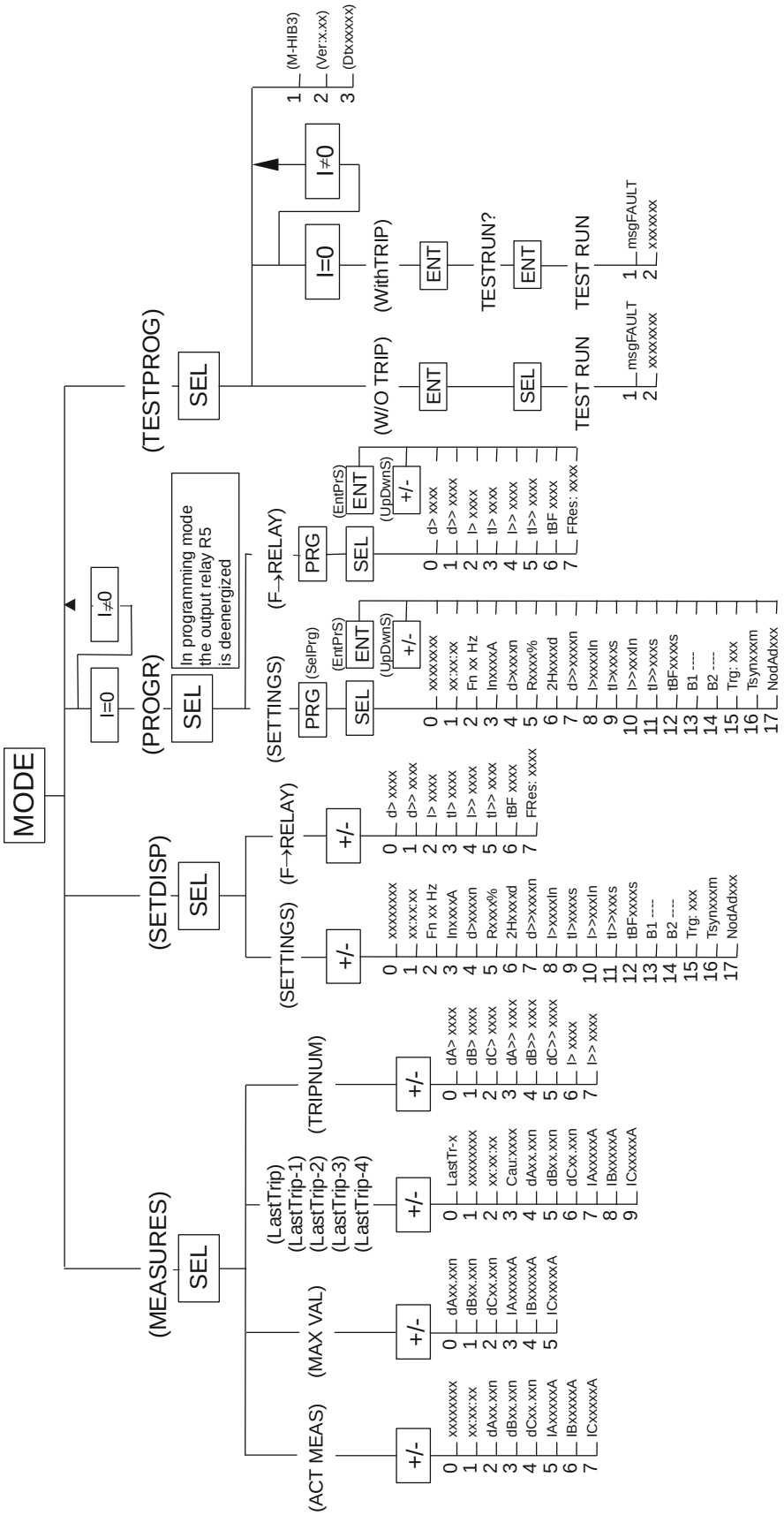




View of Rear
Terminal Connection



21. KEYBOARD OPERATIONAL DIAGRAM



22. SETTING'S FORM

Date :		**Number Relay:**	

RELAY PROGRAMMING

Default Setting				Actual Setting		
Variable	**Value**	**Units**	**Description**	**Variable**	**Value**	**Units**
xxxxxxx	random	**-**	Current date	**xxxxxxx**		**-**
xx:xx:xx	random	**-**	Current time	**xx:xx:xx**		**-**
Fn	50	**Hz**	Mains frequency	**Fn**		**Hz**
In	500	**Ap**	Rated primary current of the phase C.Ts.	**In**		**Ap**
d>	0.15	**n**	Basic minimum pick-up level of biased phase differential element	**d>**		**n**
R	10	**%**	Bias percentage in the zone $0,5<I_R<2.5In$	**R**		**%**
2H	0.50	**d**	2nd harmonic restraint level (p.u. of measured differential current)	**2H**		**d**
d>>	5.00	**n**	High set differential element	**d>>**		**n**
I>	5.00	**In**	Minimum pick-up level of low set overcurrent element	**I>**		**In**
tI>	3.00	**s**	Time delay of low set overcurrent element	**tI>**		**s**
I>>	5.0	**In**	Minimum pick-up level of high set overcurrent element	**I>>**		**In**
tI>>	3.0	**s**	Time delay of high set overcurrent element	**tI>>**		**s**
tBF	0.25	**s**	Breaker Failure time delay	**tBF**		**s**
B1	dL	-	Digital input B1 blocks the functions selected	**B1**		-
B2	IL	-	Digital input B2 blocks the functions selected	**B2**		-
Trg:	d>	-	Trigger for oscillography records is Internal or External (via digital input B3)	**Trg:**		-
Tsyn	Dis	m	Synchronisation Time Expected time interval between sync. pulse.	**Tsyn**		m
NodAd	1	----------	Identification number for connection on serial communication bus	**NodAd**		---------

CONFIGURATION OF OUTPUT RELAYS

Default Setting						Actual Setting					
Protect. Element	**Output Relays**				**Description**	**Protect. Element**	**Output Relays**				
d>	1	-	-	-	Biased Differential element	**d>**					
d>>	-	2	-	-	High set of differential element	**d>>**					
I>	-	-	3	-	Instantaneous Overcurrent low set element	**I>**					
tI>	-	-	-	4	Time delayed Overcurrent low set element	**tI>**					
I>>	-	-	3	-	Instantaneous Overcurrent high set element	**I>>**					
tI>	-	-	-	4	Time delayed Overcurrent high set element	**tI>**					
tBF		-	-	-	Breaker Failure function	**tBF**					
FRes:	Aut				**Aut** = Automatic **Man** = Manually key Enter /Reset or via serial bus	**FRes:**					