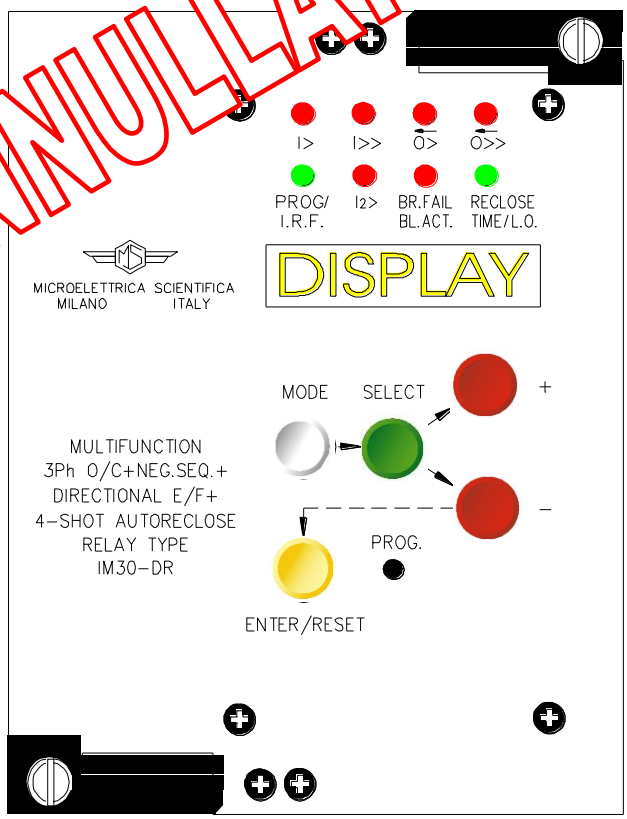
MICROPROCESSOR OVERCURRENT AND DIRECTIONAL EARTH FAULT PROTECTION RELAY + AUTORECLOSE

TYPE

IM30-DRE

OPERATION MANUAL



CE

INDEX

1 General utilization and commissioning directions 3
1.1 Storage and transportation 3
1.2 Installation 3
1.3 Electrical connection 3
1.4 Measuring inputs and power supply 3
1.5 Outputs loading 3
1.6 Protection earthing 3
1.7 Setting and calibration 3
1.8 Safety protection 3
1.9 Handling 3
1.10 Maintenance 4
1.11 Fault detection and repair 4
2 General characteristics and operation 4
2.1 Power supply 4
2.2 Algorithm of the time current curves 5
2.3 Operation of the directional earth fault element 6
2.4 Automatic cold load pick-up 8
2.5 Breaker fail 8
2.6 Autoreclose function 8
2.6.1 Operation 8
2.6.2 Reclaim time tr and lock-out status L.O 8
2.6.3 Reclose command 9
2.6.4 Programmable reclosing sequence 9
2.6.5 Dual setting 10
2.6.6 Sequence coordination 10
2.6.7 External lock-out 10
2.6.8 Reclose counters 10
2.6.9 Automatic inhibition of the high-set instantaneous overcurrent element (I>>) 10
3 Controls and measurements 11
4 Signalization 12
5 Output relays 13
6 Serial communication 13
7 Digital inputs and time synchronization input 14
7.1 Digital input 14
7.2 Clock and Calendar 15
7.2.1 Clock synchronization 15
7.2.2 Date and time setting 15
7.2.3 Time resolution 15
8 Test 16
9 Keyboard and display operation 16
10 Reading of measurements and recorded parameters 17
10.1 ACT. MEAS (Actual measure) 17
10.2 MAX VAL (Max values) 17
10.3 EVENT RECORDING (Last trip) 18
10.4 TRIP NUM (Trip number) 19
11 Reading of programmed settings and relay's configuration 19
12 Programming 20
12.1 Programming of functions settings 20
12.2 Programming the configuration of output relay 23
13 Manual and automatic test operation 24
13.1 W/O TRIP 24
13.2 WithTRIP 24
14 Maintenance 24
15 Electrical characteristics 25
16 Connection diagram (Standard Output) 26
16.1 Connection Diagram (Double Output) 26
17 Wiring the serial communication bus 27
18 Change phase current rated input 1A or 5A 28
19 Overall dimensions / Mounting 28
20 Time current curves 1/2 29
21 Time current curves 2/2 30
22 Direction for pcb's draw-out and plug-in 31
22.1 Draw-out 31
22.2 Plug-in 31
23 Keyboard operational diagram 32
24 Setting's form 33

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 (15 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 quantities are supplied to 1 Potential Transformer and to 4 Current Transformers (- three measuring phase current - one measuring the earth fault zero-sequence current).
Rated current input can be 1 or 5A
The zero sequence polarizing voltage input is rated 100V (from V1:√3/(100:3)V open delta connected V.Ts.).
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 - ALGORITHM OF THE TIME CURRENT CURVES

The Time Current Curves are generally calculated with the following equation :

$$t(I) = \left[\frac{A}{\left(\frac{I}{Is}\right)^{a} - 1} + B \right] \bullet K \bullet T_s + t_r$$ where :

t(I) = Actual trip time delay when the input current equals **I**

Is = Set minimum pick-up level

K = $\left(\frac{A}{10^{a} - 1} + B \right)^{-1}$

T_s = Set time delay : $t(I) = T_s$ when $\frac{I}{I_s} = 10$

tr = Operation time of the output relay on pick-up.

The constants **A**, **B, K** and **a** have different values for the different Time Current Curves.

Curve Name	Curve Identifier	A	B	a	K
IEC A Inverse	A	0.14	0	0.02	0.3366
IEC B Very Inverse	B	13.5	0	1	0.6667
IEC C Extr. Inverse	C	80	0	2	1.2375
IEEE Moderate Inverse	MI	0.0104	0.0226	0.02	4.1106
IEEE Short Inverse	SI	0.00342	0.00262	0.02	13.3001
IEEE Very Inverse	VI	3.88	0.0963	2	7.3805
IEEE Inverse	I	5.95	0.18	2	4.1649
IEEE Extremely Inverse	EI	5.67	0.0352	2	10.814
Independent Definite time	D	t = Ts			

Curves are user selectable for the following relay's functions

- **1F51** (FI>) = Low-set phase overcurrent
- **1F51N** (FO>) = Low-set Earth Fault current
- **F46** (FI_2>) = Negative Sequence overcurrent

For functions

- **2F51** (I>>, tI>>) = High-set phase overcurrent
- **2F51N** (O>>, tO>>) = High -set Earth Fault current

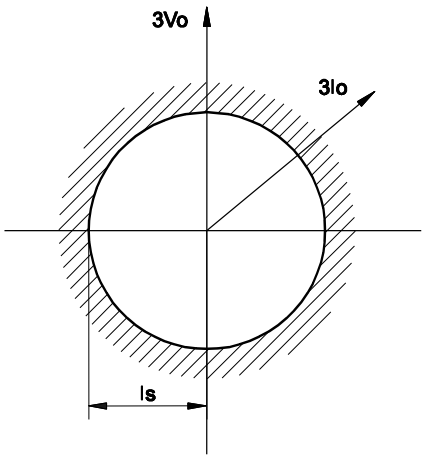
the operation is Independent Definite time only

2.3 OPERATION OF THE DIRECTIONAL EARTH FAULT ELEMENT

It is assumed :

- **Is** = Set minimum pick-up residual current (3Io) (O>,O>>)
- **Uo** = Set minimum residual voltage (level to enable Is pick-up)
- **α** = Set characteristic angle (max. torque angle)
- **3Io** = Actual earth fault relay's input current
- **3Vo** = Actual earth fault relay's input voltage
- **φo** = Actual Io/Vo phase displacement
- **Ios** = Component of Io in the direction α

The directional earth fault element can operate in three different ways according to the programming of the variable Fα.



Fα = Dis.

The element just operates as a normal overcurrent element without either residual voltage control (U_o) and zero sequence current displacement control (α)

- The element operates if : $3I_o \geq [I_s]$

Fα = Sup.

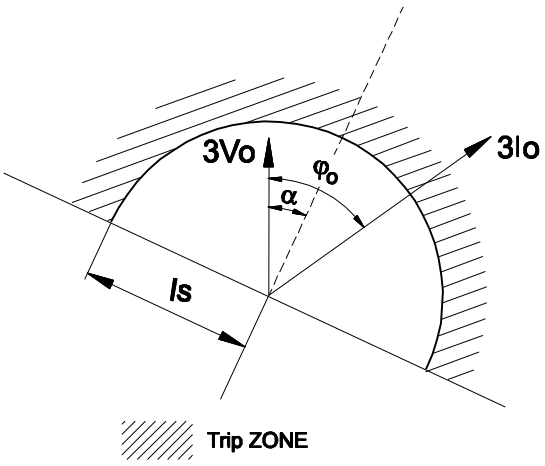
The element operates if the following 3 conditions are present :

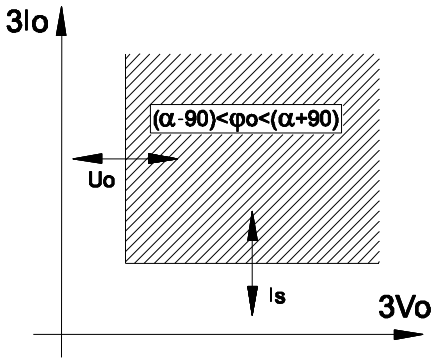
- The input residual voltage $3V_o$ exceeds the set U_o $3Vo \geq [U_o]$

- The input residual current $3I_o$ exceeds the set I_s $3I_o \geq [I_s]$

- The displacement α_o of I_o from V_o is within ± 90° from the set direction α.

$\alpha - 90 \leq \varphi_o \leq \alpha + 90$



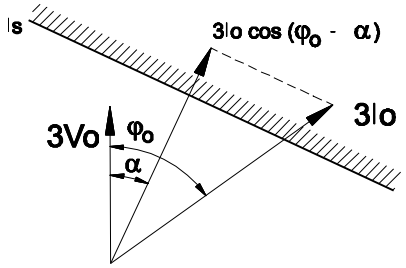


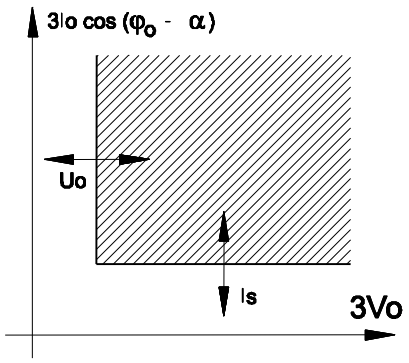
Fα = Dir

- The element performs a complete directional operation; pick-up takes place if the follow conditions ere present.

- The input residual voltage $3V_o$ exceeds the set U_o : $3V_o \geq [U_o]$

- The component of the input residual current $3I_o$ in the direction α exceeds the set level I_s : $3I_o \cos(\varphi_o - \alpha) \geq [I_s]$





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 **α= 90°**

- NEUTRAL EARTHED VIA RESISTOR **α= 0°**

- SOLIDLY EARTHED NEUTRAL **α= 60°**

2.4 Automatic Cold Load pick-up

When selected (2I>>=ON), the pick-up level of the high set overcurrent element is changed as follows. If during the first 60 msec of the breaker closing, the current exceeds 1.5 pu of the CTs rated primary current, the setting for the phase high set element is doubled until such time that the phase current drops below 1.25 pu of the rated CT primary current. This prevents nuisance trips associated with extended term cold load pick-up situation, or transformer inrush.

2.5 Breaker Fail

A programmable time delay (tBF) relay is set equal to the breaker's clearing time. If the fault is not cleared (i.e. the element has not dropped out) before this timer expires, a breaker fail is indicated. The Breaker Failure function is started by tripping of the relay BT if this is programmed. If no output relay is programmed to BT, the BF function is started at pick-up of any time delayed protection element.

2.6 Autoreclose Function

2.6.1 Operation

- The status of the Circuit Breaker (C/B) is indicated by one normally open contact of the C/B itself and is detected by the digital input "C/B" (terminals 1-2) of the relay.
- A reclose shot is started after a C/B's opening operated by one of the relay's protection elements programmed to control this reclose shot; C/B's opening operated manually or by one element not programmed to control the reclosure shot activates the Lock-out status of the Reclosure function.

2.6.2 Reclaim time tr and lock-out status L.O.

- Any time the Circuit Breaker (C/B) is closed either manually or automatically the Reclaim time **tr** is started.
- After a manual closure of the C/B, operation start or tripping of any of the relay protection elements during **tr** makes the relay enter into the Lock-Out status (L.O.). In the L.O. status the relay, after breaker opening, does not produce any command for automatic reclose; the lock-out status is monitored by the relevant LED flashing and (if programmed) by pick-up of one output relay. Reset from the L.O. status takes places when the C/B is opened and then manually reclosed.
- If none of the relay protection elements is started during **tr** after a manual closure of the C/B, the relay is ready to start the Automatic Reclose Sequence.
- If **tr** is started by an automatic reclosure, the operation start during **tr** of any element programmed for the operation of the next reclosure makes the relay proceed with the reclosing cycle.
- After **tr** is expired the reclosing cycle restarts from the first reclosure (1C).
- Pick-up of the time start of any element programmed for the control of the next reclousure, stops the counting down of **tr** which is restarted as soon as the element is reset.

2.6.3 Reclose Command

As soon as the C/B is opened due to tripping of one of the relay's elements programmed to initiate the next automatic reclose the relevant reclose time delay (t1C, t2C, t3C, t4C) is started and at the end of this txC time the reclose command is issued by the relay. The C/B is then automatically reclosed and the reclaim time **tr** is started again. If during **tr** the C/B is again opened by a relay's element programmed to initiate the next automatic reclose, the next reclose takes place after the relevant time txC; the C/B is reclosed and **tr** restarted. When the last Automatic Reclose shot of the sequence has been done, any further tripping during **tr** produces a relay's lock-out status. If after any reclose shot no tripping takes peace during **tr**, the Reclose Sequence is restarted from the beginning (starting from the first reclose shot 1C)

2.6.4 Programmable Reclosing Sequence

A reclose sequence can be programmed to operate from 1 up to four reclose shots to lock-out.
The variable " LO# "= 1, 2, 3,4 determines the number of shots to Lock-out. Each of the four reclose shots (1C, 2C, 3C, 4C) can be programmed to be initiated when the Circuit Breaker has been opened by tripping of any of the relay's time delayed protection elements (see § 12.1).
The elements which are programmed for 1C, 2C etc. can also operate one of the output relays " BT " used as breaker trip relay.

Example :

1C	=	tI> + tI>> + tO> + tO>> + tI_2>	**t1C**	=	0.3s
2C	=	tI_2> + tO> + tO>>	**t2C**	=	1s
3C	=	tI> + tO>	**t3C**	=	3s
4C	=	- - - - - - - - -	**t4C**	=	10s

- **1st Reclosure** shot is operated after 0.3s if C/B was opened on tripping of any of the relay's protection elements. (tI>, tI>>, tO>, tO>>, tI_2>)
- **2nd Reclosure** shot is operated after 1s if C/B's opening was caused by tripping of one of the relay's element tI_2>, tO>, tO>> only; if tripping was caused by another protection element not included in these programmed for this reclosure shot (for example tI>>) the relay will enter into the lock-out status.
- **3rd Reclosure** shot is operated after 3s if C/B's opening was caused by tripping of one of the elements tI>, tO> only.
- **4th Reclosure** shot is not programmed : any new tripping of the C/B after the 3rd reclosure will make the relay enter into the L.O. status. By not setting any elements as being enabling elements for a given reclose shot, it is possible to shorten the reclosing cycle. For example, by not defining any overcurrent elements for the 3rd and 4th reclose shots, then any fault sensed after the second shot will cause a lock-out condition. In this manner it is possible to set up one, two, three or four shot to lock-out reclose sequences.

It is also possible to have one of the output relays programmed as Breaker trip (BT) relay.
Any element which is enabled for the reclosing sequence and only these, will operate the BT relay in addition to the relay the individual element is programmed for; the other elements not on the list of the next reclosing shot will operate only the relay associated with their output relay settings, not the relay BT. If the Breaker tripping is controlled only by the output relay BT, the operation of any element not in the list of the next reclosure will not open the breaker and then will not start a reclousure. When the programmed number of shots to Lock-out is met the relay locks-out and no further reclousure is started.

2.6.5 Dual Setting

In addition to this flexibility, the relay has two setting groups. Two setting groups enables two different reclose sequences to be made available for changing system conditions: for example, for “storm” and “clear weather” conditions.
Selection between which setting group is active can be made manually via the relay’s keyboard or via serial interface programming.
Moreover switching-over from setting program 1 to setting program2 can be made automatically after any of the reclosing shots by programming the variable “ ChSet = 1-2-3-4-Dis ”.
For example : Programming ChSet = 3 means that after the third reclose shot the relay will automatically switch from setting 1 to setting 2 and the relay will operate according to Settings program 2. Setting program 1 is automatically restarted as soon as tr expires.
If Setting program 2 was originally programmed the ChSet function does not operate.

2.6.6 Sequence Coordination

When selected, (SEQ = ON) Sequence Coordination allows the reclose element to count downstream recloser operations as its own, thereby preventing unnecessary operations of the back-up device for a fault beyond the downstream device. This is particularly useful when the back-up breaker feeds several branch reclosers, only one of which is experiencing a fault.

2.6.7 External LOCK-OUT

The lock-out status can also be produced by activating the digital input BI (terminals 1-3) if this input was programmed for reclose lock-out. If the lock-out input is removed when the C/B is still closed, the relay will come back to its normal status after a time delay **tr**.

2.6.8 Reclose Counters

Any automatic Reclose Shot is counted by an individual counter (1Cn°, 2Cn°, 3Cn°, 4Cn°) and displayed in the menu “TripNum”. If after a reclose command the status of the C/B does not change (the C/B does not open) the reclose shot is not counted and the relay goes into the lock-out status. Another counter counts any C/B’s operation (OPSn°).

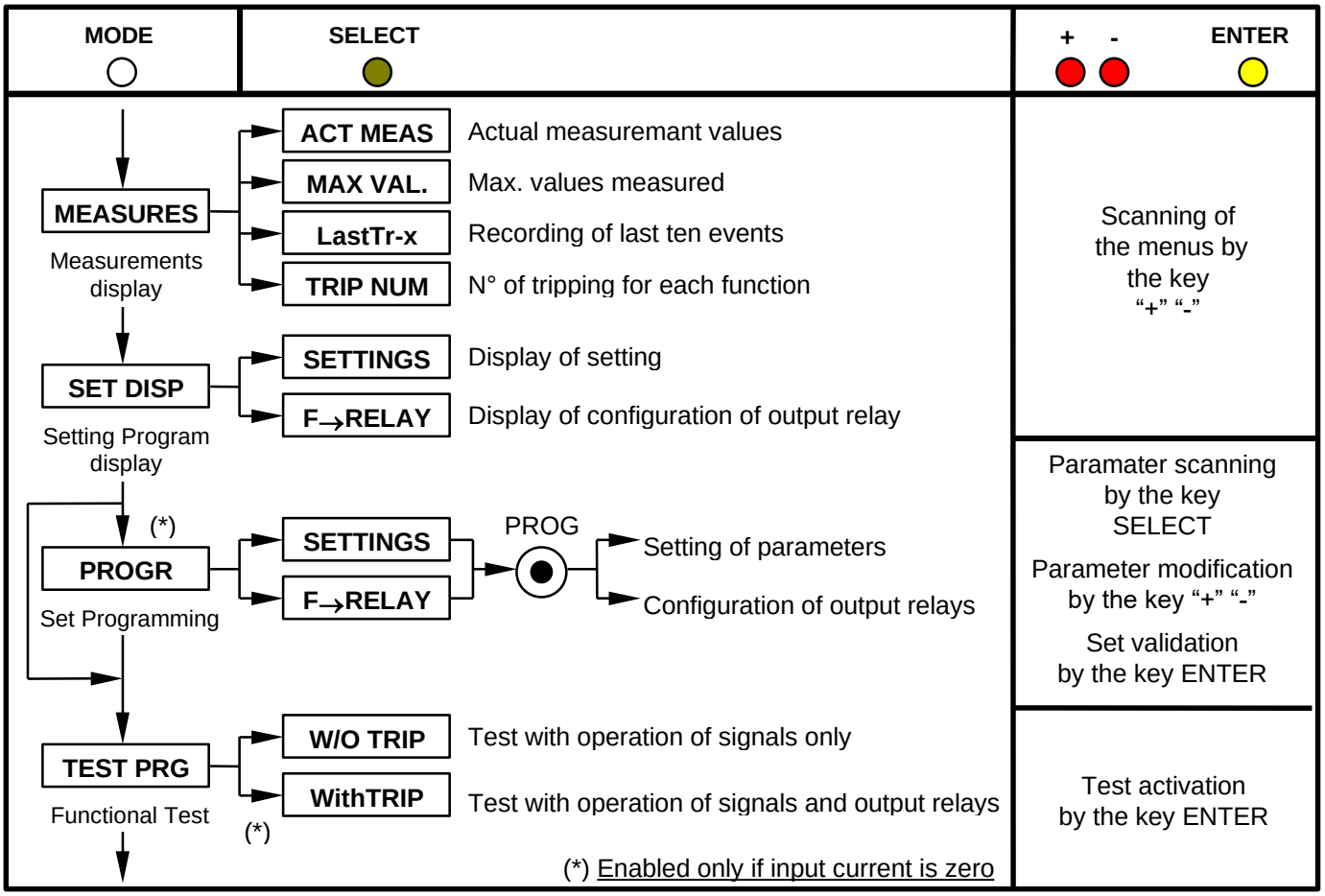
2.6.9 Automatic Inhibition of the High-Set Overcurrent Element (I>>)

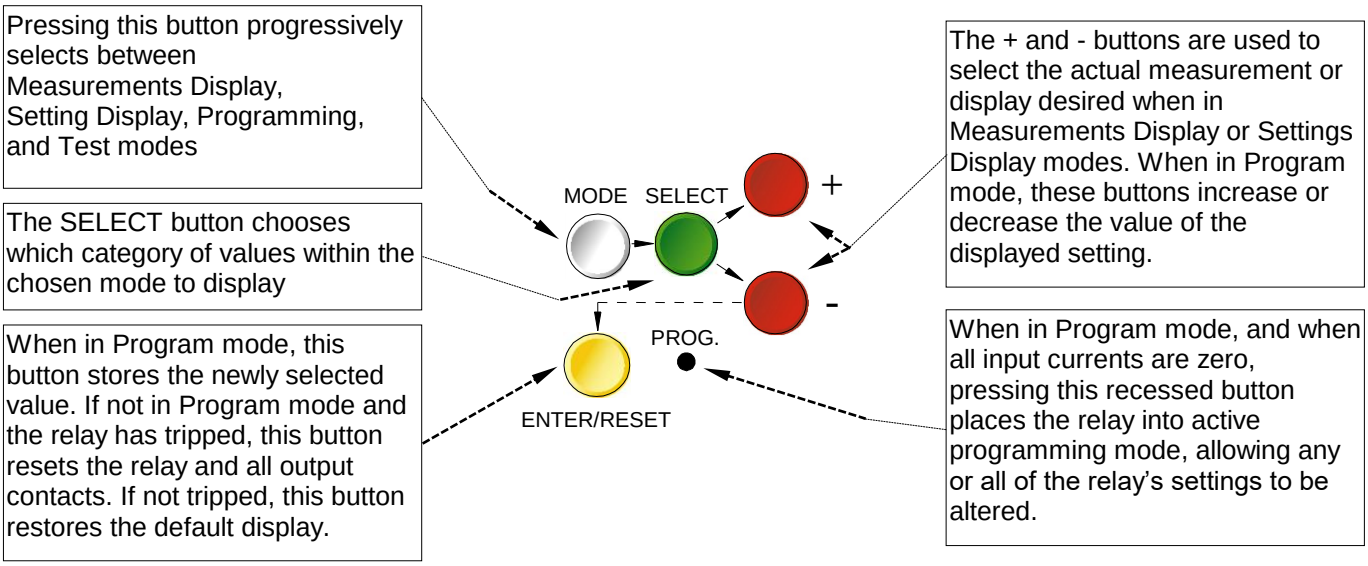
The high-set overcurrent element I>> can be blocked during the reclaim time **tr** after a manual-closure operation of the Circuit Breaker, and after automatic reclosures by programming the parameter “I>>MC”.
With “I>>MC=ON”, pick-up of the output relays, controlled by the high-set overcurrent element (I>>), is blocked for the set reclaim time [tr] on C/B manual closure and after automatic reclosures subsequent to the first shot. The block does not work during tr started by the first automatic reclosure shot.

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)

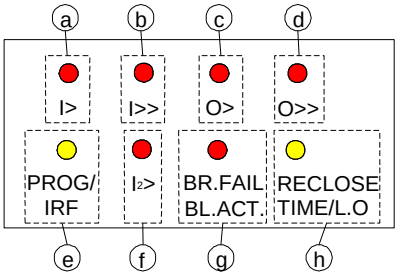
FIG.1





4. SIGNALIZATIONS

Eight signal leds (normally off) are provided:



a) Red LED **I>**
- Flashing when measured current exceeds the set trip level [I_2>].
- Illuminated on trip after expiry of the set trip time delay [tI_2>].

b) Red LED **I>>**
- Same as above related to [I>>], [tI>>].

c) Red LED **O>**
- Same as above related to [O>], [tO>].

d) Red LED **O>>**
- Same, as above related to [O>>], [tO>>].

e) Yellow LED **PROG/IRF**
- Flashing during the programming of the parameters or in case of Internal Relay Fault.

f) Red LED **I_2>**
- Flashing when measured current exceeds the set trip level [I_2>].
- Illuminated on trip after expiry of the set trip time delay [tI_2>].

g) Red LED **BR.FAIL./ BL.ACT.**
- Flashing when a blocking signal is present at the relevant input terminals.
- Lit-on when the BREAKER FAILURE function is activated.

h) Yellow LED **RECLOSE TIME/L.O.**
- Flashing during reclose timing (txC)
- Lit-on when reclosing function is in the lock-out status

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)

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 any of the IM30-DRE's functions.
Reset of the output relays after pick-up takes place automatically as soon as the tripping cause is cleared. For relays controlled by the time delayed elements of the protection functions (tI>, tI>>, tO>,tO>>, tI_2>) it is possible to select Automatic reset or Manual Reset by the front reset button (see programming of tFRes § 12.2).
The reset of the relay associated to BT (see § 2.6.2) is always automatic.

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

- internal fault
- power supply failure
- during the programming

6. 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).
Via the communication bus all settings and commands available on relay's keyboard can be operated from the computer and viceversa all information available at relay's level can be received at computer's level. The transmission standard is RS485 (converter 485/232 available).
Each relay is identified by its programmable address code (NodeAd) and can be called from the P.C. fitted with a WINDOWS (version 3.1 or later) program driven by the application program supplied by Microelettrica Scientifica.

7. DIGITAL INPUTS AND TIME SYNCHRONIZATION INPUT

7.1 Digital Inputs

Three optoisolated digital inputs are available:

- Open circuit voltage at relevant terminals (1-2, 1-3, 1-14) is 15 Vdc
- Internal resistance 2,2kΩ

The inputs are activated when relevant terminals are shorted (external resistance < 2kΩ)

- **BI** (terminals 1-3) : it blocks the operation of the time delayed element of the function programmed and or the operation of the Reclose function (see "Programming of function settings" § 12.1)

For the protection functions the blocking input blocks the operation of the output relay of the function blocked but not its time delay : when the block input is removed the output relay will trip instantaneously (if the function's trip time delay is already expired) or after the remaining time delay.
For the Autoreclose function the blocking input makes the reclose lock-out led **h** lit-on the Alarm relay (if programmed) pick-up and the reclose function to go into the Locked Status.
When the blocking input is removed the relay comes back to the normal status after the waiting time **5s**.
The presence of a blocking input signal is monitored by the red led **g** flashing.

- **C/B** (terminals 1-2) : connected to a normally open auxiliary contact of the Circuit Breaker, it discriminates Open Status (contact open) or Closed Status (contact closed) of the C/B.
  This input is used for operation of the autoreclose functions.

- **BIR** (terminals 1-14) : Another optoisolated input is available for a IRIG-B time Synchronisation input from GPS – Accuracy 10ms –
  Time Synchronization can also be made via serial communication interface (see § 7.2.1)

WARNING

Connection of a GPS system to the IRIG-B input (termination 1 – 14) must be made through a proper adapter device supplied on request as optional.

7.2 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.

7.2.1 Clock synchronization.

The clock can be synchronized via the IRIG-B digital input (terminals 1 – 14) or the serial communication interface.
By programming the variable (T_{syn} = 5', 10', 15', 30', 60', IRGI-B, Dis) the Synchronization is made in different ways :

a) T_{syn} = Dis : The current date can only be modified manually either via the front panel keyboard (SETTING MENU) or via the serial communication interface (programming mode).

b) T_{syn} = IRIG-B : The date is automatically updated by the IRIG-B input signal.

c) T_{syn} = 5', 10', 15', 30', 60' : The date is updated via the serial interface as follows :

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.

7.2.2 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.

7.2.3 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.

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. (Anyway the output relay associated to reclosing in not energized during test)

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
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.
I_2xxxxx**A**	Negative Sequence component of the 3-phase current system
Uoxxxxx**V**	True R.M.S. value of the residual voltage displayed as secondary voltage of main V.Ts. (1-210)V
φoxxxxx**°**	Io/Uo phase displacement angle in degrees.

10.2 MAX VAL

Highest values recorded starting from 100ms after closing of main Circuit Breaker plus inrush values recorded within the first 100ms from Breaker closing, (refreshed any time the breaker closes).

Display	Description
IAxxxx**In**	Max demand of phase A current after the first 100ms, displayed as p.u. of C.Ts rated current
IBxxxx**In**	As above, phase B.
ICxxxx**In**	As above, phase C.
Ioxxxx**On**	As above, earth fault current.
I_2xxxx**In**	As above, negative sequence current component
Uoxxxxx**V**	Max value of Uo recorded after the first 100ms.
SAxxxx**In**	Max demand current of phase A during the first 100ms.
SBxxxx**In**	As above, phase B.
SCxxxx**In**	As above, phase C.
Soxxxx**On**	As above, earth fault current.
SUoxxxx**V**	Max value of Uo recorded during the first 100ms.

10.3 EVENT RECORDING (LASTTRIP)

RECORDING OF THE LAST TEN EVENTS: Display of the function which caused the tripping of the relay plus values of the parameters at the moment of tripping. The memory buffer is refreshed at each new relay tripping. A much more extensive information is available from the RS485 serial port.
Each of the last ten event records stored into the FIFO memory contains:

- A date and time stamp. (A time synchronization signal can be sent either via serial interface or to the IRIG-B input allowing the use of an external satellite clock to synchronize all relays on the system with 10ms accuracy).
- Each ¼ cycle for 10 cycles (2 pre-fault, 8 post-fault), the following data are recorded :
  - The R.M.S. values of the three phase currents, ground current, negative sequence current, and the residual voltage.
  - Pick-up and trip status of the low and high set phase and ground element, the negative sequence elements and the reclose element
  - Operating status of the five output relays.
  - Time to the end of count-down of the reclose reset timer tr as well as of the timers relevant to any of the Reclose shots.

The data are stored and collected by the MS-COM application program, from which they can be organized by a spread sheet program (EXCEL)

- Two or more events taking place within 5 ms are recorded simultaneously and the indication of the Cause which produced the event shows all the function which caused the different events.
- The duration of each event record is 10 cycles : any event taking place during the recording time remains in the same event record.

Display	Description
xxXXXxx	Date : Day, Month, Year
xx:xx:xx	Hour : Hours, Minutes, Seconds
LastTr-x	Indication of the recorded event (x= 0 to 9) Example: Last event (LastTr –0) Last but one event (LastTr-1) etc…
F: xxxxx	Display of the function which caused the last tripping: **i = tI>**; **I = tI>>**; **o = tO>**; **O = tO>>**; **N=tI2>**
IAxxxx**In**	Current of phase A.
IBxxxx**In**	Current of phase B.
ICxxxx**In**	Current of phase C.
Ioxxxx**On**	Earth fault current.
I2xxxx**In**	Negative Sequence component of current.
Uoxxxxx**V**	Residual voltage.
φoxxxxx**°**	Io/Uo phase displacement.
trxxxxx**s**	Remaining time to elapse of **tr** – If tr≠0 the trip has taken place during **tr** after a closure

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
I> xxxxx	Low set timed overcurrent element [tI>] operations
I>>xxxxx	High set overcurrent element [tI>>] operations
Io>xxxxx	Low set earth fault element [tO>] operations
Io>>xxxxx	High set earth fault element [tO>>] operations
I2 xxxxx	Negative Sequence overcurrent element [tI>>] operations
1Cxxxxxx	N° of reclousure operated by the first reclosing shot 1C
2Cxxxxxx	N° of reclousure operated by the 2nd reclosing shot 2C
3Cxxxxxx	N° of reclousure operated by the 3rd reclosing shot 3C
4Cxxxxxx	N° of reclousure operated by the 4th reclosing shot 4C
OPSxxxxx	Number of Circuit Breaker's operations

11. READING OF PROGRAMMED SETTINGS AND RELAY'S CONFIGURATION

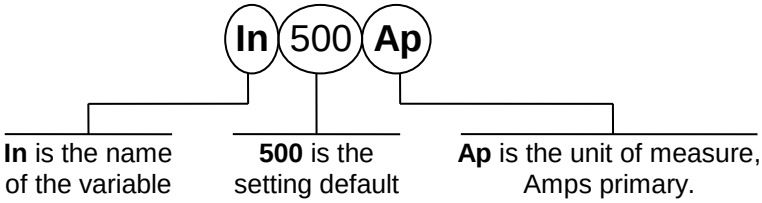
Enter the mode "SET DISP", select the menu "SETTINGS" or "F→RELAY", scroll information available in the menu by keys "+" or "-".

- 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 **(---)**]
The same factory programming is used for both the two settings – Setting 1 and Setting 2 – available as explained at § 2.6.3.
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 "SETTING1" or "SETTING2" 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).

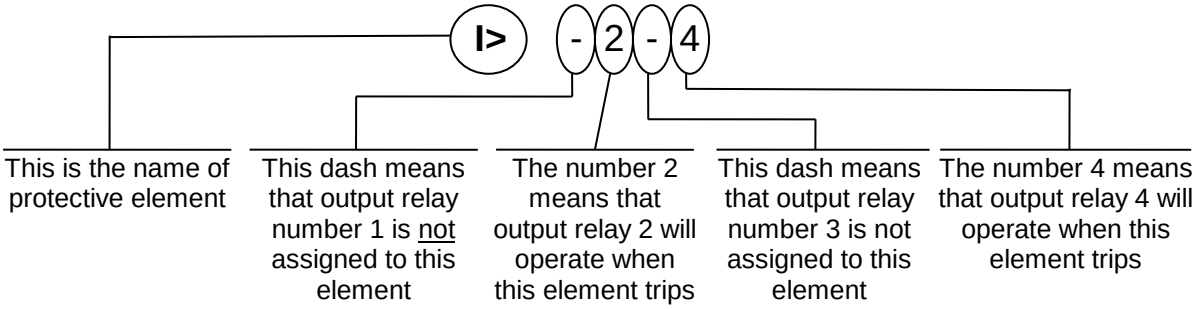
Display	Description	Setting Range	Step	Unit
xxxxxxx	Current date	DDMMMYY	-	-
xx:xx:xx	Current time	HH:MM:SS	-	-
Fn 60 **Hz**	Mains frequency	50 – 60	10	Hz
In 500**Ap**	Rated primary current of the phase C.Ts.	1 – 9999	1	A
On 500**Ap**	Rated primary current of the C.Ts. or of the tore C.T. supplying the zero sequence current	1 – 9999	1	A

Display	Description	Setting Range	Step	Unit
F(I>) D	Operation characteristic of the low-set overcurrent element: (D) = Independent definite time (A) = IEC Inverse Curve type A (B) = IEC Very Inverse Curve type B (C) = IEC Extremely Inverse Curve type C (MI) = IEEE Moderate Inverse Curve (SI) = IEEE Short Inverse Curve (VI) = IEEE Very Inverse Curve (I) = IEEE Inverse Curve (EI) = IEEE Extremely Inverse Curve	D A B C MI SI VI I EI	D A B C MI SI VI I EI	-
I> 1.0**In**	Trip level of low-set overcurrent element (p.u. of the rated current of the phase C.Ts.)	0.5 - 4 - Dis	0.01	In
tI> 2.0**s**	Trip time delay of the low-set overcurrent element In the inverse time operation [tI>] is the trip time delay at I = 10x[I>]	0.05 - 30	0.01	s
I>> 2**In**	Trip level of high-set overcurrent element (p.u. of the rated current of the phase C.Ts	0.5 - 40 - Dis	0.1	In
tI>> 1.0**s**	Trip time delay of the high-set overcurrent element	0.05 - 3	0.01	s
2I>> ON	Automatic Cold Load pick-up	ON - OFF	ON-OFF	-
Uo 10**V**	Starting level of the zero-sequence polarizing input voltage. This is the minimum level of Uo needed to enable the operation of the directional earth element.	2 - 25	1	V
Fα Dir	Operation mode of the earth fault element (see § 2.3) Fα = Dis : Non directional operation Fα = Sup : Operation with residual voltage enabling and direction supervision only $(\alpha - 90) < \alpha_o < (\alpha + 90)$ Fα = Dir : Complete directional operation	Dis Sup Dir	Dis Sup Dir	-
α= 90°	Max sensitivity direction of the earth fault current	0 - 359	1	°
F(O>) D	Operation characteristic of the low-set earth fault element: (D) = Independent definite time (A) = IEC Inverse Curve type A (B) = IEC Very Inverse Curve type B (C) = IEC Extremely Inverse Curve type C (MI) = IEEE Moderate Inverse Curve (SI) = IEEE Short Inverse Curve (VI) = IEEE Very Inverse Curve (I) = IEEE Inverse Curve (EI) = IEEE Extremely Inverse Curve	D A B C MI SI VI I EI	D A B C MI SI VI I EI	-
O> .1**On**	Trip level of low-set earth fault element (p.u. of the rated current of the C.Ts. for zero sequence detection)	0.02 - 0.4 -Dis	0.01	On
tO> 4.0**s**	Trip time delay of low-set earth fault element. In the inverse time operation [tO>] is the trip time delay at I = 10x[O>].	0.05 - 30	0.01	s
O>> .5**On**	Trip level of high-set earth fault element (p.u. of the rated current of the C.Ts. for zero sequence detection)	0.02 - 1 - Dis	0.01	On
tO>> 3.0**s**	Trip time delay of the high-set earth fault element	0.05 - 3	0.01	s

Display	Description	Setting Range	Step	Unit
F(I2) D	Operation characteristic of the Negative Sequence element: (D) = Independent definite time (A) = IEC Inverse Curve type A (B) = IEC Very Inverse Curve type B (C) = IEC Extremely Inverse Curve type C (MI) = IEEE Moderate Inverse Curve (SI) = IEEE Short Inverse Curve (VI) = IEEE Very Inverse Curve (I) = IEEE Inverse Curve (EI) = IEEE Extremely Inverse Curve	D A B C MI SI VI I EI	D A B C MI SI VI I EI	-
I2 .6**In**	Trip level of the negative sequence overcurrent element (p.u. of the rated current of phase C.Ts)	0.5 - 4 - Dis	0.01	In
tI2>2.0**s**	Trip time delay of the negative sequence element. In the inverse time operation [tI2>] is the trip time delay at I2=10x[I2>]	0.05 – 30	0.01	s
1C ––I–O	Selection of the function(s) selected to initiate the first reclosing shot 1C (i = tI>; I = tI>>; o = tO>; O = tO>>;I2=tI2>)	- - - - - I2 i I o O	-	-
2C –i–oO	As above for second reclosing shot 2C (i = tI>; I = tI>>; o = tO>; O = tO>>; I2=tI2>)	- - - - - I2 i I o O	-	-
3C –––oO	As above for third reclosing shot 3C (i = tI>; I = tI>>; o = tO>; O = tO>>; I2=tI2>)	- - - - - I2 i I o O	-	-
4C ––I–O	As above for fourth reclosing shot 4C (i = tI>; I = tI>>; o = tO>; O = tO>>; I2=tI2>)	- - - - - I2 i I o O	-	-
t1C 2**s**	Reclosing time interval of first reclosing shot	0.1 - 1800	0.1	s
t2C 4**s**	As above for 2nd reclosing shot	0.1 - 1800	0.1	s
t3C 6**s**	As above for 3rd reclosing shot	0.1 - 1800	0.1	s
t4C 8**s**	As above for 4th reclosing shot	0.1 - 1800	0.1	s
tr 8**s**	Reset interval (reclaim time)after any successful reclosure	1 - 200	1	s
LO# 3	Lock-out number. Determines the number of shots to Lock-out	1 – 2 – 3 – 4	1-2-3-4	-
ChSet 2	Change Setting. Determines when the relay automatically changes from setting group 1 to setting group 2 (not viceversa)	1-2-3-4-Dis	1-2-3-4-Dis	-
SEQ COFF	Sequence coordination with downstream recloser	ON - OFF	ON-OFF	-
tBF .25**s**	Time delay for Breaker Failure alarm	0.05 - 0.25	0.01	s
B→I> OFF	Blocking Input at terminals 1-3, blocks the timed output of the function I>	ON - OFF	ON-OFF	-
B→I>>OFF	As above, for function I>>	ON - OFF	ON-OFF	-
B→O> OFF	As above, for function O>	ON - OFF	ON-OFF	-
B→O>>OFF	As above, for function O>>	ON - OFF	ON-OFF	-
B→I2 OFF	As above, for function I2>	ON - OFF	ON-OFF	-
B→RcIOFF	Blocking Input at terminals 1-3, blocks the reclose function	ON - OFF	ON-OFF	-
Tsyn IRIG	Synchronisation Time Expected time interval between sync. pulse.	5-10 15-30-60 IRIG-B Dis	5-10 15-30-60 IRIG-B Dis	m (min)
I>>MC OFF	Block of high-set o/c element during tr ON = Active - OFF = Non Active	ON - OFF	-	-
NodAd 1	Identification number for connection on serial communication bus	1 - 250	1	-

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.

Display		Description
I>	----	Instantaneous element of low-set overcurrent operates relays R1,R2,R3,R4. (only one or more, whatever combination)
tI>	1---	As above, time delayed element.
I>>	----	Instantaneous element of high-set overcurrent operates relay R1,R2,R3,R4.
tI>>	-2--	As above, time delayed element.
O>	----	Instantaneous element of low-set earth fault element operates relay R1,R2,R3,R4.
tO>	1---	As above, time delayed element.
O>>	----	Instantaneous element of high-set earth fault element operates relay R1,R2,R3,R4.
tO>>	-2--	As above, time delayed element.
I_2	----	Instantaneous element of Negative Sequence current operates relays R1,R2,R3,R4.
tI_2	1---	As above, time delayed element.
C	---4	Reclousure operates relay R1,R2,R3,R4.
rLO	--3-	Reclose Lock-out status operates relay R1,R2,R3,R4.
tBF	----	Breaker failure alarm operates relay R1,R2,R3,R4.
BT	----	Breaker Trip relay. (see § 2.6.2)
tFRes: A		The reset after tripping of the relays associated to the time delayed elements can take place: **(A)** automatically when current drops below the trip level. **(M)** manually by the operation of the "ENTER/RESET" key. The reset is always automatic for relays assigned to instantaneous element or to the Reclose function.

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.

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. ELECTRICAL CHARACTERISTICS

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			

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

❑	Electromagnetic emission	EN55022			
❑	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/m
❑	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, 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			

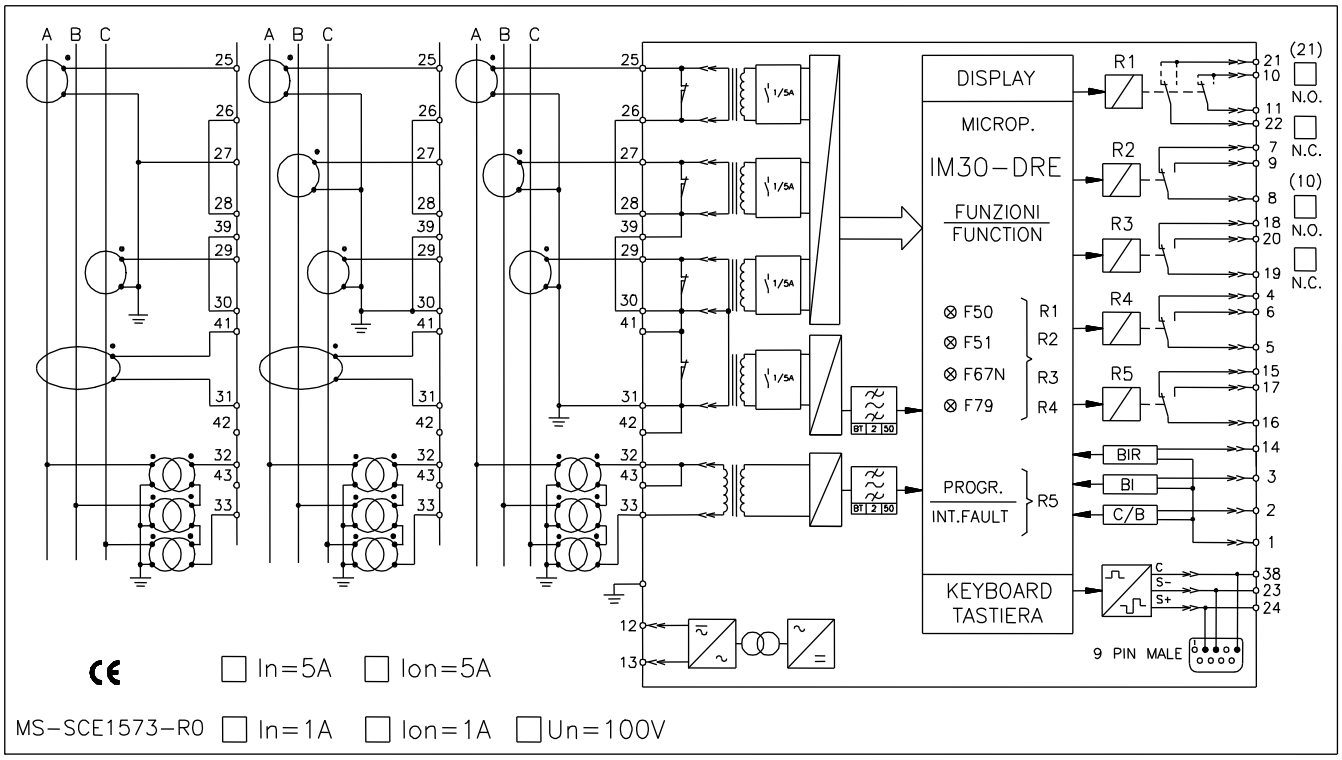
CHARACTERISTICS

❑	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 continuos
❑	Burden on current inputs	Phase : 0.01VA at In = 1A; 0.2VA at In = 5A 0.02VA at On = 1A; 0.4VA at On = 5A
❑	Rated Voltage	Un = 100V (different on request)
❑	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.)
❑	Operation ambient temperature	-10°C / +55°C
❑	Storage temperature	-25°C / +70°C
❑	Humidity	93% Without Condensing

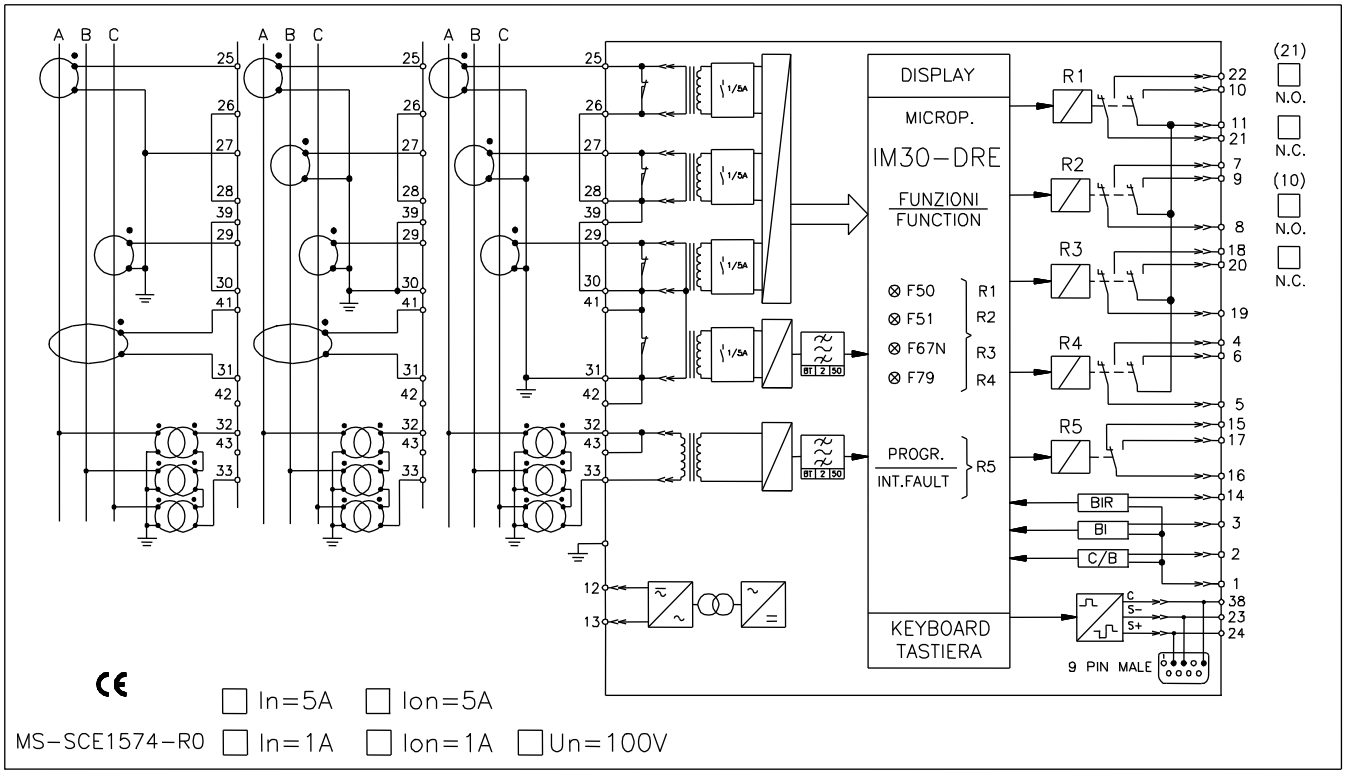
Microelettrica Scientifica S.p.A. - 20089 Rozzano (MI) - Italy - Via Alberelle, 56/68
Tel. (##39) 2 575731 - Fax (##39) 2 57510940 - Telex 351265 MIELIT I
http://www.microelettrica.com

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

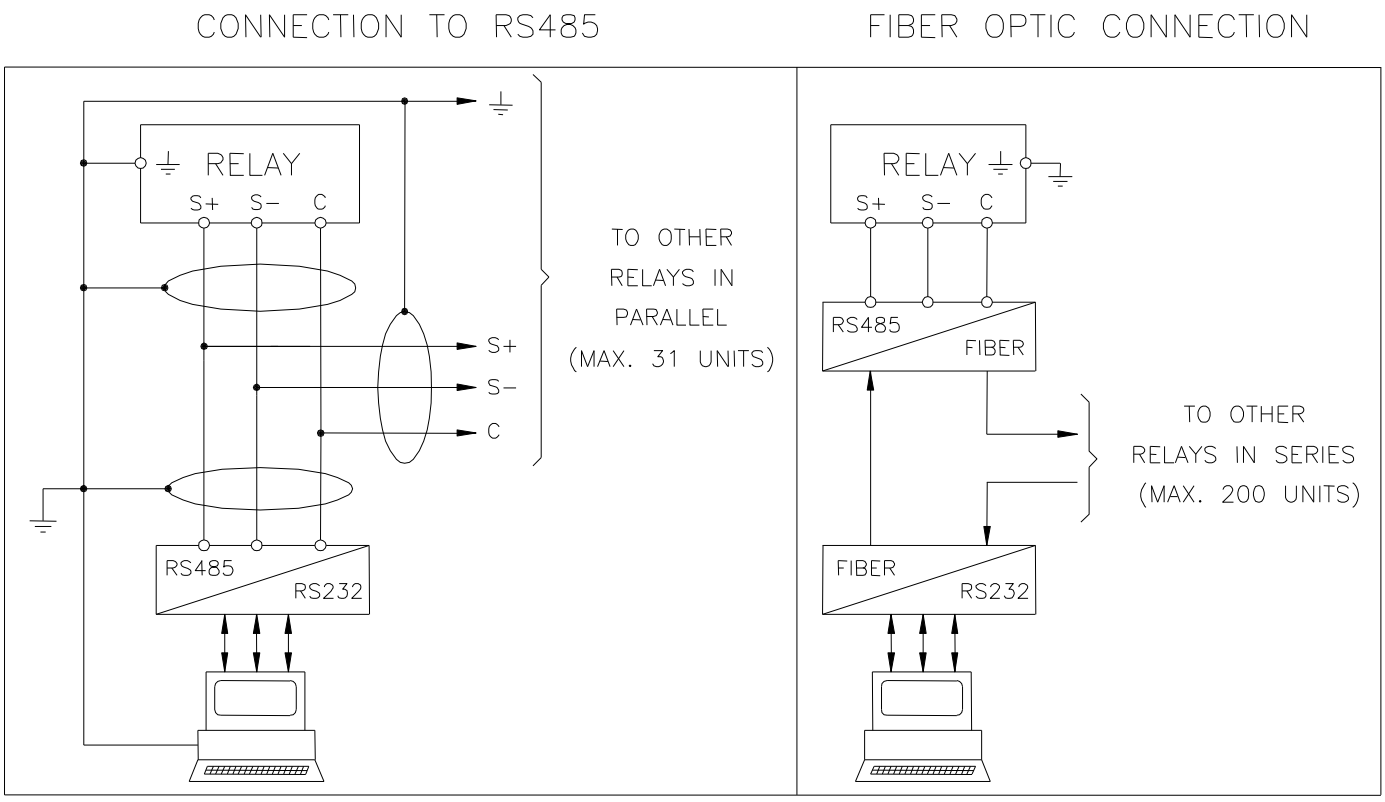
16. CONNECTION DIAGRAM (SCE1573 Rev.0 Standard Output)



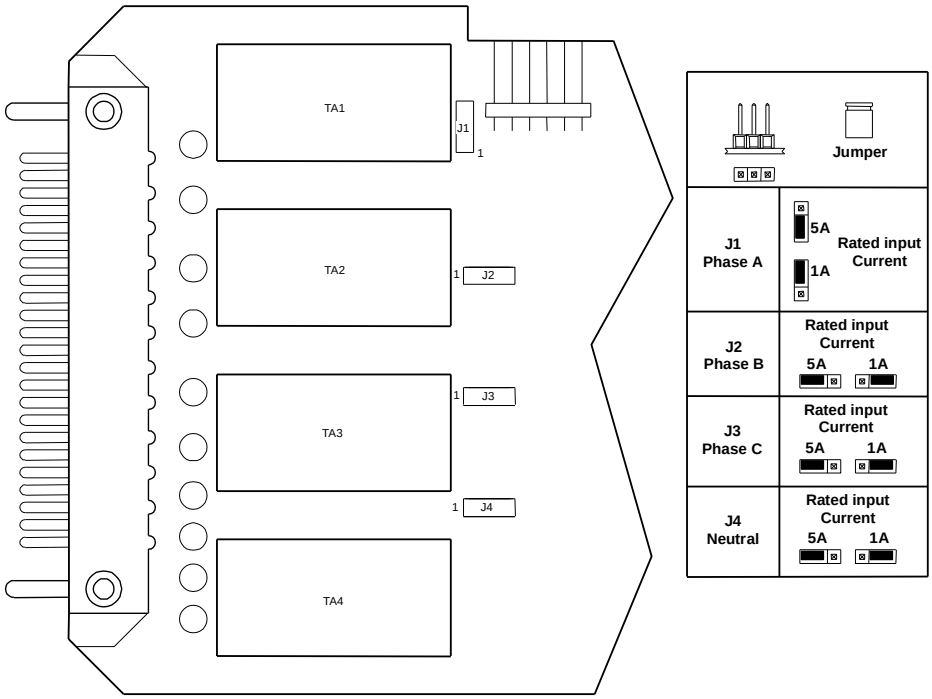
16.1 CONNECTION DIAGRAM (SCE1574 Rev.0 Double Output)



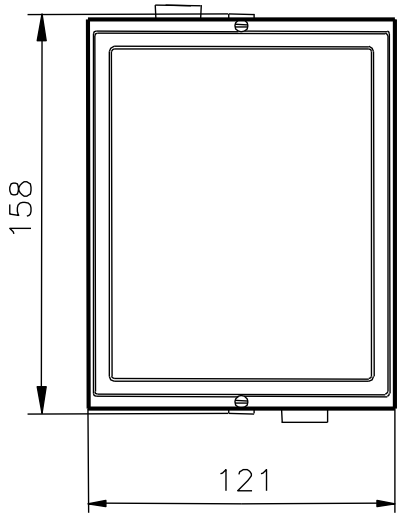
17. WIRING THE SERIAL COMMUNICATION BUS (SCE1309 Rev.0)



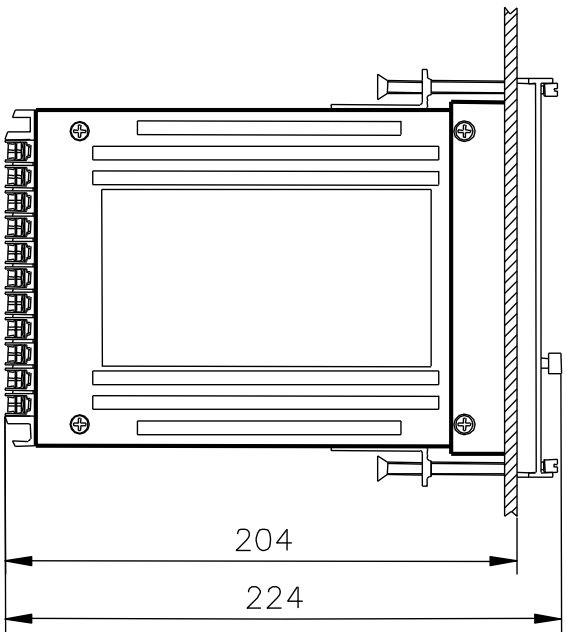
18. CHANGE PHASE CURRENT RATED INPUT 1 OR 5A



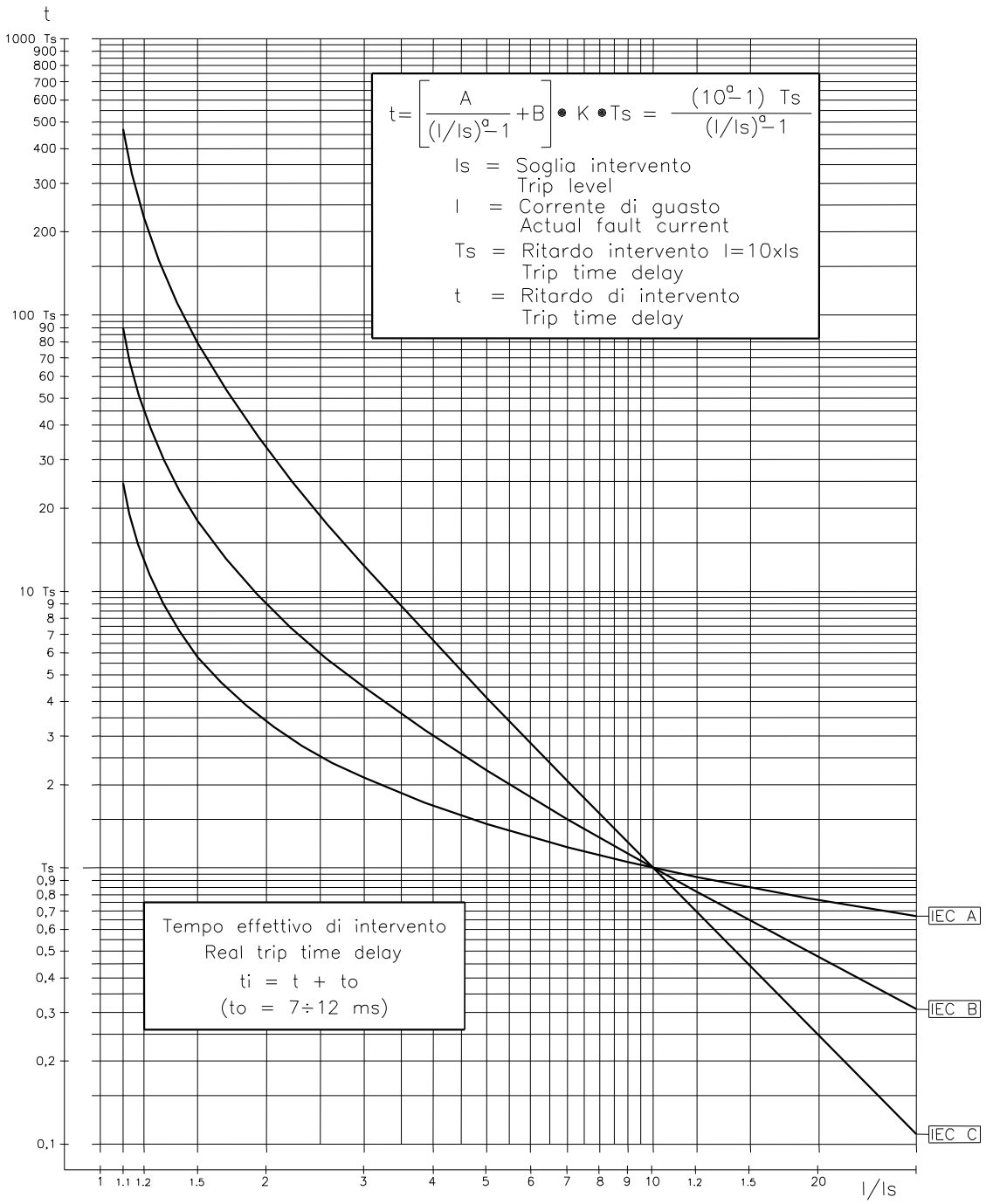
19. MOUNTING



PANEL DRILLING 113x142 (LxH)



20. TIME CURRENT CURVES (TU0353 Rev.0) 1/2



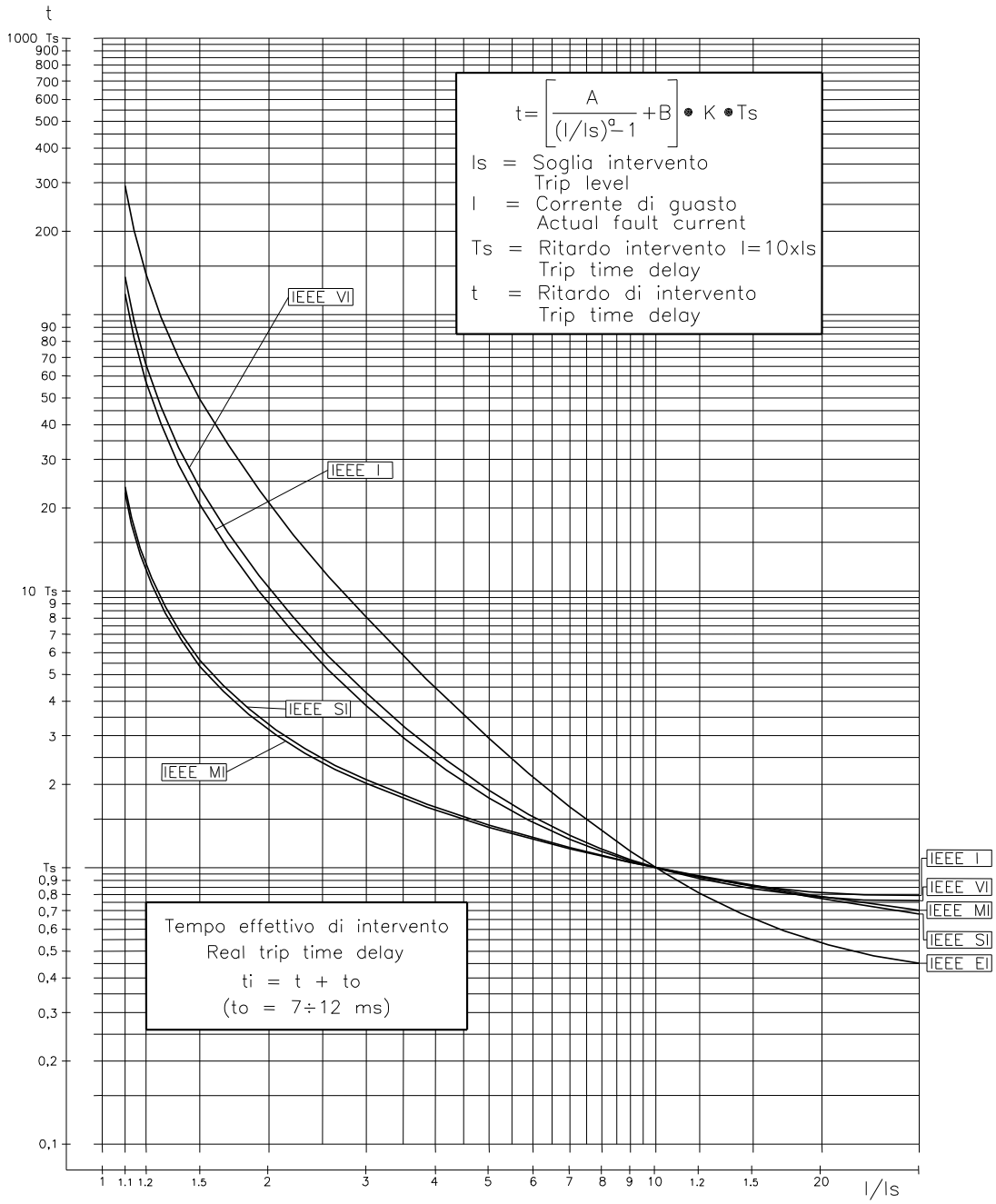
Curve Type	A	B	K	a
IEC A	0.14	0	0.336632	0.02
IEC B	13.5	0	0.666667	1
IEC C	80	0	1.2375	2

F51 { Is = I> = (0.5−4)In
Ts = tI> = (0.05−30)s

F51N { Is = 0> = (0.02−0.4)On
Ts = t0> = (0.05−30)s

For F51 saturation at I> 50 In
For F51N saturation at Io> 4 On

21. TIME CURRENT CURVES (TU0353 Rev.0) 2/2



Curve Type	A	B	K	a
MI= IEEE Moderate Inv.	0.0104	0.0226	4.110608	0.02
SI= IEEE Short Inv.	0.00342	0.00262	13.30009	0.02
VI= IEEE Very Inv.	3.88	0.0963	7.380514	2
I= IEEE Inverse	5.95	0.18	4.164914	2
EI= IEEE Extremely Inv.	5.67	0.0352	10.814	2

F51 { Is = I> = (0.5−4)In
Ts = tI> = (0.05−30)s

F51N { Is = 0> = (0.02−0.4)On
Ts = t0> = (0.05−30)s

For F51 saturation at I> 50 In
For F51N saturation at Io> 4 On

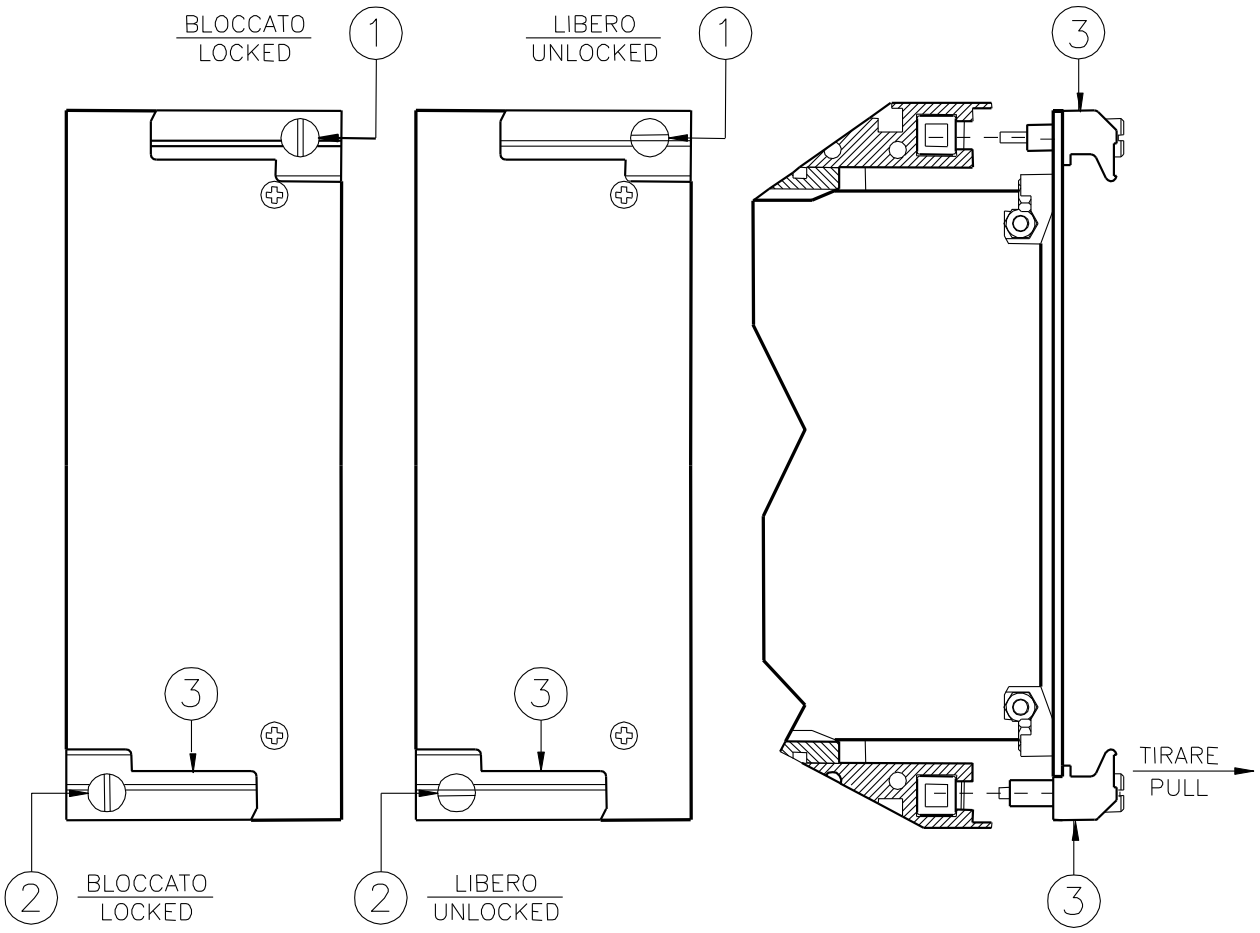
22. DIRECTION FOR PCB'S DRAW-OUT AND PLUG-IN

22.1 Draw-out

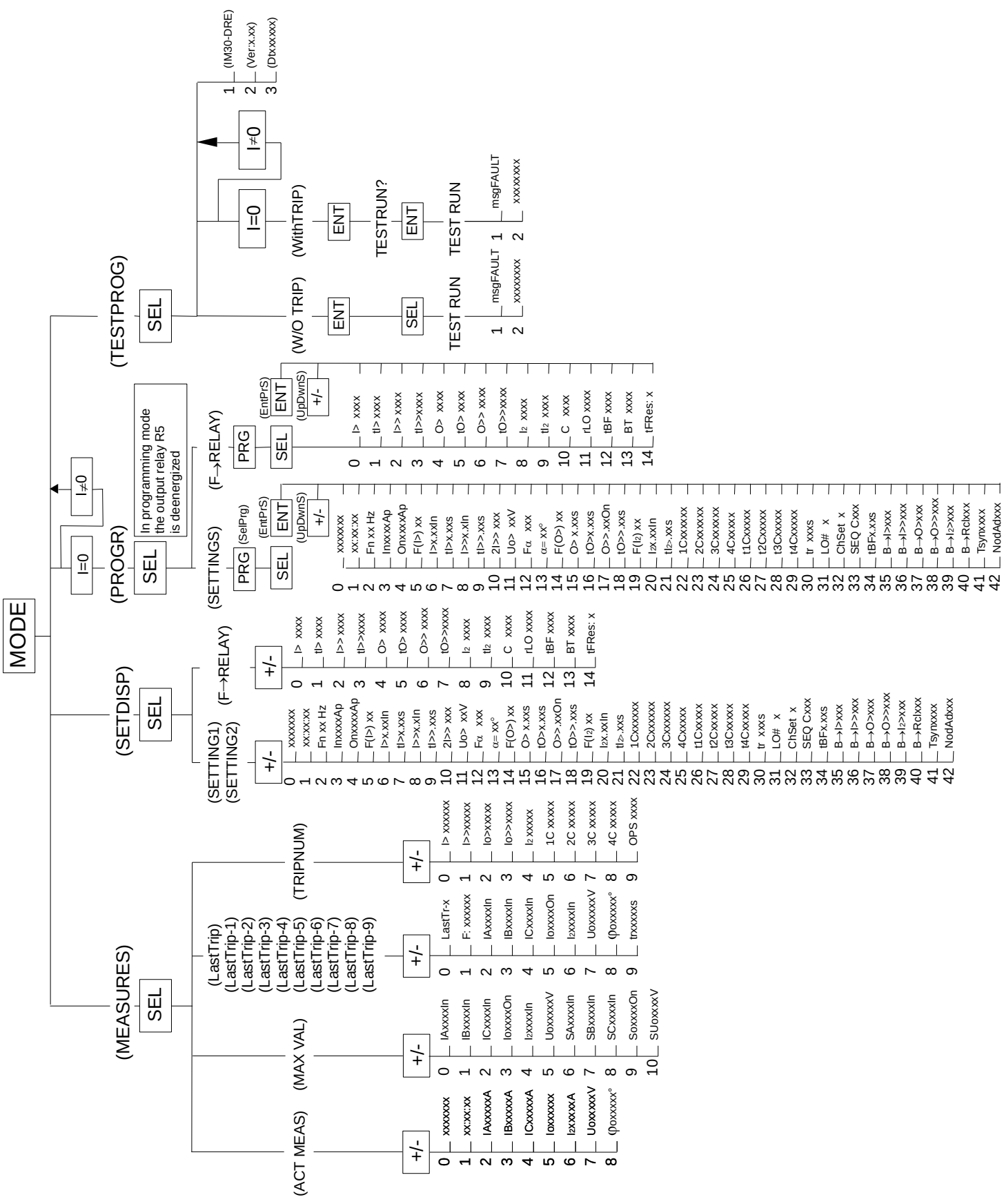
Rotate clockwise the screws ① and ② in the horizontal position of the screws-driver mark.
Draw-out the PCB by pulling on the handle ③

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. KEYBOARD OPERATIONAL DIAGRAM



24 SETTINGS' FORM

Date :		**Number Relay:**	

RELAY PROGRAMMING

Default Setting				**Actual Setting**		
Variable	**Value**	**Units**	**Description**	**Variable**	**Value**	**Units**
xxxxxxx	DDMMMYY	**-**	Current Date	**xxxxxxx**		**-**
xx:xx:xx	HH:MM:SS	**-**	Current time	**xx:xx:xx**		**-**
Fn	60	**Hz**	System Frequency	**Fn**		**Hz**
In	500	**Ap**	Rated primary current of the phase C.Ts.	**In**		**Ap**
On	500	**Ap**	Neutral CT rated primary current	**On**		**Ap**
F(I>)	D	-	Curve shape of low-set phase overcurrent	**F(I>)**		-
I>	1.0	**In**	Tap of phase low-set overcurrent elements	**I>**		**In**
tI>	2.0	**s**	Time dial of phase low-set overcurrent elements	**tI>**		**s**
I>>	2	**In**	Tap of phase high-set element	**I>>**		**In**
tI>>	1.0	**s**	Time delay of high-set phase overcurrent element	**tI>>**		**s**
2I>>	ON	-	Automatic Cold Load pick-up	**2I>>**		-
Uo	10	**V**	Enabling level of the zero-sequence polarizing input voltage	**Uo**		**V**
Fα	Dir	-	Operation mode of the earth fault element	**Fα**		-
α=	90	**°**	Max sensitivity direction of the earth fault current	**α=**		**°**
F(O>)	D	-	Curve shape of low-set ground overcurrent	**F(O>)**		-
O>	0.1	**On**	Tap of low-set overcurrent ground element	**O>**		**On**
tO>	4.0	**s**	Time dial of ground low-set overcurrent element	**tO>**		**s**
O>>	0.5	**On**	Tap of high-set overcurrent ground element	**O>>**		**On**
tO>>	3.0	**s**	Time delay of high-set ground overcurrent element	**tO>>**		**s**
F(I2)	D	-	Operation characteristic of the Negative Sequence element	**F(I2)**		-
I2	0.6	**In**	Tap of the negative sequence overcurrent element	**I2**		**In**
tI2>	2.0	**s**	Tap time delay of the negative sequence element	**tI2>**		**s**
1C	–·–I–O	-	Selection of the function(s) enabled to initiate the first reclosing	**1C**		-
2C	–i–oO	-	As above for second reclosing shot 2C	**2C**		-
3C	–·–·–oO	-	As above for third reclosing shot 3C	**3C**		-
4C	–·–I–O	-	As above for fourth reclosing shot 4C	**4C**		-
t1C	2	**s**	Reclosing time interval of first reclosing shot	**t1C**		**s**
t2C	4	**s**	As above for 2nd reclosing shot	**t2C**		**s**
t3C	6	**s**	As above for 3rd reclosing shot	**t3C**		**s**
t4C	8	**s**	As above for 4th reclosing shot	**t4C**		**s**
tr	8	**s**	Reset interval after any successful reclosure	**tr**		**s**
LO#	3	-	Lock-out number	**LO#**		-
ChSet	2	-	Change Setting	**ChSet**		-
SEQ C	OFF	-	Sequence coordination with downstream recloser	**SEQ C**		-
tBF	0.25	**s**	Time delay for Breaker Failure alarm	**tBF**		**s**
B→I>	OFF	-	Blocking Input at terminals 1-2, blocks the timed output of the function I>	**B→I>**		-
B→I>>	OFF	-	As above, for function I>>	**B→I>>**		-
B→O>	OFF	-	As above, for function O>	**B→O>**		-
B→O>>	OFF	-	As above, for function O>>	**B→O>>**		-
B→I2	OFF	-	As above, for function I2>	**B→I2**		-
B→Rcl	OFF	-	Blocking Input at terminals 1-2, blocks the reclose function	**B→Rcl**		-
Tsyn	IRIG	**m**	Synchronization Time	**Tsyn**		**m**
I>>MC	OFF	**-**	Block of high-set o/c element on manual closing	**I>>MC**		**-**
NodAd	1	-	Communication address	**NodAd**		-

CONFIGURATION OF OUTPUT RELAYS											
Default Setting						**Actual Setting**					
Protective Element	**Output Relays**				**Description**	**Protective Element**	**Output Relays**				
I>	-	-	-	-	Low-set phase overcurrent pick-up	**I>**					
tI>	1	-	-	-	Time delayed low-set phase overcurrent	**tI>**					
I>>	-	-	-	-	High-set phase overcurrent pick-up	**I>>**					
tI>>	-	2	-	-	Time delayed high-set phase overcurrent	**tI>>**					
O>	-	-	-	-	Low-set ground overcurrent pick-up	**O>**					
tO>	1	-	-	-	Time delayed low-set ground overcurrent	**tO>**					
O>>	-	-	-	-	High-set ground overcurrent pick-up	**O>>**					
tO>>	-	2	-	-	Time delayed high-set ground overcurrent	**tO>>**					
I2	-	-	-	-	Negative Sequence overcurrent pick-up	**I2**					
tI2	1	-	-	-	Time delayed Negative Sequence overcurrent	**tI2**					
C	-	-	-	4	Reclousure	**C**					
rLO	-	-	3	-	Reclose Lock-out status	**rLO**					
tBF	-	-	-	-	Breaker failure alarm	**tBF**					
BT	-	-	-	-	Breaker Trip relay	**BT**					
tFRes:	A				Relay reset mode A=Automatic, M=Manual (*)	**tFRes:**					

(*) For **C** and **rLO** reset remains anyhow automatic