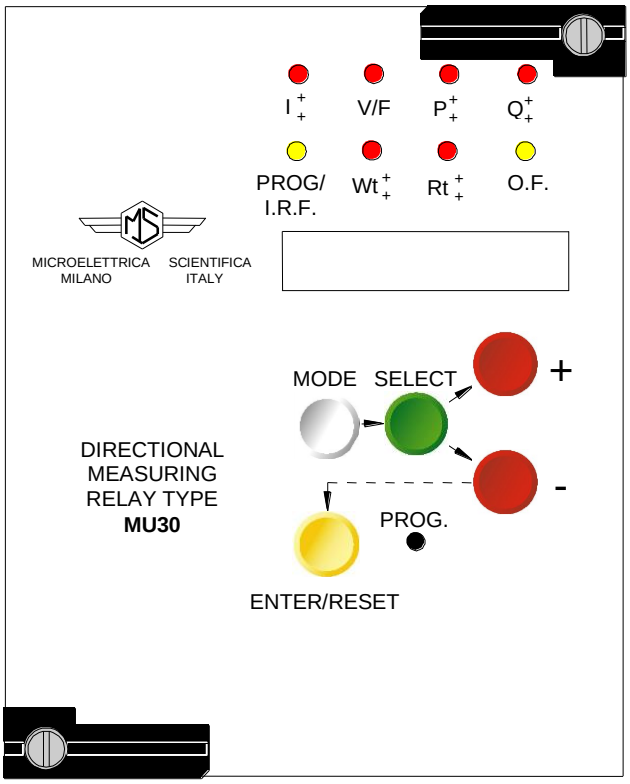
MICROPROCESSOR CONTROLLED MEASUREMENT AND SUPERVISION UNIT TYPE MU30-LP

OPERATION MANUAL



CE

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.

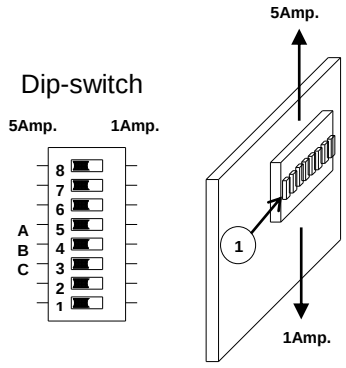
1.11 - FAULT DETECTION AND REPAIR

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

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

2. GENERAL CHARACTERISTICS

Input quantities are supplied to 3 current transformers and 3 potential transformers respectively measuring phase currents and phase-to-neutral voltages.
Phase current input can be 1 or 5A (movable jumpers on relay's card).
Rated voltage input can be programmed from 100 to 125V (phase to phase) 50 or 60Hz.
Make electric connection in conformity with the diagram reported on relay's enclosure. Check that input currents are same as reported on the diagram and on the test certificate. The auxiliary power is supplied by a built-in interchangeable module fully isolated and self protected.
Input rated current can be set to 1 or 5A by 3 dip-switches provided on relay's card (A-B-C).



2.1 AUXILIARY 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.**

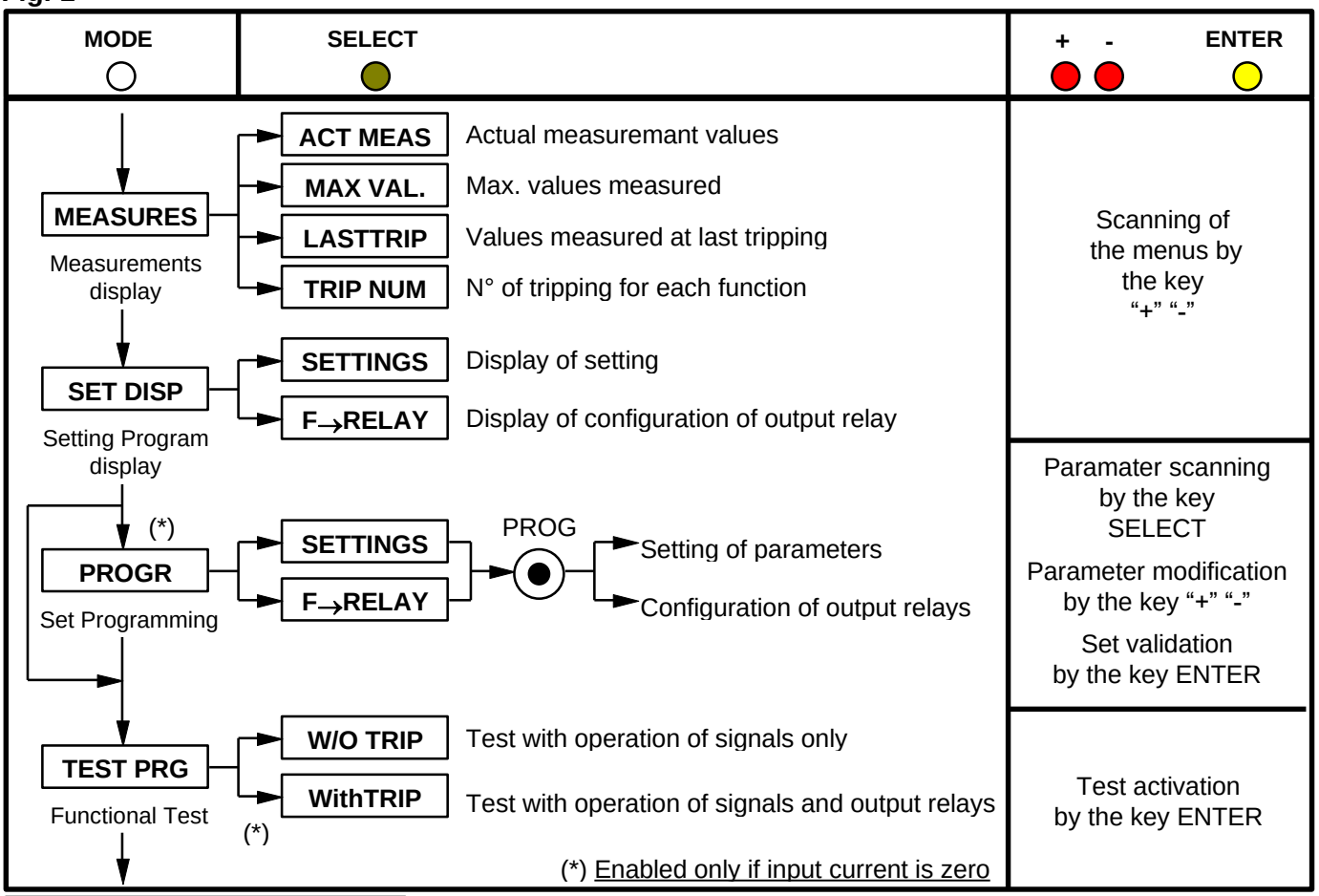
b) - { **80V(-20%) / 220V(+15%) a.c** / **90V(-20%) / 250V(+20%) d.c.**

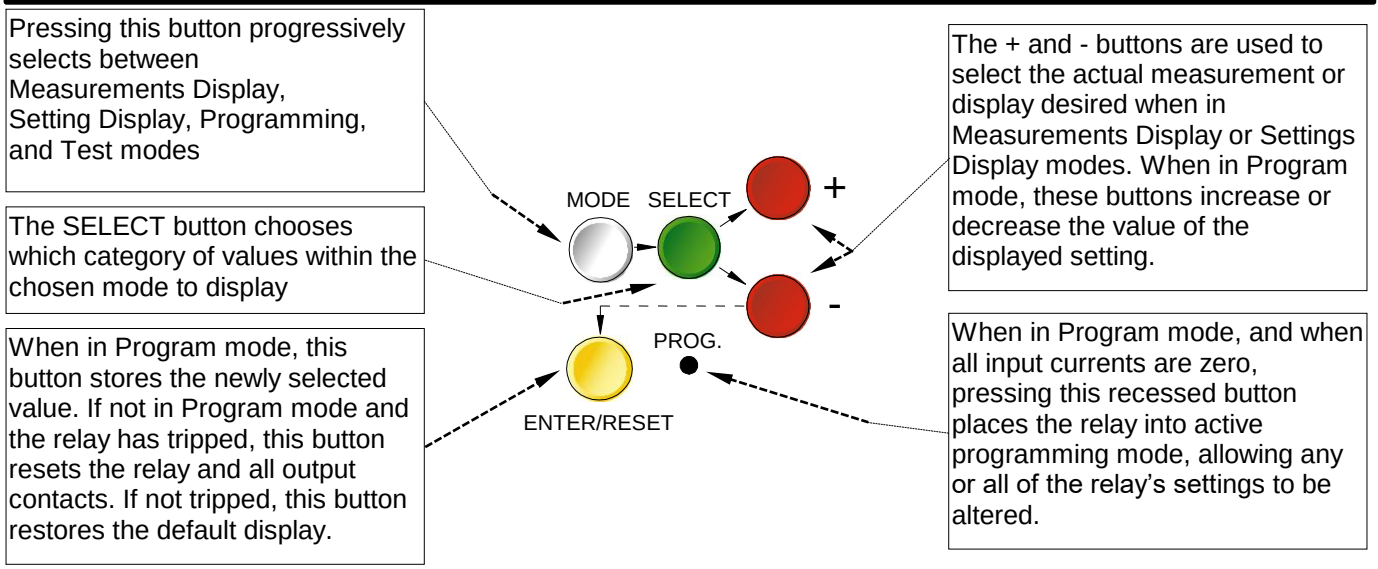
Before energizing the unit check that supply voltage is within the allowed limits.

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 **(xxxxxxx)**
(see synoptic table fig.1)

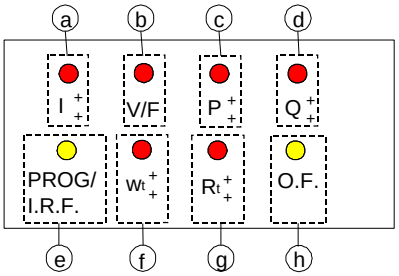
Fig. 1





4. SIGNALIZATIONS

Eight signal leds (normally off) are provided:



a) Red LED **I + +** ❑ Illuminated on trip of one of the current elements (under, over or under-over current).

b) Red LED **V/F** ❑ Illuminated on trip of one of the voltage or frequency elements (under, over or under-over voltage or frequency).

c) Red LED **P + +** ❑ Illuminated on trip of one of the active power elements (under, over or under-over active power).

d) Red LED **Q + +** ❑ Same as above, related to reactive power.

e) Yellow LED **PROG/IRF** ❑ Flashing during relay programming or internal fault.
❑ Illuminated on Internal Fault

f) Red LED **W_t + +** ❑ Same as above, related to reactive energy.

g) Red LED **R_t + +** ❑ Illuminated on trip of one of the active energy elements (active energy integrated over a definite time above a trip level set by user).

h) Yellow LED **O.F.** ❑ Flashing on overflow of any of the measured quantities.

The reset of the leds takes place as follows

❑ Leds a,b,c,d,f,g ❑ From illuminated to off, by ENTER/RESET push button or via the serial communication interface, when the lit-on cause has disappeared.

❑ Leds e,h ❑ From flashing to off, automatically when the lit-on cause disappears.

In case of 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 relays are user programmable and any of them can be associated to one of the MU30 functions. In case a relay is associated to more than one element, it gets energized when any of such elements trips and can be deenergized only when all the tripping causes have disappeared.
  Reset can be programmed as “AUTOMATIC” or “MANUAL”.
  In “AUTOMATIC” mode reset takes place as soon as the trip cause disappears.
  In "MANUAL" mode a reset command has to be issued to the relay (by the "ENTER/RESET" push button or via the serial communication interface).

- All the output relays not associated to any of the MU30 functions can be remotely energized / deenergized via the serial communication interface.

- Pulse output for external energy counters. The R3 output relay can be configured to toggle its status with a frequency which is proportional to the currently measured active power. A 1Hz square wave corresponds to the nominal active power .
  If R3 is employed for this particular function, it can’t be associated to any other element.

- The relay **R5,** normally energized, is not programmable and 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).
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 oscillographic recording data.
The unit has at RS232 / RS485 interface and can be connected either directly to a P.C. via a dedicated cable or to at RS485 serial bus, thus having many relays to exchange data with a single master P.C. using the same physical serial line. At RS485/232 converter is available on request.
The communication protocol is MODBUS RTU (only functions 3, 4 and 16 are implemented). Each relay is identified by its programmable address code (NodeAd) and can be called from the P.C.
A dedicated communication software (MSCOM) for Windows 95/98 is available.
Please refer to the MSCOM instruction manual for more information.

7. DIGITAL INPUTS.

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

- **AM** (terminals 1-2) : MAX VAL reset. When this input is activated all the recorded maximum values are instantaneously reset.
- **TR** (terminals 1-3) : Start/stop toggle input for Demand recording. When this input is activated the built-in demand recorder is started (if not running) or stopped (if running) (see § 16).
- **SO** (terminals 1-14) : Synchro. When this input is activated, the unit's clock-calendar is synchronized (see § 15).

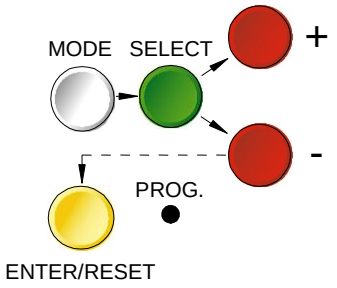
8. TEST

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 4 ms). If any internal fault is detected, the display shows a fault message, the Led "PROG/IRF" illuminates and the relay R5 is deenergized.
- Complete test activated by the keyboard or via the communication bus either with or without tripping of the output relays.

9. KEYBOARD AND DISPLAY OPERATION

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



a) - White key **MODE** : when operated it enters one of the following operation modes indicated on the display :

- **MEASURES** = Reading of all the parameters measured and of those recorded in the memory
- **SET DISP** = Reading of the settings and of the configuration of the output relays as programmed.
- **PROG** = Access to the programming of the settings and of relay configuration.
- **TEST PROG** = Access to the manual test routines.

b) - Green key **SELECT** : When operated it selects one of the menus available in the actual operation MODE

c) - Red key "**+**" AND "**-**" : When operated they allow to scroll the different information available in the menu entered by the key SELECT and to increase-decrease the settings.

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 "-" .
Pushing the ENTER button while the ACT. MEAS menu is active makes the relay enter the AUTOMATIC DISPLAY SCROLLING mode. While running in this mode the unit cyclically displays all the available measurements for 5s each. If the ENTER button is pressed again, the relay switches back to the normal display mode (the UP and DOWN buttons have to be pressed to scroll the menu).

10.1 ACT.MEAS (Actual Measurement values)

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

Display	Description
xxxxxxx	Current date in the DDMMMYY format.
xx:xx:xx	Current time in the HH:MM:SS format.
Fxx.xx**Hz**	Input Frequency
IAxxxxx**A**	True R.M.S. value of the phase A current displayed as primary Amps.
IBxxxxx**A**	As above, phase B
ICxxxxx**A**	As above, phase C
Ixxxxxx**A**	Average phase current ((IA+IB+IC)/3)
EAxxxxx**V** **EA**xx.x**KV** **EA** xxx**KV**	True R.M.S. value of the phase A voltage (phase to neutral), displayed as primary volts (or kV).
EBxxxxx**V** **EB**xx.x**KV** **EB** xxx**KV**	As above, phase B
ECxxxxx**V** **EC**xx.x**KV** **EC** xxx**KV**	As above, phase C
Exxxxxx**V** **E** x.xx**KV** **E** xxx**KV**	Average phase to neutral voltage ((EA+EB+EC)/3), displayed as primary volts (or kV)
UABxxxx**V** **UAB**xx.x**K** **UAB** xxx**K**	True R.M.S. value of the A to B voltage displayed as primary volts (or kV)
UBCxxxx**V** **UBC**xx.x**K** **UBC** xxx**K**	True R.M.S. value of the B to C voltage displayed as primary volts (or kV)
UCAxxxx**V** **UCA**xx.x**K** **UCA** xxx**K**	True R.M.S. value of the C to A voltage displayed as primary volts (or kV)
Uxxxxxx**V** **U** x.xxx**k** **U** xxxx**K**	Average phase to phase voltage displayed as primary volts (or kV).

Display	Description
PFAx.xx	Phase A power factor
PFBx.xx	As above, phase B
PFCx.xx	As above, phase C
PF x.xx	Average power factor ((PFA + PFB + PFC)/3)
SAxxxxx**K** **SA**xxx.x**M** **SA**xxxxx**M** **SA**xxx.x**G**	Apparent power of phase A, displayed as primary kVA (or MVA or GVA)
SBxxxxx**K** **SB**xxx.x**M** **SB**xxxxx**M** **SB**xxx.x**G**	As above, phase B
SCxxxxx**K** **SC**xxx.x**M** **SC**xxxxx**M** **SC**xxx.x**G**	As above, phase C
S xxxxx**K** **S** xxx.x**M** **S** xxxxx**M** **S** xxx.x**G**	Total apparent power (SA + SB + SC), displayed as primary kVA (or MVA or GVA)
PA xxxx**K** **PA** xx.x**M** **PA** xxxx**M** **PA** xx.x**G**	Active power of phase A, displayed as primary kW (or MW or GW)
PB xxxx**K** **PB** xx.x**M** **PB** xxxx**M** **PB** xx.x**G**	As above, phase B
PC xxxx**K** **PC** xx.x**M** **PC** xxxx**M** **PC** xx.x**G**	As above, phase C
P xxxxx**K** **P** xxx.x**M** **P** xxxxx**M** **P** xxx.x**G**	Total active power (PA + PB + PC) displayed as primary kW (or MW or GW)
QA xxxx**K** **QA** xx.x**M** **QA** xxxx**M** **QA** xx.x**G**	Reactive power of phase A, displayed as primary kVAR (or MVAR or GVAR)
QB xxxx**K** **QB** xx.x**M** **QB** xxxx**M** **QB** xx.x**G**	As above, phase B

Display	Description
QC xxxx**K** **QC** xx.x**M** **QC** xxxx**M** **QC** xx.x**G**	As above, phase C
Q xxxxx**K** **Q** xxx.x**M** **Q** xxxxx**M** **Q** xxx.x**G**	Total reactive power (SA + SB + SC) displayed as primary kVAR (or MVAR or GVAR)
Wh xxx**Kh** **Wh** x.x**Mh** **Wh** xxx**Mh** **Wh** x.x**Gh** **Wh** xxx**Gh**	Total active energy, displayed as kWh (or MWh or GWh)
Rh xxx**Kh** **Rh** x.x**Mh** **Rh** xxx**Mh** **Rh** x.x**Gh** **Rh** xxx**Gh**	Total reactive energy, displayed as KVARh (or MVARh or GVARh)
Wt xxx**Kh** **Wt** x.x**Mh** **Wt** xxx**Mh** **Wt** x.x**Gh** **Wt** xxx**Gh**	Active energy (integrated over a definite time T_{int}), displayed as kWh (or MWh or GWh)
Rt xxx**Kh** **Rt** x.x**Mh** **Rt** xxx**Mh** **Rt** x.x**Gh** **Rt** xxx**Gh**	Reactive energy (integrated over a definite time T_{int}), displayed as kVARh (or MVARh or GVARh)

10.2 MAX VAL (Maximum Values measured)

Time stamped maximum demand values (reset can be done via the AM digital input or the serial communication interface).

Display	Description
xxxxxxx	Date of the last MAX VAL reset (in the DDMMMYY format)
xx:xx:xx	Time of the last MAX VAL reset (in the HH:MM:SS format)
IAxxxxx**A**	Maximum phase A current, displayed as primary A
xx:xx:xx	Time between the last MAX VAL reset and the recording of the IA maximum demand value.
IBxxxxx**A**	Maximum phase A current, displayed as primary A
xx:xx:xx	Time between the last MAX VAL reset and the recording of the IB maximum demand value.
ICxxxxx**A**	Maximum phase C current, displayed as primary A
xx:xx:xx	Time between the last MAX VAL reset and the recording of the IC maximum demand value.
S xxxxx**K** **S** xxx.x**M** **S** xxxxx**M** **S** xxx.x**G**	Maximum total apparent power, displayed as primary KVA (or MVA or GVA)
xx:xx:xx	Time between the last MAX VAL reset and the recording of the S maximum demand value.
P xxxxx**K** **P** xxx.x**M** **P** xxxxx**M** **P** xxx.x**G**	Maximum total active power, displayed as primary kW (or MW or GW)
xx:xx:xx	Time between the last MAX VAL reset and the recording of the P maximum demand value.
Q xxxxx**K** **Q** xxx.x**M** **Q** xxxxx**M** **Q** xxx.x**G**	Maximum total reactive power, displayed as primary KVAR (or MVAR or GVAR)
xx:xx:xx	Time between the last MAX VAL reset and the recording of the Q maximum demand value.
Wtxxxx**Kh** **Wt** x.x**Mh** **Wt** xxx**Mh** **Wt** x.x**Gh** **Wt** xxx**Gh**	Maximum value of active energy integrated over a definite time, displayed as primary kWh (or MWh or GWh)
xx:xx:xx	Time between the last MAX VAL reset and the recording of the Wt maximum demand value.
Rtxxxx**Kh** **Rt** x.x**Mh** **Rt** xxx**Mh** **Rt** x.x**Gh** **Rt** xxx**Gh**	Maximum value of reactive energy integrated over a definite time, displayed as primary kVARh (or MVARh or GVARh)
xx:xx:xx	Time between the last MAX VAL reset and the recording of the Rt maximum demand value.

10.3 LASTTRIP (Values measured al last tripping)

Display of the function which caused the tripping of the relay plus values of the parameters at the moment of tripping.

Display	Description
Cau:xxxx	Function which produced the last event being displayed: **f1, f2, u1, u2, i1, i2, p1, p2, q1, q2, s1, s2, w1, w2, r1, r2**
Fxx.xx**Hz**	Frequency
IAxxxxx**A**	Phase A current, displayed as primary A
IBxxxxx**A**	As above, phase B
ICxxxxx**A**	As above phase C
EAxxxxx**V** **EA**xx.x**KV** **EA** xxx**KV**	Phase A voltage, displayed as primary V (or kV)
EBxxxxx**V** **EB**xx.x**KV** **EB** xxx**KV**	As above, phase B
ECxxxxx**V** **EC**xx.x**KV** **EC** xxx**KV**	As above, phase C
PFAx.xx	Phase A power factor
PFBx.xx	Phase B power factor
PFCx.xx	Phase C power factor

10.4 TRIP NUM (N° of tripping for each function)

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

Display	Description
1uxxxxxx	1st voltage element
2uxxxxxx	2nd voltage element
1fxxxxxx	1st frequency element
2fxxxxxx	2nd frequency element
1ixxxxxx	1st current element
2ixxxxxx	2nd current element
1pxxxxxx	1st active power element
2pxxxxxx	2nd active power element
1qxxxxxx	1st reactive power element
2qxxxxxx	2nd reactive power element
1sxxxxxx	1st apparent power element
2sxxxxxx	2nd apparent power element
1wxxxxxx	1st active power element
2wxxxxxx	2nd active power element
1rxxxxxx	1st reactive power element
2rxxxxxx	2nd reactive power element

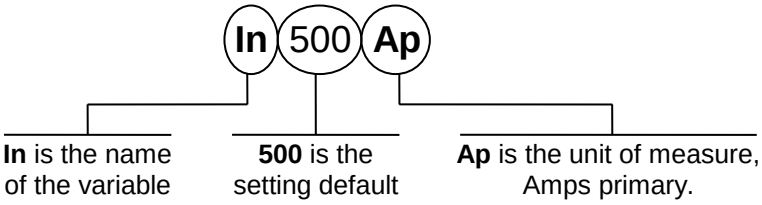
11. READING OF PROGRAMMED SETTINGS AND RELAY'S CONFIGURATION

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.
The SET DISP menu doesn't display current date and time.

12. PROGRAMMING

The relay is supplied with the standard default programming used for factory test.
[Values here below reported (--------)].
All parameters can be modified as needed in the mode PROG and displayed in the mode SET DISP
As soon as programming is enabled, the Led PRG/IRF flashes and the reclosing lock-out relay R5 is deenergized.
Enter MODE "PROG" and SELECT either "SETTINGS" for programming of parameters or "F→RELAY" for programming of output relays configuration; enable programming by the indirect operation key PROG.
The key SELECT now scrolls the available parameters. By the key (+) , (-) the displayed values can be modified; to speed up parameter's variation press the key SELECT while "+" or "-" are pressed.
Press key "ENTER/RESET" to validate the set values.
The setting of the built in clock calendar is described at paragraph 15.2

12.1 - PROGRAMMING OF FUNCTIONS SETTINGS



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

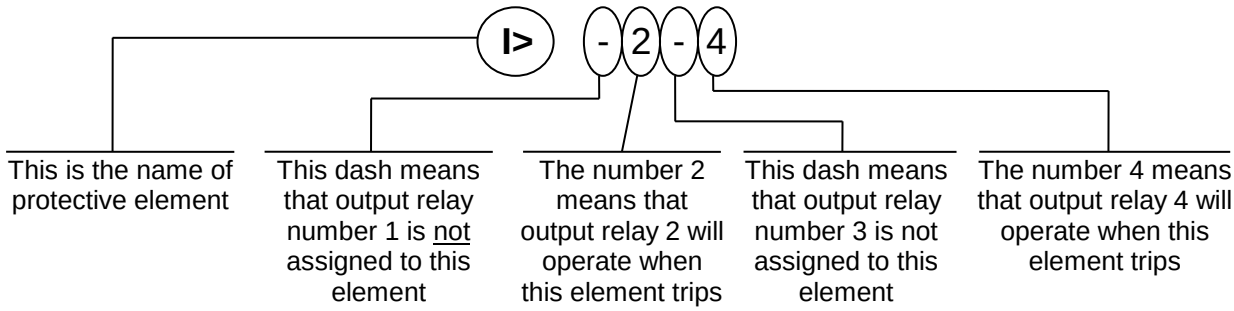
Display	Description	Setting range	Step	Unit
xxxxxxx	Current date	DDMMMYY	-	-
xx:xx:xx	Current time	HH:MM:SS	-	-
Tsyn DIS**m**	Sync period of the internal clock calendar	5-10-15 30-60-Dis	-	min
Fn 50 **Hz**	Mains frequency	50 – 60	-	Hz
In 500**Ap**	Rated primary current of phase CT's	0 – 9999	1	A
UnP 10**kV**	Rated primary phase-to-phase voltage of system's P.T.s	0,1 – 655	10	kV
UnS 100**V**	Rated secondary phase-to-phase voltage of system's P.T.s	100 – 125	1	V
TLP 60**s**	Load profiling sampling time	60 – 3600	1	s
Tint 15**m**	Energy integration time	5 – 15	1	min
WOUT OFF	Enable pulse output for external energy counters	OFF – ON	-	-

Display	Description	Setting range	Step	Unit
Un Dis**1u**	First voltage element operation mode: **+** = overvoltage **-** = undervoltage **-/+** = under/over voltage **Dis.** = Function is disabled	+ - +/- Dis	-	-
1u 90**%Un**	Trip differential level of the first voltage control element	5 – 90	1	%Un
Un Dis**2u**	Second voltage element operation mode: **+** = overvoltage **-** = undervoltage **-/+** = under/over voltage **Dis.** = Function is disabled	+ - +/- Dis	-	-
2u 90**%Un**	Trip differential level of the second voltage control element	5 – 90	1	%Un
Fn Dis**1f**	First frequency element operation mode: **+** = overfrequency **-** = underfrequency **-/+** = under/over frequency **Dis.** = Function is disabled	+ - +/- Dis	-	-
1f9.99**Hz**	Trip differential level of the first frequency control element	0,05 – 9,99	0,01	Hz
Fn Dis**2f**	Second frequency element operation mode: **+** = overfrequency **-** = underfrequency **-/+** = under/over frequency **Dis.** = Function is disabled	+ - +/- Dis	-	-
2f9.99**Hz**	Trip differential level of the second frequency control element	0,05 – 9,99	0,01	Hz
In Dis**1i**	First current element operation mode: **+** = overcurrent **-** = undercurrent **-/+** = under/over current **Dis.** = Function is disabled	+ - +/- Dis	-	-
1i 95**%In**	Trip differential level of the first current control element	5 – 95	1	%In
In Dis**2i**	Second current element operation mode: **+** = overcurrent **-** = undercurrent **-/+** = under/over current **Dis.** = Function is disabled	+ - +/- Dis	-	-
2i 95**%In**	Trip differential level of the second current control element	5 – 95	1	%In
Pn Dis**1p**	First active power element operation mode: **+** = overpower **-** = underpower **-/+** = under/over power **Dis.** = Function is disabled	+ - +/- Dis	-	-
1p 95**%Pn**	Trip differential level of the first active power control element	5 – 95	1	%Pn

Display	Description	Setting range	Step	Unit
Pn Dis**2p**	Second active power element operation mode: **+** = overpower **-** = underpower **-/+** = under/over power **Dis.** = Function is disabled	+ - +/- Dis	-	-
2p 95**%Pn**	Trip differential level of the second active power control element	5 – 95	1	%Pn
Qn Dis**1q**	First reactive power element operation mode: **+** = overpower **-** = underpower **-/+** = under/over power **Dis.** = Function is disabled	+ - +/- Dis	-	-
1q 95**%Qn**	Trip differential level of the first reactive power control element	5 – 95	1	%Qn
Qn Dis**2q**	Second reactive power element operation mode: **+** = overpower **-** = underpower **-/+** = under/over power **Dis.** = Function is disabled	+ - +/- Dis	-	-
2q 95**%Qn**	Trip differential level of the second reactive power control element	5 – 95	1	%Qn
Sn Dis**1s**	First apparent power element operation mode: **+** = overpower **-** = underpower **-/+** = under/over power **Dis.** = Function is disabled	+ - +/- Dis	-	-
1s 95**%Sn**	Trip differential level of the first apparent power control element	5 – 95	1	%Sn
Sn Dis**2s**	Second apparent power element operation mode: **+** = overpower **-** = underpower **-/+** = under/over power **Dis.** = Function is disabled	+ - +/- Dis	-	-
2s 95**%Sn**	Trip differential level of the second apparent power control element	5 – 95	1	%Sn
1wDis**Wtn**	Trip level of first active energy element.	5 – 95 – Dis	1	%Wtn
2wDis**Wtn**	Trip level of second active energy element.	5 – 95 - Dis	1	%Wtn
1qDis**Qtn**	Trip level of first reactive energy element.	5 – 95 - Dis	1	%Qtn
2qDis**Qtn**	Trip level of second reactive energy element.	5 – 95 - Dis	1	%Qtn
NodAd 1	Identification number for the 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	
1u	----	1st voltage element operates	relays R1, R2, R3, R4
2u	----	2ns voltage element operates	relays R1, R2, R3, R4
1f	----	1st frequency element operates	relays R1, R2, R3, R4
2f	----	2ns frequency element operates	relays R1, R2, R3, R4
1i	----	1st current element operates	relays R1, R2, R3, R4
2i	----	2ns current element operates	relays R1, R2, R3, R4
1p	----	1st active power element operates	relays R1, R2, R3, R4
2p	----	2ns active power element operates	relays R1, R2, R3, R4
1q	----	1st reactive power element operates	relays R1, R2, R3, R4
2q	----	2ns reactive power element operates	relays R1, R2, R3, R4
1s	----	1st apparent power element operates	relays R1, R2, R3, R4
2s	----	2ns apparent power element operates	relays R1, R2, R3, R4
1w	----	1st active energy element operates	relays R1, R2, R3, R4
2w	----	2ns active energy element operates	relays R1, R2, R3, R4
1r	----	1st reactive energy element operates	relays R1, R2, R3, R4
2r	----	2ns reactive energy element operates	relays R1, R2, R3, R4
Rem	----	Remote control function operates	relays R1, R2, R3, R4
tFRes	**M**	Output relays reset mode (M = manual, A = automatic)	

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 (current date).
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 Authorized Dealer mentioning the relay's Serial No reported in the label on relays enclosure.

WARNING

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

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

15. POWER FREQUENCY INSULATION TEST

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

16 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.

16.1 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.

16.2 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.

16.3 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.

16.4 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.

16.5 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).

17. TIME STAMPING OF MAXIMUM DEMAND VALUES.

Maximum demand values are time stamped by means of the internal clock/calendar. To avoid overloading the MAX VAL menu with too many items, the time stamp is expressed as follows:

- Time of the last max. val. reset (DDMMMYY, HH:MM:SS)
- For each parameter, time elapsed between the last max. val. reset and the recording of the parameter itself (HH:MM:SS). (max. time is 99:59:59)

Note that all the times are also available with a 10ms resolution via the serial communication interface.

18. ENERGY MEASUREMENTS – ALGORITHMS

The unit calculates both total energy and energy integrated during a definite time (T_{int}).
Total energy is simply obtained by integrating power. That is, every second the current value of power is multiplied by 1s and added to total energy according to the following formula:

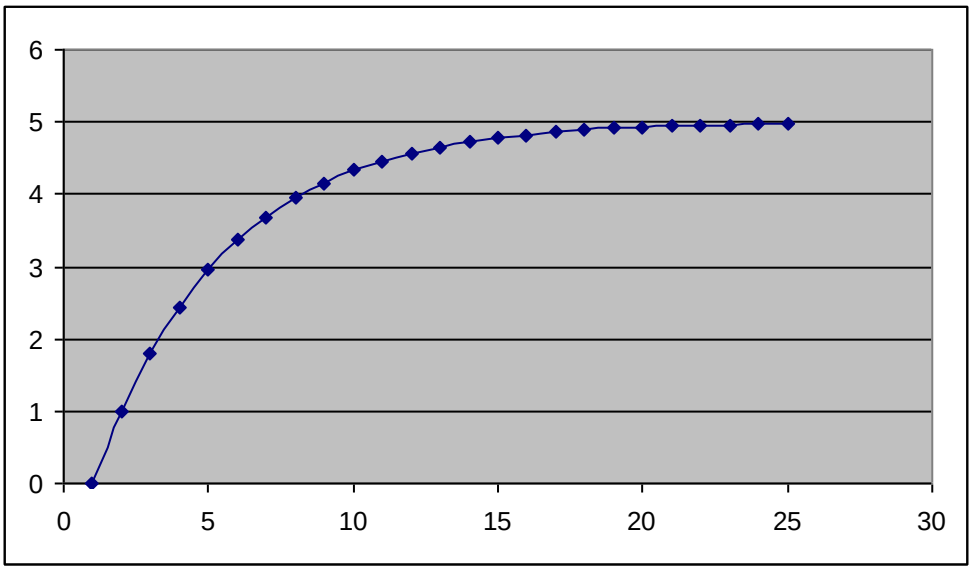
$$T\_ENERGY(t) = T\_ENERGY(t-1) + POWER(t) * 1s$$

where T_ENERGY(t) stands for total energy at time t.

For what concerns energy integrated in a definite time (D_ENERGY), an approximate calculation is done.
Every second the following algorithm is executed:

$$D\_ENERGY(t) = D\_ENERGY(t-1) + POWER(t-1) * 1s - \frac{D\_ENERGY(t-1)}{T_{int} * 60}$$

Such algorithm introduces an error. In practice, if we start with D_ENERGY = 0 and inject a constant power, D_ENERGY won't follow a ramp, but an exponential curve. The following example shows what happens if we take POWER = 1 and T_{int} = 5 seconds (impossible value to set, but convenient for an example):



To get a faster response the algorithm has been slightly improved:

$$IF(t < T_{int})$$

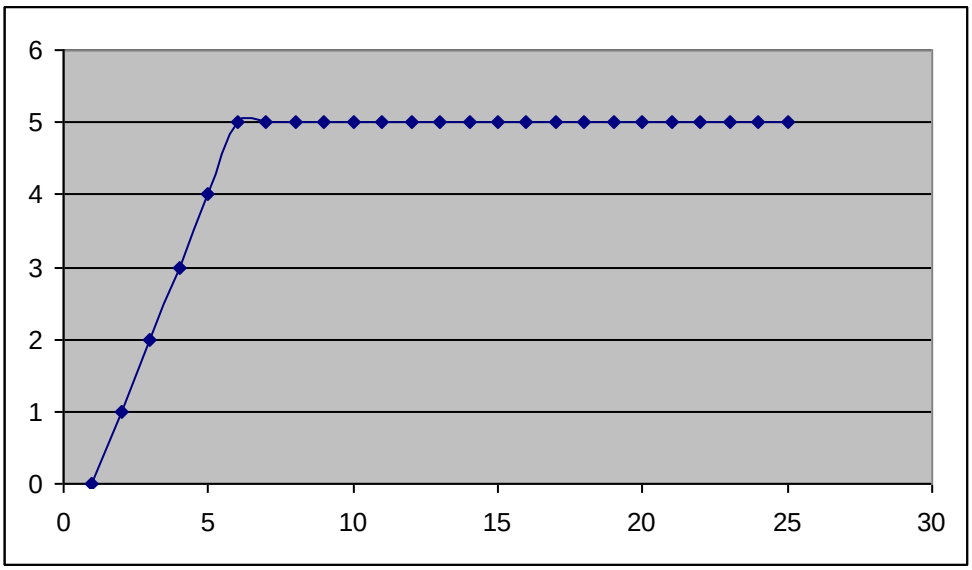
$$D\_ENERGY = D\_ENERGY + POWER * 1s$$

ELSE

$$D\_ENERGY = D\_ENERGY + POWER * 1s - \frac{D\_ENERGY}{T_{int} * 60}$$

A timer is started as soon as power becomes non-zero (t = 0). During the first T_{int} minutes, D_ENERGY is only incremented. When t reaches T_{int}, we switch back to the old formula. This leads to the following curve (which is just what was expected):

Fig. 2



WARNING

When a 'reset energy counters' command is sent to the unit, the timer measuring the first T_{int} seconds IS NOT RESET. As a result, D_ENERGY could follow an exponential curve as described in fig. 1

19. LOAD PROFILING

When the Load Profiling function is running, the unit periodically calculates the amounts of total active and reactive energies measured during the previous [TLP] seconds and stores such amounts into its non-volatile memory.
The load profiling function is started when a logic 0 to logic 1 transition of the 1-3 digital input is detected (the input is physically shorted). At that time a time-stamp (including current date and time) is stored into the non-volatile memory.
The function runs normally until another 0 to 1 transition of the 1-3 digital input is detected (load profiling stop).
A maximum of couples of energy values (corresponding to 40.5 days when TLP is equal to 3600s) can be stored. When the maximum memory capacity is reached, values are overwritten in a FIFO fashion (oldest samples are overwritten first).
Start and stop commands can be issued to the unit via the serial port also.
Load profiling data is available for reading via the unit's MODBUS serial port. The following paragraphs describe the data retrieval procedure.

19.1 Reading of the demand recording data.

The unit internally represents data according to the following structure, which can be accessed via the serial port:

Offset (word)	Contents
0	Start time: Sec. / 100ths of sec, BCD format
1	Start time: Hours / Min., BCD format
2	Start date: Months / Days, BCD format
3	Start date: 00 / Years, BCD format
4	Index of start sample: 0 to n-1
5	Sampling period
6	Sample 0
.....	.....
6 + n	Sample n

Table 1

Each sample is 16bits (1 word) wide. The LSB (Least Significant Byte) represents active energy as an 8bits signed number, while the MSB (Most Significant Byte) represents reactive energy as an 8 bits signed number.
To obtain each energy in p.u. of the rated value, stored samples must be converted to 8 bits signed numbers and then divided by 38.
Example:

Sample (16bits) = 0xF020.

Active Energy => 0x21 => 33 => W = 33 / 38 = 0.868 En
Reactive Energy => 0xED => -19 => R = -19 / 38 = -0.5 En

Note that if the start command is issued via the serial port, the least significant digit of start time is meaningless (due to unpredictable communication delays).
The number of samples stored in the buffers is reset when a start signal is received and incremented every time the relay stores a new sample.
For communication purposes, the memory area represented in Table 1 has been divided into 16 words wide blocks (also called windows). If a word has to be accessed, the proper window must first be selected. To do that, the user has to write the relevant window number to word 11001.

The following table lists the read only words concerning load profiling.

Word Number (MODBUS Address)	Contents
10999	Number of valid samples since last start command
11000	Reserved
11001	Reserved
11002	Max number of samples (7680)
11003	Data available (0 => no , 1 => yes)
11004	Word 0 of currently selected window
11005	Word 1 of currently selected window
11006	Word 2 of currently selected window
11007	Word 3 of currently selected window
11008	Word 4 of currently selected window
11009	Word 5 of currently selected window
11010	Word 6 of currently selected window
11011	Word 7 of currently selected window
11012	Word 8 of currently selected window
11013	Word 9 of currently selected window
11014	Word 10 of currently selected window
11015	Word 11 of currently selected window
11016	Word 12 of currently selected window
11017	Word 13 of currently selected window
11018	Word 14 of currently selected window
11019	Word 15 of currently selected window

Example: to read the start date and time of the currently running demand recording session, the following procedure must be followed:

1) Since date/time words have offset ranging from 0 to 3, window 0 must be selected by writing 0 into word #11001.

2) Date and time are now available at MODBUS addresses 11004..11007

20. ELECTRICAL CHARACTERISTICS

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

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

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

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

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

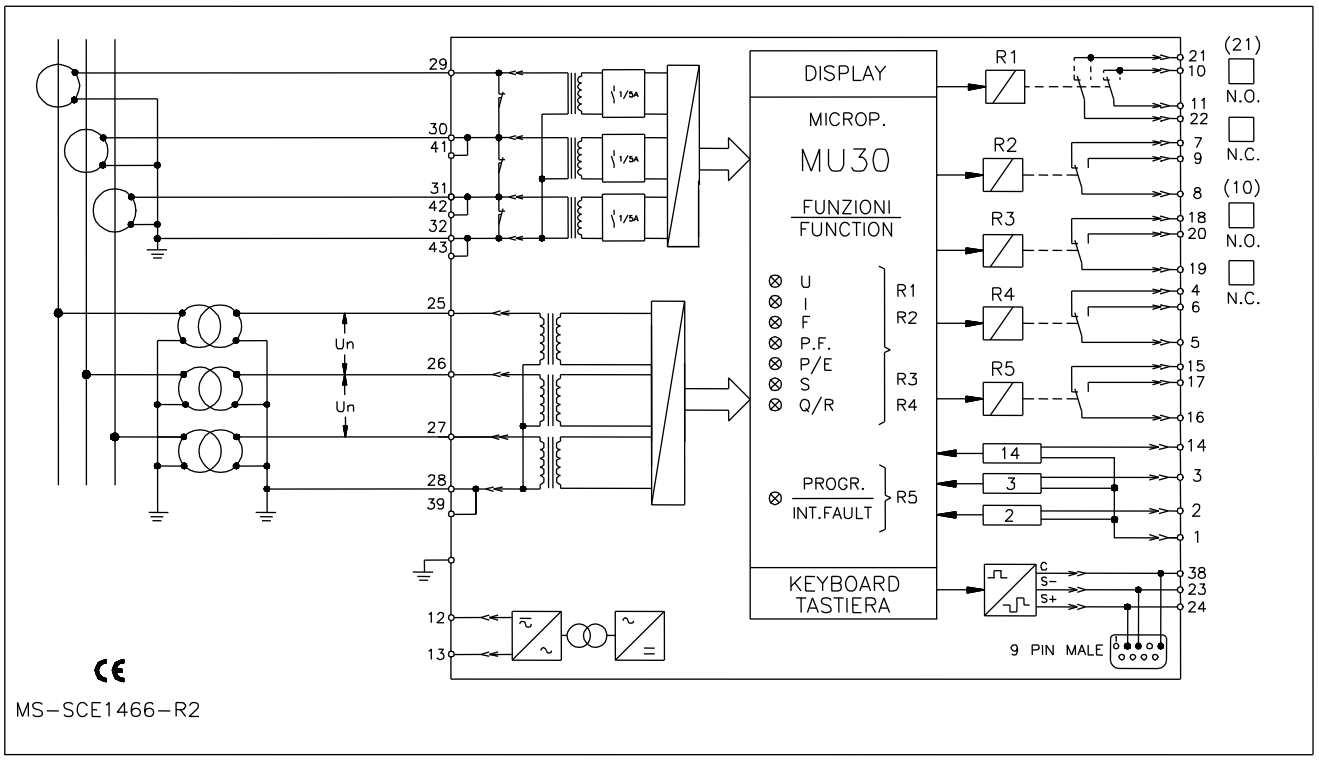
❑	Electromagnetic emission	EN55022 industrial environment			
❑	Radiated electromagnetic field immunity test	IEC61000-4-3 ENV50204	level 3	80-1000MHz 900MHz/200Hz	10V/m 10V/m
❑	Conducted disturbances immunity test	IEC61000-4-6	level 3	0.15-80MHz	10V
❑	Electrostatic discharge test	IEC61000-4-2	level 4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

CHARACTERISTICS

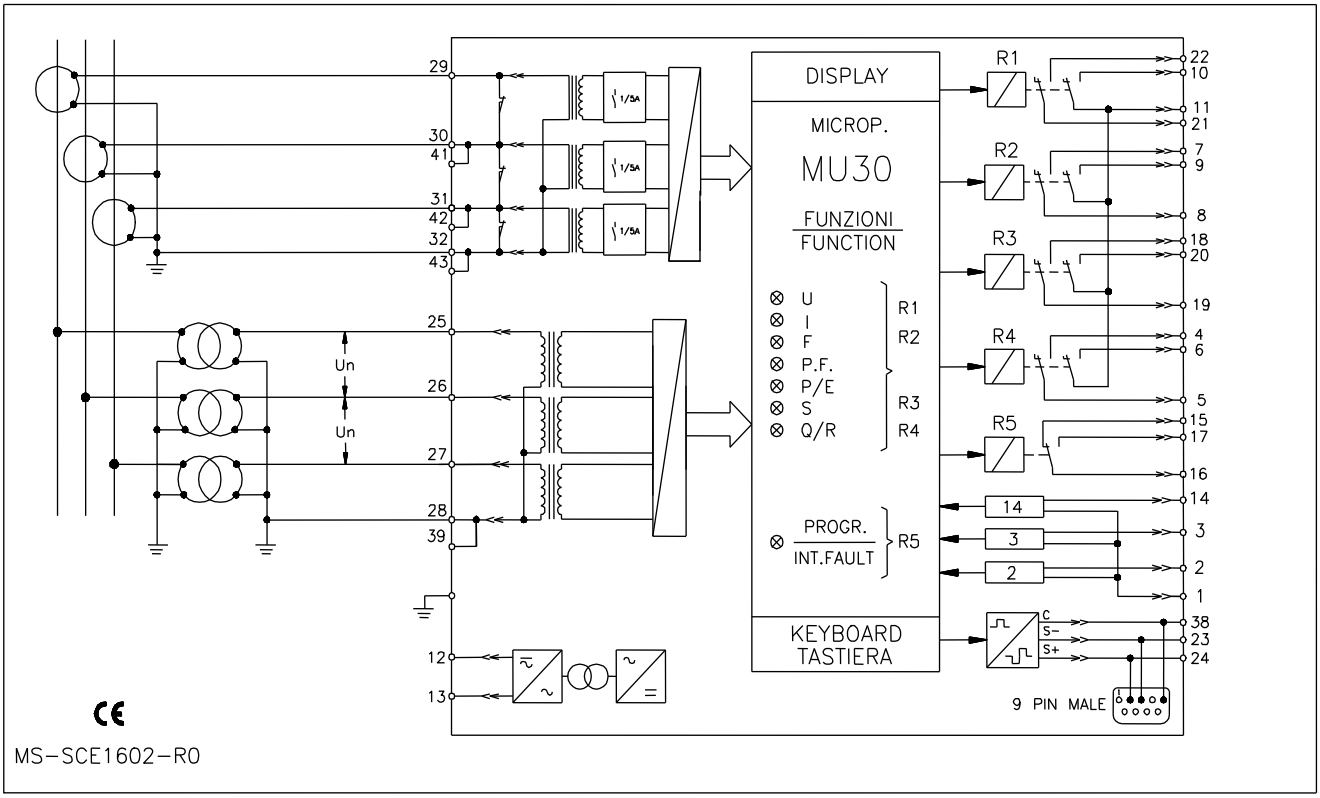
❑	Accuracy at reference value of influencing factors	2% for measure 2% +/- 10ms for times
❑	Rated Current	In = 1A or 5A
❑	Current overload	200A for 1 sec; 10A continuous
❑	Burden on current input	Phase : 0.01VA at In = 1A; 0.2VA at In = 5A
❑	Rated Voltage	Un = 100V (different on request)
❑	Voltage overload	2 Un continuous
❑	Burden on voltage input	0,08 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.)

Microelettrica Scientifica S.p.A. - 20089 Rozzano (MI) - Italy - Via Alberelle, 56/68
Tel. (##39) 02 575731 - Fax (##39) 02 57510940 - Telex 351265 MIELIT I
http://www.microelettrica.com **e-mail :** ute@microelettrica.com

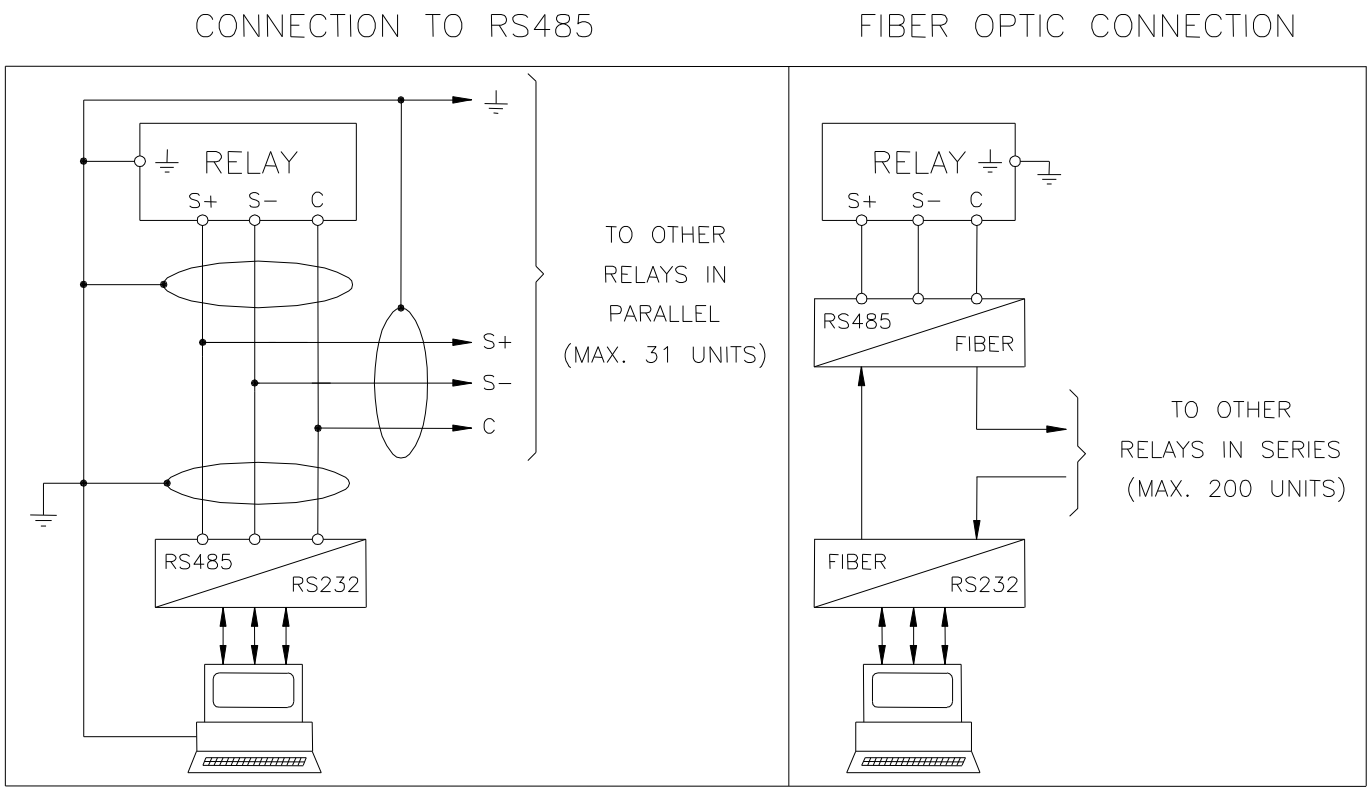
21. CONNECTION DIAGRAM (SCE1466 Rev.2 STANDARD OUTPUT)



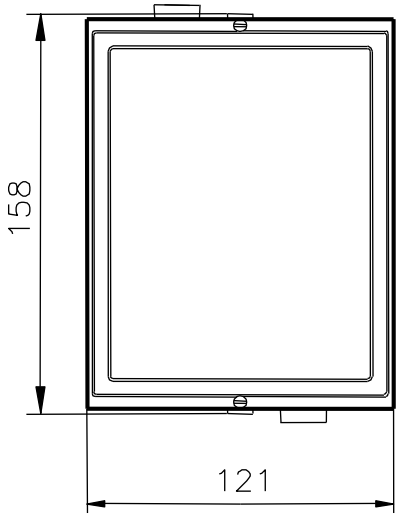
21.1 CONNECTION DIAGRAM (SCE1602 Rev.0 Double Output)



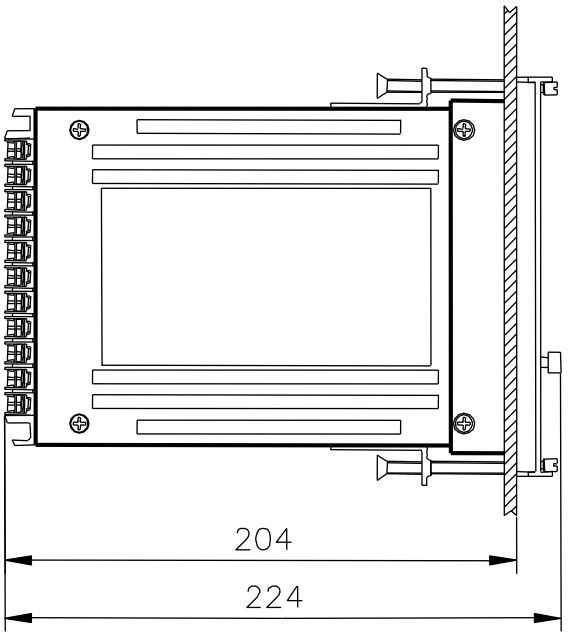
22. WIRING THE SERIAL COMMUNICATION BUS (SCE1309 Rev.0)

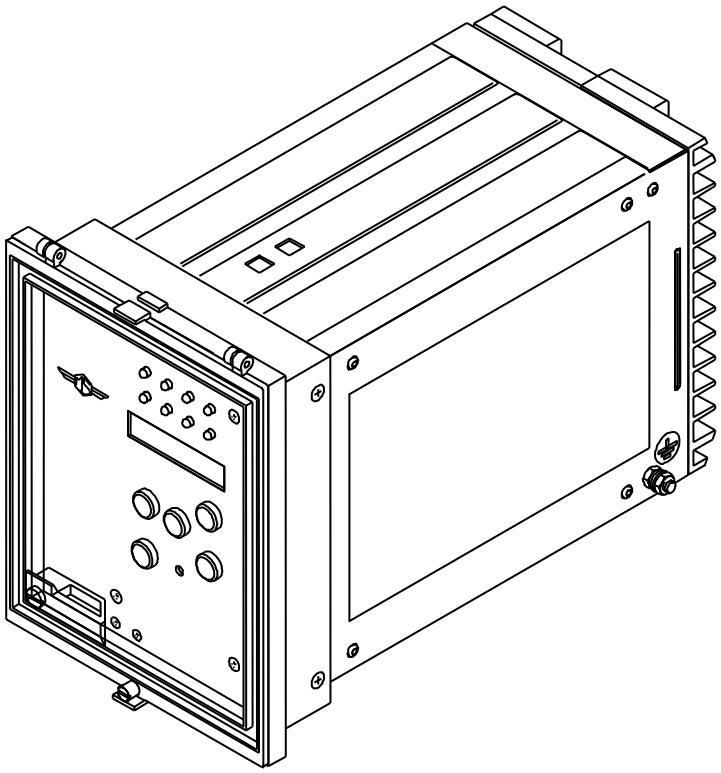


23. OVERALL DIMENSIONS

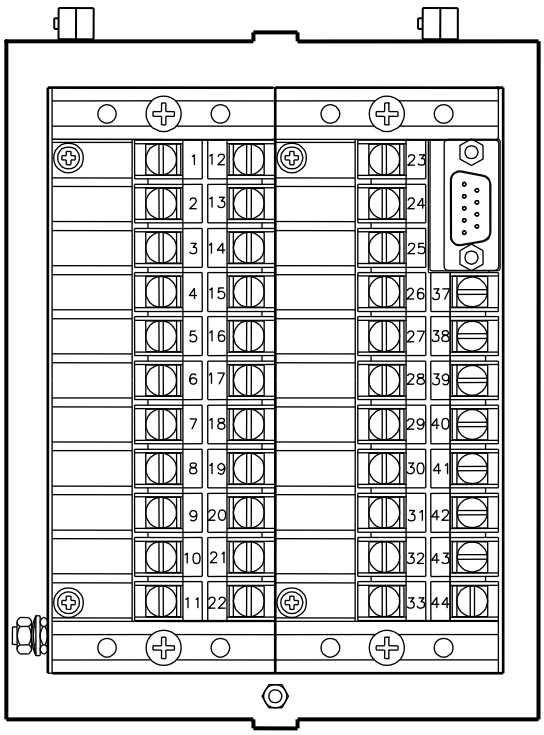


PANEL CUT-OUT 113x142 (LxH)





View of Rear Terminal Connection



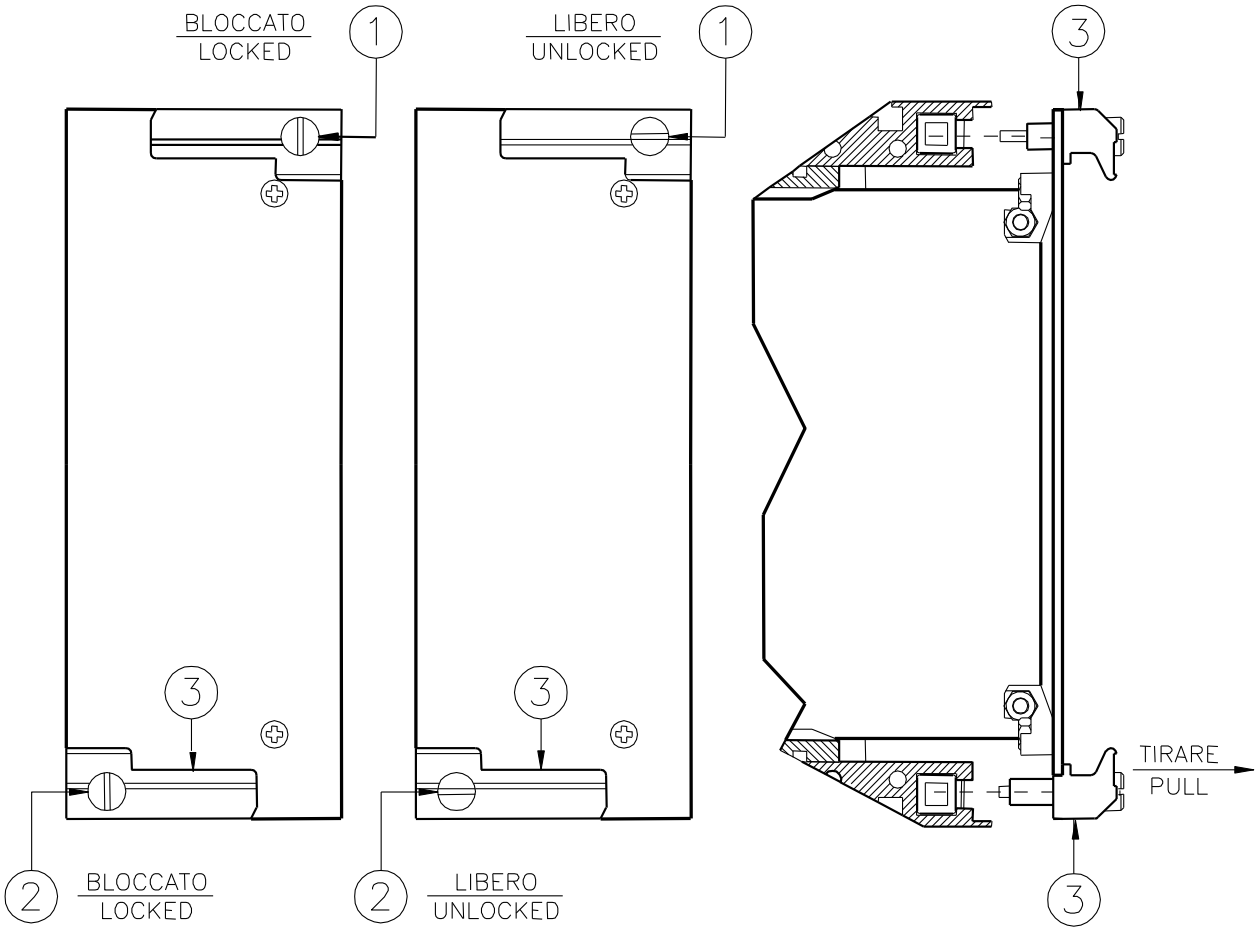
24. DIRECTION FOR PCB'S DRAW-OUT AND PLUG-IN

24.1 Draw-out

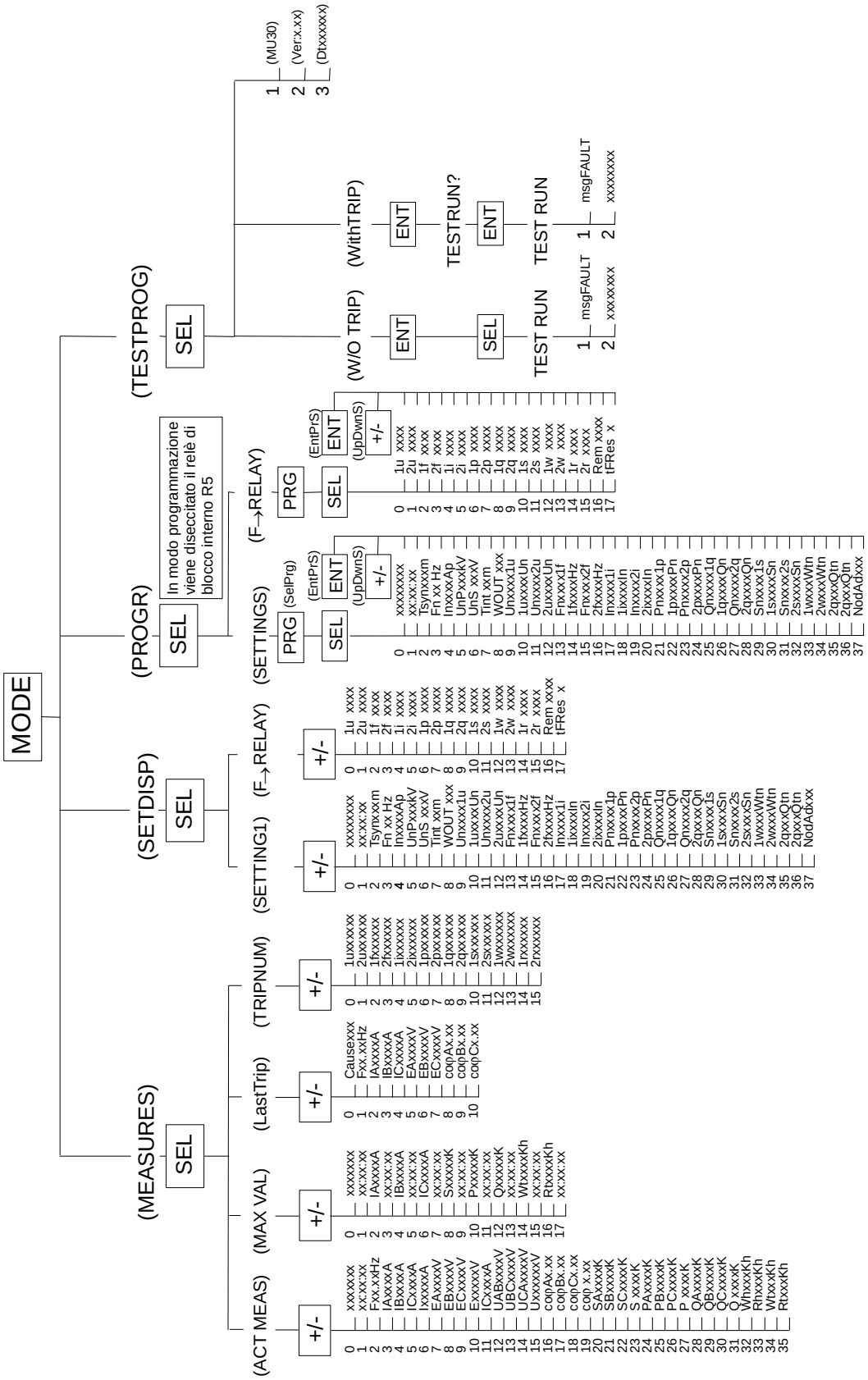
Rotate clockwise the screws ① and ② in the horizontal position of the screws-driver mark.
Draw-out the PCB by pulling on the handle ③

24.2 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).



25. KEYBOARD OPERATIONAL DIAGRAM



26. Setting Form – Commissioning Test Record

Relay Type	MU30-LP	Station :	Circuit :
Date :	/ /		Relay Serial Number :
Power Supply	☐ 24V(-20%) / 110V(+15%) a.c. 24V(-20%) / 125V(+20%) d.c. ☐ 80V(-20%) / 220V(+15%) a.c. 90V(-20%) / 250V(+20%) d.c.	Rated Voltage :	

RELAY PROGRAMMING

Variable	Description	Setting Range		Default Setting	Actual Setting	Test Result	
						Pick-up	Reset
xxxxxxx	Current date	DDMMMYY	**-**	random			
xx:xx:xx	Current time	HH:MM:SS	**-**	random			
Tsyn	Sync period of the internal clock calendar	5-10-15 30-60-Dis	**m**	Dis			
Fn	Mains frequency	50 – 60	**Hz**	50			
In	Rated primary current of phase CT's	0 – 9999	**Ap**	500			
UnP	Rated primary phase-to-phase voltage of system's P.T.s	0,1 – 655	**kV**	10			
UnS	Rated secondary phase-to-phase voltage of system's P.T.s	100 – 125	**V**	100			
TLP	Load profiling sampling time	60 – 3600	**s**	60			
Tint	Energy integration time	5 – 15	**m**	15			
WOUT	Enable pulse output for external energy counters	OFF – ON	-	OFF			
Un	First voltage element operation mode:	+, -, +/-, Dis	**1u**	Dis			
1u	Trip differential level of the first voltage control element	5 – 90	**Un**	90**%**			
Un	Second voltage element operation mode:	+, -, +/-, Dis	**2u**	Dis			
2u	Trip differential level of the second voltage control element	5 – 90	**%Un**	90			
Fn	First frequency element operation mode:	+, -, +/-, Dis	**1f**	Dis			
1f	Trip differential level of the first frequency control element	0,05 – 9,99	**Hz**	9.99			
Fn	Second frequency element operation mode:	+, -, +/-, Dis	**2f**	Dis			
2f	Trip differential level of the second frequency control element	0,05 – 9,99	**Hz**	9.99			
In	First current element operation mode:	+, -, +/-, Dis	**1i**	Dis			
1i	Trip differential level of the first current control element	5 – 95	**%In**	95			
In	Second current element operation mode:	+, -, +/-, Dis	**2i**	Dis			
2i	Trip differential level of the second current control element	5 – 95	**%In**	95			
Pn	First active power element operation mode:	+, -, +/-, Dis	**1p**	Dis			
1p	Trip differential level of the first active power control element	5 – 95	**%Pn**	95			
Pn	Second active power element operation mode:	+, -, +/-, Dis	**2p**	Dis			
2p	Trip diff. level of the second active power control element	5 – 95	**%Pn**	95			
Qn	First reactive power element operation mode	+, -, +/-, Dis	**1q**	Dis			
1q	Trip diff. level of the first reactive power control element	5 – 95	**%Qn**	95			
Qn	Second reactive power element operation mode	+, -, +/-, Dis	**2q**	Dis			
2q	Trip diff.l level of the second reactive power control element	5 – 95	**%Qn**	95			
Sn	First apparent power element operation mode:	+, -, +/-, Dis	**1s**	Dis			
1s	Trip diff.l level of the first apparent power control element	5 – 95	**%Sn**	95			
Sn	Second apparent power element operation mode:	+, -, +/-, Dis	**2s**	Dis			
2s	Trip diff. level of the second apparent power control element	5 – 95	**%Sn**	95			
1w	Trip level of first active energy element.	5 – 95 – Dis	**Wtn**	Dis			
2w	Trip level of second active energy element.	5 – 95 - Dis	**Wtn**	Dis			
1q	Trip level of first reactive energy element.	5 – 95 - Dis	**Qtn**	Dis			
2q	Trip level of second reactive energy element.	5 – 95 - Dis	**Qtn**	Dis			
NodAd	Identification number for the connection on serial communication bus	1 - 250	**-**	1			

CONFIGURATION OF OUTPUT RELAYS											
Default Setting							**Actual Setting**				
Protect. Element	**Output Relays**				**Description**		**Protect. Element**	**Output Relays**			
1u	-	-	-	-	1st voltage element operates relays		**1u**				
2u	-	-	-	-	2ns voltage element operates relays		**2u**				
1f	-	-	-	-	1st frequency element operates relays		**1f**				
2f	-	-	-	-	2ns frequency element operates relays		**2f**				
1i	-	-	-	-	1st current element operates relays		**1i**				
2i	-	-	-	-	2ns current element operates relays		**2i**				
1p	-	-	-	-	1st active power element operates relays		**1p**				
2p	-	-	-	-	2ns active power element operates relays		**2p**				
1q	-	-	-	-	1st reactive power element operates relays		**1q**				
2q	-	-	-	-	2ns reactive power element operates relays		**2q**				
1s	-	-	-	-	1st apparent power element operates relays		**1s**				
2s	-	-	-	-	2ns apparent power element operates relays		**2s**				
1w	-	-	-	-	1st active energy element operates relays		**1w**				
2w	-	-	-	-	2ns active energy element operates relays		**2w**				
1r	-	-	-	-	1st reactive energy element operates relays		**1r**				
2r	-	-	-	-	2ns reactive energy element operates relays		**2r**				
Rem	-	-	-	-	Remote control function operates relays		**Rem**				
tFRes	M				Output relays reset mode (M = manual, A = automatic)		**tFRes**				

Commissioning Engineer : _____ **Date :** _____

Customer Witness : _____ **Date :** _____