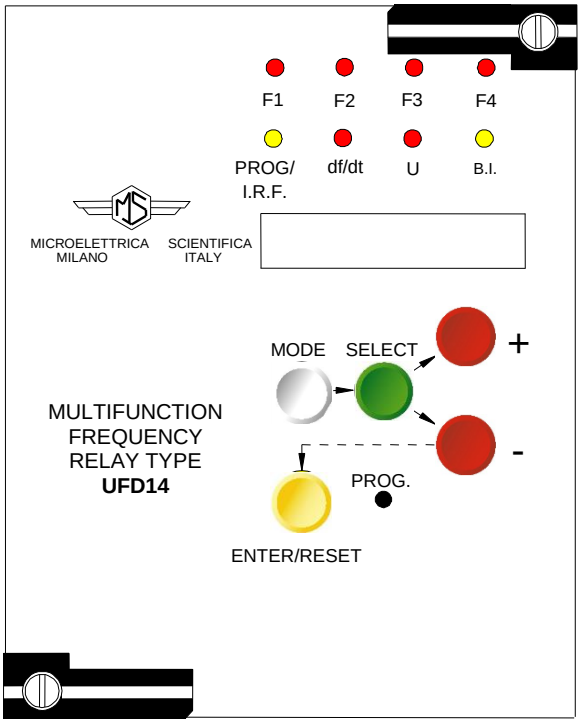
MULTIFUNCTION FREQUENCY RELAY

TYPE
UFD14

OPERATION MANUAL



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1. General utilization and commissioning directions

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

1.1 STORAGE AND TRANSPORTATION,

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

1.2 INSTALLATION,

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

1.3 ELECTRICAL CONNECTION,

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

1.4 MEASURING INPUTS AND POWER SUPPLY,

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

1.5 OUTPUTS LOADING,

must be compatible with their declared performance.

1.6 PROTECTION EARTHING

When earthing is required, carefully check its efficiency.

1.7 SETTING AND CALIBRATION

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

1.8 SAFETY PROTECTION

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

1.9 HANDLING

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

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

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

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

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

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

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

1.10 - MAINTENANCE

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

1.11 - FAULT DETECTION AND REPAIR

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

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

2. GENERAL CHARACTERISTICS

The measured quantities are supplied from 1 of the system's P.Ts to the input transformer.
The relay is normally provided for 100V phase-to-phase input. Any different input voltage is available on request.
The rated input voltage is marked on the relay's P.C. board as well as on the connection diagram printed on its enclosure.
Check that input voltages are same as reported on the diagram and on the test certificate.
The auxiliary power is supplied by a built-in interchangeable module fully isolated an self protected.

2.1 POWER SUPPLY

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

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

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

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

2.2 - OPERATION PRINCIPLE OF FREQUENCY RELAYS

2.2.1 - Acquisition Principle of relay UFD14

The input voltage sinus signal is converted into a square wave where oscillations and pulses in the proximity of the zero crossing are filtered out.
Every microsecond (10^{-6} sec) the relay, via the high speed input of its microcontroller, samples the voltage wave and at any zero crossing associated with a leading edge produces a read out of the internal timer.
The time between two consecutive leading edges (1 cycle) is measured with a resolution of one microsecond and is used to calculate the frequency :

$$f_x = \left(t_x - t_{(x-1)}\right)^{-1}$$

The values of frequency thus measured are continuously stored into a FIFO (First in – First out) memory that contains as many values as the number of cycles “Ncy” programmed in the algorithms for the evaluation.

2.2.2 - Operating time

At relay’s switch-on the minimum operating time is

$$t = \left[\frac{Ncy}{f} + 0.01\right] s$$

During the operation the minimum operating time is t ≤ 30ms.

2.2.3 - Algorithm of the frequency control elements

2.2.3.1 - Frequency operation only

1. Each frequency control stage “xf” (4 stages for UFD14 : 1f, 2f, 3f, 4f) can be individually programmed to operate as underfrequency, overfrequency or frequency balance by programming the operation mode (Fn – xf) or (Fn + xf) or (Fn ± xf).

2. The operation level of each element can be individually adjusted by programming the value of the frequency difference xf (1f = stage 1--------- 4f = stage 4).

   “xf” programmable from 0.05 to 9.99 Hz in steps of 0.01 Hz.

3. The reset of each element takes place when the measured frequency difference equals (xf – 0.02)Hz.

4. Each individual stage includes one instantaneous element and one time delayed element. The time delay “xt” is individually programmable for each stage
   (1f = stage 1 ------- 4t = stage 4)

   “xt” programmable from 0.05 to 99.99 sec in steps of 0.01s

5. The number of cycles “Ncy” used in the frequency control algorithm is programmable (same for all the stages).

   “Ncy” programmable from 3 to 10cy in steps of 1 cy

6. The relay includes an undervoltage lock out element, which blocks the operation of any frequency element if the voltage is below an adjustable set level U<.

   “U<” programmable from 30 to 90% Un in steps of 1% Un

   This element is instantaneous and can also operate an output relay (30ms total trip time).

7. Operation of each element (see example of page 10)

   As already reported at paragraph 1, the frequency measured at every cycle is stored into a FIFO memory which contains as many values as the number of evaluation cycles “Ncy” programmed (see 5.).

   If among the “Ncy” number of frequency measurements evaluated

   - at least **‘Ncy-1’** are in the “evaluation” zone between the tripping and the reset value or in the tripping zone

   and

   - at least **1 value** among the “Ncy” evaluated is in the tripping zone

   the instantaneous element of the stage is tripped (the relevant relay energized) and the timer of the time delayed element of the same stage is started.

   As soon as at least one frequency measurement (1 cycle) is in the reset zone, the instantaneous element as well as the timer are reset.

   If during the time delay no measurement is detected into the reset zone, the time delayed element is tripped and the relevant output relay is energized.

The reset after tripping of the relay associated to the time delayed element (when the reset condition is present) can be programmed to be

- Automatic instantaneous
- Manual by the reset button on relays front or by a command via serial communication port or by activation of the reset digital input D3.
- Time delayed with an adjustable time relay.

The reset time delay is individually adjustable for each frequency stage.

"XR" programmable from 0.05 to 99.99 s in steps of 0.01 sec.

Any time a tripping of a time delayed element takes place, the counter of n° of tripping of the stage is increased and the values of frequency, voltage and frequency rate of variation are recorded into the event recording memory.

8. Minimum operation time of the instantaneous element

- If the frequency values of the former cycles were in the reset zone, the minimum trip time is the summation of the periods of the number of cycles programmed for the evaluation plus the pick-up time of the output relay.
- If the frequency values of at least Ncy-1 former cycles were in the evaluation zone, the trip time is <30ms : 1 cy plus the pick-up time of the output relay (<10ms).
- The reset time is always less than 30ms : 1 cy plus the drop-out of the output relay (<5ms).

2.3 - Frequency operation with df/dt control

Besides the functionality above described, the UFD model also includes the following programmable settings relevant to control of the "Rate of change" of the frequency.

2.3.1 - Additional settings on frequency control stages

2.3.1.1 Each frequency stage can be individually programmed to operate without any df/dt control or with control from one of the two df/dt elements 1f', 2f'

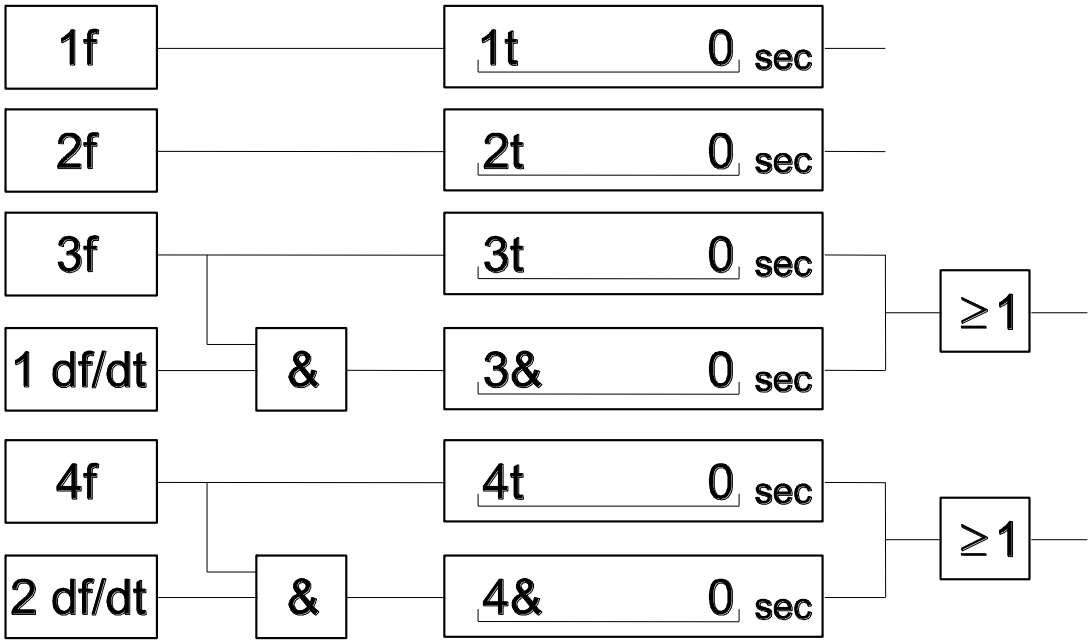
&f' = OFF : no control
&f' = 1f' : control from 1f' level
&f' = 2f' : control from 2f' level

2.3.1.2 Each frequency stage has a second trip time delay setting "xt&" individually adjustable which operates in conjunction with the df/dt control.

"xt&" programmable from 0.05 to 99,99 s in step of 0.01 s.

If the frequency control is activated and the rate of change of frequency is above the set level, the time delayed element of the frequency stage involved will trip after shortest between the set time delays “xt” and xt&”.
If the frequency control is not activated (&f’ = OFF) or it is activated but df/dt is below the set level, the time delay of the frequency stage will remain that corresponding to the set time “xt” (see § 2.1.4).

Example : Elements 3f and 4f with df/dt control respectively from 1f’ and 2f’



2.4 - Algorithm of the element for control of the “Rate of change” of the frequency (UFD models only)

The relay includes two programmable elements for df/dt detection : 1f’, 2f’.

2.4.1 The operation level of each df/dt element can be individually adjusted.

xf’ programmable from 0.1 to 9.9 Hz/s in step of 0.1 Hz/s.

2.4.2 Each df/dt element can be individually programmed to detect

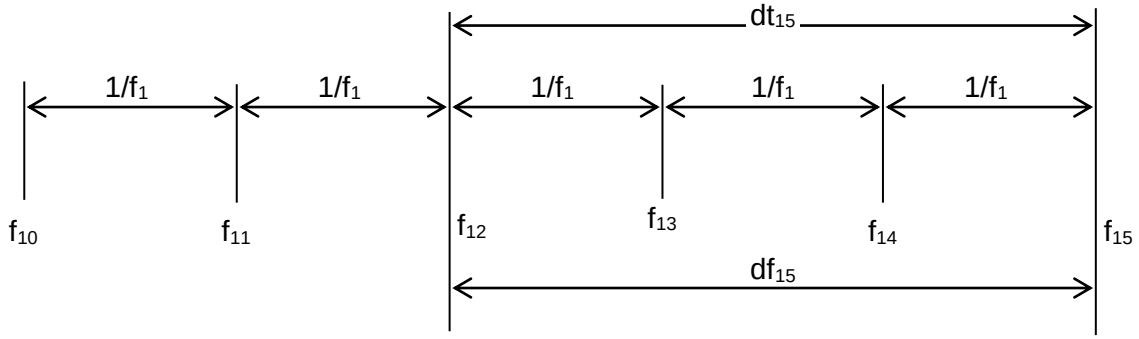
- the “rate of rise” $\left(\mathbf{xdf} = + \rightarrow \frac{df}{dt} > 0 \right)$
- the “rate of decrease” $\left(\mathbf{xdf} = - \rightarrow \frac{df}{dt} < 0 \right)$
- the “rate of change” $\left(\mathbf{xdf} = +/- \rightarrow \left| \frac{df}{df} \right| > 0 \right)$

2.5 - Operation of df/dt elements

According to the evaluation number of cycles (Ncy) programmed, at each cycle the relay computes the difference between the frequency measured and that measured Ncy cycles before and counts the time into which the variation has been detected.

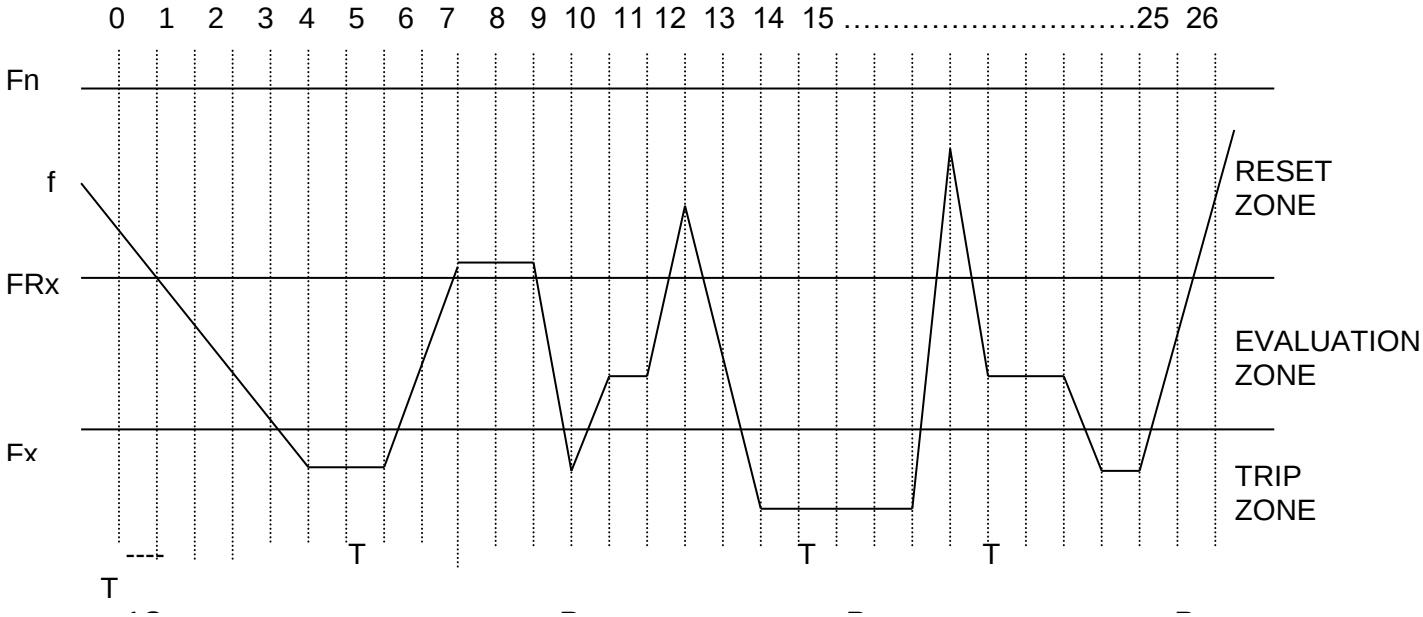
Example : Ncy = 3

$$\left.\begin{aligned} df_x &= f_x - f_{x-3} \\ dt_x &= \frac{1}{f_x} + \frac{1}{f_{(x-1)}} + \frac{1}{f_{(x-2)}} \end{aligned}\right\} \qquad fx' = \frac{df_x}{dt_x}$$



$$f'_{10} = (f_{10} - f_7) : \left(\frac{1}{f_{10}} + \frac{1}{f_9} + \frac{1}{f_8}\right) \ldots\ldots\ldots f'_{15} = (f_{15} - f_{12}) : \left(\frac{1}{f_{15}} + \frac{1}{f_{14}} + \frac{1}{f_{13}}\right)$$

EXAMPLE OF UNDERFREQUENCY OPERATION – Ncy=3



Fx = Trip Level ; FRx = Reset Level ; Fn = Rated Freq. ; f = Frequency ; f ' = df / dt

O = NO TRIPPING **T = TRIPPING** **R = RESET**

(f_0, f_1, f_2) = 0 $$f'_0 = (f_0 - f_{-3}) : \left(\frac{1}{f_0} + \frac{1}{f_{-1}} + \frac{1}{f_{-2}}\right)$$

(f_1, f_2, f_3) = 0 $$f'_1 = (f_1 - f_{-2}) : \left(\frac{1}{f_1} + \frac{1}{f_0} + \frac{1}{f_{-1}}\right)$$

(f_2, f_3, f_4) = 0 $$f'_2 = (f_2 - f_{-1}) : \left(\frac{1}{f_2} + \frac{1}{f_1} + \frac{1}{f_0}\right)$$

(f_3, f_4, f_5) = T $$f'_3 = (f_3 - f_0) : \left(\frac{1}{f_3} + \frac{1}{f_2} + \frac{1}{f_1}\right)$$

(f_4, f_5, f_6) = T .

(f_5, f_6, f_7) = T .

(f_6, f_7, f_8) = T .

(f_7, f_8, f_9) = R .

. .

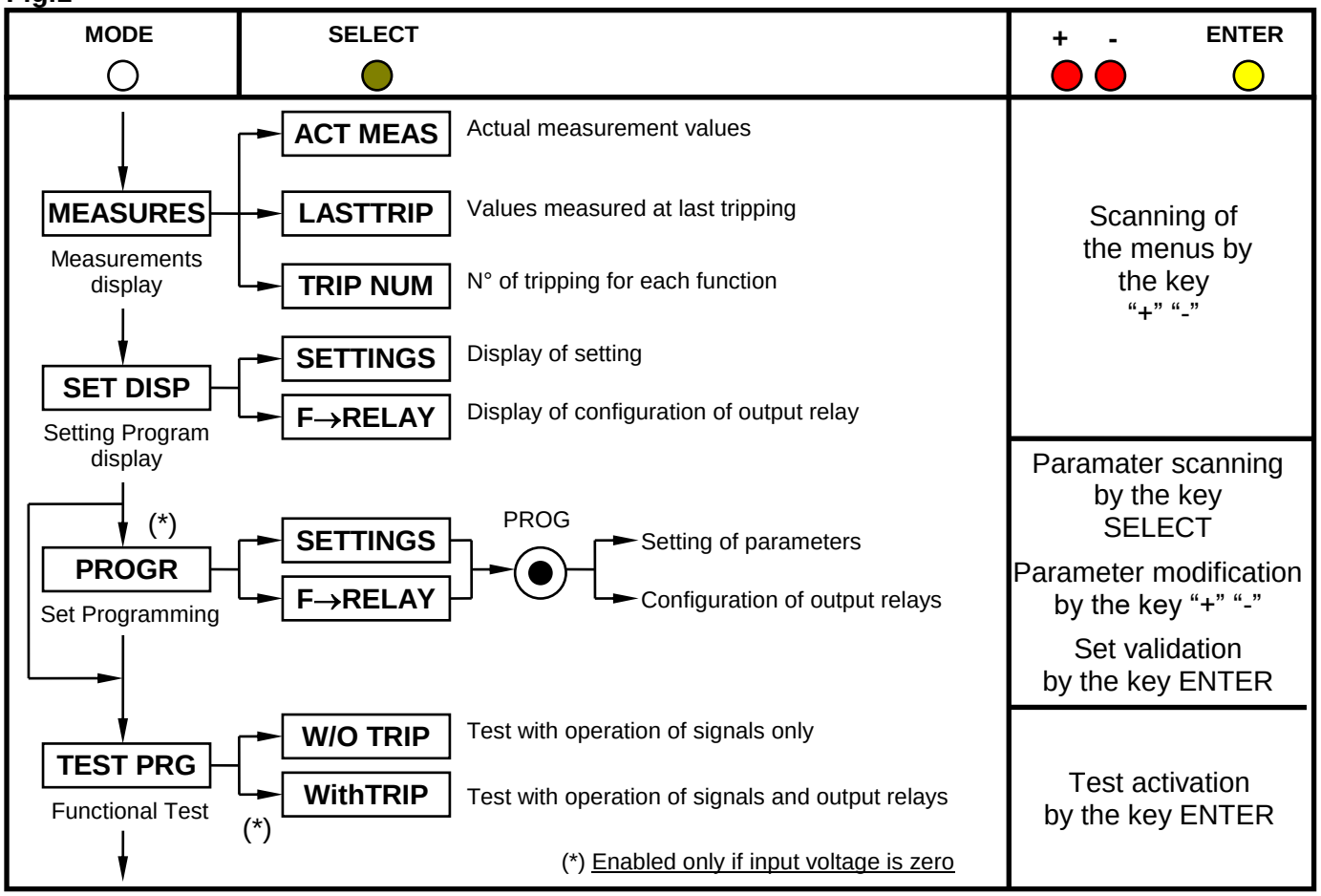
. .

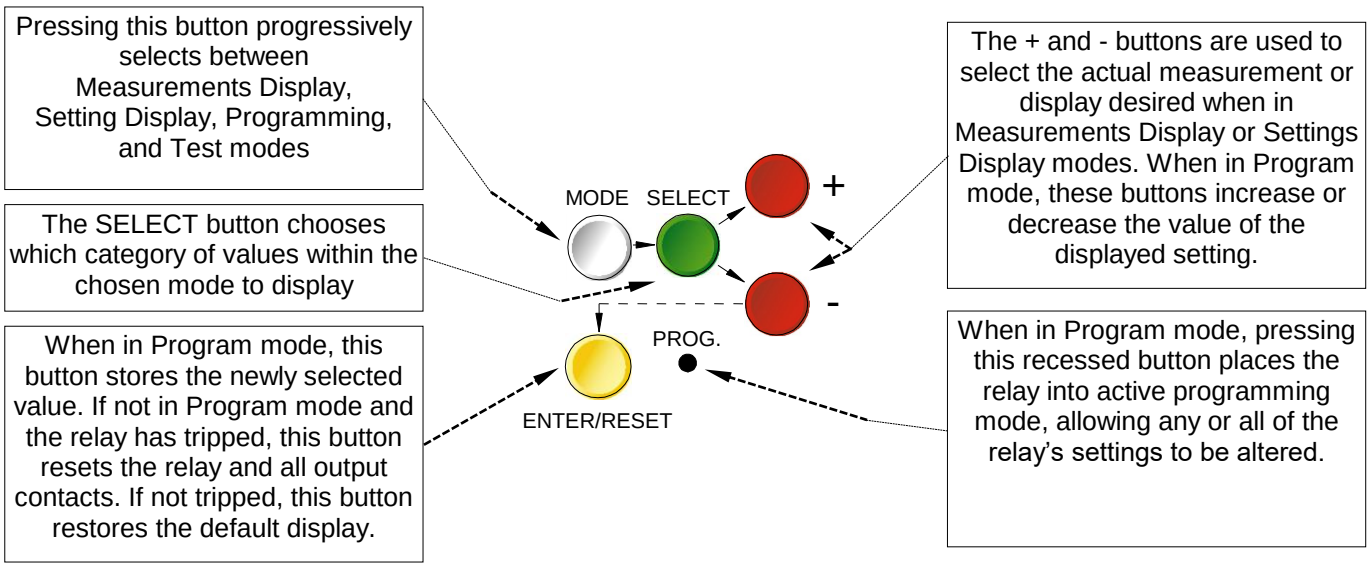
(f_{27}, f_{28}, f_{29}) = R $$f'_{27} = (f_{27} - f_{24}) : \left(\frac{1}{f_{27}} + \frac{1}{f_{26}} + \frac{1}{f_{25}}\right)$$

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)

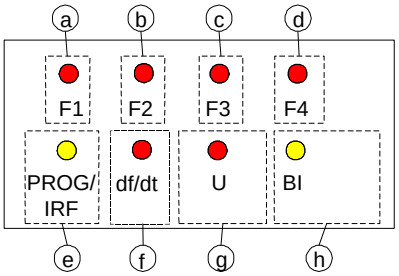
Fig.1





4. SIGNALIZATIONS

Eight signal leds (normally off) are provided:



a)	Red LED	**F1**	❑ flashing as soon as the 1st frequency control element starts to operate ❑ lit-on at the end of the set time delay
b)	Red LED	**F2**	❑ as above for the 2nd frequency control element
c)	Red LED	**F3**	❑ as above for the 3rd frequency control element
d)	Red LED	**F4**	❑ as above for the 4th frequency control element
e)	Yellow LED	**U**	❑ flashing when the undervoltage lock-out element is operating.
f)	Red LED	**df/dt**	❑ flashing as soon as any of the two df/dt elements starts to operate ❑ lit-on when any of the frequency elements trips in conjunction with the df/dt control.
g)	Red LED	**PRG/I.R.F.**	❑ Flashing when programming ❑ lit-on in case of internal fault detected during relay's autotest.
h)	Yellow LED	**BI**	❑ Lit-on when a blocking signal input is present (BI).

The reset of the leds takes place as follows:

❑	Leds a,b,c,d,e,f	:	❑ From flashing to off, when the start cause disappears. ❑ From lit-on to off, by the "ENTER/RESET" push button or via serial bus only if the tripping cause has been cleared.
❑	Leds g,h	:	❑ From flashing/lit-on to off, automatically when the lit-on cause disappears.

In case of auxiliary power supply failure the status of the leds is recorded and reproduced when power supply is restored.
At switch-on of auxiliary power the relay performs an automatic self diagnostic test routine during which all signal leds are lit-on and the display shows the type of the relay (UFD14).
If no internal fault has been detected, after a few seconds the leds are turned off and the display is turned to its default indication.

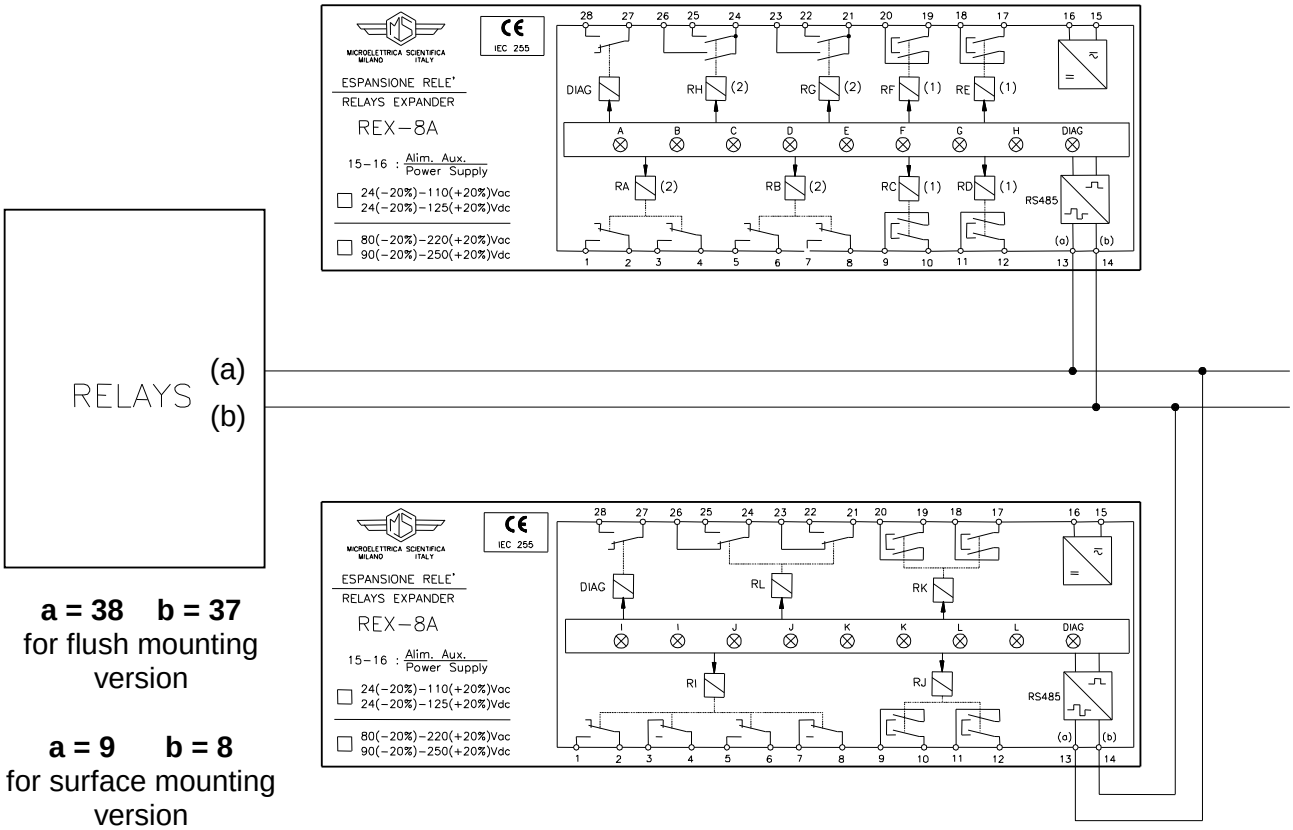
5. OUTPUT RELAYS

The unit UFD14 includes four (R1, R2, R3, R4) user programmable plus one diagnostic (R5) output relays.
The number of output relays can be increased by the addition of one or two optional Relay Expansion modules REX-8.
The modules REX-8 are for protruding mounting and are controlled by the master module UFD14 via a screened twisted pair of cables connecting dedicated RS485 serial ports (see diagram herebelow).
The module REX-8 includes eight (RA, RB, RC, RD, RE, RF, RH, RG) user programmable plus one (R-Diag) diagnostic output relays
The master module UFD14 can control altogether up to sixteen output relays

- 4 internal R1 – R2 – R3 – R4
- 8 from the first optional REX-8 module RA – RB – RC – RD – RE – RF – RG – RH
- 4 from a second optional REX-8 module RI(RA+RB) – RJ(RC+RD) – RK(RE+RF) – RL(RG+RH)

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

Any of the functions featured by the UFD14 can be programmed to control up to four out of the sixteen user programmable output relays



a = 38 b = 37
for flush mounting version

a = 9 b = 8
for surface mounting version

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

a) - The reset after trip can only take place if the relevant tripping cause has been cleared.
The reset function is programmable as follows :
- Automatic instantaneous (Rxtr AUT.)
- Automatic after adjustable time delay 0.05 to 99.99 (Rxtr xx.xx s)
- Manual (Rxtr MAN.) : in this mode the reset is operated either by the ENTER/RESET push button on the relay's front face or via serial bus or via the digital input D3.

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

R5
- internal fault of UFD14
- UFD14 power supply failure
- during the programming

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

6. SERIAL COMMUNICATION

Besides the serial port used for driving the Relay Expansion REX-8, 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).
The communication protocol is MODBUS RTU (only functions 3, 4 and 16 are implemented).
Each relay is identified by its programmable address code (NodeAd) and can be called from the P.C.
A dedicated communication software (MSCOM) for Windows 95/98/NT4 SP3 (or later) is available.
Please refer to the MSCOM instruction manual for more information Microelettrica Scientifica.

7. DIGITAL INPUTS

Three blocking inputs activated by external cold contacts are available at relay's terminal board.

- **D1** : When active inhibits the operation of the output relays controlled by any (one or more) as programmed of the instantaneous functions : 1f, 2f, 3f, 4f.
- **D2** : When active inhibits the operation of the output relays controlled by any (one or more) as programmed of the time delayed functions : 1t/&,2t/&,3t/&,4t/&.
- **D3** : When activated is starts the reset of all the output relays and signal leds.

DIGITAL INPUTS		Mounting Version E	Mounting Version I
D1	Terminals	1 - 2	1 – 3
D2	Terminals	1 - 3	1 – 4
D3	Terminals	1 - 14	1 – 2

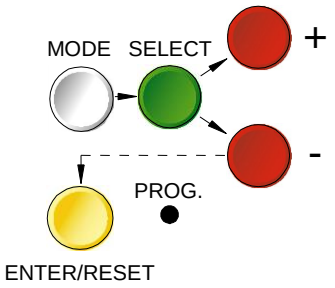
8. TEST

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
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 menu "ACT.MEAS" or "LAST TRIP" or "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
Fxxxxx**Hz**	Input frequency : 30.00 - 80.00 Hz
Uxxx**V,kV**	R.M.S. value of system's phase-to-phase voltage U : 0-999V or 0-9.99kV or 0-999kV with automatic scale selection (kV showed as K)

10.2 LASTTRIP

Display of the function which caused the tripping of the relay plus values of the parameters at the moment of tripping.
The last five events are recorded.
The memory buffer is refreshed at each new relay tripping with a decreasing numbering (FIFO logic)

Display	Description
LastTr-x	Indication of the recorded event (x=0 to 4) Example : Last event (LastTr-0) Last but one event (LastTr-1) etc…
Cau:xxxx	Display of the time delayed function which has operated the last tripping : **--1t** = 1st frequency element only **-1t&** = 1st frequency element with df/dt control **--2t** = 2nd frequency element only **-2t&** = 2nd frequency element with df/dt control **--3t** = 3rd frequency element only **-3t&** = 3rd frequency with df/dt control **--4t** = 4th frequency element only **-4t&** = 4th frequency element with df/dt control
Fxxxx**Hz**	Frequency as measured at the instant of trip
U xxx**%Un**	Voltage as measured at the instant of trip
f' xxx	Frequency rate of variation as detected at the instant of trip

10.3 TRIP NUM

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

Display	Description
1t xxxxx	1st frequency delayed element only
1t& xxxxx	1st frequency & df/dt delayed element
2t xxxxx	2nd frequency delayed element only
2t& xxxxx	2nd frequency & df/dt delayed element
3t xxxxx	3rd frequency delayed element only
3t& xxxxx	3rd frequency & df/dt delayed element
4t xxxxx	4th frequency delayed element only
4t& xxxxx	4th frequency & df/dt delayed element

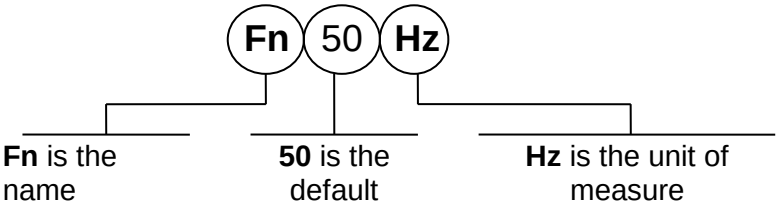
11. READING OF PROGRAMMED SETTINGS AND RELAY'S CONFIGURATION

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.

12. PROGRAMMING

The relay is supplied with the standard default programming used for factory test. [Values here below reported in the " Display " column].
All parameters can be modified as needed in the mode PROG and displayed in the mode SET DISP
Local Programming by the front face key board is enabled only if no input current is detected (main switch open). Programming via the serial port is always enabled but a password is required to access the programming mode. The default password is the null string; in the standard application program for communication "MS-COM" it is also provided an emergency password which can be disclosed on request only.
As soon as programming is enabled, the Led PRG/IRF flashes and the 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 FUNCTION SETTINGS



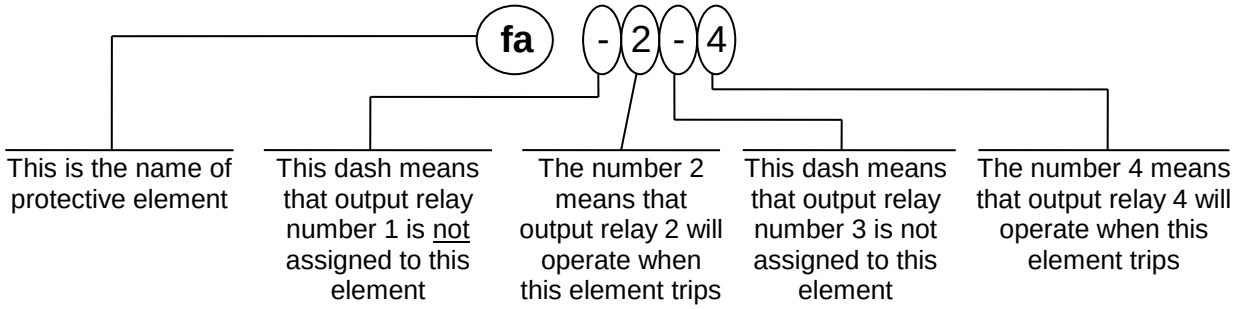
Mode PROG menu SETTINGS. (Production standard settings here under shown).

Display	Description	Setting Range	Step	Unit
Fn 50 **Hz**	System frequency	50 - 60	-	Hz
UnP 10**kV**	Rated primary phase-to-phase voltage of system's P.Ts.	0.1 - 655	(0.1-1) 0.01 (1.1-9.9) 0.1 (10-655) 1	kV
UnS 100**V**	Rated secondary phase-to-phase voltage of system's P.Ts.	50 - 125	0.1	V
Ncy 3	Number of cycles evaluated for f and df/dt tripping	3 - 10	1	Cy
Fn - **1f**	Operation mode of the first frequency control element : **+** = overfrequency **-** = underfrequency **-/+** = under/over frequency **Dis** = function is disactivated	- + -/+ Dis	- + -/+ Dis	-
1f 0.50 **Hz**	Trip differential level of the 1st frequency control element	0.05 - 9.99	0.01	Hz
1t 2 **s**	Trip time delay of the first freq. element without df/dt control	0.05 – 99.99	0.01	s
1&f' OFF	The first frequency element can be controlled by the first df/dt element = 1f' by the second df/dt element =2f' no df/dt = OFF	OFF 1f' 2f'	OFF 1f' 2f'	-
1& 1 **s**	Trip time delay of the first frequency element when df/dt control is operating	0.05 - 99.99	0.01	s

Display	Description	Setting Range	Step	Unit
Fn - 2f	Operation mode of the second frequency control element : **+** = overfrequency **-** = underfrequency **-/+** = under/over frequency **Dis** = function is disactivated	- + -/+ Dis	- + -/+ Dis	-
2f 1 **Hz**	Trip differential level of the 2nd frequency control element	0.05 - 9.99	0.01	Hz
2t 1.5 **s**	Trip time delay of the 2nd frequency element without df/dt control	0.05 – 99.99	0.01	s
2&f' OFF	The second frequency element can be controlled by the first df/dt element = 1f' by the second df/dt element =2f' no df/dt = OFF	OFF 1f' 2f'	OFF 1f' 2f'	-
2& 2**s**	Trip time delay of the second frequency element when df/dt control is operating	0.05 - 99.99	0.01	s
Fn - 3f	Operation mode of the third frequency control element : **+** = overfrequency **-** = underfrequency **-/+** = under/over frequency **Dis** = function is disactivated	- + -/+ Dis	- + -/+ Dis	-
3f 1.5 **Hz**	Trip differential level of the 3rd frequency control element	0.05 - 9.99	0.01	Hz
3t 1**s**	Trip time delay of the 3rd frequency element without df/dt control	0.05 – 99.99	0.01	s
3&f' 1f'	The third frequency element can be controlled by the first df/dt element = 1f' by the second df/dt element =2f' no df/dt = OFF	OFF 1f' 2f'	OFF 1f' 2f'	-
3& 0.75**s**	Trip time delay of the third frequency element when df/dt control is operating	0.05 - 99.99	0.01	s
Fn - 4f	Operation mode of the fourth frequency control element : **+** = overfrequency **-** = underfrequency **-/+** = under/over frequency **Dis** = function is disactivated	- + -/+ Dis	- + -/+ Dis	-
4f 1.50 **Hz**	Trip differential level of the 4th frequency control element	0.05 - 9.99	0.01	Hz
4t 0.75**s**	Trip time delay of the 4th frequency element without df/dt control	0.05 – 99.99	0.01	s
4&f' 2f'	The fourth frequency element can be controlled by the first df/dt element = 1f' by the second df/dt element =2f' no df/dt = OFF	OFF 1f' 2f'	OFF 1f' 2f'	-
4& 0.5**s**	Trip time delay of the fourth frequency element when df/dt control is operating	0.05 - 99.99	0.01	s
1df -/+	Operation mode of the first df/dt element : **+** df/dt > 0 = rate of rise **-** df/dt < 0 = rate of decrease **-/+** |df/dt| > 0 = rate of variation **Dis** = function is disactivated	- + -/+ Dis	- + -/+ Dis	-
1f' 0.2 **Hz/s**	Trip level of the first df/dt element	0.1 – 9.9	0.1	Hz/s
2df -/+	Operation mode of the second df/dt element : **+** df/dt > 0 = rate of rise **-** df/dt < 0 = rate of decrease **-/+** |df/dt| > 0 = rate of variation **Dis** = function is disactivated	- + -/+ Dis	- + -/+ Dis	-
2f' 0.5 **Hz/s**	Trip level of the second df/dt element	0.1 – 9.9	0.1	Hz/s
U< 30**%**	Undervoltage operation lock-out	30 - 90	1	%Un
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 (Settings out of production are here under shown).
The key "**+**" operates as cursor; it moves through the digits corresponding to the four relays programmable for any functions in the sequence 4-3-2-1-L-K-J-I-H-G-F-E-D-C-B-A (4=Relay R4 etc.) and makes start flashing the information actually present in the digit. The information present in the digit can be either the number/letter of the relay (if this was already associated to the function actually on programming) or a dot (-) if this place was not yet addressed.

The key "**-**" changes the existing status from the dot to the relay number or viceversa.

Display	Description			
1f ----	Instantaneous elem. of 1st frequency level operates relays	R1, R2, R3, R4	Only for Version UFD14-X	RA,RB→RL
1t/& 1---	As above, time delayed element.	R1, R2, R3, R4		RA,RB→RL
2f ----	Instantaneous elem. of 2nd frequency level operates relays	R1, R2, R3, R4		RA,RB→RL
2t/& -2--	As above, time delayed element.	R1, R2, R3, R4		RA,RB→RL
3f ----	Instantaneous elem. of 3rd frequency level operates relays	R1, R2, R3, R4		RA,RB→RL
3t/& --3-	As above, time delayed element.	R1, R2, R3, R4		RA,RB→RL
4f ----	Instantaneous elem. of 4th frequency level operates relays	R1, R2, R3, R4		RA,RB→RL
4t/& ---4	As above, time delayed element.	R1, R2, R3, R4		RA,RB→RL
U< ----	Voltage lock-out element.	R1, R2, R3, R4		RA,RB→RL
1f' ----	Element of 1st df/dt level operates relays	R1, R2, R3, R4		RA,RB→RL
2f' ----	Element of 2nd df/dt level operates relays	R1, R2, R3, R4		RA,RB→RL
1tr Aut.	Reset time delay of output relay R1 can be : - instantaneous (R1tr Aut.) - time delayed (R1tr 0.01- 99.99 s) step 0.01 s - manual (R1tr Man.)			
2tr Aut.	As above for relay R2.			
3tr Aut.	As above for relay R3.			
4tr Aut.	As above for relay R4.			
Atr Aut.	As above for relay RA.			
Btr Aut.	As above for relay RB.			
Ctr Aut.	As above for relay RC.			
Dtr Aut.	As above for relay RD.			
Etr Aut.	As above for relay RE.			
Ftr Aut.	As above for relay RF.			
Gtr Aut.	As above for relay RG.			
Htr Aut.	As above for relay RH.			
Itr Aut.	As above for relay RI.			
Jtr Aut.	As above for relay RJ.			
Ktr Aut.	As above for relay RK.			
Ltr Aut.	As above for relay RL.			
D1f ----	Blocking input D1, when active, blocks the operation of the function 1f, 2f, 3f, 4f, as selected.			
D1f' ----	Blocking input D1, when active, blocks the operation of the function 1f', 2f', 3f', 4f', as selected.			
D2t ----	Blocking input D2, when active, block the operation of the output relay controlled by the time delayed function 1t&, 2t&, 3t&, 4t& as detected.			

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

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

WARNING

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

14. MAINTENANCE

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

WARNING

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

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

15. POWER FREQUENCY INSULATION TEST

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

16. ELECTRICAL CHARACTERISTICS

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

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

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

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

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

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

CHARACTERISTICS

❑	Accuracy at reference value of influencing factors	2% Rated Input for measure 2% +/- 10ms for times
❑	Rated Voltage	Un = 50 - 125V (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
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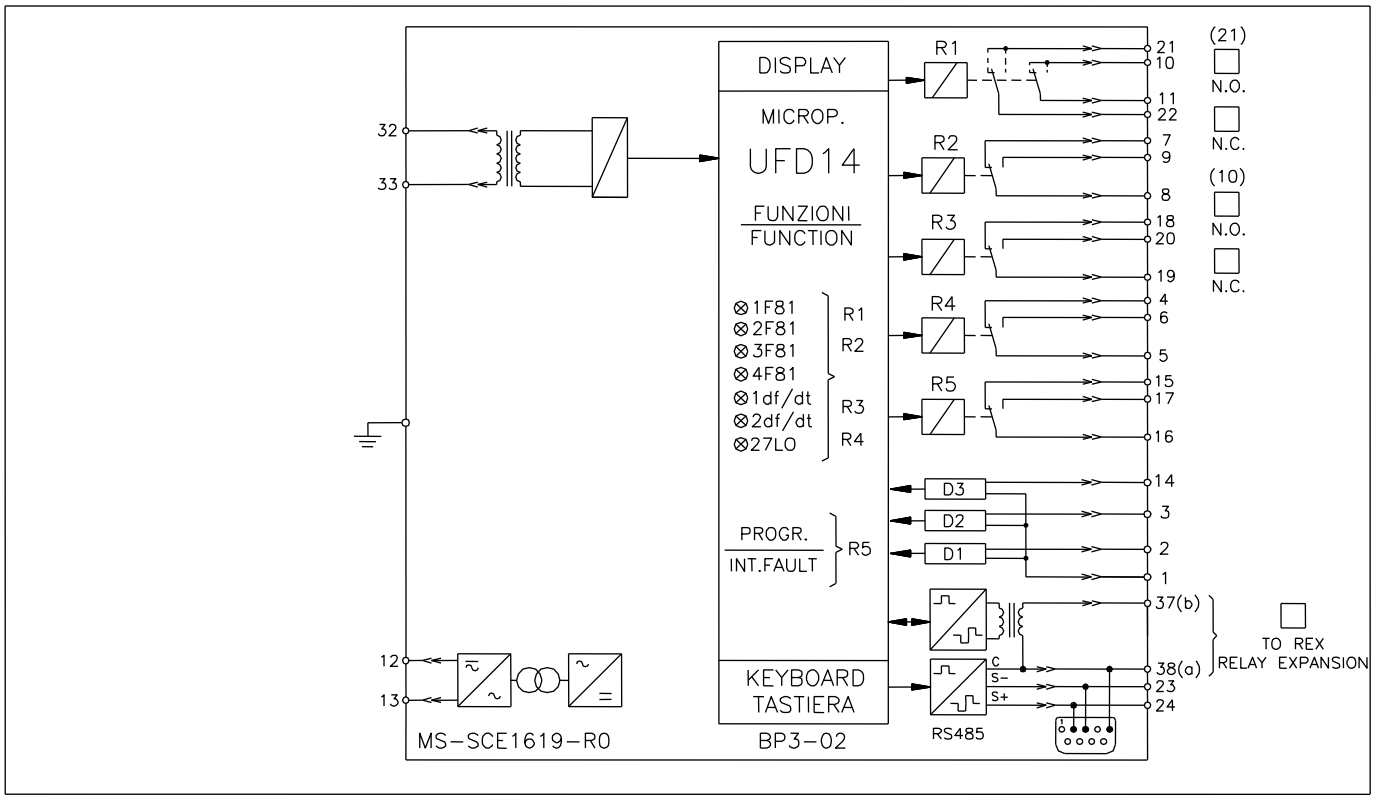
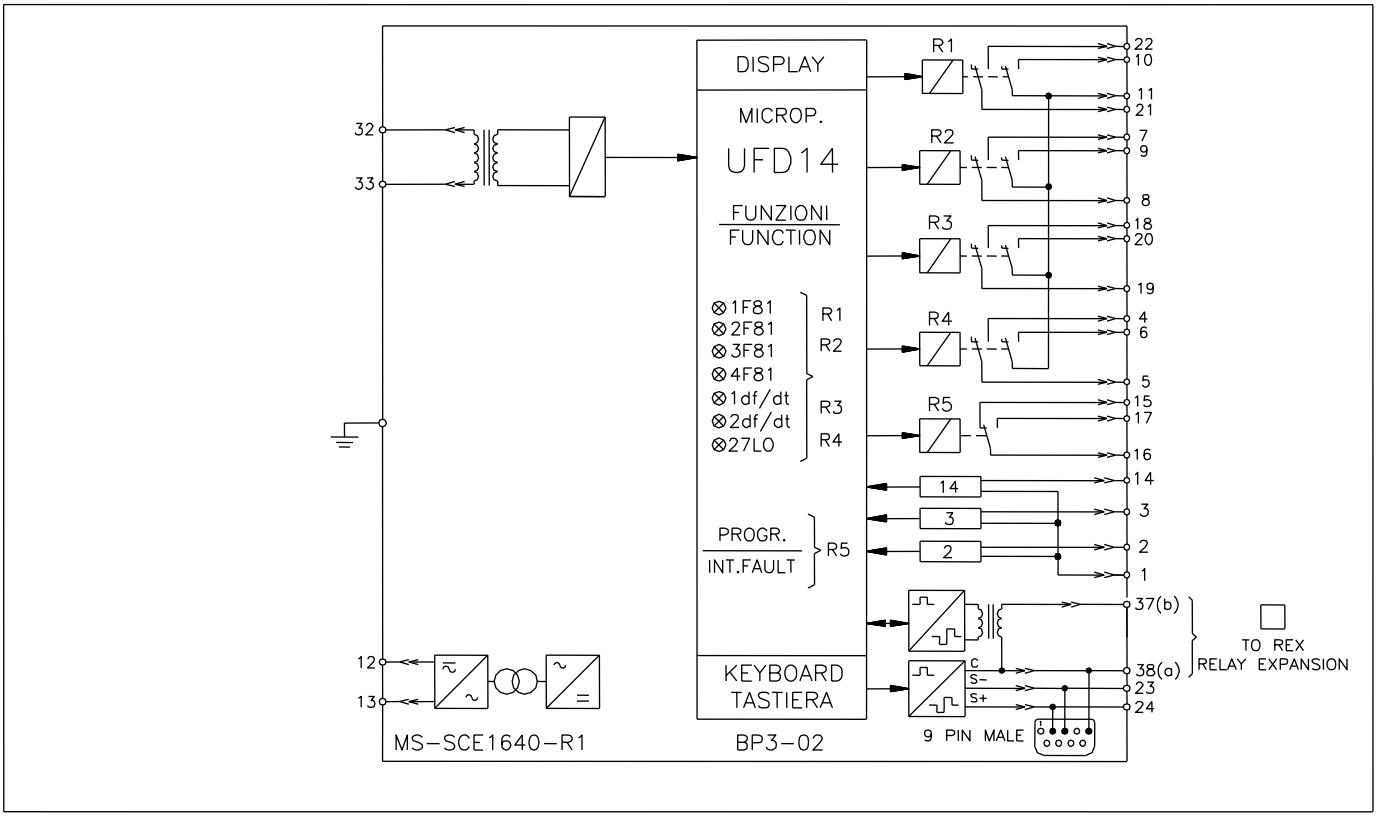
The performances and the characteristics reported in this manual are not binding and can modified at any moment without notice

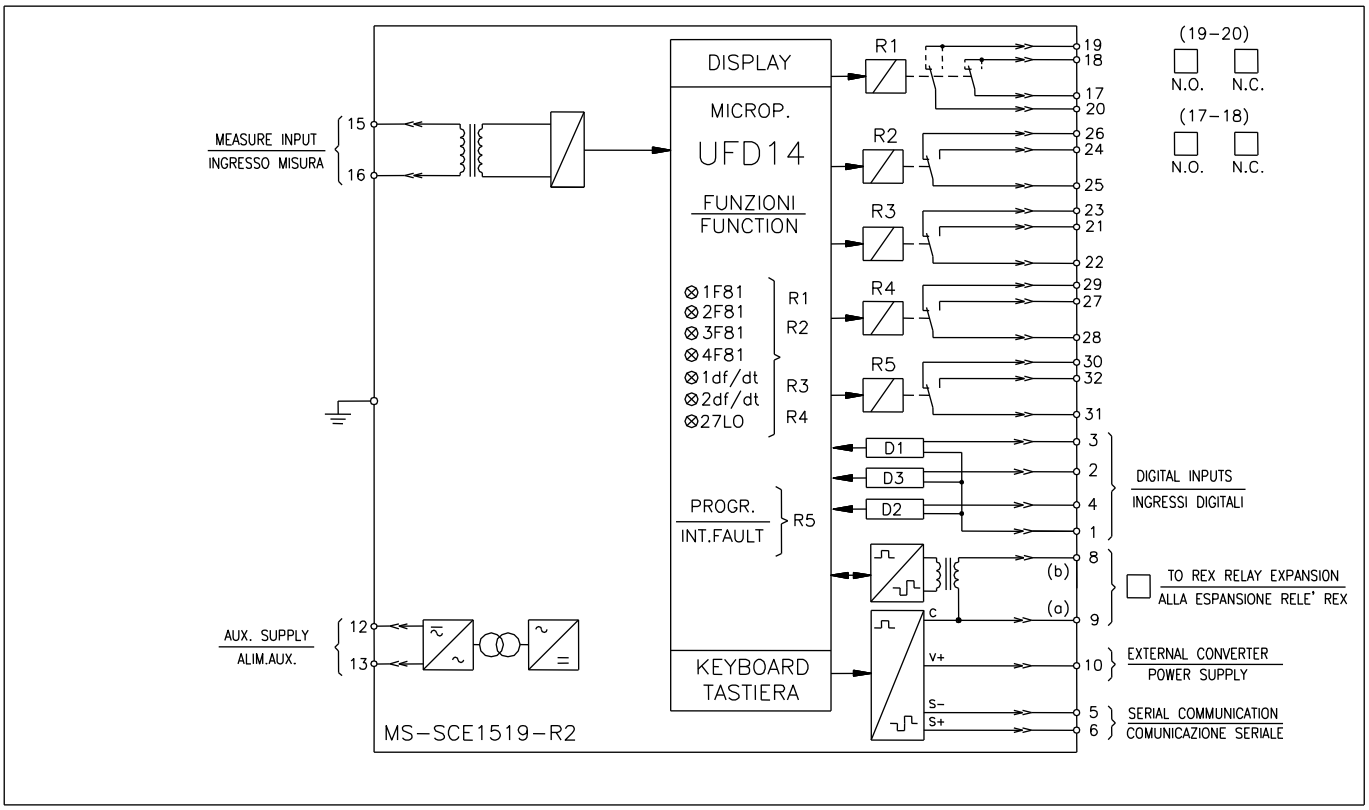
17. CONNECTION DIAGRAM (SCE1619 Rev.0 Standard Output) for mounting version E



17.1 - CONNECTION DIAGRAM (SCE1640 Rev.0 Double Output) for mounting version E

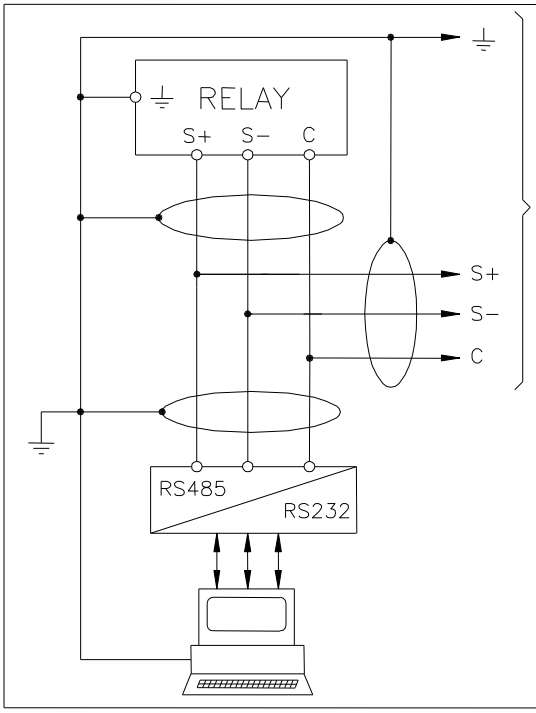


17.2 CONNECTION DIAGRAM (SCE1519 Rev.2) for mounting version I



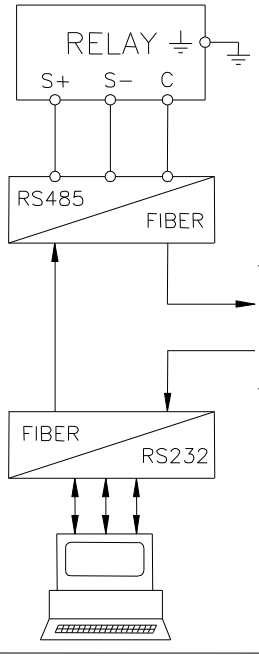
18. WIRING THE SERIAL COMMUNICATION BUS (SCE1309 Rev.0)

CONNECTION TO RS485



TO OTHER RELAYS IN PARALLEL (MAX. 31 UNITS)

FIBER OPTIC CONNECTION



TO OTHER RELAYS IN SERIES (MAX. 200 UNITS)

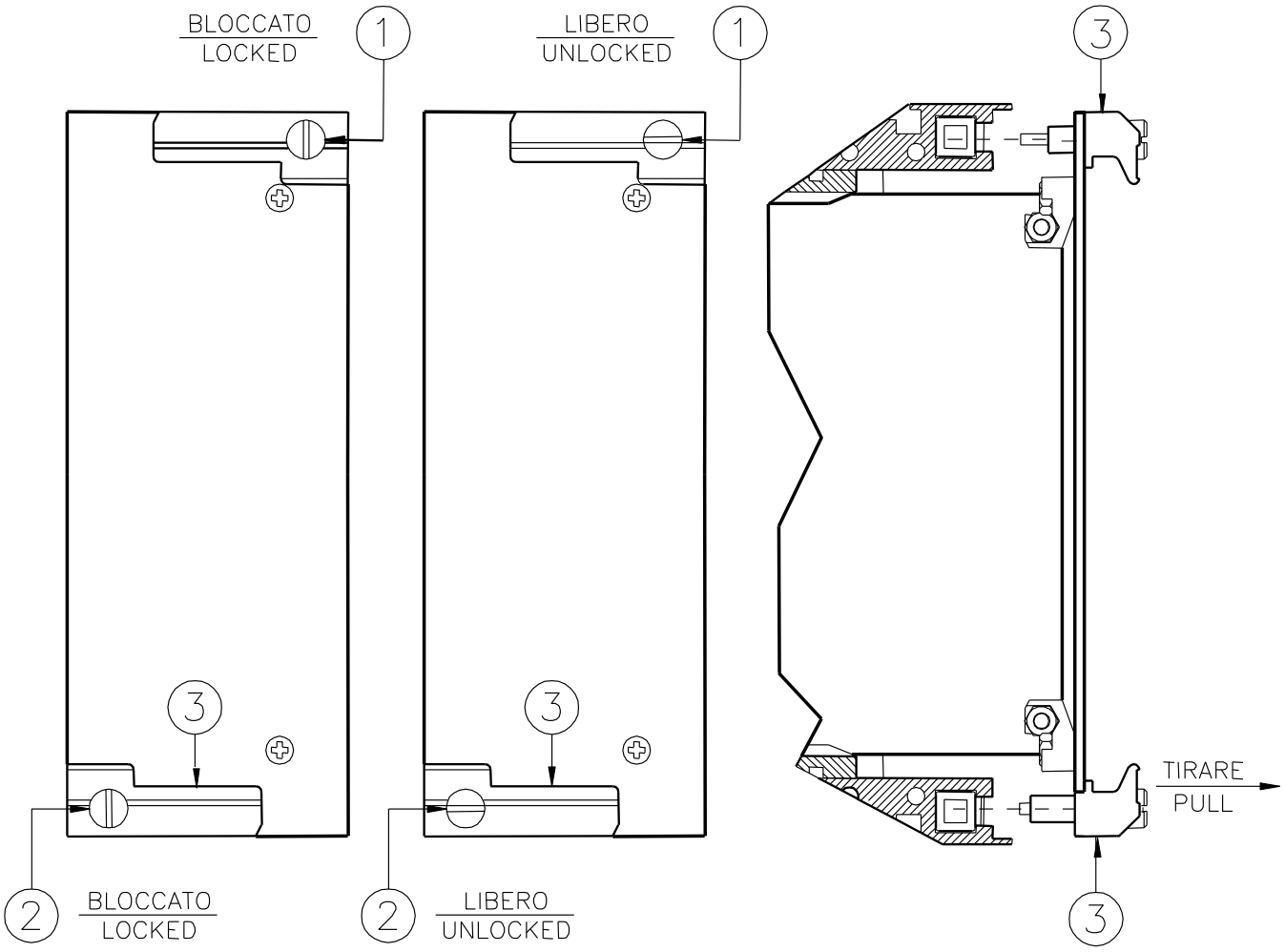
19. DIRECTION FOR PCB'S DRAW-OUT AND PLUG-IN

19.1 DRAW-OUT

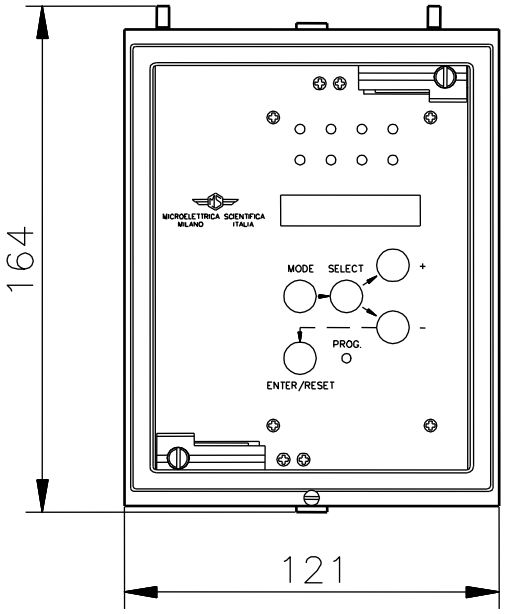
Rotate clockwise the screws ① and ② in the horizontal position of the screws-driver mark.
Draw-out the PCB by pulling on the handle ③

19.2 PLUG-IN

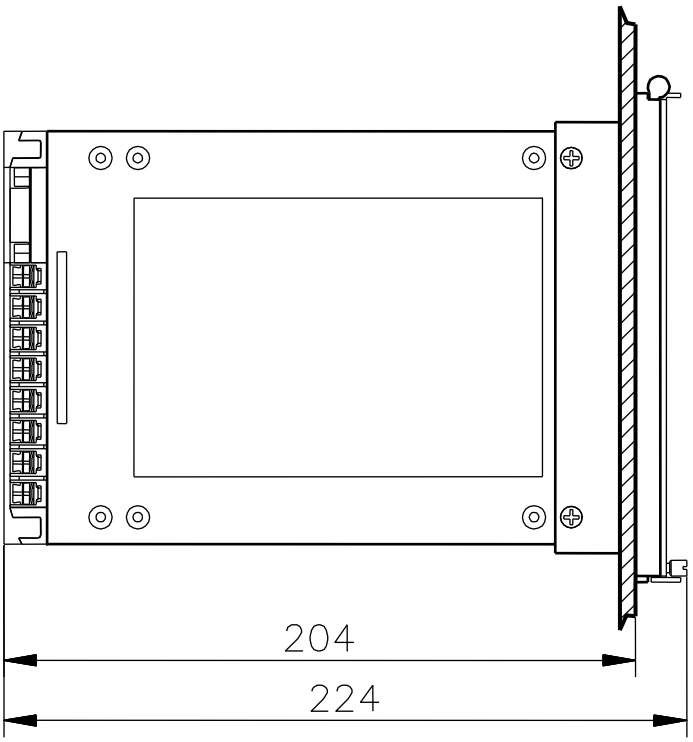
Rotate clockwise the screws ① and ②in the horizontal position of the screws-driver mark.
Slide-in the card on the rails provided inside the enclosure.
Plug-in the card completely and by pressing the handle to the closed position.
Rotate anticlockwise the screws ① and ② with the mark in the vertical position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

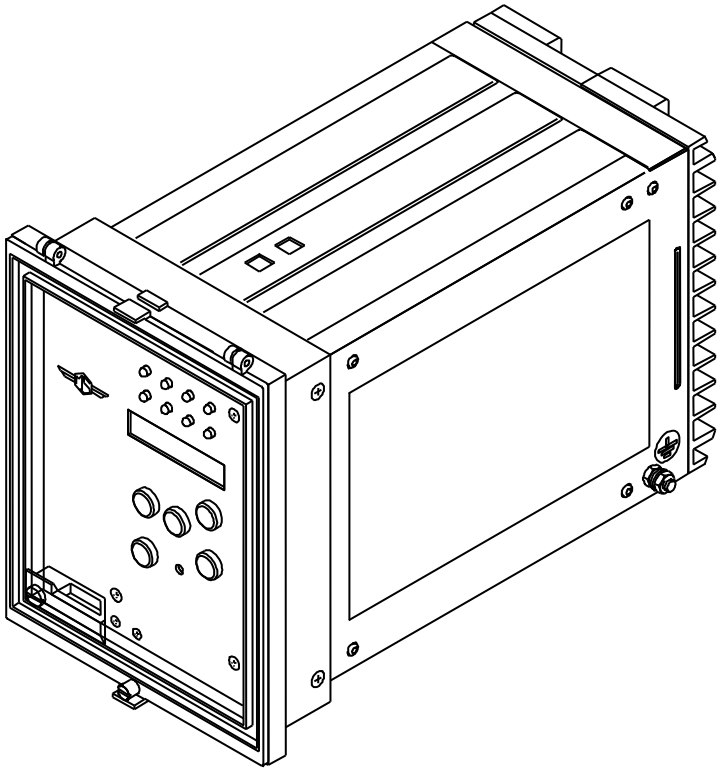


20. OVERALL DIMENSIONS (Version E)

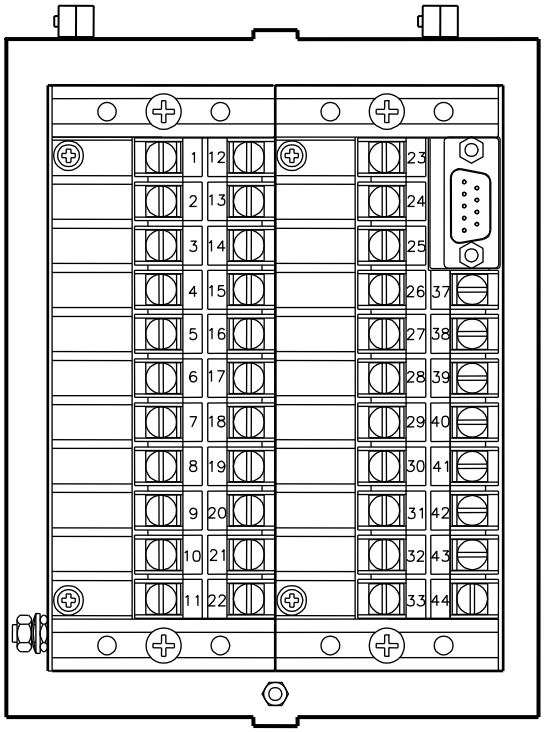


PANEL CUT-OUT 113x142 (LxH)

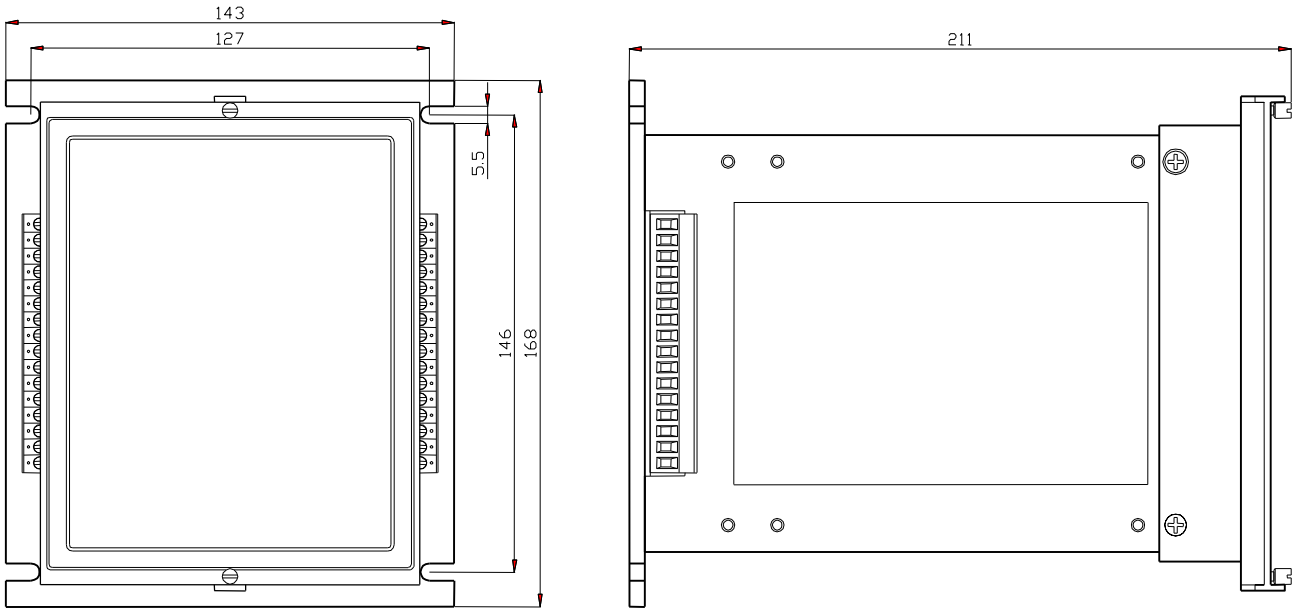




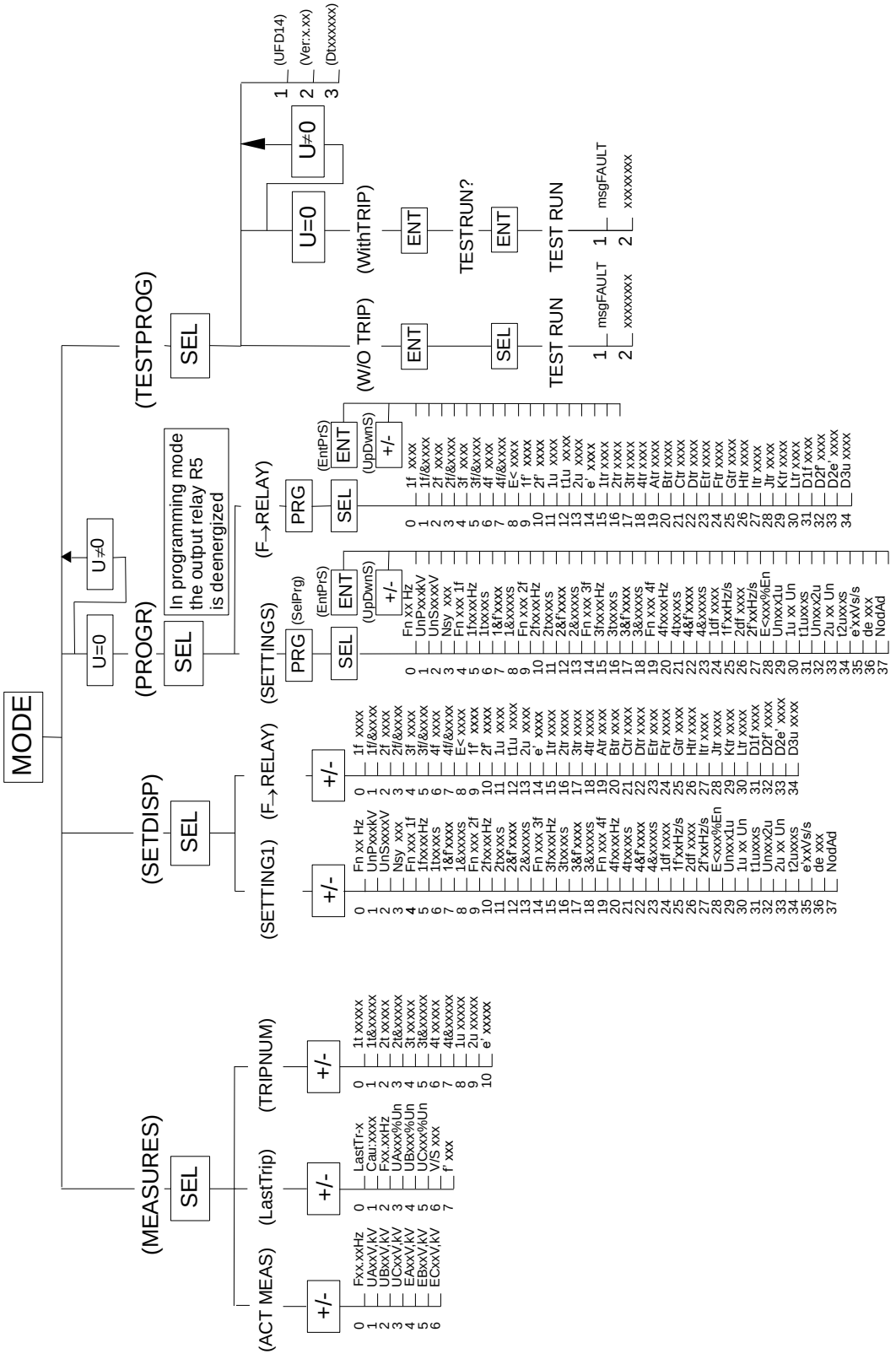
View of Rear Terminal Connection



20.1 OVERALL DIMENSIONS (Version I)



21. KEYBOARD OPERATIONAL DIAGRAM



22. SETTING'S FORM

Relay Type Date :	UFD14 / /	Station :	Circuit : 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
Fn	System frequency	50 - 60	**Hz**	50			
UnP	Rated primary phase-to-phase voltage	0.1 - 655	**kV**	10			
UnS	Rated secondary phase-to-phase voltage	100 - 125	**V**	100			
Ncy	Number of cycles evaluated for f and df/dt tripping	3 - 10	-	3			
Fn	Operation mode of the first frequency control element	+, -, -/+,Dis	**1f**	-			
1f	Trip differential level of the 1st frequency control element	0.05 - 9.99	**Hz**	0.50			
1t	Trip time delay of the first freq. element without df/dt control	0.05-99.99	**s**	2			
1&f'	The first frequency element can be controlled	OFF,1f',2f'	-	OFF			
1&	Trip time delay of the first frequency element	0.05 - 99.99	**s**	1			
Fn	Operation mode of the second freq. control element	+, -, -/+,Dis	**2f**	-			
2f	Trip differential level of the 2nd frequency control element	0.05 - 9.99	**Hz**	1			
2t	Trip time delay of the 2nd frequency element without df/dt control	0.05 - 99.99	**s**	1.5			
2&f'	The second frequency element can be controlled	OFF,1f',2f'	-	OFF			
2&	Trip time delay of the second frequency element	0.05 - 99.99	**s**	2			
Fn	Operation mode of the third frequency control element	+, -, -/+,Dis	**3f**	-			
3f	Trip differential level of the 3rd frequency control element	0.05 - 9.99	**Hz**	1.5			
3t	Trip time delay of the 3rd frequency element without df/dt control	0.05 - 99.99	**s**	1			
3&f'	The third frequency element can be controlled	OFF,1f',2f'	**f'**	1			
3&	Trip time delay of the third frequency element when df/dt control is operating	0.05 - 99.99	**s**	0.75			
Fn	Operation mode of the fourth frequency control element	+, -, -/+,Dis	**4f**	-			
4f	Trip differential level of the 4th frequency control element	0.05 - 9.99	**Hz**	1.50			
4t	Trip time delay of the 4th frequency element without df/dt control	0.05 - 99.99	**s**	0.75			
4&f'	The fourth frequency element can be controlled	OFF,1f',2f'	**f'**	2			
4&	Trip time delay of the fourth frequency element when df/dt control is operating	0.05 - 99.99	**s**	0.5			
1df	Operation mode of the first df/dt element	+, -, -/+,Dis	-	-/+			
1f'	Trip level of the first df/dt element	0.1 – 9.9	**Hz/s**	0.2			
2df	Operation mode of the second df/dt element	+, -, -/+,Dis	-	-/+			
2f'	Trip level of the second df/dt element	0.1 – 9.9	**Hz/s**	0.5			
U<	Undervoltage operation lock-out	30 - 90	**%**	30			
NodAd	Identification number for connection on serial communication bus	1 - 250	-	1			

CONFIGURATION OF OUTPUT RELAYS															
Default Setting						**Actual Setting**									
Prot Elem.	**Output Relays**				**Description**	**Prot. Elem.**	**Output Relays**								
1f ----	-	-	-	-	Instantaneous elem. of 1st frequency level operates relays										
1t/& 1---	1	-	-	-	As above, time delayed element.										
2f ----	-	-	-	-	Instantaneous elem. of 2nd frequency level operates relays										
2t/& -2--	-	2	-	-	As above, time delayed element.										
3f ----	-	-	-	-	Instantaneous elem. of 3rd frequency level operates relays										
3t/& --3-	-	-	3	-	As above, time delayed element.										
4f ----	-	-	-	-	Instantaneous elem. of 4th frequency level operates relays										
4t/& ---4	-	-	-	4	As above, time delayed element.										
U< ----	-	-	-	-	Voltage lock-out element.										
1f' ----	-	-	-	-	Element of 1st df/dt level operates relays										
2f' ----	-	-	-	-	Element of 2nd df/dt level operates relays										
1tr	Aut.				Reset time delay of output relay R1										
2tr	Aut.				As above for relay R2.										
3tr.	Aut				As above for relay R3.										
4tr	Aut.				As above for relay R4.										
Atr	Aut.				As above for relay RA.										
Btr	Aut.				As above for relay RB.										
Ctr	Aut.				As above for relay RC.										
Dtr	Aut.				As above for relay RD.										
Etr	Aut.				As above for relay RE.										
Ftr	Aut.				As above for relay RF.										
Gtr	Aut.				As above for relay RG.										
Htr	Aut.				As above for relay RH.										
Itr	Aut.				As above for relay RI.										
Jtr	Aut.				As above for relay RJ.										
Ktr	Aut.				As above for relay RK.										
Ltr	Aut.				As above for relay RL.										
D1f	-	-	-	-	Blocking input D1, when active, blocks the operation of the function 1f, 2f, 3f, 4f, as selected.										
D1f'	-	-	-	-	Blocking input D1, when active, blocks the operation of the function 1f', 2f', 3f', 4f', as selected.										
D2t	-	-	-	-	Blocking input D2, when active, block the operation of the output relay controlled by the time delayed function 1t&, 2t&, 3t&, 4t& as detected.										

Commissioning Engineer : _____ **Date :** _____

Customer Witness : _____ **Date :** _____