DIVISIONE ELETTRONICA E SISTEMI

DIA4N

DIGITAL PROTECTION RELAY FOR MV ENERGY PRODUCTORS

USER MANUAL

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1 GENERAL CHARACTERISTICS

The protection relay DIA4N performs functions such interface relay for MV energy productors, according to Italian norm **CEI 0-16 ed. 3** issued on December 2012.

The protection relay DIA4N is also useful as generic voltage and/or frequency relay in different contexts from those foreseen by norm CEI 0-16.

The functions shown in the following table are available.

Function	ANSI
Undervoltage	27
Overvoltage	59
Residual overvoltage	59N / 59Vo
Under frequency	81<
Over frequency	81>
Frequency thresholds with voltmetric control	81V
Positive sequence undervoltage	27V1
Negative sequence overvoltage	59V2
Breaker failure	
Remote trip	

All the set-up and measured parameters can be viewed on the front panel display and transmitted on the RS485 communication serial port.

THRESHOLD – the following threshold are available:

- 2 three phase undervoltage thresholds 27.1 - 27.2
- 2 three phase overvoltage thresholds 59.1 - 59.2
- 1 residual overvoltage threshold 59N.1
- 2 over frequency thresholds 81> - 81>>
- 2 under frequency thresholds 81< - 81<<
- 1 positive sequence undervoltage threshold 27V1
- 1 negative sequence overvoltage threshold 59V2

The available settings for each threshold are listed in Table A.

The protection functions related to frequency measurement are disabled (trip condition and relay activation) in the following conditions:

- Measured voltage lower than 0.2 Un

Thresholds 27V1 and 59V2 are used only to perform the 81V function, therefore they are not equipped with all the features usually available for the other thresholds (for example, they do not have the counters of shots).

TRIP DELAYS - a programmable time delay (TI) is available for each threshold; it can be programmed by the user.

In certain thresholds / functions, which will be specified later, there is a release timer (TR time), whose value can be set by the user.

The available settings for each timers are listed in Table A.

OUTPUT RELAYS - the DIA4N controls 4 output relays (named R1, R2, R3 and R4); these relays can be programmed to be activated on START or TRIP conditions of one or more thresholds.

START	instantaneous activation of the output relay when at least one of the measured voltages exceeds the programmed threshold value
TRIP	activation of the output relay when the programmed time delay (TI) related to a threshold expires.

The quiescent state of each single relay R1, R2, R3 and R4 can be programmed as normally energized (ON) or normally de-energized (OFF).

An additional relay R5 (normally energized) is controlled by the self-diagnosis routines to report detected fault conditions.

Related to each threshold, partial and total counters of TRIP conditions are available.

DIGITAL INPUTS - there are available 3 digital inputs to activate the following functions (when enabled by the programmed set-up):

- on/off thresholds (related to one or more thresholds)
- STATUS function (recording of measures on external event)
- pilot wire fault monitoring (only for DIG2)
- Local Command function
- Circuit breaker status (open / close) for BF function
- Remote trip

For each digital input can be programmed the condition that activates the related functions:

HI voltage =	> 20 V dc / ac
LO voltage =	0 ÷ 10 V dc / ac

The digital input acquisition is valid when the voltage value stays in the range HI or LO for at least 30 ms.

DISPLAY OF MEASURES - the user can select the continuous display of a measured voltage (primary values) or the frequency (in Hz); all the measures can be transmitted to an external controller through the RS485 port.

EVENTS - information related to the last 8 events (POWER ON, TRIP or STATUS) are recorded in the EEPROM memory.

Information includes the threshold set-up and activated relays (TRIP event only), the measured voltages, the digital input status, date and time of the event.

SELF-DIAGNOSIS - the software includes a non stop monitoring module that controls the functionality of all hardware and software resources of the protection relay.

Detected fault conditions are reported by:

- diagnostic message on the display
- glow of a red LED on front panel
- R5 output relay drop-off

The fault condition signaling stays until faults are pointed out by the monitoring module; during this condition the protection functions are suspended to avoid unsuitable tripping.

STATUS FUNCTION - when the STATUS function is activated by one of the digital input (when programmed) the protection relay memorizes information related to measured voltages and digital input status (see par. 5.10 - EVENTS). The recorded information allows an analysis of trip causes in co-operative protection relays systems.

PILOT WIRE FAULT MONITORING - when the function is programmed, the digital input DIG2 is used to control the correct functionality of the pilot wire. Digital input DIG2 is always expected to be complementary of DIG1 input (HI-LO or LO-HI) to identify faults on pilot wire.

The fault condition is reported as detected by the self-diagnosis module but the protection functions are not suspended; only the functions related to DIG1 digital input are suspended as the DIG1 status cannot be longer considered as true.

The fault condition is reported when DIG1 and DIG2 signals are not complementary for more than 100 ms.

REMOTE COMMUNICATION - the opto-insulated serial port RS485 can communicate with a personal computer or a remote control and monitoring system equipped with an RS485 interface or with a standard RS485/RS232 converter.

It is possible to select the communication standard between STANDARD (ASCII 7 bit - Seb protocol) or MODBUS (ASCII mode, SLAVE).

All the set-up and measured parameters can be transmitted on the RS485 communication serial port; when communication is active (LED REMOTE glows), the operator on front panel can view the relay set-up but changes of parameters are disabled (ENTER and buttons disabled).

1.1 Undervoltage thresholds (ANSI 27)

Two three phase undervoltage are available (**27.1**, **27.2**).
Both thresholds may be enabled or disabled by the user, in independent mode between them.
When one or more of the measured phase voltages drops under the threshold value, the threshold trips.

The available settings for the thresholds are listed in Table A.

1.2 Overvoltage thresholds (ANSI 59)

Two three phase overvoltage are available (**59.1**, **59.2**).
Both thresholds may be enabled or disabled by the user, in independent mode between them.
When one or more of the measured phase voltages exceed the threshold value, the threshold trips.

The threshold **59.1** uses a 10 minutes mean value of the voltages, according to Annex S of the norm CEI 0-16. The measured value is updated every 3 seconds.

The available settings for the thresholds are listed in Table A.

1.3 Residual overvoltage threshold (ANSI 59N)

One residual overvoltage threshold is available (**59N.1**).
The threshold may be enabled or disabled by the user.

This threshold has a timer on start condition falloff (TR 59N.1), which is useful to avoid continuous activation and falloff of the start 59N.1 signal in the case of intermittent fault or at the extinction of the fault, due to saturation of the inductive ferromagnetic VT connected between phase and neutral. The recommended value for this timer is 200 ms.

The available settings for the thresholds are listed in Table A.

1.4 Under frequency thresholds (ANSI 81)

Two under frequency thresholds are available (**81<**, **81<<**)
Both thresholds may be enabled or disabled by the user, in independent mode between them.[1]

[1] If you use the 81V function (as required by the norm CEI 0-16 ed. 3), both the thresholds 81< and 81<< have to be enabled.

The under frequency threshold, with the related over frequency thresholds, are specially suitable for the following applications:

- control of the frequency
- graded load-shedding in overloaded systems due to loss of generating units or mains failure

The available settings for the thresholds are listed in Table A.

1.5 Over frequency thresholds (ANSI 81)

Two over frequency thresholds are available (**81>**, **81>>**)
Both thresholds may be enabled or disabled by the user, in independent mode between them.[2]

The available settings for the thresholds are listed in Table A.

1.6 Frequency thresholds with voltmetric control (ANSI 81V)

This function is required by norm CEI 0-16 ed. 3, therefore should be enabled if the protection relay is used in systems that must meet the requirements of this rule.

This function may be enabled or disabled by the user.

For proper operation of this function it is necessary that both two under frequency threshold (81< and 81<<) and two over frequency threshold (81> and 81>>) are enabled.

For its operation, in addition to the logic signals for start and trip from 59N1 threshold, this function uses a negative sequence overvoltage threshold (59V2) and a positive sequence undervoltage threshold (27V1). Both the values of these two thresholds are programmable by the user (see Table A). These thresholds are equipped with the related timer, whose value is programmable by the user and should be used if you wish to use the logic trip signal (TRIP) in place of the start signal (START) to enable the thresholds 81> and 81<; thresholds 81>> and 81<< are always enabled.

If you enable this function, you have to set a digital input to acquire the status of the Local Command signal. When the Local Command signal has logical status HIGH, the protection relay operates always with restrictive frequency thresholds (81> and 81<) active; when the Local Command has logical status LOW, the restrictive frequency thresholds (81> and 81<) activation is related to the thresholds 27V1, 59V2 and 59N1 exceeding.

If it is enabled, this function acts on the restrictive frequency thresholds (81> and 81<), enabled only when one or more of the following conditions occur:

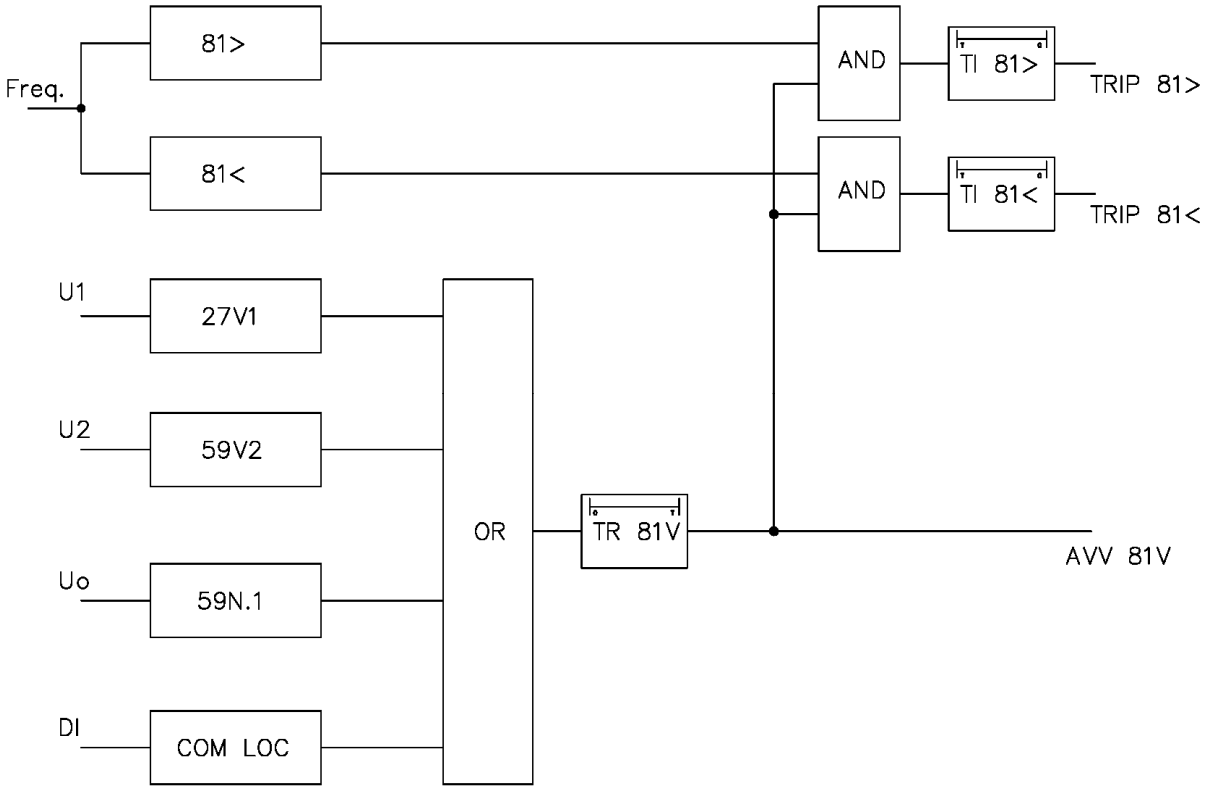
- threshold 27V1 exceeding
- threshold 59V2 exceeding
- threshold 59N.1 exceeding
- logical status of Local Command signal is HIGH

[2] If you use the 81V function (as required by the norm CEI 0-16 ed. 3), both the thresholds 81> and 81>> have to be enabled.

The mode in which the thresholds 27V1, 59V2 and 59N1 determine the enabling of the thresholds 81> and 81< can be selected by the user according to three different modes:

- OFF Threshold not used in function 81V
- START The threshold exceeding condition is the start one[3]
- TRIP The threshold exceeding condition is the trip one

The operating logic of the frequency threshold with voltmetric control is shown in the following diagram.



Legend:

Freq.	Frequency measurement
U1	Positive sequence voltage (calculated by relay)
U2	Negative sequence voltage (calculated by relay)
Uo	Earth fault voltage (measured by relay)
DI	Digital input (set as Local Command)
AVV 81V	"Start 81V"[4] signaling
TRIP 81>	Trip threshold 81>
TRIP 81<	Trip threshold 81<

Please note the presence of a release timer (TR 81V), useful to not vary continuously the enabling of thresholds 81< and 81> during the reclosing cycles.
The suggested setting value for that timer is 30 s.

When you use the function 81V, the delay timers for thresholds 81> and 81< (TI 81> and TI81<) should have the same value.

[3] This is the setting required by norm CEI 0-16 ed. 3
[4] This signal can be carried outside by configuring one of the available relays, to communicate to the external generators the operating condition with frequency thresholds restricted enabled.

During the setup procedure, the protection relay do a check on setup parameters, and it shows an error message when one or more of the following case occurs:

- no digital input programmed to acquire the Local Command signal
- one or more frequency threshold are disabled (OFF)
- the setup values of restrictive frequency thresholds (81< and 81>) are more distant form the nominal value than the permissive frequency thresholds (81<< and 81>>)
- one or more frequency thresholds could be disabled by digital inputs

In case you don't enable the 81V function, the frequency thresholds don't have special constraints except those related to their enabling settings, according to the user preferences.

1.7 Breaker Failure function (MAI function)

This function uses a digital input to get the "circuit breaker open" status or the "circuit breaker close" status.

When a circuit breaker opening command is issued as a result of the protection functions, it is expected that the signal "circuit breaker closed" to disappear within a preset time, or that the signal "circuit breaker open" appears within a preset time, indicating that the circuit breaker has been successfully opened. If this does not happen, or at the expiration of the time provided for the circuit breaker is still in the closed condition, another command it is issued to open another circuit breaker.

This function could be enabled or disabled by the user.

The available settings for the timer related to this function are listed in Table A.

1.8 Remote Trip function

This function uses a digital input, properly programmed to acquire the "Remote Trip" signal (TRIP EXT) and, after a programmable delay (TI EXT), it issues a command to open the circuit breaker.

The function is automatically enabled when a digital input is programmed with the TRIP EXT function.

2 FRONT PANEL KEYS

The 5 push-buttons on the front panel allow to visualize all the protection parameters and to modify the protection set-up.

right arrow

down arrow

programming session activation or parameter confirmation

change or increment of the selected parameter

reset of the protection relay (rif. par. 4.3)

VISUALIZATION OF PARAMETERS

- all visualizations are circular and they can be displayed using the two arrow push-buttons.
- the structure of the visualizations and their contents are showed in Figures 1, 2 and 3.
- when the sealable transparent front panel is installed only the arrow push-buttons and the RESET push-button are accessible to prevent unauthorized modification of the protection set-up.

MODIFICATION OF PARAMETERS

- remove the transparent sealable front panel to access ENTER and push-buttons.

3 FRONT PANEL LED SIGNALLINGS

POWER (green)	⊕	auxiliary supply available
FAIL (red)	⊕	fault condition detected by SELF-DIAGNOSIS software or by PILOT WIRE FAULT MONITORING function.
REMOTE (red)	⊕	communication session active on RS485 port
27 - 59 (red)	⊕	trip condition on 27.1, 27.2, 59.1 or 59.2 thresholds
59N (red)	⊕	trip condition on 59N.1 threshold
81 (red)	⊕	trip condition on 81>, 81>>, 81< or 81<< thresholds

The last trip condition (threshold indication) is also showed on front panel display; more information on trip condition are presented in the recorded EVENT (see par. 5.10).

4 PROGRAMMING AND TEST

The protection relay is easily programmable following the instructions in the next paragraphs:

- HOW TO PROGRAM THE PROTECTION RELAY
- HOW TO MODIFY A VISUALIZED PARAMETER

All parameters can be freely modified; the proper protection set- up as required by the plant management is submitted to the operator's judgment.

4.1 How to program the protection relay

The programmable parameters are showed in Figures 1, 2, 3 and 4 at the following references:

B2÷B7	relay address (RS485) and date/time
D1÷D6	nominal values, contrast etc.
E1÷E4	setup values and time delays for 27 and 59 thresholds
E1N÷E5N	setup values and time delays for 59N threshold
E1F÷E3F	setup values and time delays for 81 thresholds
E1V÷E10V	setup values and time delays for 81V function
E1M÷E3M	setup values and time delays for MAI function
F1÷F15	output relays functions
G1÷G3	digital input functions
H1÷H2	special functions
R1÷R22	partial trip counters reset

The programming sequence is the following:

1) **SELECT** the visualization (on display) of the parameter to be modified using the arrow push-buttons

2) **ACTIVATE the PARAMETER MODIFICATION** session depressing the [ENTER] push-button and modify the parameter value

3) **END** the parameter modification session depressing again the [ENTER] push-button

4) **REPEAT** the procedure from 1) to 3) for all the parameters required to obtain the new protection relay set-up

5) **CONFIRM** the new protection relay set-up at the visualization CONFIRM PROG? (Fig. 3, ref. J1) within 5 minutes depressing the push-buttons buttons [ENTER], [+] up to visualize **YES** and [ENTER] again to confirm.

NOTE: The protection relay continues to operate using the previous set-up until the new set-up is confirmed as at point 5) above; the visualization of the modified parameters before the new set-up confirmation is only temporary to allow an easy definition of the new protection set-up.

If the new set-up is not confirmed within 5 minutes from the last pressed push-button, the protection relay visualizes again the previous set-up (the parameters set-up that the protection relay is still using).

4.2 How to modify a visualized parameter

When the parameter to be modified is visualized on front panel display do the following sequence:

1) PRESS [ENTER] to activate the parameter modification session

If one or more parameters are modifiable, on the first of them will appear a blinking cursor.

If no parameters are modifiable, no blinking cursor will appear.

2) MODIFY THE PARAMETER pressing the arrow push-buttons and

when two parameters are modifiable, the push-button allows to point-out the parameter to be modified (the selected parameter will blink)

when numerical parameters are pointed-out the push-button allows to select the digit to be modified

increasing of the parameter

a) the digits are increased by 1 unit

b) the other parameters are presented following the selection list

3) PRESS [ENTER] to end parameter modification session

The modification session is ended and the parameter stops to blink

NOTE: if a numerical parameter is selected out of the accepted range (as shown in Table A) when the push-button [**ENTER**] is pressed for few seconds an error message will be displayed as:

```
Data
Error
```

and the parameter will be displayed again with the former value.

4.3 Reset

When the push-button **[RESET]** is pressed, the protection relays returns to the standard condition:

- reset of glowing LEDs

- drop-off of tripped relays
- reset of any parameter changed but not confirmed (parameters are shown as confirmed at the end of the last programming session)
- display on STANDARD MODE (Fig. 1, ref. A1 - par. 5.1)

4.4 Test of output relays

When the output relays test is selected (Fig. 2, ref. F8) it is possible to command an output relay (one at the time) to trip from the current status allowing functional tests on electrical plants.

The output relays are activated with the following sequence:

1) **SELECT THE VISUALIZATION** of the desired output relay to be tested

```
TEST R1
OFF
```

2) **PRESS [ENTER]** to activate the test session; the message OFF will start to blink.

3) **PRESS** [+]; and the message on the display will change as:

```
TEST R1
ON
```

4) **PRESS [ENTER]** to command the instantaneous trip of the output relay (change of the current status).

The relay will stay on the new condition until:

- the [⇨] or [RESET] push-button is pressed
- the [ENTER] push-button is pressed and the sequence at points 3 and 4 is repeated (presenting OFF condition)

The same procedure will be used for R2, R3 and R4 relays.

5 DISPLAY AND PROGRAMMING

The contents and the structure of the displayed messages are shown in figures 1, 2, 3 and 4; the references A1, B1, B2 etc. identify specific displayed messages in the figures.

5.1 Standard display

A1 - STANDARD DISPLAY

It is the standard displayed message without operator's intervention (no push-buttons pressed for at least 5 minutes) or when the RESET push-button has been pressed.

The displayed information is function of the protection relay status.

NORMAL FUCTIONING
During this state the following information can be visualized (as defined by set-up):

Protection function (ANSI code) - the display shows the ANSI codes of the active functions.

Measured values - the display shows one of the measured voltages or the frequency; the values to be visualized is selected by operator (ref. D5).

The voltages are visualized as primary value, in Volt, the frequency is visualized in Hz.

ON TRIP CONDITION
When a trip condition occurs the protection relay visualizes the TRIP message that includes the threshold related to the trip; the displayed messages are as the following:

TRIP 27.1	TRIP 59.1	TRIP 81<	TRIP 81>

The information of the trip, as well the glowing of the related LEDs, is displayed until the [RESET] push-button is pressed.

If a new trip condition occurs, the displayed information will be updated; information related to previous trips are recorded in EVENTS memory.

FAULT CONDITION
When a permanent or temporary fault condition is detected by the self-diagnosis module, the following message is displayed:

FAIL eeeeeeee

The string eeeeeeee can be:

F.PILOTA Detected fault condition on pilot wire; the function related to DIG1 digital input is suspended
Corrective action - verify pilot wire (short or open circuit)

HARDWARE Detected fault condition on hardware or software resources of the protection relay; all functions are suspended.
Corrective action - replace the protection relay and contact SEB post sales service

5.2 Visualization structure

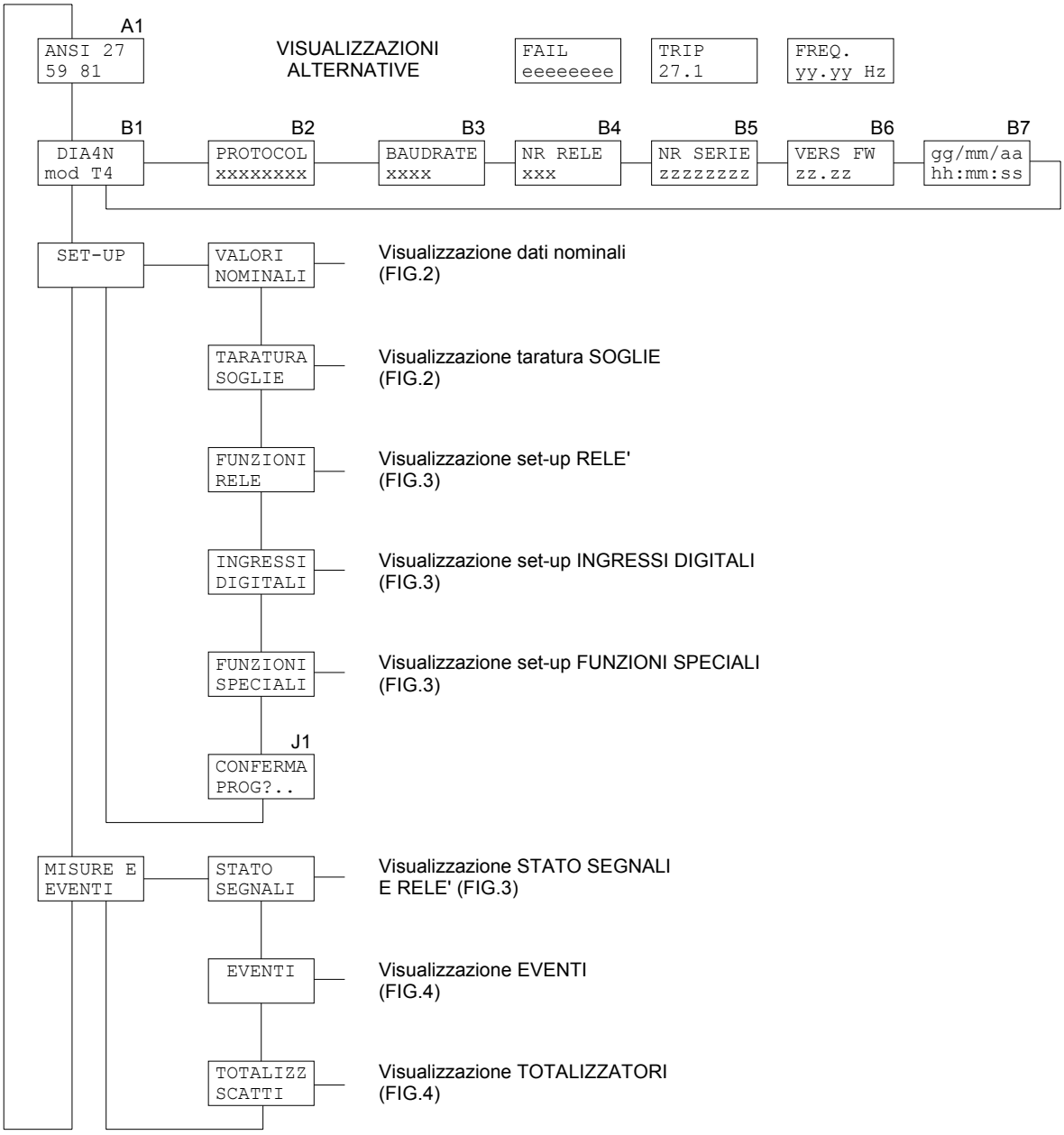


Figure 1

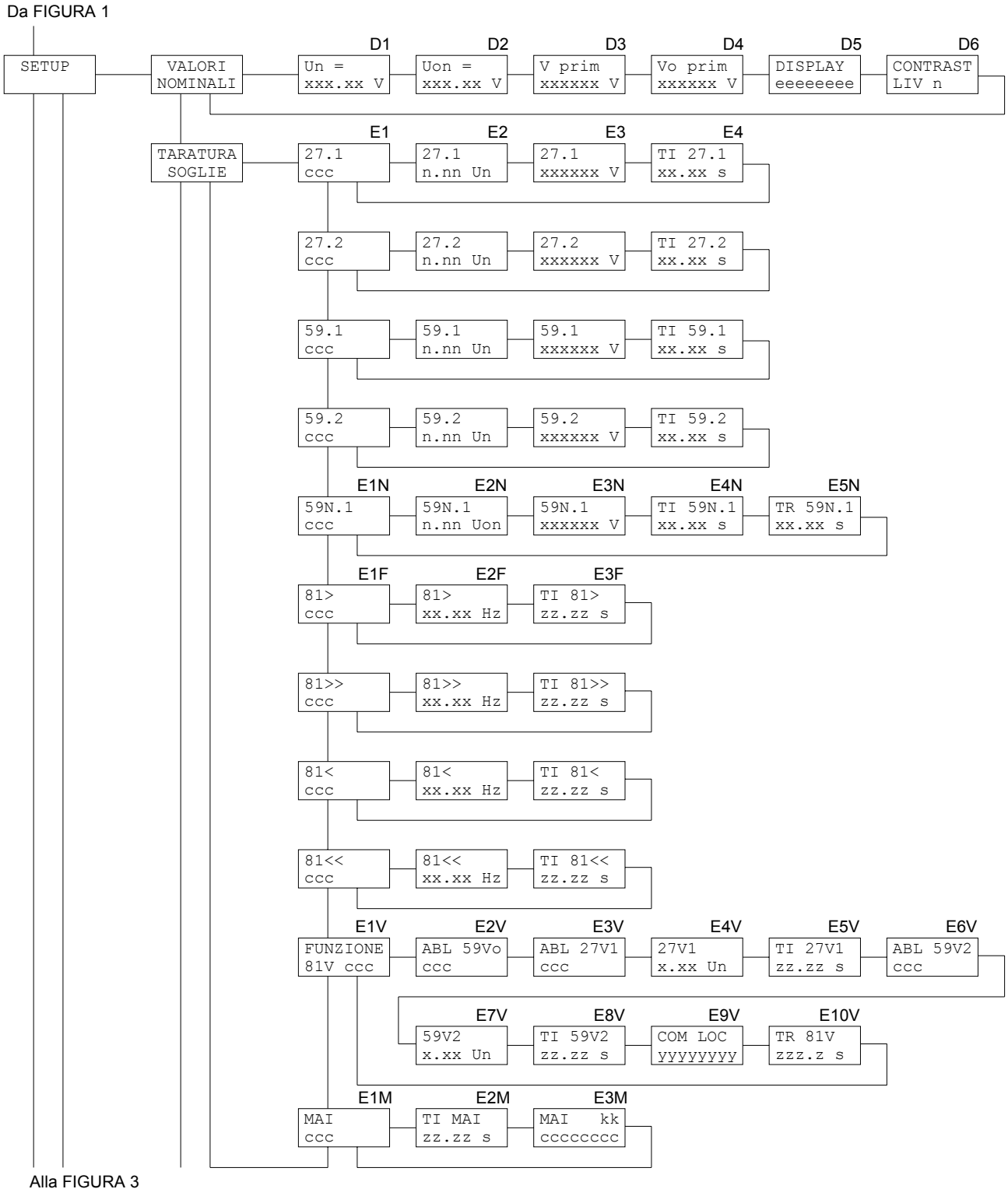

Da FIGURA 1
SETUP
VALORI NOMINALI
D1
Un = xxx.xx V
D2
Uon = xxx.xx V
D3
V prim xxxxxx V
D4
Vo prim xxxxxx V
D5
DISPLAY eeeeeeee
D6
CONTRAST LIV n
TARATURA SOGLIE
E1
27.1 ccc
E2
27.1 n.nn Un
E3
27.1 xxxxxx V
E4
TI 27.1 xx.xx s
27.2 ccc
27.2 n.nn Un
27.2 xxxxxx V
TI 27.2 xx.xx s
59.1 ccc
59.1 n.nn Un
59.1 xxxxxx V
TI 59.1 xx.xx s
59.2 ccc
59.2 n.nn Un
59.2 xxxxxx V
TI 59.2 xx.xx s
E1N
59N.1 ccc
E2N
59N.1 n.nn Uon
E3N
59N.1 xxxxxx V
E4N
TI 59N.1 xx.xx s
E5N
TR 59N.1 xx.xx s
E1F
81> ccc
E2F
81> xx.xx Hz
E3F
TI 81> zz.zz s
81>> ccc
81>> xx.xx Hz
TI 81>> zz.zz s
81< ccc
81< xx.xx Hz
TI 81< zz.zz s
81<< ccc
81<< xx.xx Hz
TI 81<< zz.zz s
E1V
FUNZIONE 81V ccc
E2V
ABL 59Vo ccc
E3V
ABL 27V1 ccc
E4V
27V1 x.xx Un
E5V
TI 27V1 zz.zz s
E6V
ABL 59V2 ccc
E7V
59V2 x.xx Un
E8V
TI 59V2 zz.zz s
E9V
COM LOC yyyyyyyy
E10V
TR 81V zzz.z s
E1M
MAI ccc
E2M
TI MAI zz.zz s
E3M
MAI kk cccccccc
Alla FIGURA 3

Figure 2

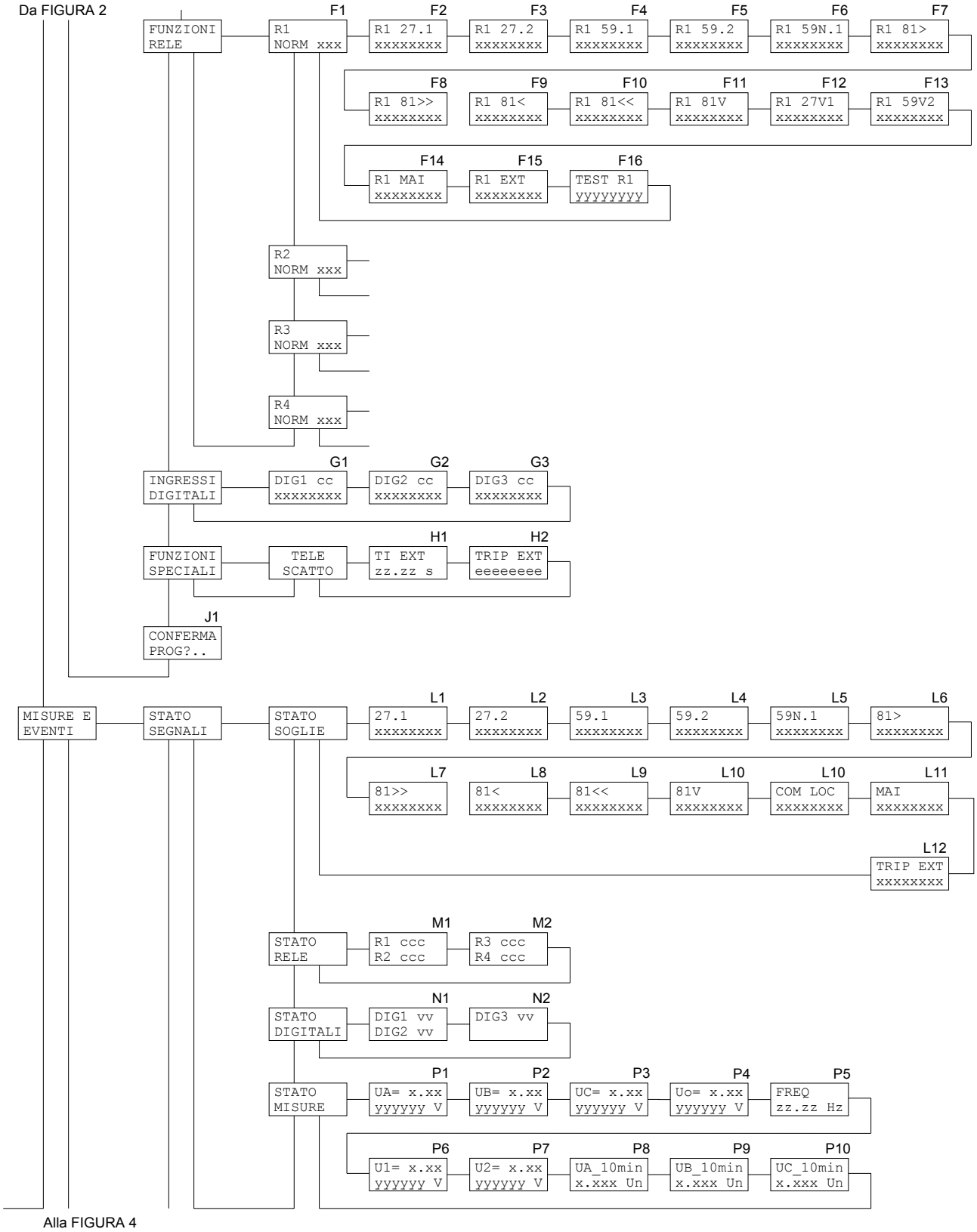

Da FIGURA 2
FUNZIONI RELE
R1 NORM xxx
F1
R1 27.1 xxxxxxxx
F2
R1 27.2 xxxxxxxx
F3
R1 59.1 xxxxxxxx
F4
R1 59.2 xxxxxxxx
F5
R1 59N.1 xxxxxxxx
F6
R1 81> xxxxxxxx
F7
R1 81>> xxxxxxxx
F8
R1 81< xxxxxxxx
F9
R1 81<< xxxxxxxx
F10
R1 81V xxxxxxxx
F11
R1 27V1 xxxxxxxx
F12
R1 59V2 xxxxxxxx
F13
R1 MAI xxxxxxxx
F14
R1 EXT xxxxxxxx
F15
TEST R1 yyyyyyyy
F16
R2 NORM xxx
R3 NORM xxx
R4 NORM xxx
INGRESSI DIGITALI
DIG1 cc xxxxxxxx
G1
DIG2 cc xxxxxxxx
G2
DIG3 cc xxxxxxxx
G3
FUNZIONI SPECIALI
TELE SCATTO
TI EXT zz.zz s
H1
TRIP EXT eeeeeeee
H2
CONFERMA PROG?..
J1
MISURE E EVENTI
STATO SEGNALI
STATO SOGLIE
27.1 xxxxxxxx
L1
27.2 xxxxxxxx
L2
59.1 xxxxxxxx
L3
59.2 xxxxxxxx
L4
59N.1 xxxxxxxx
L5
81> xxxxxxxx
L6
81>> xxxxxxxx
L7
81< xxxxxxxx
L8
81<< xxxxxxxx
L9
81V xxxxxxxx
L10
COM LOC xxxxxxxx
L10
MAI xxxxxxxx
L11
TRIP EXT xxxxxxxx
L12
STATO RELE
R1 ccc R2 ccc
M1
R3 ccc R4 ccc
M2
STATO DIGITALI
DIG1 vv DIG2 vv
N1
DIG3 vv
N2
STATO MISURE
UA= x.xx yyyyyy V
P1
UB= x.xx yyyyyy V
P2
UC= x.xx yyyyyy V
P3
Uo= x.xx yyyyyy V
P4
FREQ zz.zz Hz
P5
U1= x.xx yyyyyy V
P6
U2= x.xx yyyyyy V
P7
UA_10min x.xxx Un
P8
UB_10min x.xxx Un
P9
UC_10min x.xxx Un
P10
Alla FIGURA 4

Figure 3

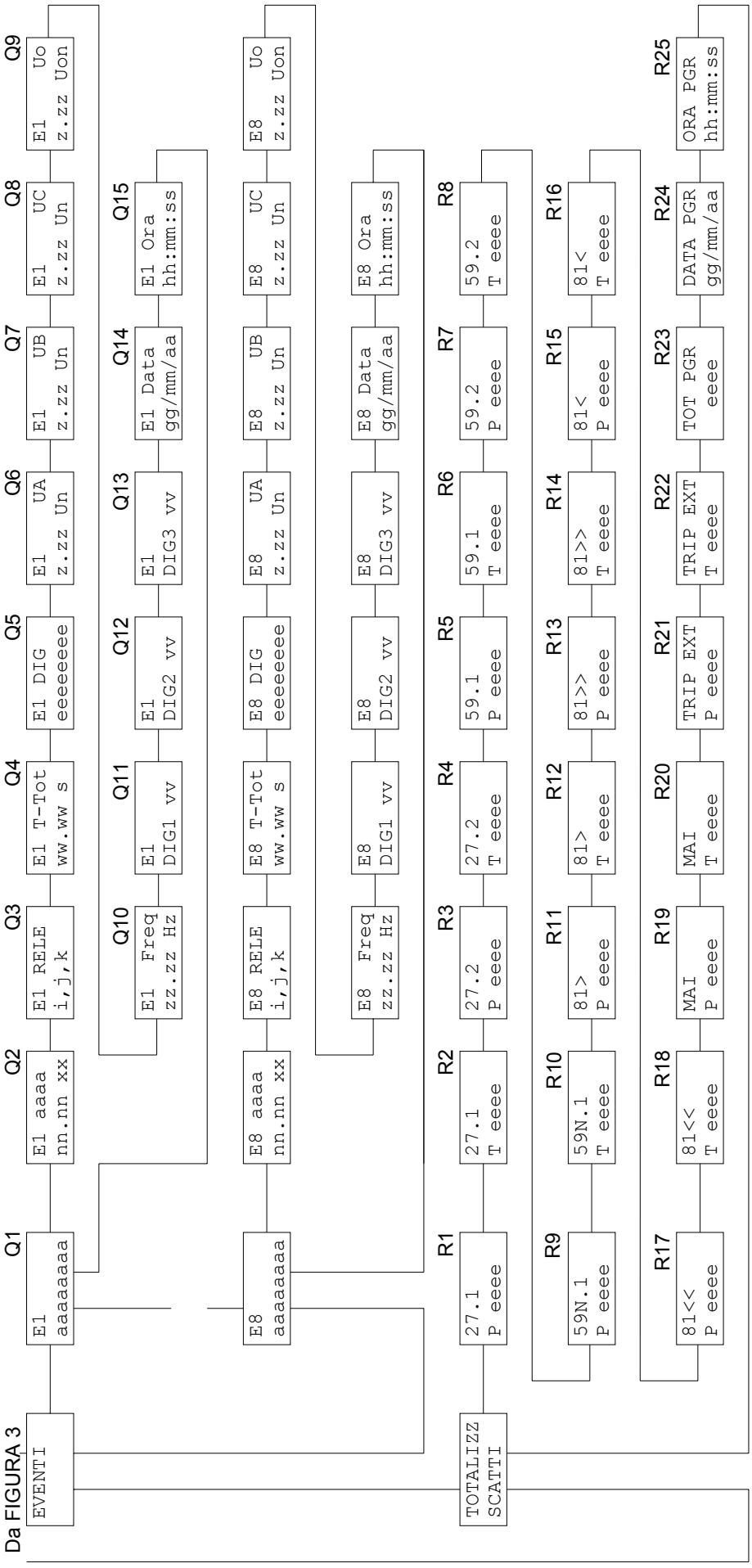

Da FIGURA 3
EVENTI
TOTALIZZ
SCATTI
Q1
E1
aaaaaaaa
Q2
E1 aaaa
nn.nn xx
Q3
E1 RELE
i,j,k
Q4
E1 T-Tot
ww.ww s
Q5
E1 DIG
eeeeeeee
Q6
E1 UA
z.zz Un
Q7
E1 UB
z.zz Un
Q8
E1 UC
z.zz Un
Q9
E1 Uo
z.zz Uon
Q10
E1 Freq
zz.zz Hz
Q11
E1
DIG1 vv
Q12
E1
DIG2 vv
Q13
E1
DIG3 vv
Q14
E1 Data
gg/mm/aa
Q15
E1 Ora
hh:mm:ss
E8
aaaaaaaa
E8 aaaa
nn.nn xx
E8 RELE
i,j,k
E8 T-Tot
ww.ww s
E8 DIG
eeeeeeee
E8 UA
z.zz Un
E8 UB
z.zz Un
E8 UC
z.zz Un
E8 Uo
z.zz Uon
E8 Freq
zz.zz Hz
E8
DIG1 vv
E8
DIG2 vv
E8
DIG3 vv
E8 Data
gg/mm/aa
E8 Ora
hh:mm:ss
R1
27.1
P eeee
R2
27.1
T eeee
R3
27.2
P eeee
R4
27.2
T eeee
R5
59.1
P eeee
R6
59.1
T eeee
R7
59.2
P eeee
R8
59.2
T eeee
R9
59N.1
P eeee
R10
59N.1
T eeee
R11
81>
P eeee
R12
81>
T eeee
R13
81>>
P eeee
R14
81>>
T eeee
R15
81<
P eeee
R16
81<
T eeee
R17
81<<
P eeee
R18
81<<
T eeee
R19
MAI
P eeee
R20
MAI
T eeee
R21
TRIP EXT
P eeee
R22
TRIP EXT
T eeee
R23
TOT PGR
eeee
R24
DATA PGR
gg/mm/aa
R25
ORA PGR
hh:mm:ss

Figure 4

5.3 Address and Time (fig. 1)

B1 - RELAY MODEL (not programmable)

DIA4N
mod. T4

B2 - COMMUNICATION PROTOCOL (programmable)

B2

PROTOCOL
xxxxxxxx

The communication protocol is programmable between the followings:

STANDARD:	ASCII SEB protocol
MODBUS:	Modbus ASCII protocol (SLAVE)

When the MODBUS protocol is selected the following display is showed to allow the selection of the transmission speed:

B3

BAUDRATE
xxxx

The xxxx parameter is selectable between the followings:

300 - 600 - 1200 - 2400 - 4800 - 9600

When the STANDARD protocol is selected the baud rate is automatically selected by the protection relay.

B4 - ADDRESS (programmable)

NR RELAY
001

Programmable address from 001 to 255.

The number is used on RS485 port to address a specific relay when two or more protection relays are linked on the same serial line.

B5 - RELAY SERIAL NUMBER (not programmable)

SER. NR
0012345

B6 - FIRMWARE VERSION (not programmable)

VERS. FW
zz.zz

B7 - TIME/DATE (programmable)

```
dd/mm/yy
hh:mm:ss
```

Time and date are programmable and they are used to mark recorded events.

The clock circuit is equipped with a supercapacitor, which ensures the proper functioning of the clock for 1 week even in the absence of auxiliary voltage. In case the supercapacitor run out of its charge, the clock is reset to date:

```
01/01/10
00:00:00
```

5.4 Nominal values set-up (fig. 2)

D1 - NOMINAL LINE VOLTAGE SELECTION - Un (programmable)

```
Un =
xxx.xx V
```

Un: nominal line voltage selection (nominal secondary voltage of plant VTs) selectable between the followings:

57,73 - 63,50 - 72,16 - 100 - 110 - 125 - 190 - 220 - 230 - 380 - 400
200 - 202 - 208 - 240 - 270 - 277 - 300 - 315 - 320

D2 - NOMINAL RESIDUAL VOLTAGE SELECTION - Uon (programmable)

```
Uon =
xxx.xx V
```

Uon: nominal residual voltage selection (nominal secondary voltage of plant residual voltage transformers) selectable between the followings:

100 - 110 - 125

D3 - PRIMARY LINE VOLTAGE (programmable)

```
V prim
xxxxxx V
```

Primary voltage value of the installed line VT's; the value is programmable from 000001 to 999999 V.

In case of direct insertion (without VT's), we suggest to set as primary voltage the same value used as nominal voltage (ref. D1).

Note: The value of the primary line voltage is only used to display the thresholds / measurements in engineering units, and has no influence on the protective functions.

D4 - PRIMARY VT's RESIDUAL VOLTAGE (programmable)

```
Vo prim
xxxxxx V
```

Primary voltage value of the installed residual voltage VT; the value is programmable from 000001 to 999999 V.

D5 - STANDARD DISPLAY SELECTION (programmable)

```
DISPLAY
eeeeeeee
```

It allows to select the standard displayed information (ref. A1) when no trip condition occurs and no fault condition have been detected by the self-diagnosis module; the available selections are the following:

NORMALE	displays of ANSI code
UA	displays measured voltage UA
UB	displays measured voltage UB
UC	displays measured voltage UC
Uo	displays measured residual voltage Uo
FREQ	displays measured frequency

The voltages can be line-to-line or line-to-neutral depending on VT's or relay insertion.

Voltages are displayed in primary values (the value depends on D3 and D4 set-ups).

Selection examples:

```
DISPLAY
NORMALE
```

```
DISPLAY
UA
```

```
DISPLAY
Uo
```

D6 - DISPLAY CONTRAST LEVEL (programmable)

```
CONTRAST
LIV x
```

The display contrast level is programmable from 0 to 9.
The backlighted display is switched off if no push-button is pressed for at least 5 minutes; when one of the front panel push- button is pressed the display is switched on.

5.5 Thresholds and time delays set-up (fig. 2)

5.5.1 Undervoltage and overvoltage thresholds (27-59)

The information and set-ups related to threshold 27.1 in the following points are effective for all the thresholds 27.2, 59.1, 59.2 changing the threshold identifier.

E1 – THRESHOLD ENABLING (programmable)

```
27.1
ccc
```

27.1 threshold identification (27.1, 27,2, 59.1, 59.2)

ccc ON - enabled threshold
OFF - disabled threshold (available but not active)

Examples:

27.1 ON	59.1 OFF

Note: when a threshold is disabled, the remaining views (E2 ÷ E3) will not be accessible

E2 - THRESHOLD LEVEL SET-UP (programmable)

27.1 n.nn Un

n.nn threshold level expressed in terms of relative values of Un

The available settings for the thresholds are listed in Table A

Examples:

27.1 0.50 Un	59.2 1.30 Un

E3 - THRESHOLD LEVEL IN PRIMARY VALUES (not programmable)

27.1 xxxxxx V

The programmed threshold (ref. E2) is shown in terms of primary voltage; the value depends on the programmed VT's primary values (ref. D3 – paragraph 5.4)

xxxxxx threshold level expressed in Volt (primary values)

E4 - TIME DELAY SET-UP (programmable)

TI 27.1 xx.xx s

Set-up of time-delay to the activation (TRIP) of the programmed output relays when the measured voltage exceeds the threshold level.

xx.xx time delay to activate the programmed output relays, in seconds, from 00.05 to 99.99

5.5.2 Earth fault overvoltage threshold (59N)

E1N - THRESHOLD ENABLING (programmable)

59N.1 ccc

ccc ON - enabled threshold
OFF - disabled threshold (available but not active)

Examples:

59N.1
ON

59N.1
OFF

Note: when the threshold is disabled, the remaining views (E2N ÷ E5N) will not be accessible

E2N - THRESHOLD LEVEL SET-UP (programmable)

59N.1
n.nn Uon

n.nn threshold level expressed in terms of relative values of Uon

The available settings for the threshold are listed in Table A

Examples:

59N.1
0.05 Uon

E3N - THRESHOLD LEVEL IN PRIMARY VALUES (not programmable)

59N.1
xxxxxx V

The programmed threshold (ref. E2N) is shown in terms of primary voltage; the value depends on the programmed VT's primary values (ref. D4 – paragraph 5.4)

xxxxxxx threshold level expressed in Volt (primary values)

E4N - TIME DELAY SET-UP (programmable)

TI 59N.1
xx.xx s

Set-up of time-delay to the activation (TRIP) of the programmed output relays when the measured earth voltage exceeds the threshold level.

xx.xx time delay to activate the programmed output relays, in seconds, from 00.05 to 99.99

E5N – RELASE TIME DELAY SET-UP (programmable)

TR 59N.1
xx.xx s

Set-up of release time-delay of threshold start condition.

xx.xx release time delay, in seconds from 00.00 to 99.99

5.5.3 Under frequency and over frequency thresholds (81)

The information and set-ups related to threshold 81> in the following points are effective for all the thresholds 81>>, 81< and 81<<, changing the threshold identifier.

E1F - THRESHOLD ENABLING (programmable)

```
81>
ccc
```

81> threshold identifier (81>, 81>>, 81< or 81<<)

ccc ON - enabled threshold
OFF - disabled threshold (available but not active)

Note: when a threshold is disabled, the remaining views (E2F ÷ E3F) will not be accessible

E2F - THRESHOLD LEVEL SET-UP (programmable)

```
81>
nn.nn Hz
```

nn.nn threshold level, in Hertz

The available settings for the thresholds are listed in Table A

Examples:

```
81>
50.50 Hz
```

```
81<
49.30 Hz
```

E3F - TIME DELAY SET-UP (programmable)

```
TI 81>
xx.xx s
```

Set-up of time-delay to the activation (TRIP) of the programmed output relays when the measured frequency exceeds the threshold level.

xx.xx time delay to activate the programmed output relays, in seconds, from 00.05 to 99.99

5.5.4 Frequency thresholds with voltmetric control function (81V)

E1V - FUNCTION ENABLING (programmable)

```
FUNZIONE
81V ccc
```

ccc ON - enabled function
OFF - disabled function (available but not active)

Note: when the function is disabled, the remaining views (E2V ÷ E10V) will not be accessible

E2V – THRESHOLD 59Vo ENABLING (programmable)

```
ABL 59Vo
kkkkkkkk
```

kkkkkkk OFF – threshold not enabled in function 81V
START – enabled on start condition of threshold 59N.1
TRIP – enabled on trip condition of threshold 59N.1

Note: the threshold setup level of the voltmetric control threshold 59Vo is the same of the threshold 59N.1 (item E2N)

E3V – THRESHOLD 27V1 ENABLING (programmable)

```
ABL 27V1
kkkkkkkk
```

kkkkkkk OFF – threshold not enabled in function 81V
START – enabled on start condition of threshold 27V1
TRIP – enabled on trip condition of threshold 27V1

Note: when this threshold is disabled, the remaining views (E4V, E5V) will not be accessible

E4V - THRESHOLD LEVEL SET-UP (programmable)

```
27V1
n.nn Un
```

n.nn threshold level expressed in terms of relative values of Un

The available settings for the threshold are listed in Table A

Example:

```
27V1
0.70 Un
```

E5V - TIME DELAY SET-UP (programmable)

```
TI 27V1
xx.xx s
```

Set-up of time-delay to the activation (TRIP) of the programmed output relays when the measured voltage exceeds the threshold level.

xx.xx time delay to activate the programmed output relays, in seconds, from 00.05 to 99.99

Note: this view is accessible only if you have selected TRIP condition in the view E3V.

E6V – THRESHOLD 59V2 ENABLING (programmable)

```
ABL 59V2
kkkkkkkk
```

kkkkkkk OFF – threshold not enabled in function 81V
START – enabled on start condition of threshold 59V2
TRIP – enabled on trip condition of threshold 59V2

Note: when this threshold is disabled, the remaining views (E7V, E8V) will not be accessible

E7V - THRESHOLD LEVEL SET-UP (programmable)

```
59V2
n.nn Un
```

n.nn threshold level expressed in terms of relative values of Un

The available settings for the threshold are listed in Table A

Example:

```
59V2
0.20 Un
```

E8V - TIME DELAY SET-UP (programmable)

```
TI 59V2
xx.xx s
```

Set-up of time-delay to the activation (TRIP) of the programmed output relays when the measured voltage exceeds the threshold level.

xx.xx time delay to activate the programmed output relays, in seconds, from 00.05 to 99.99

Note: this view is accessible only if you have selected TRIP condition in the view E6V.

E9V – LOCAL COMMAND SIGNAL STATUS (not programmable)

```
COM LOC
yyyy
```

yyyy BASSO – Local Command signal is at logical status LOW
ALTO – Local Command signal is at logical status HIGH
NON PRES – no digital input programmed for COM LOC function

This indicator shows the current logic state of the digital input set as COM LOC (Local Command).

E10V - RELASE TIME DELAY SET-UP (programmable)

```
TR 81V
xxx.x s
```

xxx.x function release time delay, in seconds, from 0.0 to 999.9

Example:

```
TR 81V
180.0 s
```

5.5.5 Breaker Failure Function (MAI)

E1M - FUNCTION ENABLING (programmable)

```
MAI
ccc
```

ccc ON - enabled function
OFF - disabled function (available but not active)

E2M - TIME DELAY FUNCTION SET-UP (programmable)

```
TI MAI
xx.xx s
```

xx.xx delay time for detecting open status of circuit breaker, in seconds, from 00.05 to 99.99

Example:

```
TI MAI
00.20 s
```

E3M – ADDITIONAL INFORMATION (not programmable)

```
MAI   zz
eeeeeeee
```

This view shows information on digital inputs related to this function.

The parameter **zz** could have one of the following values:

AP	digital input get the open status of the circuit breaker
CH	digital input get the close status of the circuit breaker
--	no digital input is programmed to get the status of the circuit breaker

The parameter **eeeeee** could have one of the following values:

DISABIL	no digital input is programmed to get the status of the circuit breaker [5]

[5] The combination of no digital input configured to acquire the status of the circuit breaker and function of MAI enabled, it is signaled as being erroneous condition and it is not possible to store the setup data. You have to correct this by appropriately programming the digital inputs or disabling the MAI function.

DIG1	digital input 1 is programmed to acquire the circuit breaker status
DIG2	digital input 2 is programmed to acquire the circuit breaker status
DIG3	digital input 3 is programmed to acquire the circuit breaker status

Only one digital input could be programmed to acquire the circuit breaker status.

Example:

```
MAI   AP
DIG1
```

This allows to the DIA4N protection relay to command a further circuit breaker in case that the main circuit breaker does not open.

Note: In connection schematics at par. 6 it is shown a possible solution for the realization of the Breaker Failure function. The setup values related to digital inputs and output relays for such solution are listed in Table B and C.

5.6 Output relays programming (fig. 3)

The session allows to program the activation of the output relays R1, R2, R3 or R4 on START or TRIP conditions for each threshold.

Equivalent information and set-up related to relay R1 is available for the relays R2, R3 and R4 just changing the relay identification.

F1 - OUTPUT RELAY R1 QUIESCENT STATUS (programmable)

```
R1
NORM xxx
```

Programming of the R1 relay status when no START or TRIP conditions are activated (none of the measured voltages exceed their thresholds).

NORM OFF: normally de-energized (energized status on activation)
NORM ON: normally energized (de-energized status on activation)

Note: As default setting the output relay R1 is programmed as normally energized and it collects the TRIP conditions of the various protection functions; in such way that output relay can be used to control the interface circuit breaker, which, according to the norm CEI 0-16 ed. 3, must be equipped with an undervoltage coil.

F2 - OUTPUT RELAY R1 ACTIVATION ON THRESHOLD 27.1 STATUS (programmable)

```
R1  27.1
xxxxxxxx
```

Programming of the R1 output relay activation (START / TRIP / NO AZION) for threshold 27.1.

The parameter **xxxxx** is selectable as the following:

START instantaneous output relay R1 activation when one of the measured line voltage is below the programmed threshold 27.1

TRIP output relay R1 activation when one of the measured line voltage is below the programmed threshold level 27.1 for at least TI seconds

NO AZION no activation related to threshold 27.1

F3 ÷ F15 - OUTPUT RELAY ACTIVATION ON THRESHOLDS 27.2, 59.1, 59.2, 59N.1, 81>, 81>>, 81<, 81<<, 81V, MAI, EXT (programmable)

Examples:

R1 27.2 xxxxxxxx	R1 59.2 xxxxxxxx	R1 59N.1 xxxxxxxx

Programming of the R1 output relay activation (START, TRIP or NO AZION) on thresholds 27.2, 59.1, 59.2, 59N.1, 81>, 81>>, 81<, 81<<, 81V, 27V1, 59V2, MAI, EXT (the same as threshold 27.1 - rif. F2).

Notes:

1. For MAI and EXT functions it is only possible to program the items TRIP or NO AZION.
2. For 81V function it is only possible to program the items START or NO AZION.
3. If the function 81V is disabled, the settings related to functions 81V, 27V1 and 59V2 will not be available.
4. If the function MAI is disabled, the settings related to function MAI will not be available.

The output relay settings on thresholds 27V1 and 59V2 are usually used only during commissioning.

F16 - TEST OF OUTPUT RELAY R1

TEST R1 xxxxxxxx

See paragraph 4.4

5.7 Digital inputs function programming (fig. 3)

For each digital input one of the following functions are selectable:

a) disable of one threshold, or for a threshold group or for all thresholds;

b) STATUS function (recording of measures on external command) (paragraph 1)

c) pilot wire fault monitoring (only DIG2 monitors DIG1) (paragraph 1)

d) remote trip command (TRIP EXT)

e) circuit breaker status

f) Local Command signal status

When the function of more than one digital input refers to the same threshold, the priority will be the following:

a) the OF TUTTI selection (ALL the thresholds) has the priority on single threshold selection

G1 - DIGITAL INPUT DIG1 SET-UP (programmable)

```
DIG1  cc
xxxxxxxx
```

Programming of the function related to digital input channel 1 (DIG1).

Parameter cc: programming of the condition that activates the function related to digital input DIG1; the condition is selectable between HI and LO.

Parameter xxxxxxx: programming of the function related to digital input DIG1; to scroll the list use the key [+]. The following functions are selectable:

ESCLUSO	no functions active related to digital input DIG1
OF 27	thresholds 27.1 and 27.2 disabled
OF 27.1	threshold 27.1 disabled
OF 27.2	threshold 27.2 disabled
OF 59	thresholds 59.1 and 59.2 disabled
OF 59.1	threshold 59.1 disabled
OF 59.2	threshold 59.2 disabled
OF 59N.1	threshold 59N.1 disabled
OF 81	thresholds 81>, 81>>, 81< and 81<< disabled
OF 81>	threshold 81> disabled
OF 81>>	threshold 81>> disabled
OF 81<	threshold 81< disabled
OF 81<<	threshold 81<< disabled
OF MAI	MAI function disabled
OF TUTTI	all thresholds disabled
COM LOC	get the Local Command status signal
TRIP EXT	get the Remote Trip signal
52 AP	get the circuit breaker OPEN status signal
52 CH	get the circuit breaker CLOSE status signal
STATO	activation of status function (see paragraph 1)

G2 - DIGITAL INPUT DIG2 SET-UP (programmable)

```
DIG2  cc
xxxxxxxx
```

Programming of the function related to digital input channel 2 (DIG2); the selections available are the same as presented for DIG1 (ref. G1) plus the following:

MONITOR	activation of pilot wire monitor function.

G3 - DIGITAL INPUT DIG3 SET-UP (programmable)

DIG3 cc
xxxxxxxx

Programming of the function related to digital input channel 3 (DIG3); the selections available are the same as presented for DIG1 (ref. G1).

5.8 Special functions programming (fig. 3)

5.8.1 Remote trip

Allows you to configure the parameters related to the function of remote trip (trip on external signal).

H1 - TRIP EXT DELAY (programmable)

TI EXT
xx.xx s

Programming the delay for the operation of the output relay associated to the remote trip external signal (TRIP EXT, par. 5.6 – rif. F15 and par. 5.7).

H2 – ADDITIONAL INFORMATIONS (not programmable)

TRIP EXT
yyyyyyyy

It shows information on digital inputs related to this function.

The setting **yyyyyyyy** is one in the following values:

DISABIL	no digital input is programmed to acquire the remote trip signal. The function is disabled
DIG1	digital input 1 acquires the remote trip signal
DIG2	digital input 2 acquires the remote trip signal
DIG3	digital input 3 acquires the remote trip signal

It is possible to program two o more digital inputs to acquire the remote trip signals (es. DIG 1,3). In such case an OR logical is used to get the resulting signal.

5.9 Parameter values visualization (fig. 3)

L1 ÷ L12 - THRESHOLDS STATUS

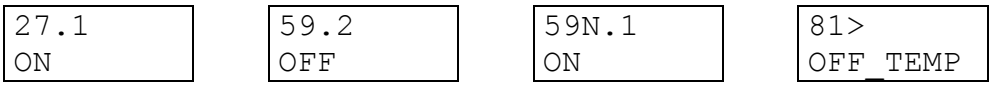
The actual status of each threshold is displayed.

For each threshold are displayed the threshold identification (27.1, 59.1, etc.) and the threshold status; the status can show one of the following values

ON	active threshold
OFF	disabled threshold (programmed OFF at ref E1, E1N, E1F - par. 5.5)
OFF_DIG	threshold programmed active but momentary disabled by a digital input actual status (ref. G1, G2, G3 - par. 5.7)

OFF_TEMP threshold programmed active but momentary disabled for the absence of conditions for enabling of the threshold one[6].

Examples:



M1 - M2 - OUTPUT RELAY STATUS

The actual status of each output relay is displayed; for each relay the following information is displayed:

- relay identification (R1, R2, R3, R4)
- relay status (ON - activated, OFF - non activated)

Note that ON/OFF do not necessary mean energized or de-energized (see ref. F1).

N1 - N2 - DIGITAL INPUT STATUS

The actual status of each digital input is displayed.

For each digital input the following information is presented:

- digital input identification (DIG1, DIG2, DIG3)
- digital input status (HI or LO)

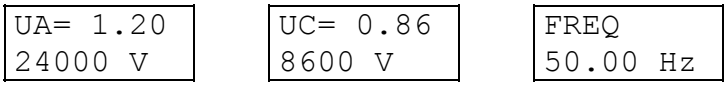
P1 ÷ P10 - DISPLAY OF MEASUREMENTS

The actual value of the measured voltages and frequency is displayed.

It displays in succession the current status of the measurements of line voltages, the residual voltage, frequency, positive voltage sequence, negative voltage sequence and line voltages averaged over 10 minutes.

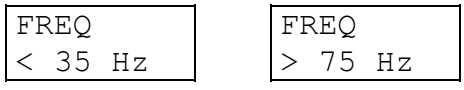
In each view it is shown the identifier of the measurement and the measurement unit.

Examples:



When an electrical quantity is not measurable it is presented with "*" (asterisks); this may occur for example when the amplitude of the voltage UA is below the minimum threshold for a reliable measurement of the frequency.

If the frequency is outside the measurement range of protection relay, a special indication is presented, depending if the frequency measurement is too low or too high.



[6] This condition may occur for the function 81V and thresholds 81> and 81<.

5.10 Events (fig. 4)

On the display are shown the memorized information related to the last 8 TRIP events of thresholds or for the STATO function (ref. par. 1).

The 8 events are recorded and identified with a progressive number from 1 to 8; the more recent event shows a lower number.

Note: through the event recording function, you can retrieve information about the last threshold trip also if there has been a subsequent absence of the auxiliary voltage. In such case there would be the disappearance of the signals stored by the LEDs and the display.

Q1 - EVENT NUMBER

```
E1
cccccccc
```

The index E1, E2 ... E8 identifies the memorized event.

The parameter **cccccccc** gives information on the kind of event and it can show one of the following values:

NESSUNO	no event memorized
27.1	event on threshold 27.1 trip
27.2	event on threshold 27.2 trip
59.1	event on threshold 59.1 trip
59.2	event on threshold 59.2 trip
59N.1	event on threshold 59N.1 trip
81>	event on threshold 81> trip
81>>	event on threshold 81>> trip
81<	event on threshold 81< trip
81<<	event on threshold 81<< trip
EXT	event caused by function TRIP EXT
MAI	event caused by function MAI
STATO	information recorded on external command (function STATO ref. par. 1)
POWER ON	switch-on of the protection relay (auxiliary power)

For the event NESSUNO no other information is presented.

For the event POWER ON, the date and time of the switch-on of the protection relay are presented.

For the other events the following displays give more detailed information on the event.

Q2 - TRIP THRESHOLD (TRIP)

```
E1  sss
xx.xx
```

The information is not shown on STATO, MAI and TRIP EXT events

It shows the threshold related to the TRIP condition of the protection relay and the value of the threshold (in relative terms).

sss threshold identifier (i.e.: 27.1, 59.2, 81>, etc.)

xx.xx threshold value

Examples:

Q2

```
E4 27.1
0.50 Un
```

Q2

```
E2 81>
51.00 Hz
```

Q3 - ACTIVATED OUTPUT RELAYS

```
E1  RELE
nnnnnnn
```

The information is not shown on STATO events

It shows the list of the output relays activated by the threshold trip.

Examples:

```
E1  RELE
1,3,4
```

```
E3  RELE
1,4
```

When no output relays have been activated (no relays programmed to TRIP on the threshold) the following message will be displayed:

```
E1  RELE
NESSUNO
```

Q4 - TOTAL TIME DELAY TO TRIP

```
E1 T-Tot
www.ww s
```

It is shown the total delay to the TRIP of the output relays related to the threshold. If the total time is greater than 999 seconds the display of tenths is omitted.

When the event is memorized on external command (STATO), the message N/A (Not Applicable) is shown instead of the number of seconds.

```
E1 T-Tot
   N/A
```

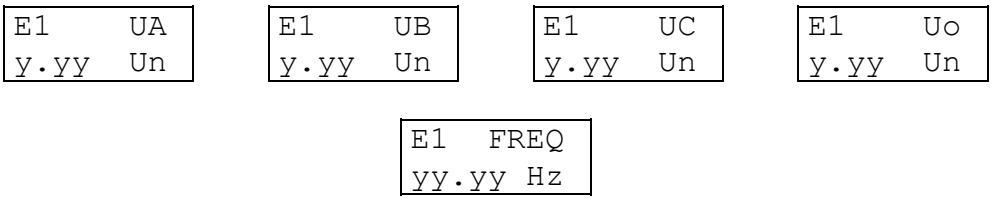
Q5 - DIGITAL CHANNELS RELATED TO MEMORIZED EVENT

```
E1 DIG
1,3
```

The list of the digital inputs related to the memorized event is displayed (function STATO - ref. E4 - par. 5.7).

If no digital inputs were activated, the message NESSUNO is shown.

Q6 - Q7 - Q8 - Q9 - Q10 - MEMORIZED MEASURED VOLTAGES AND FREQUENCY ON EVENT



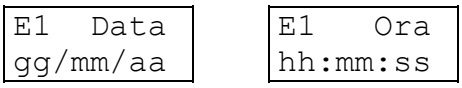
The values of the measured voltages and frequency at the event are displayed; for the voltages the values are expressed as Un and Uon terms, the frequency is in Hertz.

Q11 - Q12 - Q13 - DIGITAL INPUTS STATUS ON EVENT

The status of the digital inputs at the event are displayed.

The parameter **vv** can assume the value HI or LO.

Q14 - Q15 - DATE AND TIME OF THE EVENT



The date and time of the event are showed

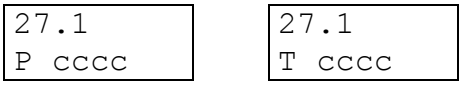
5.11 Trip counters (fig. 4)

In this section are displayed the total and partial counters of the output relay activation (on TRIP conditions) for each thresholds and the numbers of programming sessions with the date and time of the last confirmed programming session.

The total counters, the number of confirmed programming sessions and the date and time of the last confirmed programming session are not modifiable or resettable; the information related to the last programming session are used to control unauthorized access.

The partial counter can be modified following the standard set-up procedure for parameters as described at paragraph 4.2; the partial counters are immediately modified in the memory (the recorded values are immediately resetted without the need of the programming confirmation).

R1 ÷ R22 - TRIP COUNTERS



Display of the partial (P) and total (T) counters of the TRIP condition related to each threshold.

When the value exceed 9999 the counter starts again from 0000.

The counters are identified by the threshold name (27,1, 27.2, 59.1, 59.2, 59N.1, etc.).

The partial counters are modifiable in the range from 0000 to 9999 following the standard set-up procedure (paragraph 4.2).

R23 ÷ R25 - TOTAL PROGRAMMING SESSIONS AND DATE/TIME OF THE LAST PROGRAMMING SESSION

TOT PRG	DATA PRG	ORA PRG
eeee	gg/mm/aa	hh:mm:ss

Display of the number of confirmed programming sessions (from the factory set-up) and the date and time of the last confirmed programming session.

6 INSTALLATION

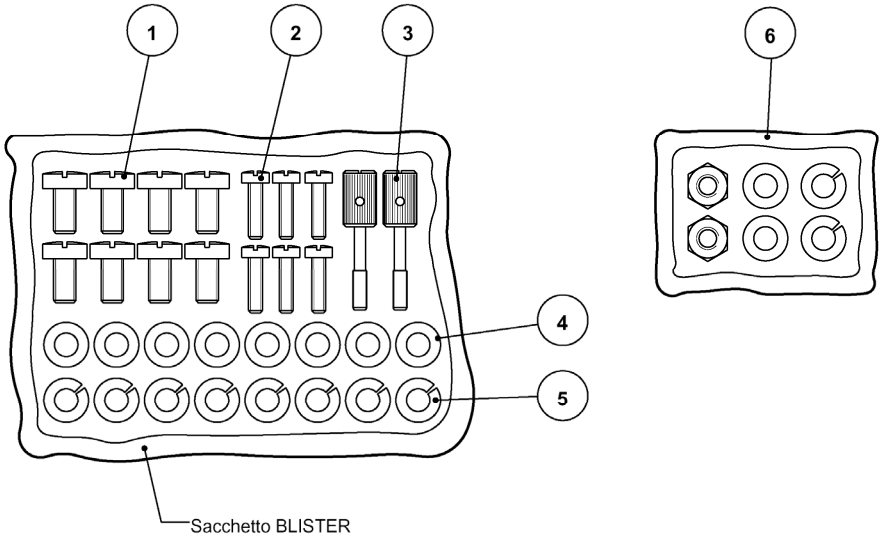
6.1 Supplied kit

RK VERSION - 19" rack installation (the proper rack is supplied by SEB)

- protection relay module DIA4N with rear socket
- transparent front panel for rack installation
- blister with items 1-2-3-4-5

CS VERSION - flush mounting installation

- protection relay module DIA4N with rear socket
- transparent front panel for rack flush mounting installation
- n° 2 brackets for flush mounting
- blister with items 1-2-3-4-5
- blister with item 6



1) n° 8 screws to fix wire terminals of current circuits (NOT USED)
2) n° 4 screws to fix the relay rear socket on the 19" rack (or on the two brackets for flush mounting) and n° 2 screws to fix (optionally) the protection relay on the front of the 19" rack
3) n° 2 knobs to fix the transparent front panel
4) n° 8 washers to be used to fix wire current terminals (NOT USED)
5) n° 8 growers to be used to fix wire current terminals (NOT USED)
6) small items to fix brackets on the cabinet (only CS version)

The knobs to fix the transparent front panel must be screwed through the front panel itself; the operation will create a screw thread in the plastic material to prevent knob missing.

NOTE The items related to current inputs are the standard supplied items with all SIGMA N protection relays but for the DIA4N model they are not used.

6.2 Cabling

Voltage circuits

It is suggested to terminate the voltage wirings using plug terminals.

Minimum suggested wire cross section: 1,5 mm^2

With reference to the insertion diagram in the next page, the voltages measured by the protection relay have the following matching:

UA	terminals 1 – 3	voltages with Un programmed greater than 125 V to 400 V
	terminals 2 - 3	voltages with Un programmed from 0 to 125 V
UB	terminals 6 – 8	voltages with Un programmed greater than 125 V to 400 V
	terminals 7 - 8	voltages with Un programmed from 0 to 125 V
UC	terminals 11 – 13	voltages with Un programmed greater than 125 V to 400 V
	terminals 12 - 13	voltages with Un programmed from 0 to 125 V
Uo	terminals 17 - 18	voltages with Uon programmed from 0 to 125 V

The input terminals related to Uo have to be connected to a VT sensible to residual voltages (e.g. star-open delta VT module).

Other circuits(output relays etc.)

It is suggested to terminate the wiring using plug terminals.

Minimum suggested wire cross section: 1,5 mm^2

IMPORTANT

In case of use of the protection relay in plants compliant to the requirements of the norm CEI 0-16 ed. 3, due to the presence of the positive sequence undervoltage and negative sequence overvoltage thresholds, it is absolutely necessary **to respect the phase rotation sequence** in the connection of the plant and the DIA4N protection relay.

In the case of plants built according to wiring diagrams found in previous versions of the manual, used with DIA4N equipped with firmware versions prior to 3.4, in which the phase rotation sequence was not important, please check the connections of the line voltages, to ensure the correct phase rotation sequence.

Please refer to the wiring diagrams on the following pages.

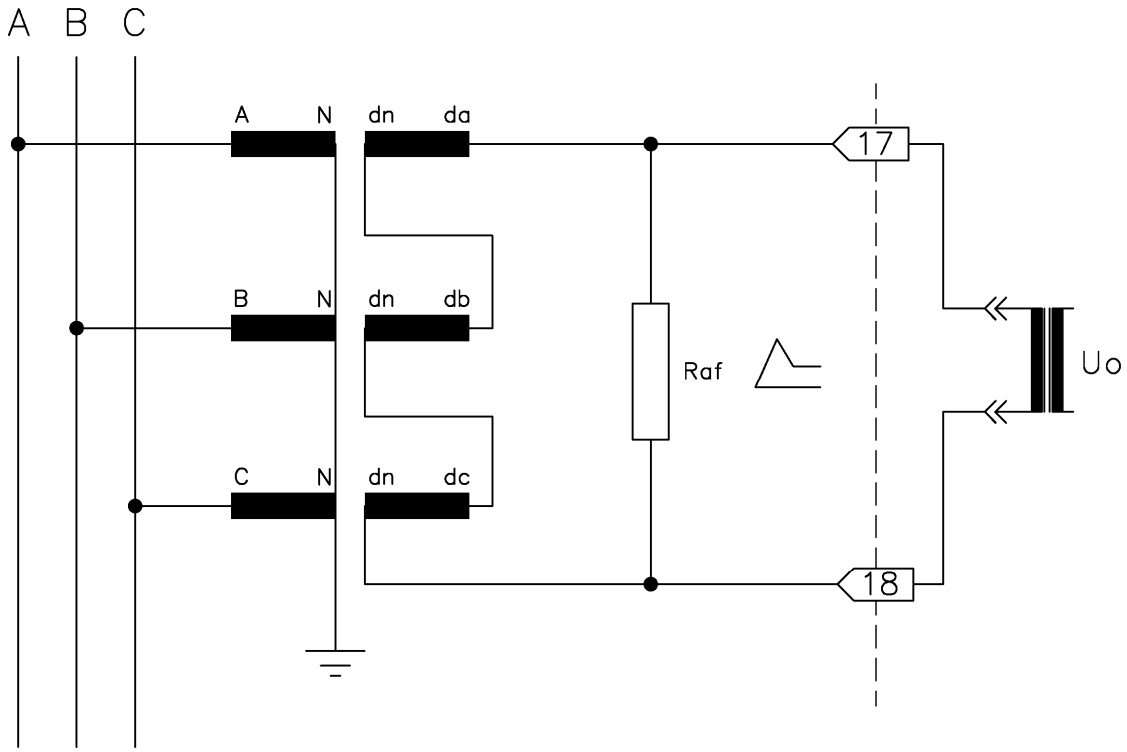
To verify the correct phase rotation sequence you must enabled: the function 81V, the thresholds 27.1 and 59.2. In this way, you can measure the positive sequence voltage

(U1) and negative sequence voltage (U2) in the appropriate section of the menu (see P6 and P7, par. 5.9).

In conditions of absence of a fault in the network, you must have a positive sequence voltage (U1) almost equal to that of the line voltages and a negative sequence voltage (U2) close to 0.

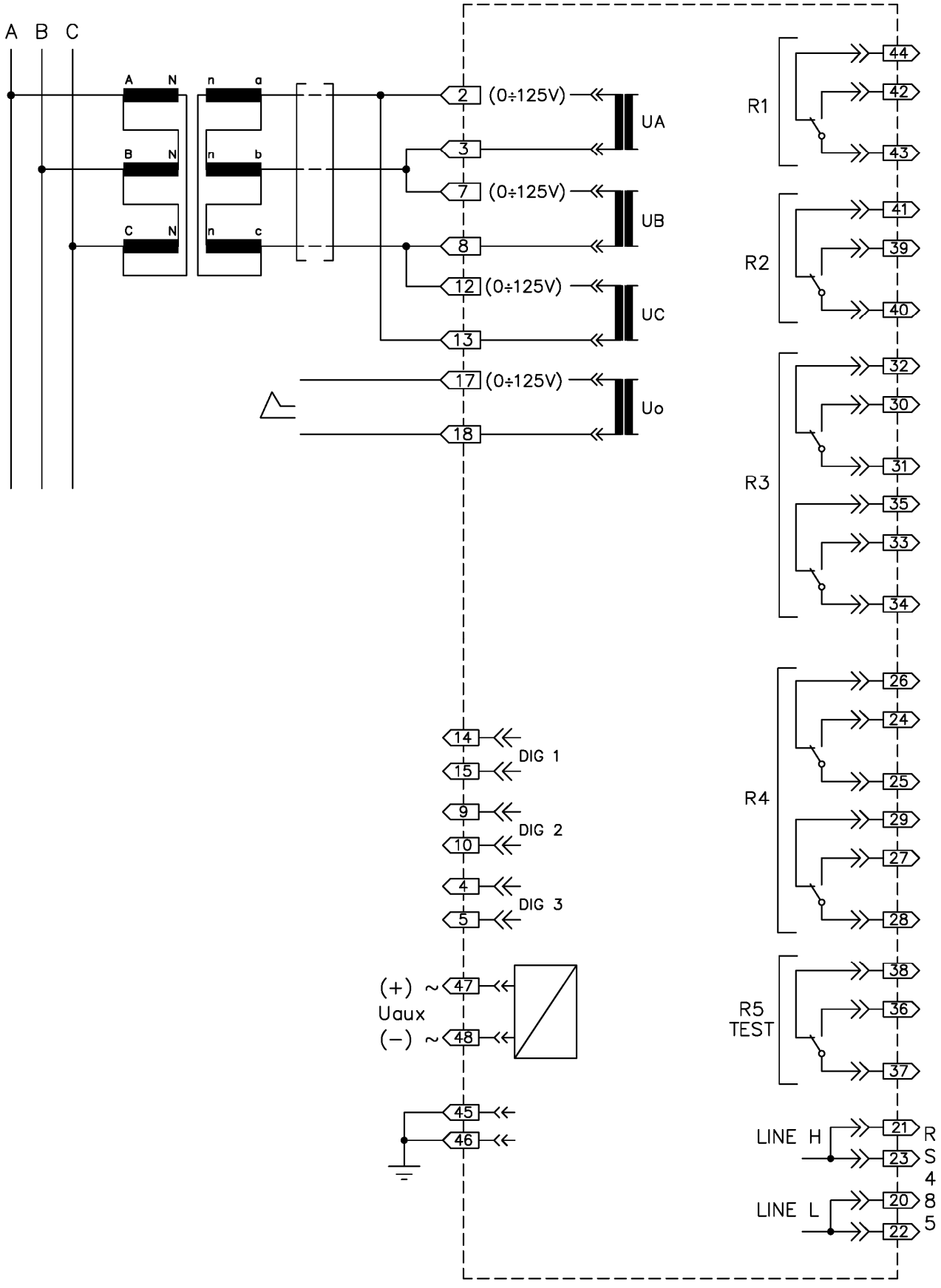
If the previous tests are failed, please check the wiring between the line voltage and the input voltages of the DIA4N protection relay.

The following figure shows the connection for the measurement of residual voltage, obtained by using the 3 TVs connected phase-to-ground in MV.

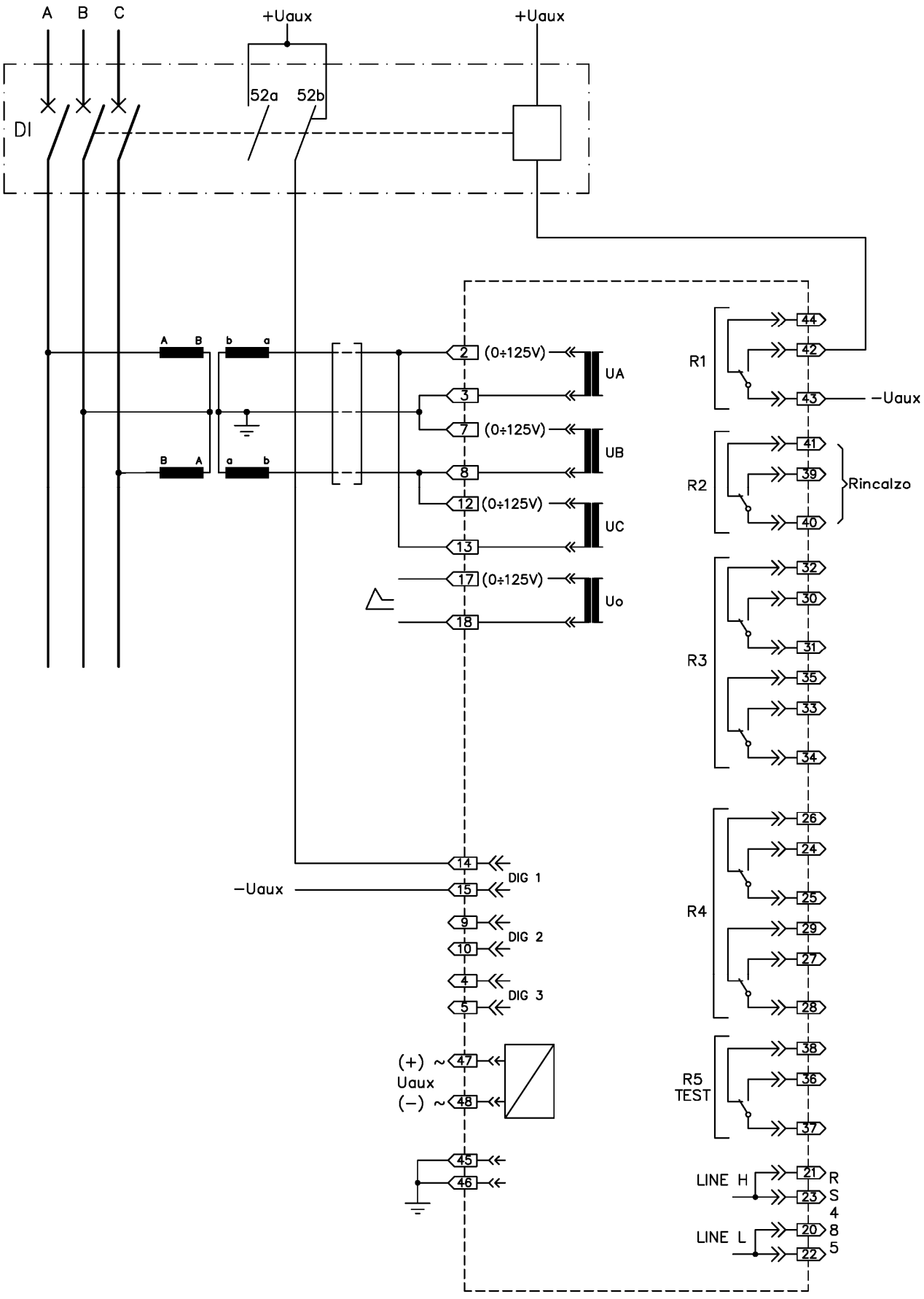


Residual voltage measurement (Uo) in MV using 3 TVs

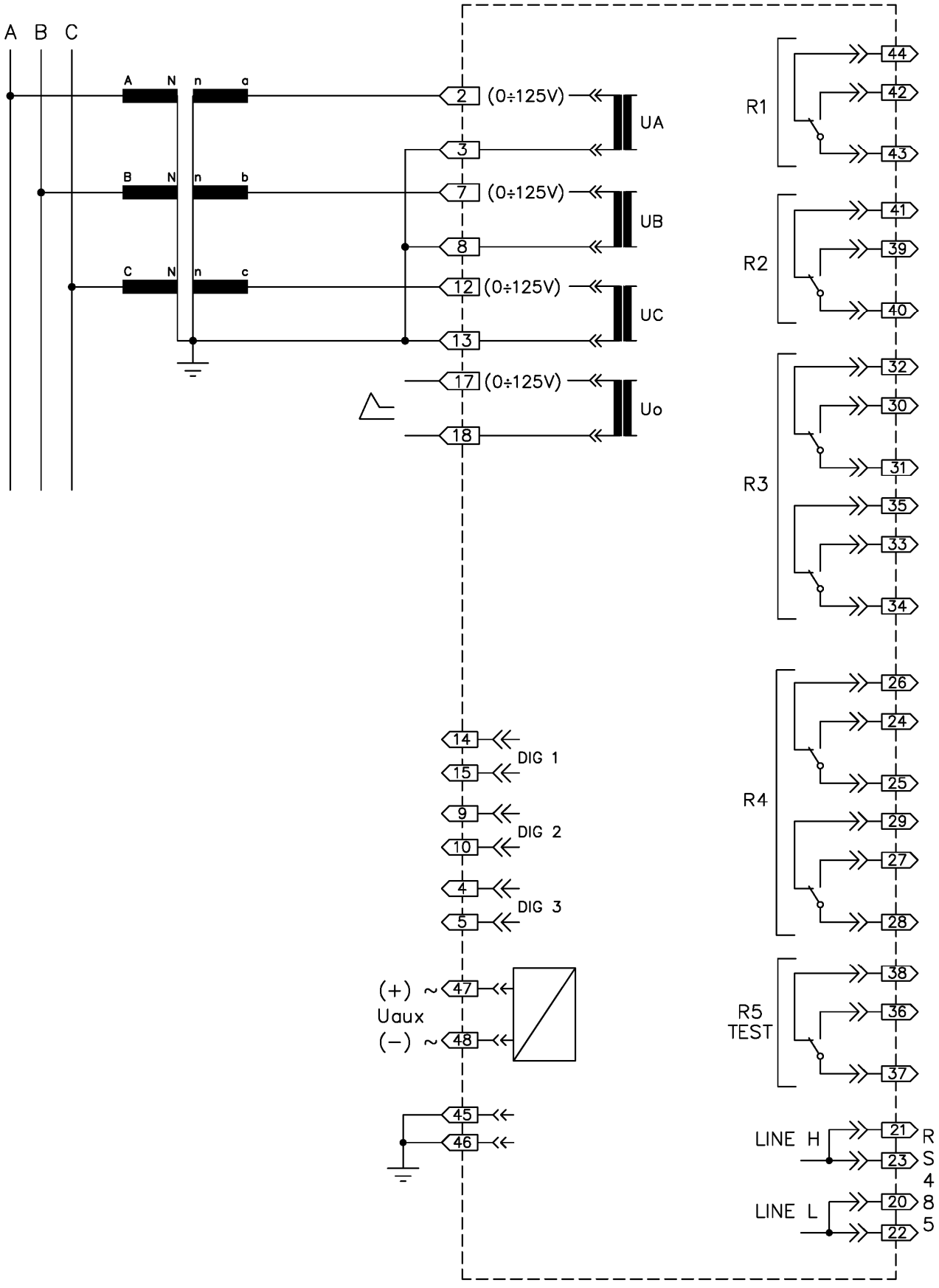
In the following wiring diagrams in which it is represented the Interface Device (DI), it is assumed that it is equipped with undervoltage coil (as required by the norm CEI 0-16).



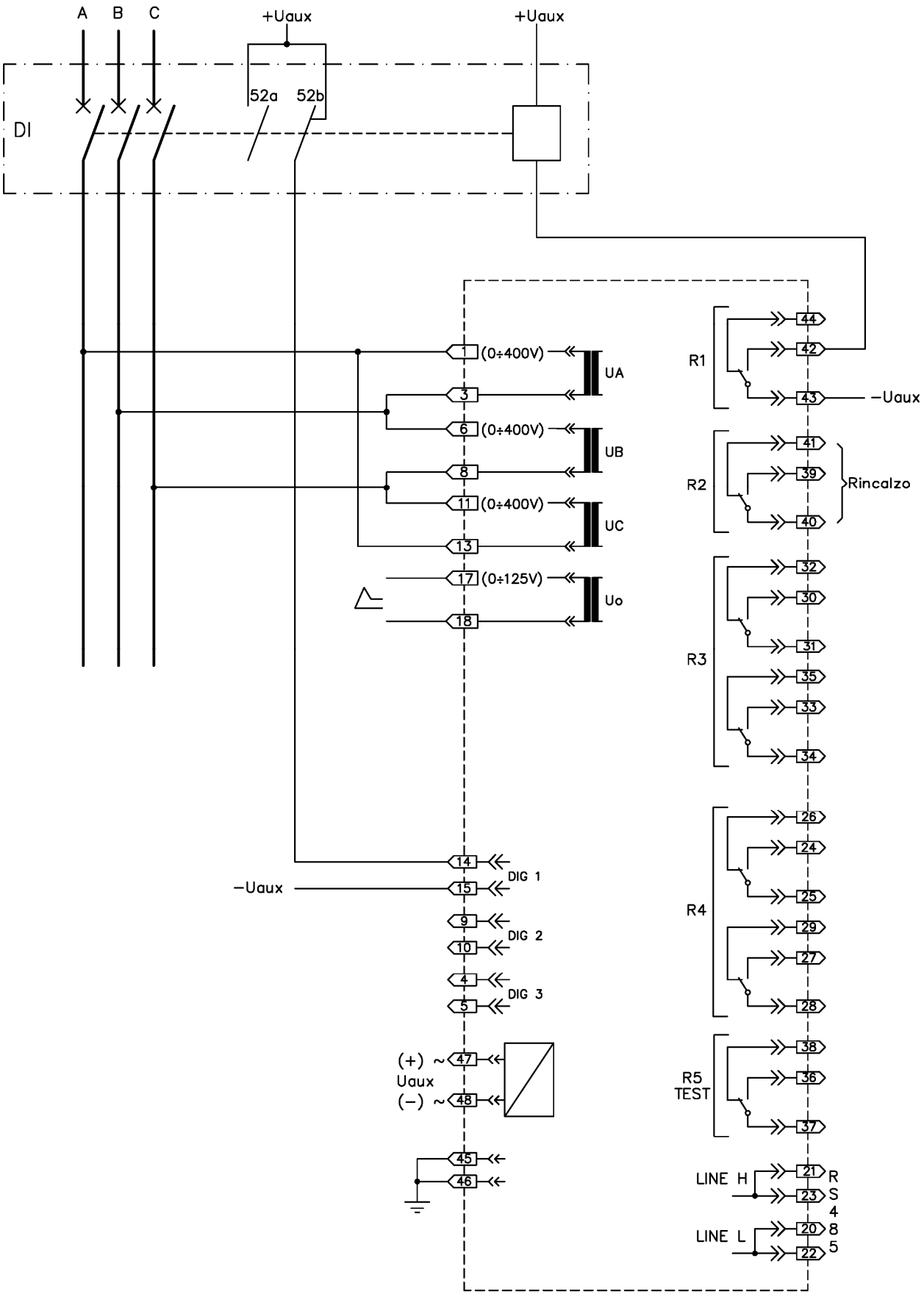
Phase to phase insertion in MV with 3 TVs (Un secondary ≤ 125 V)



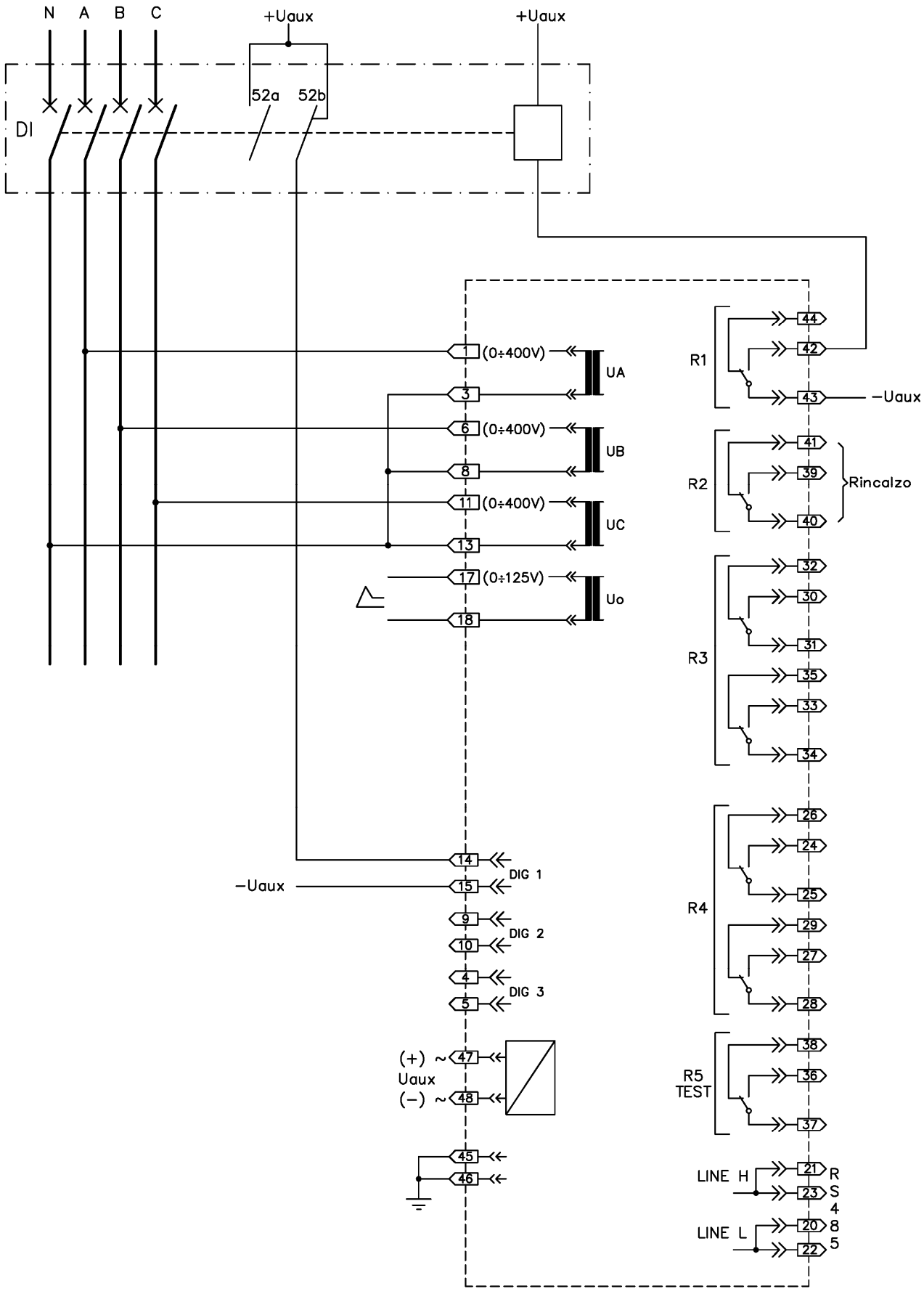
Phase to phase insertion in MV with 2 TVs (Un sec. ≤ 125 V) – With MAI function
Recommended solution for MV connection according to norm CEI 0-16



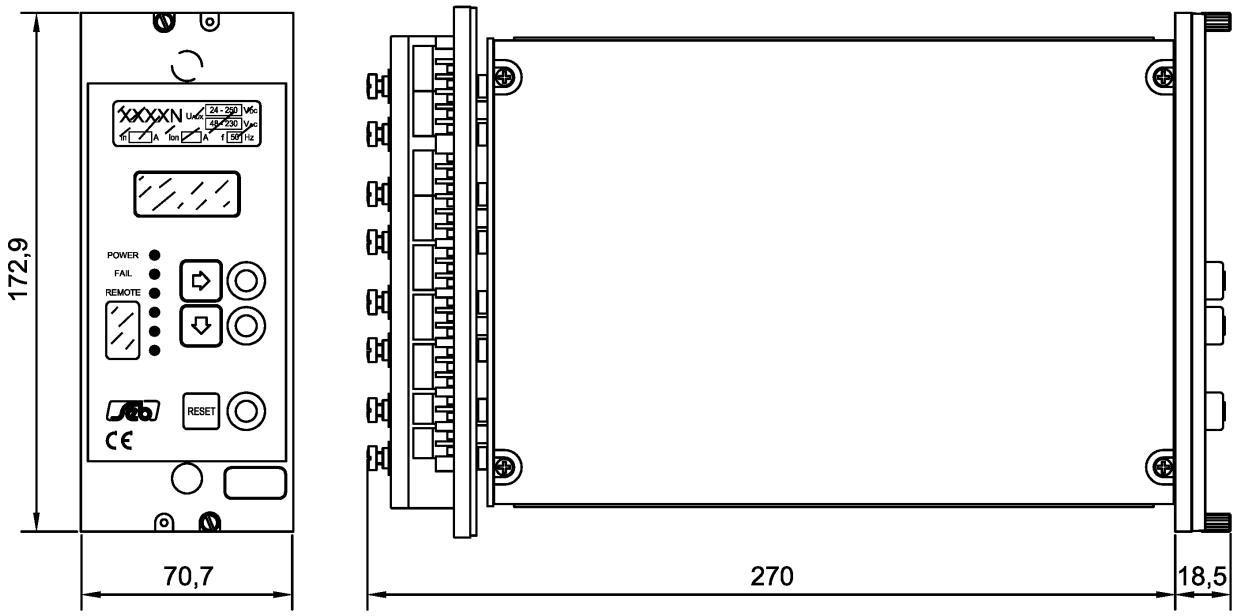
Phase to ground insertion in MV with 3 TVs (Un secondary ≤ 125 V)
Useful only for plants <u>which are not compliant</u> to norm CEI 0-16



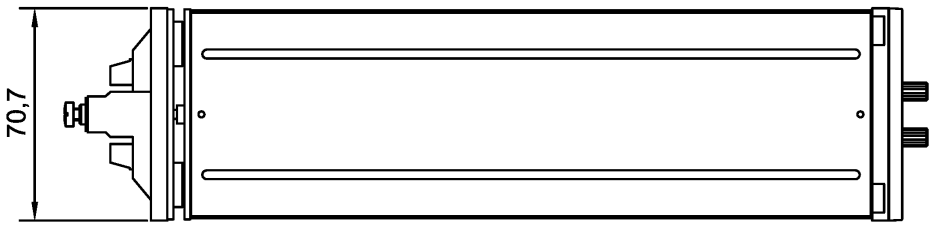
Phase to phase insertion in LV (Un > 125 V) – With MAI function
Recommended solution for LV connection according to norm CEI 0-16

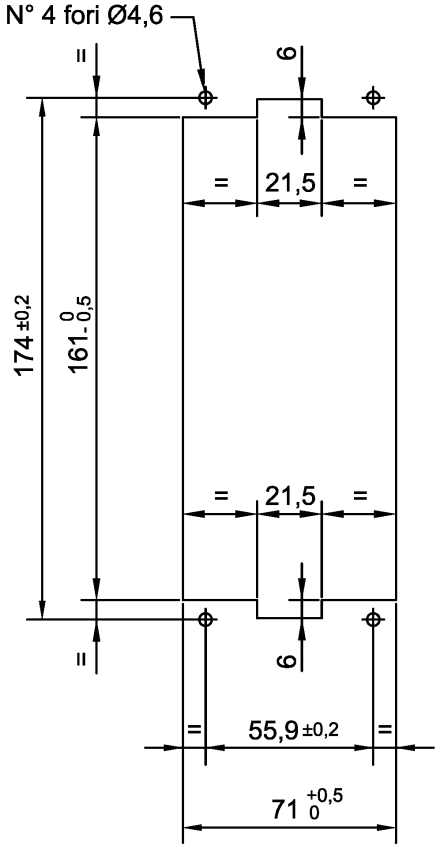


Phase to neutral insertion in LV (Un > 125 V) – With MAI function (optional)
Useful only for plants <u>which are not compliant</u> to norm CEI 0-16



Dimensioni meccaniche
Case outlines





Dima montaggio da incasso
Flush mounting panel cut - out

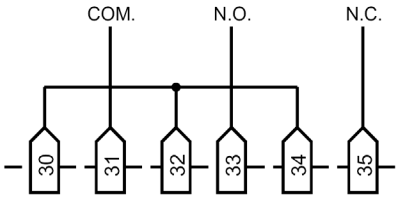
Montaggio incassato / Flush mounting
Dimensioni pannello frontale trasparente :
Transparent front panel sizes :
208 x 89,5 mm.

6.3 Relays R3 and R4 - Signaling / Command set-up

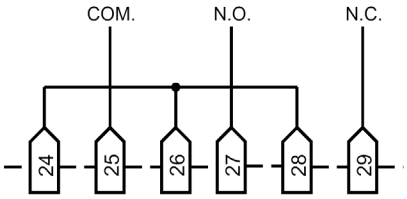
The protection relay is supplied with R3 and R4 relays configured as **SIGNALING RELAYS**, with 2 change-over output contacts with breaking capability equals to 0.2 A at 110 Vdc, L/R = 40 ms, 100000 operations.

Each R3 and R4 relay can be configured as **COMMAND RELAY** with 1 change-over output contact with breaking capability equals to 0.5 A at 110 Vdc, L/R = 40 ms, 100000 operations.

The new configuration is obtained with the following cabling:



R3



R4

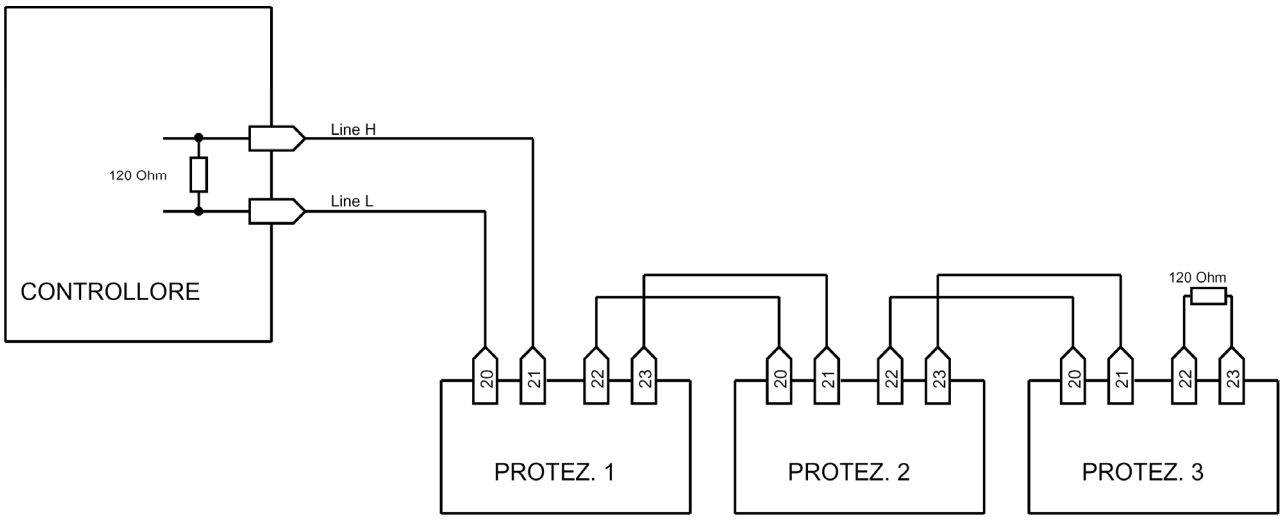
6.4 RS485 serial communication port

The digital protection relay DIA4N has an insulated serial interface RS485 half-duplex that allow the multi-drop connection up to 31 protection units.

When the STANDARD Seb communication protocol is selected, the transmission speed is automatically selected between 300 to 9600 bauds and the protocol is ASCII-HEX; the documentation related to the protocol is freely available on request.

When the MODBUS communication protocol is selected, the transmission speed can be programmed between 300 to 9600 bauds (ref. B3, par 5.3); the protocol is in ASCII mode and runs as SLAVE functional mode.

It is suggested to use a shielded twisted pair AWG22; terminal 19 (not connected internally) can be used for shields connections.



It is suggested to terminate the serial line with a resistance 120 Ω, 1/4 W.

7 TECHNICAL CHARACTERISTICS

Measuring inputs

Rated line voltage (Un)	programmable 57,73 - 63,50 - 72,16 - 100 - 110 V 125 - 190 - 220 - 230 - 380 - 400 V 200 - 202 - 208 - 240 - 270 - 277 V 300 - 315 - 320 V
Rated residual voltage (Uon)	programmable 100 - 110 - 125 V
Thermal withstand continuously	2 Un - Uon
Thermal withstand for 1 s	2 Un - Uon
Rated frequency	50 Hz
Primary VT's voltage	1 - 999999 V
Burden at rated voltage	0.5 VA / phase
Frequency measurement range	35 ÷ 75 Hz

Output contacts ratings

Number of relays (note 1)	4 + 1
Rated current	5 A
Rated voltage	250 V
Contact configuration	change over
Breaking capability (note 2)	
- tripping relays (R1, R2)	0.5 A
- signaling relays (R3, R4, R5) (note 3)	0.2 A
Mechanical life	> 10^6

Digital inputs

Number of inputs	3
External control voltage	as Uaux
Typical current (sink)	2 mA

Data transmission

Standard	RS485 half duplex
Communication protocol	MOD-BUS ASCII
Transmission speed	300 - 9600 baud selectable
Optional	optical fiber module

Auxiliary supply

Range	24 ÷ 320 Vdc ± 20% 48 ÷ 230 Vac ± 20%
Frequency (Vac)	47 ÷ 63 Hz
Burdens (min/max)	5 / 10 W

Environmental conditions

Operation	- 10 / +60 °C
Transport and storage	- 25 / +80 °C
Relative humidity (without condensation)	< 95%
Protection degree for flush mounting (optional)	IP 52 (IP 54)

Weight	2.5 kg

Note 1) The additional relay R5 is controlled by self-test program
Note 2) Breaking capability at 110 Vdc, L/R 40 ms, 100.000 operations
Note 3) The output contacts of R3 and R4 relays can be configured as signaling or tripping relays

8 TABLES

Table A Rated values and settings

ANSI	THRESHOLDS	Settings	Resolution	Dropout ratio
27	Undervoltage (27.1, 27.2)	0.05 ÷ 1.00 Un	0.01 Un	≤ 1.05
59	Overvoltage (59.1, 59.2)	0.50 ÷ 1.50 Un	0.01 Un	≥ 0.95
59N	Residual earth fault (59N.1)	0.02 ÷ 1.00 Uon	0.01 Uon	≥ 0.95
81	Over frequency (81>, 81>>)	50.00 ÷ 55.00 Hz	0.01 Hz	≥ 0.998
	Under frequency (81<, 81<<)	45.00 ÷ 50.00 Hz	0.01 Hz	≤ 1.002
27V1	Positive sequence undervoltage (27V1)	0.05 ÷ 1.00 Un	0.01 Un	≤ 1.05
59V2	Negative sequence overvoltage (59V2)	0.05 ÷ 1.50 Un	0.01 Un	≥ 0.95
Timers		**Settings**	**Resolution**	
Delay time	All thresholds	0.05 ÷ 99.99 s	0.01 s	
TR 59N.1		0.00 ÷ 99.99 s	0.01 s	
TR 81V		0.0 ÷ 999.9 s	0.1 s	
Remote Trip		0.00 ÷ 99.99 s	0.01 s	

Table B: Configuration for operation in accordance with CEI 0-16 ed. 3

This table shows an example of configuration for DIA4N protection relay for using in plants compliant to norm CEI 0-16. The values shown as "typical" in Table B correspond to the default configuration of the protection; these values are preset with the aim of allowing an easier configuration of the setting parameters in the process of commissioning of the protection relay, by minimizing, to the extent possible, the number of parameters to be changed by the user.

Verification of the configuration parameters to the characteristics of the plant and to the calibration values required by the energy distributor is under the responsibility to the user of protection.

The settings for the MAI function are referred to connections according to the previous wiring diagram.

Un	According to plant characteristics
Uon	According to plant characteristics (typical 100 V)
Up	According to plant characteristics
Uop	According to plant characteristics
27.1	ON
27.1	According to energy distributor requirements (typical 0.85 Un)
TI 27.1	According to energy distributor requirements (typical 1.5 s)
27.2	ON
27.2	According to energy distributor requirements (typical 0.40 Un)
TI 27.2	According to energy distributor requirements (typical 0.2 s)
59.1	ON
59.1	According to energy distributor requirements (typical 1.10 Un)
TI 59.1	According to energy distributor requirements (typical 3 s)
59.2	ON
59.2	According to energy distributor requirements (typical 1.20 Un)
TI 59.2	According to energy distributor requirements (typical 0.6 s)
59N.1	ON
59N.1	According to energy distributor requirements (typical 0.05 Uon)
TI 59N.1	According to energy distributor requirements (typical 25 s)
TR 59N.1	According to energy distributor requirements (typical 0.2 s)
81>	ON
81>	According to energy distributor requirements (typical 50.2 Hz)
TI 81>	According to energy distributor requirements (typical 0.15 s)
81>>	ON
81>>	According to energy distributor requirements (typical 51.5 Hz)
TI 81>>	According to energy distributor requirements (typical 1.0 s)
81<	ON
81<	According to energy distributor requirements (typical 49.8 Hz)
TI 81<	According to energy distributor requirements (typical 0.15 s)
81<<	ON
81<<	According to energy distributor requirements (typical 47.5 Hz)

TI 81<<	According to energy distributor requirements (typical 4.0 s)		
81V	ON		
ABL 59Vo	START		
ABL 27V1	START		
27V1	According to energy distributor requirements (typical 0.7 Un)		
ABL 59V2	START		
59V2	According to energy distributor requirements (typical 0.15 Un)		
COM LOC	According to energy distributor requirements		
TR 81V	According to energy distributor requirements (typical 30 s)		
MAI	ON (if required by energy distributor) (default OFF)		
TMAI	0.5 s		
TEXT	0.00 s		
DIG1	active status→ HI	52 AP (Only if MAI function is enabled) (default ESCLUSO)	
DIG2	active status→ HI	COM LOC[7]	
DIG3	active status→ HI	TRIP EXT	
RL1	Norm ON	TRIP 27.1 27.2 59.1 59.2 59N.1 81> 81>> 81< 81<< EXT	
RL2	Norm OFF	TRIP MAI	
RL3	Norm OFF	START 81V	
RL4	Norm OFF		

Other settings not listed in this table are not important for the functionality of the protection relay.

Note: For the proper operation of the protection relay in plant compliant to norm CEI 0-16, it is recommended not to change the configuration of the relay RL1 (used to control the interface circuit breaker) from the default programming.

[7] The setting of the Local Command status is supplied by the energy distributor

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