DIVISIONE ELETTRONICA E SISTEMI

IFD4N

M.V. LINE PROTECTION

USER MANUAL

P500D826 **November 2011**

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1 GENERAL CHARACTERISTICS

The protection relay IFD4N performs functions such as overcurrent and earth fault relay, and directional earth fault relay.
The protection relay IFD4N is in compliance with characteristics required by CEI 0-16 Italian standard.
The user can select one of the functions listed in the table below

Function	ANSI	Measures
Two-phase overcurrent	51	I1, I2
Directional earth fault	67	Vo, Io, Phase
Two-phase overcurrent + Directional earth fault	50 67	I1, I2, Vo, Io, Phase
Earth fault overcurrent (non directional)	51N	Io
Two-phase overcurrent + Earth fault overcurrent (non directional)	51 51N	I1, I2, Io
Directional earth fault + Earth fault overcurrent (non directional)	67 51N	Vo, Io, Phase
Two-phase overcurrent + Directional earth fault + Earth fault overcurrent (non directional)	50 67 51N	I1, I2, Vo, Io, Phase

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

THRESHOLDS - the IFD4N relay manages the following independent thresholds:

- 3 two-phase overcurrent thresholds 51.S1, 51.S2, 51.S3
- 3 directional earth fault thresholds 67.S1, 67.S2, 67.S3
- 3 earth fault overcurrent thresholds 51.N1, 51.N2, 51.N3
- 1 poles wearing index threshold I2t

The directional earth-fault function can be selected as:

- 3 INDEPEDENT DIRECTIONAL thresholds (according to ENEL DV63 specification)
- DIRECTIONAL with NON operating zone around the origin (according to ENEL DV1001 specification) (see fig. 1)

The available settings for each threshold are listed in Table A; the operation of the directional thresholds is described in paragraph 1.1.

TRIP DELAYS - a programmable time delay (TI) is available for each threshold; thresholds 51.S1, 67.S1 and 51.N1 can be programmed as time definite or time dependent in compliance with IEC 255-4 standard.

For each threshold programmed as definite time, an additional programmable time delay (TA) is available; the additional time delay is added to time delay TI. The additional time delay activation is controlled by the digital inputs to allow the use of the IFD4N relay with cooperating protection relays.

The available settings for each time delay are listed in Table A.

OUTPUT RELAYS - the IFD4N 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 electrical parameters exceed the programmed threshold values.
TRIP	activation of the output relay when the programmed time delay (TI or TI+TA) 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):

- additional time delay (related to one or more thresholds)
- on/off thresholds
- STATUS function (recording of measures on external event)
- pilot wire fault monitoring (only DIG2)

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 40 ms.

DISPLAY OF MEASURES - the user can select the continuous display of a measured parameter (currents, voltage, phase); all the measured and computed parameters can be transmitted to an external controller through the RS485 port.

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

Information includes the threshold set-up and activated relays (TRIP event only), the measured current, voltage, phase, 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 signalling 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 parameters 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 then 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 Directional thresholds

The IFD4N protection relay measures the residual voltage, the earth current and computes the phase angle between the voltage (reference - Vo) and the current (Io).

Three independent directional thresholds S1, S2 and S3 are available; each threshold is defined by the following parameters:

Isx>	overcurrent threshold
Usx>	overvoltage threshold
Φsx<	angular sector threshold

ANGULAR SECTOR THRESHOLD - the threshold is defined by the following parameters:

Φx	characteristic angle (e.g.: Φ1 related to directional threshold S1)
DΦx	sector width (e.g.: DΦ1 related to directional threshold S1)

Characteristic angle - The characteristic angle is defined with the measured voltage as reference (straight line C in figure 2).

The characteristic angle can be programmed from +180° to -180° and it is shown using the notation **Φx**. The angle **Φx** of the sector axis is positive when lagging the voltage vector (see figure 2).

Sector width - the sector width is symmetrically defined referred to the straight line C. The sector width can be programmed from +15° to +180° and it is shown using the notation **DΦx**.

DIRECTIONAL THRESHOLD OPERATION - The directional thresholds (i.e. 67.S1) operates when the following conditions are verified:

- the measured current is greater than the threshold Is1>
- the measured voltage is greater than the threshold Us1>
- the measured current phasor is within the sector defined by the parameter Φ1 and DΦ1

therefore if the following characteristic angle is programmed:

Φ1 = +90° DΦ1 = 15°

the directional threshold will operate if the angle of the measured current phasor is lagging the voltage phasor from +75° to +105° (+90° ± 15°).

For the available settings of the thresholds **Isx>**, **Usx>** and of the parameters **Φx** and **DΦx** please refer to Table A.

NON DIRECTIONAL THRESHOLDS - When the sector width **DΦx** is defined equal to 180° the threshold becomes non-directional and the voltage threshold is indifferent (only the modules of the measured currents are taken into consideration by the protection relay).

This functionality allows the programming of additional non-directional thresholds to obtain a higher degree of protection.

Every threshold can be programmed ON / OFF or disabled with an external command through digital inputs.

1.2 Directional earth-fault - 3 independent thresholds (DV63)

The 3 independent directional earth-fault thresholds are defined by the followings:

threshold **67.S1** - Is1>, Us1>, Φs1< (parameters DΦ1 and Φ1)

threshold **67.S2** - Is2>, Us2>, Φs2< (parameters DΦ2 and Φ2)
threshold **67.S3** - Is3>, Us3>, Φs3< (parameters DΦ3 and Φ3)

Each current threshold **Isx>**, voltage threshold **Usx>** and each angular sector (characteristic angle **Φx** and sector width **DΦx)** is independently programmable; the threshold **67.S1** can be programmed as definite time or dependent time, whilst the remaining thresholds are time definite only (see Time Dependent Curves - chapter 7).

Each threshold **67.S1**, **67.S2** and **67.S3** can be activated or disabled by the user. The protection operates on the directional threshold 67.Sx if AT THE SAME TIME the measured current and voltage are greater than the thresholds Isx> and Usx> and if the current phasor is in the angular sector Φsx< defined as Φx ± DΦx (with the measured voltage as reference).

The available settings for each time delay are listed in Table A.

1.3 Directional earth-fault with non-operating zone around the origin (DV1001)

The thresholds **67.S1** and **67.S2** (current thresholds Is1> and Is2> and voltage thresholds Us1> and Us2>) are logically combined (OR) to obtain the threshold **67.SA** and they allow you to have an operating voltage-current characteristic as showed in figure 1 (for any angular sector **ΦA<**); this characteristic allows very low voltage and current thresholds with a NON operating zone around the origin; the threshold **67.S3** remains independent.

The threshold **67.SA** has only one angular sector threshold **ΦA<** defined by the parameters **ΦA** and **DΦA**.

That is: 67.SA → logical OR threshold 67.S1 → Is1>, Us1>
threshold 67.S2 → Is2>, Us2>

angular sector threshold ΦA< = ΦA ± DΦA

The constraints on the current and voltage thresholds are the followings:

$Is1> \leq Is2>$ $Us1> \geq Us2>$

These constraints are verified by the protection relay during the set-up and an error message will be displayed if required.

The **67.S3** threshold operates normally with the parameters Is3>, Us3> and Φs3<.

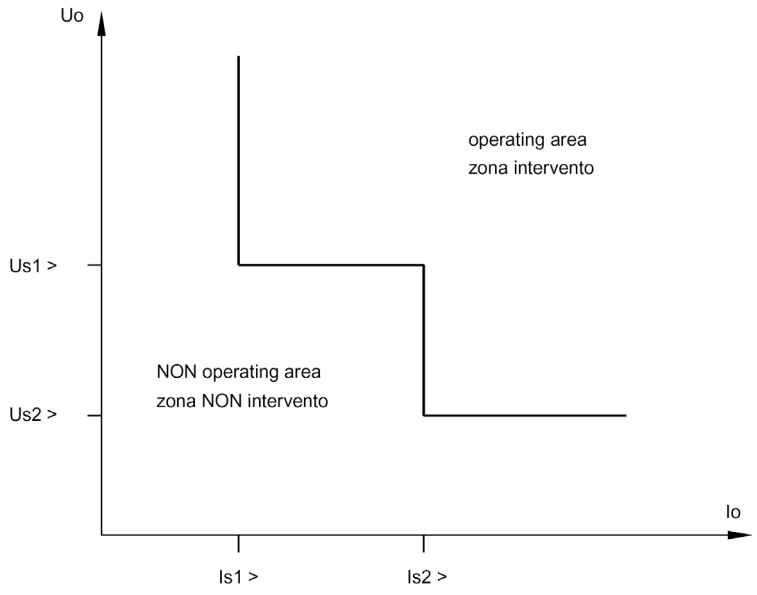


Figure 1

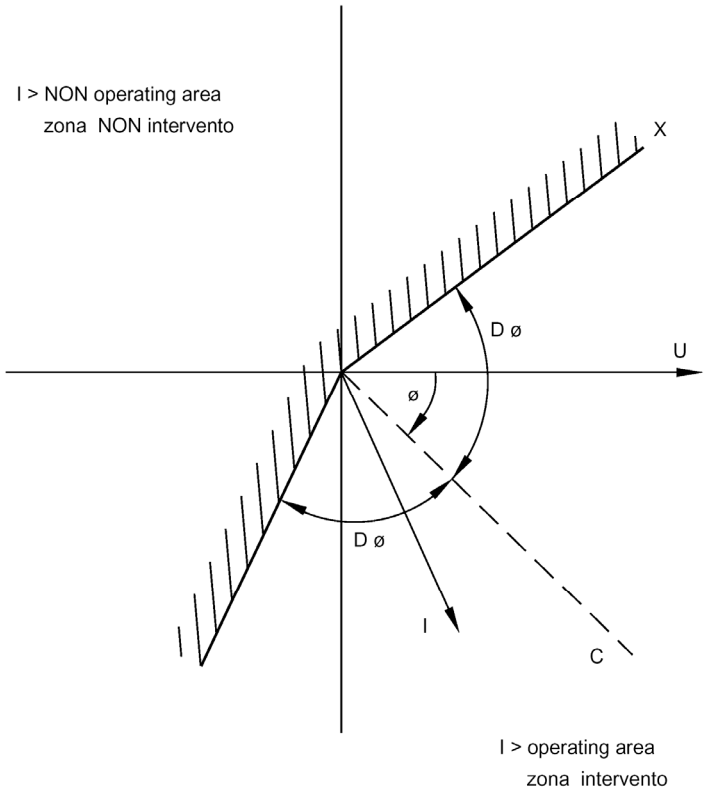


Figure 2

1.4 Directional earth-fault characteristic angles

When it operates as directional earth-fault the following characteristic angles **ΦSx** (where x = 1, 2, 3, A) are suggested:

- unearthed + 90°
- solidly earthed - 75°
- via earthing resistor + 180°

- via earthing transformer - 90°
- via Petersen coil + 180°

The suggested sector width **DΦx** in the first 4 cases is 85°.

With unearthed systems the threshold **67.S3** could be programmed with -90° characteristic angle to be used as reserve function against earth faults on different lines.

1.5 Pole wearing monitoring function

This function is available only if the two-phase overcurrent protection is selected by the user.

When enabled by the operator, the function is activated by a **circuit-breaker open commands**:

- TRIP condition of one of the programmed IFD4N thresholds if an output relay is programmed to operate on the TRIP condition

The IFD4N protection computes the **I^2t** pole wearing index, where:

t = **TPOLO** time, programmable from 0.005 to 1.000 s, resolution 0.001 s
I = measured current (in primary values) at the TRIP condition

The computation of the **I^2t** index is done **for each pole** and the result expressed as **kA^2s** is added to the related register.

There are 2 registers (**PL1** and **PL2**).
The registers can be resetted by the operator.

The operator must program the time **TPOLO** (medium time to extinguish the electric arc in the circuit-breaker) used by the **I^2t** function.

One of the output relays can be programmed to be activated on a **I^2t** threshold (**I2T>**) programmable from 0.0 to 9999.999 kA^2s , resolution 0.001; the threshold is common to all registers (PL1 and PL2).

The output relay will remain activated until the **I^2t** registers are resetted or until the RESET push-button on the protection relay is pressed.

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 (ref. 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 3, 4, 5 and 6.
- 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
51 (red)	⊕	trip condition on 51.S1, 51.S2 or 51.S3 thresholds
67 - 51N (red)	⊕	trip condition on 67.S1, 67.S2, 67.SA or 67.S3 or 51.N1, 51.N2 or 51.N3
Anom. C. BRK (red)	⊕	trip condition on I^2t function

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 3, 4, 5 and 6 at the following references:

B2÷B7	relay address (RS485) and date/time
C1	protection function
D1	directional earth fault functional mode
E1÷E7	nominal values, contrast, etc.
F1S÷F3M	thresholds and time delays
G1÷G12	output relays functions
H1÷H3	digital input functions
S1÷S22	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. 4, ref. J1) within 5 minutes depressing the push-buttons [ENTER] and [+] 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 LED's
- 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. 3, ref. A1 – par. 5.1)

4.4 Test of output relays

When the output relays test is selected (Fig. 5, ref. G13) 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 3, 4, 5 and 6; the references A1, B1, B2 etc. identify specific displayed messages in the figures.

5.1 Standard display

A1 - STANDARD DISPLAY (fig. 3)

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 FUNCTIONING
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 main selectable functions (ref. C1 - FUNCTION SELECTION).

- **Measured parameters** - the display shows one of the measures (current, voltage, angle).

The measure is visualized as primary value (Ampere, Volt or degree).

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 51.S1	TRIP 67.S2	TRIP 67.SA	TRIP 51.N2

The information of the trip, as well the glowing of the related LED's, 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 will be displayed:

FAIL eeeeeeee

The string **eeeeeeee** can be:

F.PILOT 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

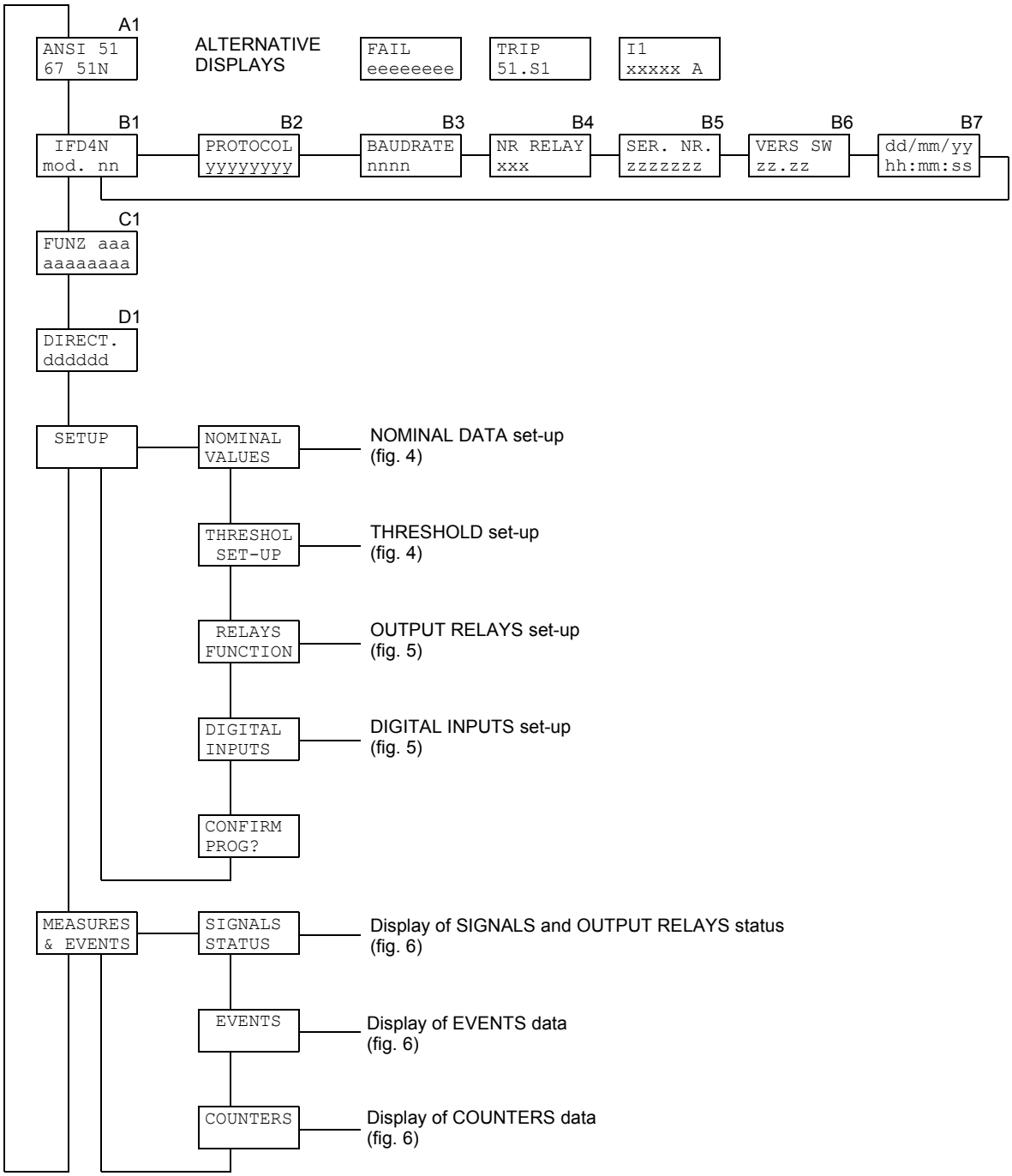


Figure 3

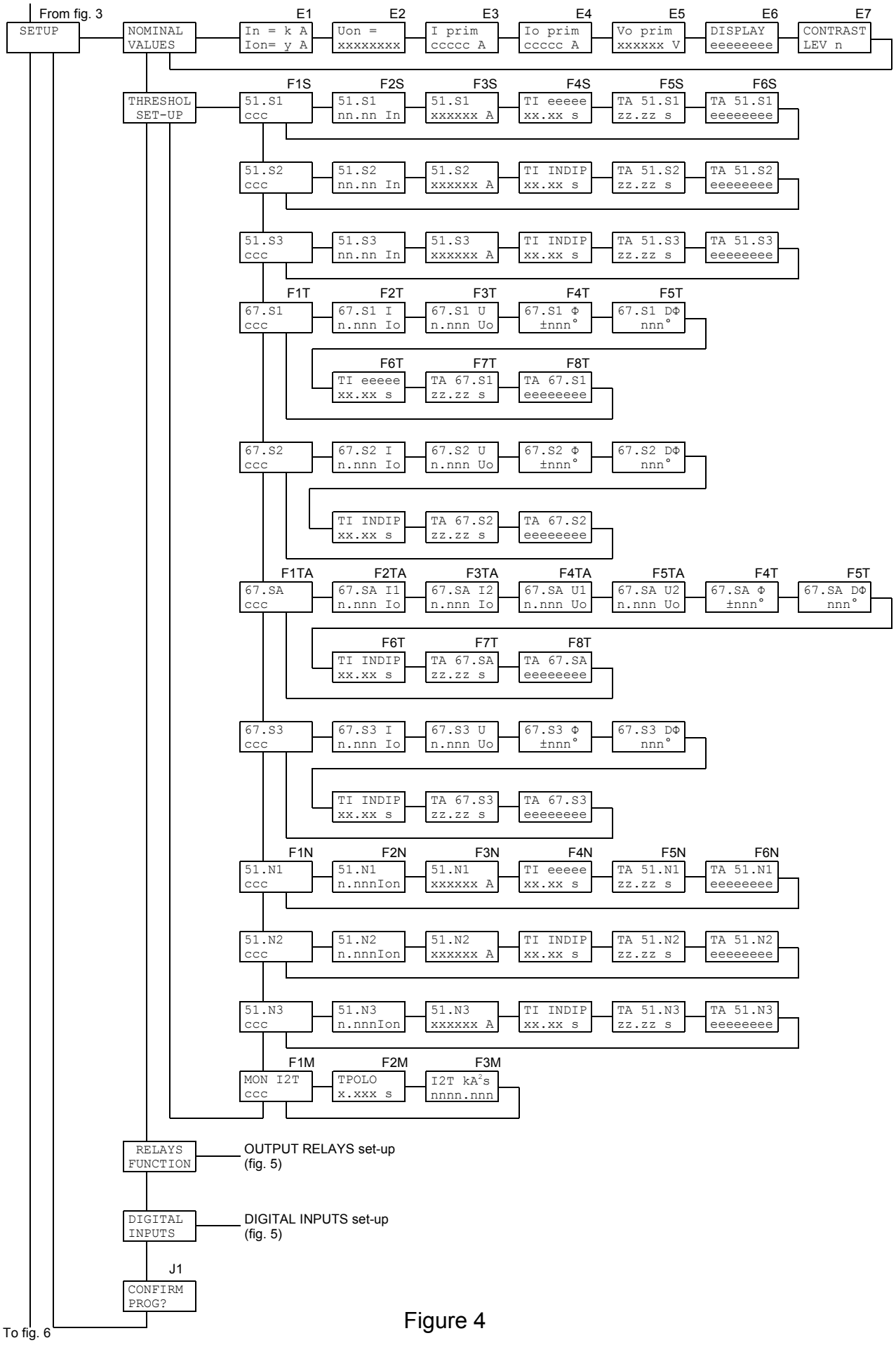

From fig. 3
SETUP
NOMINAL VALUES
E1
In = k A
Ion= y A
E2
Uon =
xxxxxxxx
E3
I prim
ccccc A
E4
Io prim
ccccc A
E5
Vo prim
xxxxxx V
E6
DISPLAY
eeeeeeee
E7
CONTRAST
LEV n
THRESHOL SET-UP
F1S
51.S1
ccc
F2S
51.S1
nn.nn In
F3S
51.S1
xxxxxx A
F4S
TI eeeee
xx.xx s
F5S
TA 51.S1
zz.zz s
F6S
TA 51.S1
eeeeeeee
51.S2
ccc
51.S2
nn.nn In
51.S2
xxxxxx A
TI INDIP
xx.xx s
TA 51.S2
zz.zz s
TA 51.S2
eeeeeeee
51.S3
ccc
51.S3
nn.nn In
51.S3
xxxxxx A
TI INDIP
xx.xx s
TA 51.S3
zz.zz s
TA 51.S3
eeeeeeee
F1T
67.S1
ccc
F2T
67.S1 I
n.nnn Io
F3T
67.S1 U
n.nnn Uo
F4T
67.S1 Φ
±nnn°
F5T
67.S1 DΦ
nnn°
F6T
TI eeeee
xx.xx s
F7T
TA 67.S1
zz.zz s
F8T
TA 67.S1
eeeeeeee
67.S2
ccc
67.S2 I
n.nnn Io
67.S2 U
n.nnn Uo
67.S2 Φ
±nnn°
67.S2 DΦ
nnn°
TI INDIP
xx.xx s
TA 67.S2
zz.zz s
TA 67.S2
eeeeeeee
F1TA
67.SA
ccc
F2TA
67.SA I1
n.nnn Io
F3TA
67.SA I2
n.nnn Io
F4TA
67.SA U1
n.nnn Uo
F5TA
67.SA U2
n.nnn Uo
F4T
67.SA Φ
±nnn°
F5T
67.SA DΦ
nnn°
F6T
TI INDIP
xx.xx s
F7T
TA 67.SA
zz.zz s
F8T
TA 67.SA
eeeeeeee
67.S3
ccc
67.S3 I
n.nnn Io
67.S3 U
n.nnn Uo
67.S3 Φ
±nnn°
67.S3 DΦ
nnn°
TI INDIP
xx.xx s
TA 67.S3
zz.zz s
TA 67.S3
eeeeeeee
F1N
51.N1
ccc
F2N
51.N1
n.nnnIon
F3N
51.N1
xxxxxx A
F4N
TI eeeee
xx.xx s
F5N
TA 51.N1
zz.zz s
F6N
TA 51.N1
eeeeeeee
51.N2
ccc
51.N2
n.nnnIon
51.N2
xxxxxx A
TI INDIP
xx.xx s
TA 51.N2
zz.zz s
TA 51.N2
eeeeeeee
51.N3
ccc
51.N3
n.nnnIon
51.N3
xxxxxx A
TI INDIP
xx.xx s
TA 51.N3
zz.zz s
TA 51.N3
eeeeeeee
F1M
MON I2T
ccc
F2M
TPOLO
x.xxx s
F3M
I2T kA²s
nnnn.nnn
RELAYS FUNCTION
OUTPUT RELAYS set-up
(fig. 5)
DIGITAL INPUTS
DIGITAL INPUTS set-up
(fig. 5)
J1
CONFIRM PROG?
To fig. 6

Figure 4

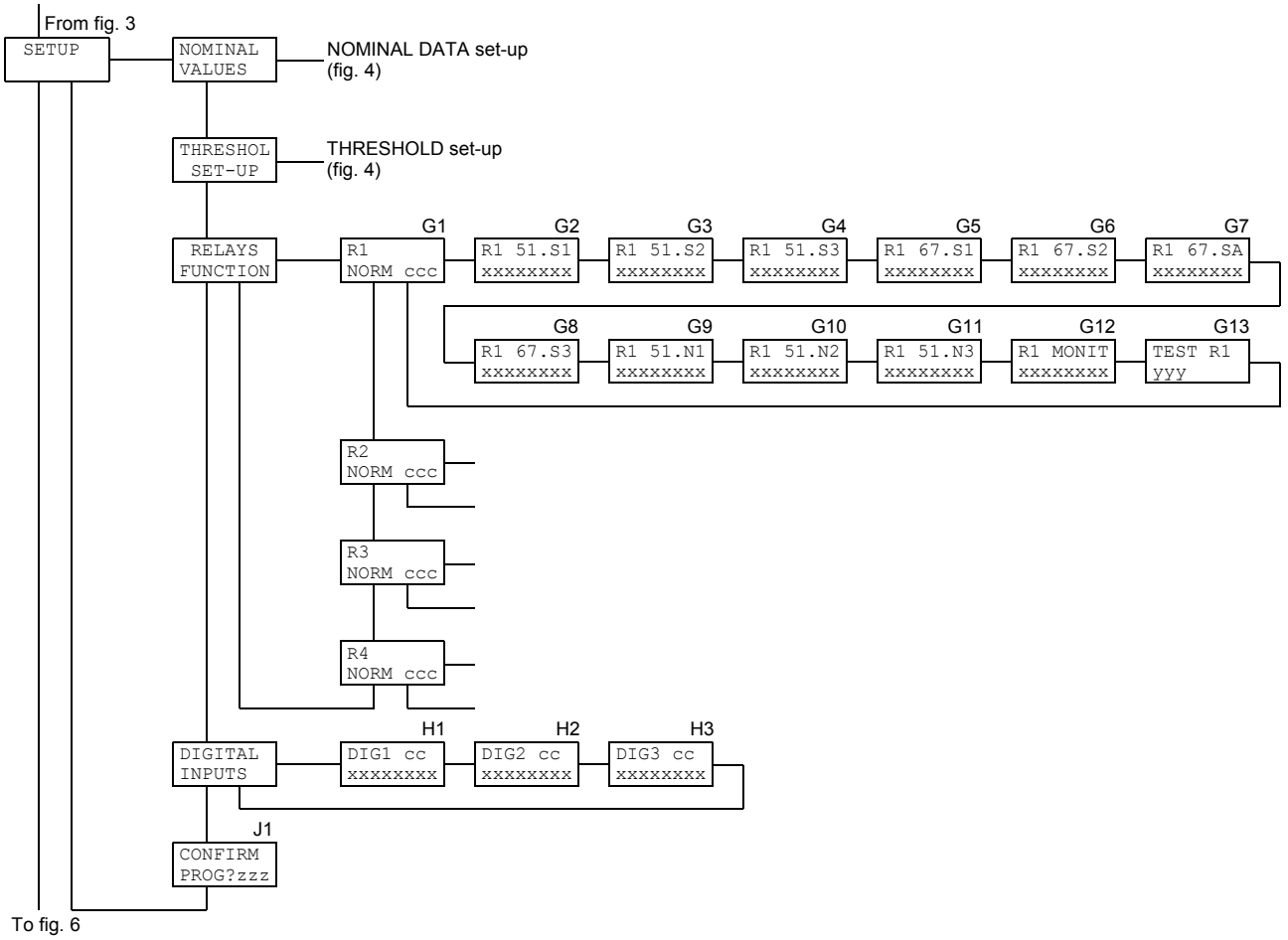

From fig. 3
SETUP
NOMINAL VALUES
NOMINAL DATA set-up (fig. 4)
THRESHOL SET-UP
THRESHOLD set-up (fig. 4)
RELAYS FUNCTION
G1
R1 NORM ccc
G2
R1 51.S1 xxxxxxxx
G3
R1 51.S2 xxxxxxxx
G4
R1 51.S3 xxxxxxxx
G5
R1 67.S1 xxxxxxxx
G6
R1 67.S2 xxxxxxxx
G7
R1 67.SA xxxxxxxx
G8
R1 67.S3 xxxxxxxx
G9
R1 51.N1 xxxxxxxx
G10
R1 51.N2 xxxxxxxx
G11
R1 51.N3 xxxxxxxx
G12
R1 MONIT xxxxxxxx
G13
TEST R1 yyy
R2 NORM ccc
R3 NORM ccc
R4 NORM ccc
DIGITAL INPUTS
H1
DIG1 cc xxxxxxxx
H2
DIG2 cc xxxxxxxx
H3
DIG3 cc xxxxxxxx
J1
CONFIRM PROG?zzz
To fig. 6

Figure 5

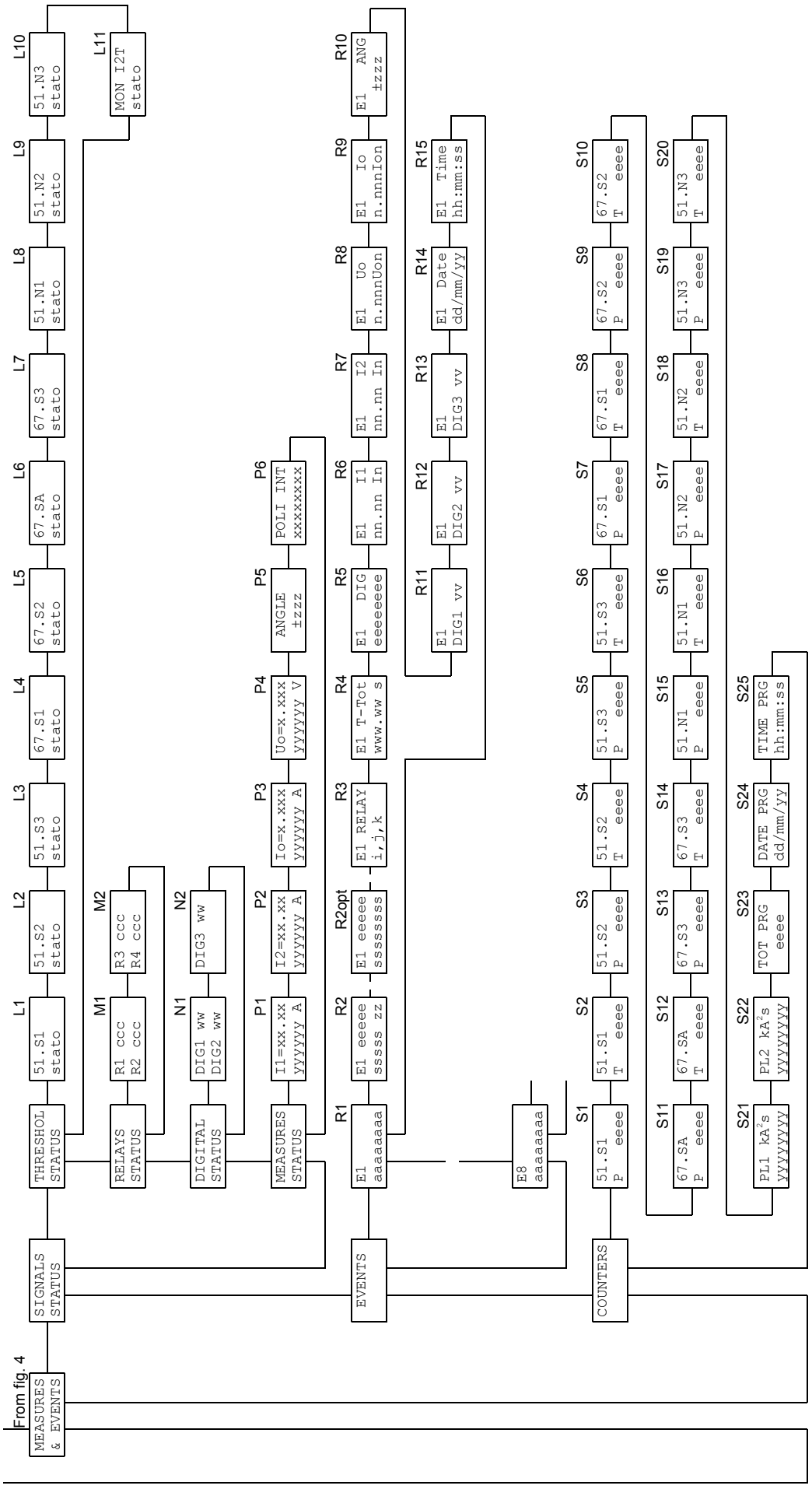

From fig. 4
MEASURES & EVENTS
SIGNALS STATUS
THRESHOL STATUS
L1 51.S1 stato
L2 51.S2 stato
L3 51.S3 stato
L4 67.S1 stato
L5 67.S2 stato
L6 67.SA stato
L7 67.S3 stato
L8 51.N1 stato
L9 51.N2 stato
L10 51.N3 stato
L11 MON I2T stato
RELAYS STATUS
M1 R1 ccc R2 ccc
M2 R3 ccc R4 ccc
DIGITAL STATUS
N1 DIG1 ww DIG2 ww
N2 DIG3 ww
MEASURES STATUS
P1 I1=xx.xx yyyyyy A
P2 I2=xx.xx yyyyyy A
P3 Io=x.xxx yyyyyy A
P4 Uo=x.xxx yyyyyy V
P5 ANGLE ±zzz
P6 POLI INT xxxxxxxx
EVENTS
R1 E1 aaaaaaaa
R2 E1 eeeee sssss zz
R2opt E1 eeeee ssssssss
R3 E1 RELAY i,j,k
R4 E1 T-Tot www.ww s
R5 E1 DIG eeeeeeee
R6 E1 I1 nn.nn In
R7 E1 I2 nn.nn In
R8 E1 Uo n.nnnUon
R9 E1 Io n.nnnIon
R10 E1 ANG ±zzz
E8 aaaaaaaa
R11 E1 DIG1 vv
R12 E1 DIG2 vv
R13 E1 DIG3 vv
R14 E1 Date dd/mm/yy
R15 E1 Time hh:mm:ss
COUNTERS
S1 51.S1 P eeee
S2 51.S1 T eeee
S3 51.S2 P eeee
S4 51.S2 T eeee
S5 51.S3 P eeee
S6 51.S3 T eeee
S7 67.S1 P eeee
S8 67.S1 T eeee
S9 67.S2 P eeee
S10 67.S2 T eeee
S11 67.SA P eeee
S12 67.SA T eeee
S13 67.S3 P eeee
S14 67.S3 T eeee
S15 51.N1 P eeee
S16 51.N1 T eeee
S17 51.N2 P eeee
S18 51.N2 T eeee
S19 51.N3 P eeee
S20 51.N3 T eeee
S21 PL1 kA²s yyyyyyyy
S22 PL2 kA²s yyyyyyyy
S23 TOT PRG eeee
S24 DATE PRG dd/mm/yy
S25 TIME PRG hh:mm:ss

Figure 6

5.3 Address and time (fig. 3)

B1 - RELAY MODEL (not programmable)

```
IFD4N
mod nn
```

Models: nn = A1 (nominal earth fault current = 1 A)
nn = A5 (nominal earth fault current = 5 A)

The nominal phase current is programmable 1 A or 5 A.

B2 - COMMUNICATION PROTOCOL (programmable)

B2

```
PROTOCOL
xxxxxxxx
```

The communication protocol is programmable between the followings:

STANDARD:	ASCII SEB protocol
MODBUS:	Modbus 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 - SOFTWARE REVISION LEVEL (not programmable)

```
SW REV
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.

NOTE: the clock is not provided with back-up battery, therefore a loss of auxiliary supply will force time/date to the following condition:

```
01/01/90
00:00:00
```

5.4 Protection function selection (fig. 3)

C1 - FUNCTION SELECTION (programmable)

```
FUNC xxx
xxxxxxxx
```

It allows to select, between the various possibilities offered by the protection relay, the required functions, as specified in chapter 1. The selection is done through a list of possible combinations.

Settings related to functions that are not enabled by this selection, are not displayed in the remaining parts of the interface, similar considerations apply to the measures.

D1 - DIRECTIONAL EARTH FAULT OPERATING MODE (programmable)

```
DIRECT.
xxxxxxxx
```

This setting is accessible only if you have enabled the directional earth fault protection (67) in item C1.

The function selection defines the available thresholds:

FUNCTION	SELECTION	ACTIVE THRESHOLDS
Directional earth-fault with 3 independent thresholds (ENEL DV63)	EARTH 1	67.S1, 67.S2, 67.S3
Directional earth-fault with non-operating zone around the origin (ENEL DV1001)	EARTH 2	67.SA, 67.S3

Examples:

```
DIRECT.
EARTH 1
```

```
DIRECT.
EARTH 2
```

5.5 Nominal values set-up (fig. 2)

E1 - NOMINAL CURRENT SELECTION - In and Ion (programmable)

In = x A Ion= 1 A	In = x A Ion= 5 A

In nominal phase current programmable 1 A or 5 A
Ion nominal earth current (defined by models - manufacturer set-up – see B1)

Ion = 5 A: IFD4N model A5 Ion = 1 A: IFD4N model A1

E2 - NOMINAL VOLTAGE SELECTION - Uon (programmable)

Uon = xxx.xx V

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

57.73 - 63.50 - 72.16 - 100 - 110 – 125 V

E3 - E4 - PRIMARY PHASE AND EARTH CT's VALUE (programmable)

E3	**E4**
In prim xxxxx A	Ion prim xxxxx A

In prim Primary current value of the installed phase CTs
Ion prim Primary current value of the installed earth CT

The primary value of phase and earth CT is programmable from 0001 to 18500 A.

E5 - PRIMARY VT's VOLTAGE (programmable)

V prim xxxxxx V

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

E6 - 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 has been detected by the self-diagnosis module; the available selections are the following:

ANSI	ANSI code of the selected functions (ref. C1)
I1	displays measured phase current I1
I2	displays measured phase current I2

Io	displays measured earth current Io
Uo	displays measured residual voltage Uo
ANGLE	displays measured angle between residual voltage and earth current

The list of available selection is according to the setting FUNCTION SELECTION (ref. C1)

Examples:

DISPLAY ANSI	DISPLAY Io	DISPLAY ANGLE

E7 - DISPLAY CONTRAST LEVEL (programmable)

CONTRAST LEV 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.

5.6 Thresholds and time delays set-up (fig. 4)

In the programming session are displayed only the thresholds available depending on FUNCTION SELECTION set-up (ref. C1).

5.6.1 Overcurrent set-up 51 (fig. 4)

The information and set-ups related to threshold 51.S1 in the following points (references F1S÷F6S) are effective for the thresholds 51.S2 and 51.S3, just taking into consideration the change of the threshold identification (with limits as presented in table A).

F1S - ON / OFF THRESHOLD (programmable)

51.S1 ccc

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

F2S - THRESHOLD LEVEL SET-UP (programmable)

51.S1 nn.nn In

nn.nn threshold level expressed in terms of relative values (In)

Examples:

51.S1 00.50 In	51.S1 02.00 In

F3S - THRESHOLD LEVEL IN PRIMARY VALUES (not programmable)

51.S1 xxxxxx A

The programmed threshold (ref. F2S) is shown in terms of primary current; the value depends on the programmed CTs primary values (ref. E3 – paragraph 5.5).

51.S1 threshold identification (51.S1, 51.S2 or 51.S3)
xxxxxx: threshold level expressed in Amperes (primary values)

F4S - TIME DELAY SET-UP (programmable)

```
TI eeeee
xx.xx s
```

Set-up of the time-delay to the activation (TRIP) of the programmed output relays when the **51.S1** directional threshold operates.

Parameter TI eeeee: time delay characteristic

For the **51.S1** threshold the time delay can be selected between one of the followings:

INDIP	definite time delay
DIP=A	time delay as curve A IEC 255-4 (inverse time)
DIP=B	time delay as curve B IEC 255-4 (very inverse time)
DIP=C	time delay as curve C IEC 255-4 (extremely inverse time)

For the thresholds 51.S2 and 51.S3 the TI parameter is fixed as INDIP (definite time).

Parameter xx.xx:

Time definite - time delay (seconds) to activate the programmed output relays: the output relay trips when the measured current exceeds the threshold level (programmable from 00.02 to 99.99 s).

Time dependent - value of the parameter K (see formulas at chapter 7).

```
TI DIP=B
02.50 K
```

```
TI DIP=A
10.00 K
```

```
TI INDIP
03.25 s
```

NOTE: the index “K” or “s” is shown coherently to the selected time-delay characteristic when the push-button ENTER is pressed.

F5S - ADDITIONAL TIME DELAY SET-UP (programmable)

The selection is displayed only when a DEFINITE TIME characteristic has been selected (TI INDIP at ref. F4S); when TIME DEPENDENT characteristic has been programmed, the selection will not be displayed.

```
TA 51.S1
xx.xx s
```

The additional time delay TA is programmable from 00.00 to 99.99 seconds; please note that at least one of the digital inputs should be programmed to activate the time delay function (ref. H1, H2, H3 - par. 5.8).

The additional time delay TA is added to the time delay TI to obtain the output relay trip when the TI+TA time expires.

The additional time delay TA will be added if the time delay TI is programmed at least equals to 50 ms (digital input acquisition time - 40 ms)

F6S - DIGITAL INPUT ACTIVE ON THRESHOLD (not programmable)

```
TA 51.S1
eeeeeeee
```

It shows the digital input programmed to activate the additional time delay TA on the displayed threshold.

The parameter **eeeeeeee** can show one of the following values:

DISABLED	none of the digital inputs has been programmed to activate an additional time delay related to threshold 51.S1
DIG1	digital input DIG1 activates the TA delay on threshold 51.S1
DIG2	digital input DIG2 activates the TA delay on threshold 51.S1
DIG3	digital input DIG3 activates the TA delay on threshold 51.S1

When a TIME DEPENDENT characteristic threshold has been programmed, the visualization is omitted as no additional time delays can be defined and programmed on time dependent delays.

More than one digital input can activate the same additional time delay (e.g. DIG 1,3).

Please note that to activate the additional time delay at least one of the digital inputs should be programmed (ref. H1, H2, H3 - par. 5.8).

5.6.2 Directional earth fault set-up 67 (fig. 4)

According to the directional earth fault operating mode (ref. D1), the following thresholds are available:

Directional earth fault operating mode	EARTH 1	thresholds 67.S1, 67.S2, 67.S3
Directional earth fault operating mode	EARTH 2	thresholds 67.SA, 67.S3

The information and set-ups related to threshold 67.S1 in the following points are effective for the thresholds 67.S2 and 67.S3 and, as applicable, for threshold 67.SA, just taking into consideration the change of the threshold identification.

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

F1T - ON / OFF THRESHOLD (programmable)

```
67.S1
ccc
```

ccc ON - enabled threshold

OFF - disabled threshold (available but not active)

F2T - CURRENT THRESHOLD LEVEL SET-UP (programmable)

```
67.S1 I
n.nnn Io
```

n.nnn Threshold level referred to the earth current nominal value (Ion)

Examples:

```
67.S1 I
0.050 Io
```

```
67.S1 I
0.150 Io
```

F3T - VOLTAGE THRESHOLD LEVEL SET-UP (programmable)

```
67.S1 U
n.nnn Uo
```

n.nnn Threshold level referred to the residual voltage nominal value (Uon)

Examples:

```
67.S1 U
0.050 Uo
```

```
67.S1 U
0.200 Uo
```

F4T - F5T - ANGULAR SECTOR THRESHOLD SET-UP (programmable)

F4T

```
67.S1 Φ
   ±nnn°
```

F5T

```
67.S1 DΦ
   nnn°
```

nnn threshold parameters expressed in degree (ref. paragraph 1.1)

Φ characteristic angle (programmable from -180° to +180°)

DΦ sector width (programmable from 015° to 180°)

Please use the right arrow push-button to select the sign or the digit to be modified and the down arrow push-button to select the parameter to be modified.

Examples:

```
67.S1 Φ
  +090°
```

```
67.S1 DΦ
  075°
```

NOTE When a sector width **DΦ** is defined equal to 180° the related threshold **Φ<** becomes NOT-directional and it will be sensible only to the earth current threshold (the overvoltage threshold **Us>** will be indifferent) as ANSI 51N.

F6T - TIME DELAY SET-UP (programmable)

```
TI eeeee
xx.xx s
```

Set-up of the time-delay to the activation (TRIP) of the programmed output relays when the **67.S1** directional threshold operates.

Parameter TI eeeee: time delay characteristic

For the **67.S1** threshold the time delay can be selected between one of the followings:

INDIP	definite time delay
DIP=A	time delay as curve A IEC 255-4 (inverse time)
DIP=B	time delay as curve B IEC 255-4 (very inverse time)
DIP=C	time delay as curve C IEC 255-4 (extremely inverse time)

For the thresholds 67.S2 and 67.S3 and 67.SA the TI parameter is fixed as INDIP (definite time).

Parameter xx.xx:

Time definite - time delay (seconds) to activate the programmed output relays: the output relay trips when the measured current exceeds the threshold level (programmable from 00.02 to 99.99 s).

Time dependent - value of the parameter K (see formulas at chapter 7).

TI DIP=B 02.50 K	TI DIP=A 10.00 K	TI INDIP 03.25 s

NOTE: the index “K” or “s” is shown coherently to the selected time-delay characteristic when the push-button ENTER is pressed.

F7T - ADDITIONAL TIME DELAY SET-UP (programmable)

The selection is displayed only when a DEFINITE TIME characteristic has been selected (TI INDIP at ref. F6T); when TIME DEPENDENT characteristic has been programmed, the selection will not be displayed.

TA 67.S1 xx.xx s

The additional time delay TA is programmable from 00.00 to 99.99 seconds; please note that at least one of the digital inputs should be programmed to activate the time delay function (ref. H1, H2, H3 - par. 5.8).

The additional time delay TA is added to the time delay TI to obtain the output relay trip when the TI+TA time expires.

The additional time delay TA will be added if the time delay TI is programmed at least equals to 50 ms (digital input acquisition time - 40 ms)

F8T - DIGITAL INPUT ACTIVE ON THRESHOLD (non programmable)

```
TA 67.S1
eeeeeeee
```

It shows the digital input programmed to activate the additional time delay TA on the displayed threshold.

The parameter eeeeeeee can show one of the following values:

DISABLED	none of the digital inputs has been programmed to activate an additional time delay related to the threshold 67.S1
DIG1	digital input DIG1 activates the TA delay on threshold 67.S1
DIG2	digital input DIG2 activates the TA delay on threshold 67.S1
DIG3	digital input DIG3 activates the TA delay on threshold 67.S1

When a TIME DEPENDENT characteristic threshold has been programmed the visualization is omitted as no additional time delays can be defined and programmed on time dependent delays.

More than one digital input can activate the same additional time delay (e.g. DIG 1,3).

Please note that to activate the additional time delay at least one of the digital inputs should be programmed (ref. H1, H2, H3 - par. 5.8).

5.6.3 Set-up threshold 67.SA (fig. 4)

F1TA - ON / OFF THRESHOLD (programmable)

```
67.SA
ccc
```

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

F2TA - F3TA - CURRENT THRESHOLD LEVEL SET-UP (programmable)

```
67.SA I1
n.nnn Io
```

```
67.SA I2
n.nnn Io
```

n.nnn Threshold level referred to the earth current nominal value (Ion)

Examples:

```
67.SA I1
0.050 Io
```

```
67.SA I2
0.100 Io
```

NOTE The threshold level **67.SA I2** must be greater or equal to the threshold level **67.SA I1**; if the condition is not verified, an error message will be displayed.

F4TA - F5TA - OVERVOLTAGE THRESHOLDS LEVEL SET-UP (programmable)

67.SA U1	67.SA U2
n.nnn Uo	n.nnn Uo

n.nnn Threshold level referred to the residual voltage nominal value (Uon)

Examples:

67.SA U1	67.SA U2
0.500 Uo	0.100 Uo

NOTE The threshold level **67.SA U1** must be greater or equal to the threshold level **67.SA U2**; if the condition is not verified, an error message will be displayed.

For further parameters settings, please see paragraph 5.6.2.

You have to keep in mind that, similar to what we saw in that paragraph, when the sector width (DΦ) is programmed with 180 degrees, the threshold becomes NOT-directional, sensitive only to the minimum value of earth current thresholds (the residual overvoltage threshold 67.SA U1 and 67.SA U2 will be indifferent) that undermines the potential of the functional mode EARTH 2.

Therefore we recommend to use the threshold 67.S3 as NOT-directional threshold or to select the functional mode EARTH 1.

5.6.4 Overcurrent earth set-up 51N (fig. 4)

The information and set-ups related to threshold **51.N1** in the following points (references F1N÷F6N) are effective also for the thresholds 51.N2 and 51.N3 just taking into consideration the change of the threshold identification (with limits as presented in table A).

F1N - ON / OFF THRESHOLD (programmable)

51.N1
ccc

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

F2N - THRESHOLD LEVEL SET-UP (programmable)

51.N1
n.nnn Io

n.nnn threshold level expressed in terms of relative values (Ion)

Examples:

51.N1	51.N1
0.050 Io	2.000 Io

F3N - THRESHOLD LEVEL IN PRIMARY VALUES (not programmable)

```
51.N1
xxxxxx A
```

The programmed threshold (ref. F2N) is shown in terms of primary current; the value depends on the programmed earth CT primary values (ref. E4 par. 5.5).

F4N - TIME DELAY SET-UP (programmable)

```
TI eeeee
xx.xx s
```

Set-up of the time-delay to the activation (TRIP) of the programmed output relays when the **51.N1** directional threshold operates.

Parameter TI eeeee: time delay characteristic

For the **51.N1** threshold the time delay can be selected between one of the followings:

INDIP	definite time delay
DIP=A	time delay as curve A IEC 255-4 (inverse time)
DIP=B	time delay as curve B IEC 255-4 (very inverse time)
DIP=C	time delay as curve C IEC 255-4 (extremely inverse time)

For the thresholds 51.N2 and 51.N3 the TI parameter is fixed as INDIP (definite time).

Parameter xx.xx:

Time definite - time delay (seconds) to activate the programmed output relays: the output relay trips when the measured current exceeds the threshold level (programmable from 00.02 to 99.99 s).

Time dependent - value of the parameter K (see formulas at chapter 7).

```
TI DIP=B
02.50 K
```

```
TI DIP=A
10.00 K
```

```
TI INDIP
03.25 s
```

NOTE: the index “K” or “s” is shown coherently to the selected time-delay characteristic when the push-button ENTER is pressed.

F5N - ADDITIONAL TIME DELAY SET-UP (programmable)

The selection is displayed only when a DEFINITE TIME characteristic has been selected (TI INDIP at ref. F4N); when TIME DEPENDENT characteristic has been programmed, the selection will not be displayed.

```
TA 51.N1
xx.xx s
```

The additional time delay TA is programmable from 00.00 to 99.99 seconds; please note that at least one of the digital inputs should be programmed to activate the time delay function (ref. H1, H2, H3 - par. 5.8).

The additional time delay TA is added to the time delay TI to obtain the output relay trip when the TI+TA time expires.

The additional time delay TA will be added if the time delay TI is programmed at least equals to 50 ms (digital input acquisition time - 40 ms)

F6N - DIGITAL INPUT ACTIVE ON THRESHOLD (not programmable)

```
TA 51.N1
eeeeeeee
```

It shows the digital input programmed to activate the additional time delay TA on the displayed threshold.

The parameter **eeeeeeee** can show one of the following values:

DISABLED	none of the digital inputs has been programmed to activate an additional time delay related to threshold 51.N1
DIG1	digital input DIG1 activates the TA delay on threshold 51.N1
DIG2	digital input DIG2 activates the TA delay on threshold 51.N1
DIG3	digital input DIG3 activates the TA delay on threshold 51.N1

When a TIME DEPENDENT characteristic threshold has been programmed, the visualization is omitted as no additional time delays can be defined and programmed on time dependent delays.

More than one digital input can activate the same additional time delay (e.g. DIG 1,3).

Please note that to activate the additional time delay at least one of the digital inputs should be programmed (ref. H1, H2, H3 - par. 5.8).

5.6.5 Pole wearing monitor programming (fig. 4)

The programming of the pole wearing index function will be presented only if the function 51 is selected (ref. C1 - par. 5.4).

F1M – POLE WEARING MONITOR FUNCTION ENABLED (programmable)

```
MON I2T
ccc
```

ccc ON – enabled function
OFF – disabled function

F2M – CIRCUIT BREAKER EXTINCTION TIME (programmable)

```
TPOLO
z.zzz s
```

z.zzz typical electric arc extinction time of the circuit breaker programmable 0.005 ÷ 9.999 seconds, resolution 0.001 sec.

F3M – POLE WEARING THRESHOLD (programmable)

```
I2T kA²s
xxxx.xxx
```

xxxx.xxx value of the pole wearing index to enable the signaling (excessive wearing of the circuit breaker poles)
programmable 0.000 ÷ 9999.999 kA^2s, resolution 0.001 kA^2s

5.7 Output relays programming (fig. 5)

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

In the programming session are displayed only the thresholds available depending on FUNCTION SELECTION set-up (ref. C1 – paragraph 5.4).

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

G1 - 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 currents exceed their thresholds).

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

G2 - OUTPUT RELAY R1 ACTIVATION ON THRESHOLD 51.S1 STATUS (programmable)

```
R1 51.S1
xxxxxxxx
```

Programming of the R1 output relay activation (START/TRIP/NONE) when one of the phase currents exceeds the programmed threshold 51.S1.

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

START instantaneous output relay R1 activation when one of the measured phase currents exceeds the programmed threshold 51.S1

TRIP output relay R1 activation when one of the measured phase currents exceeds the programmed threshold level 51.S1 for at least TI or TI+TA seconds

NONE no activation related to threshold 51.S1

G3 ÷ G11 - OUTPUT RELAY ACTIVATION ON THRESHOLD 51.S2, 51.S3, 67.S1, 67.S2, 67.SA, 67.S3, 51.N1, 51.N2, 51.N3 (programmable)

Examples:

R1 51.S2
xxxxxxxx

R1 67.SA
xxxxxxxx

R1 51.N3
xxxxxxxx

Programming of the output relay activation (START / TRIP / NONE) for thresholds 51.S2, 51.S3, 67.S1, 67.S2, 67.SA, 67.S3, 51.N1, 51.N2, 51.N3 (as threshold 51.S1 - ref. G2).

G12 – RELAY ACTIVATION ON POLE WEARING MONITOR (programmable)

R1 MONIT
xxxxxxxx

The parameter **xxxxxxxx** is selectable between:

TRIP output relay R1 activation on excessive POLE WEARING condition

NONE no activation on POLE WEARING MONITOR function

G13 – TEST OF OUTPUT RELAY R1

TEST R1
xxxxxxxx

See paragraph 4.2

5.8 Digital inputs function programming (fig. 5)

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

a) additional time delay (related to one or more thresholds - only time definite threshold)

b) ON / OFF threshold

c) STATUS function (recording of measures on external command)

d) pilot wire fault monitoring (only DIG2 monitors DIG1).

When function a) is programmed, a message is displayed at F6S reference for thresholds 51.S1, 51.S2 e 51.S3, at F8T reference for thresholds 67.S1, 67.S2, 67.SA e 67.S3, and at F6N reference for thresholds 51.N1, 51.N2 e 51.N3.

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

a) OF selection (threshold disabled) has the priority on TA function (additional time delay)

b) the ALL selection (ALL the thresholds) has the priority on single threshold selection.

H1 - 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; the following functions are selectable (only the active thresholds are presented - ref. C1):

NONE	no functions active related to digital input DIG1
TA 51.S1	additional time delay on threshold 51.S1
TA 51.S2	additional time delay on threshold 51.S2
TA 51.S3	additional time delay on threshold 51.S3
TA 67.S1	additional time delay on threshold 67.S1
TA 67.S2	additional time delay on threshold 67.S2
TA 67.SA	additional time delay on threshold 67.SA
TA 67.S3	additional time delay on threshold 67.S3
TA 51.N1	additional time delay on threshold 51.N1
TA 51.N2	additional time delay on threshold 51.N2
TA 51.N3	additional time delay on threshold 51.N3
TA ALL	additional time delay on all thresholds
OF 51.S1	threshold 51.S1 disabled
OF 51.S2	threshold 51.S2 disabled
OF 51.S3	threshold 51.S3 disabled
OF 67.S1	threshold 67.S1 disabled
OF 67.S2	threshold 67.S2 disabled
OF 67.SA	threshold 67.SA disabled
OF 67.S3	threshold 67.S3 disabled
OF 51.N1	threshold 51.N1 disabled
OF 51.N2	threshold 51.N2 disabled
OF 51.N3	threshold 51.N3 disabled
OF I2T	POLE WEARING MONITOR function disabled
OF ALL	all thresholds disabled
STATUS	activation of status function (see paragraph 1)

H2 - 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. H1) plus the following:

MONITOR	activation of pilot wire monitor function.

H3 - 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. H1).

5.9 Parameter values visualization (fig. 6)

L1 ÷ L11 – THRESHOLDS STATUS

The actual status of each threshold is displayed; only the thresholds available depending on FUNCTION SELECTION set-up are visualized (ref. paragraph 5.4).

For each threshold are displayed the threshold identification 51.S1, 51.S2 etc.) and the threshold status; the status can show one of the following values:

ON	active threshold
OFF	disabled threshold (programmed OFF at ref. F1S, F1T, F1N e F1M - see par. 5.6)
OFF_DIG	threshold programmed active but disabled by a digital input actual status (ref. H1, H2, H3 see par. 5.8).

Examples:

51.S1 ON	67.S2 ON	51.N3 OFF

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. G1)).

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 ÷ P6 - MEASUREMENT DISPLAY

The actual values of the measures and of the computed parameters are displayed (currents, voltages, phase angles); the parameters related to disabled thresholds are not displayed.

For each measure the following information is displayed:

measure identification (I1, I2, Io, Vo, ANGLE)
actual values expressed as Amperes, Volts and degrees

For the pole wearing monitor function the following information is displayed:

- OK circuit breaker pole wearing status lower than the programmed threshold
- USURATO circuit breaker pole wearing status higher than the programmed threshold

5.10 Events (fig. 6)

On the display are shown the memorized information related to the last 8 TRIP or STATUS events.

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

R1 - EVENT NUMBER

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:

NONE	no event memorized
51.S1	event on trip threshold 51.S1
51.S2	event on trip threshold 51.S2
51.S3	event on trip threshold 51.S3
67.S1	event on trip threshold 67.S1
67.S2	event on trip threshold 67.S2
67.S3	event on trip threshold 67.S3
67.SA	event on trip threshold 67.SA
51.N1	event on trip threshold 51.N1
51.N2	event on trip threshold 51.N2
51.N3	event on trip threshold 51.N3
I2T>	event on pole wearing monitor threshold I2T>
STATUS	information recorded on external command (ref. par. 1)
POWER ON	switch-on of the protection relay (auxiliary power)

For the events NONE and POWER ON no other information is presented: for the other events the following displays give more detailed information on the event.

R2 - R2opt PARAMETERS RELATED TO THE TRIP THRESHOLD

It shows the threshold related to the TRIP condition of the protection relay and the value of the threshold (in relative terms); depending on the threshold that has resulted in tripping, the number of screens required can vary from one (as in the case of thresholds 51 or 51N) to six (as in the case of 67.SA).

R3 - ACTIVATED OUTPUT RELAYS

```
E1 RELAY
nnnnnnn
```

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

Examples:

```
E1 RELAY
1,3,4
```

```
E3 RELAY
1,4
```

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

```
E1 RELAY
NONE
```

R4 - TOTAL TIME DELAY ON TRIP

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

It is shown the total delay to the TRIP of the output relays from the threshold pick up detection; when additional delays are activated, the change of the status of the digital input that controls the additional delay during the delay itself could bring to a total time different from the sum of the programmed delays. If the total time is greater than 999 seconds the display of tenths is omitted.

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

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

R5 - DIGITAL CHANNELS RELATED TO MEMORIZED EVENT

```
E1 DIG
1, 3
```

The list of the digital inputs related to the memorized event is displayed (STATUS function command or additional time TA enabled (ref. H1-H2-H3 - par. 5.8).

If no digital inputs were activated, the message NONE is displayed.

R6 ÷ R10 - MEMORIZED MEASURES ON EVENT

The values of the measures at the event are displayed (phase currents, earth current, residual voltage and angle between the earth current and the residual voltage); the values are expressed as relative terms (In, Ion and Uon), the angle between earth current and residual voltage is expressed in degrees.

R6

```
E3    I1
nn.nn In
```

R7

```
E3    I2
nn.nn In
```

R8

```
E3   Uo
n.nnnUon
```

R9

```
E3   Io
n.nnnIon
```

R10

```
E3  ANG
  ±nnn°
```

There are presented only the measures coherently with the selection on FUNCTION SELECTION set-up (ref. C1 – paragraph 5.4).

R11 - R12 - R13 - DIGITAL INPUTS STATUS ON EVENT

```
E1
DIG1  vv
```

```
E1
DIG2  vv
```

```
E1
DIG3  vv
```

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

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

R14 - R15 - DATE AND TIME OF THE EVENT

```
E1  Date
dd/mm/yy
```

```
E1  Time
hh:mm:ss
```

The date and time of the event are showed

5.11 Trip counters and pole wear index (fig. 6)

In this section are displayed the total and partial counters of the output relay activation (on TRIP conditions) for each threshold, the numbers of the programming sessions with the date and time of the last confirmed programming session and the actual value of the wearing index for each pole of the circuit breaker (expressed as kA^2s).

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

S1 ÷ S20 - TRIP COUNTERS

```
51.S1
P   cccc
```

```
51.S1
T   cccc
```

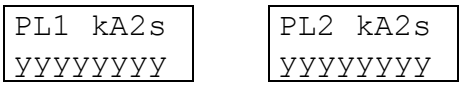
Display of the partial (P) and total (T) counters of the TRIP condition related to each threshold.

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

The counters are identified by the threshold name (51.S1, 51.S2, etc.); there are presented only the counters related to the active thresholds coherently with the selection on FUNCTION SELECTION set-up (ref. C1 – paragraph 5.4).

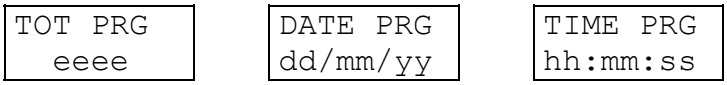
The partial counters are modifiable in the range from 0000 to 9999 following the standard set-up procedure (paragraph 4.2).

S21 ÷ S22 - POLE WEARING INDEX REGISTERS



Display of the wearing index registers of the poles of the circuit breakers; the content of each register is expressed as kA^2s; it is present a register for each pole of the circuit breaker.

S23 ÷ S25 - TOTAL PROGRAMMING SESSIONS AND DATE/TIME OF THE LAST PROGRAMMING SESSION



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

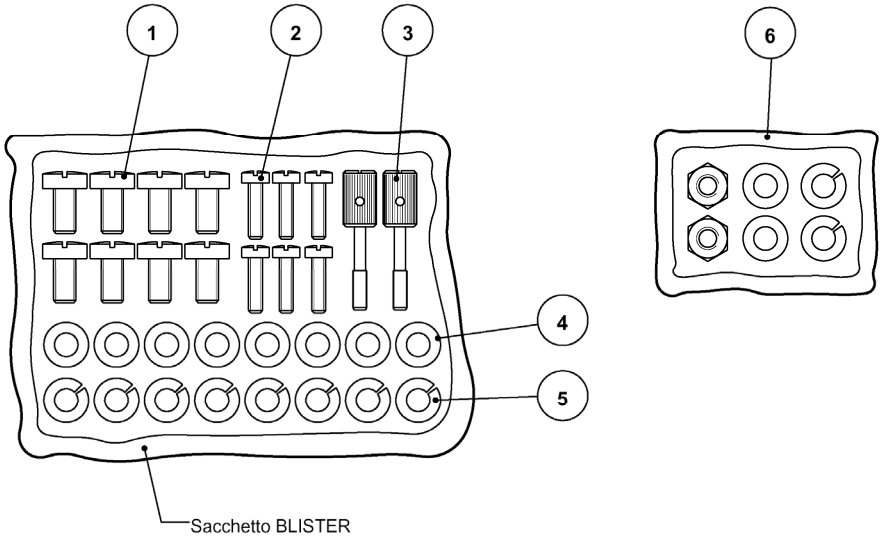
6.1 Supplied kit

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

- protection relay module IFD4N 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 IFD4N 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
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 current wire terminals
5) n° 8 growers to be used to fix current wire terminals
6) items to fix the brackets for flush mounting (only with CS version)

The knobs to fix the transparent front panel must be screwed through the panel the front panel itself; the operation will create a screw thread in the plastic material and the knobs will never be missed.

6.2 Cabling

Current circuits

It is suggested to terminate the current wirings using eyelet terminals.

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

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

I1	terminals A1 - A2
I2	terminals B1 - B2
Io	terminals D1 - D2

The terminal D1-D2 must to be connected to a CT sensible to earth currents.

Voltage circuits

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

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

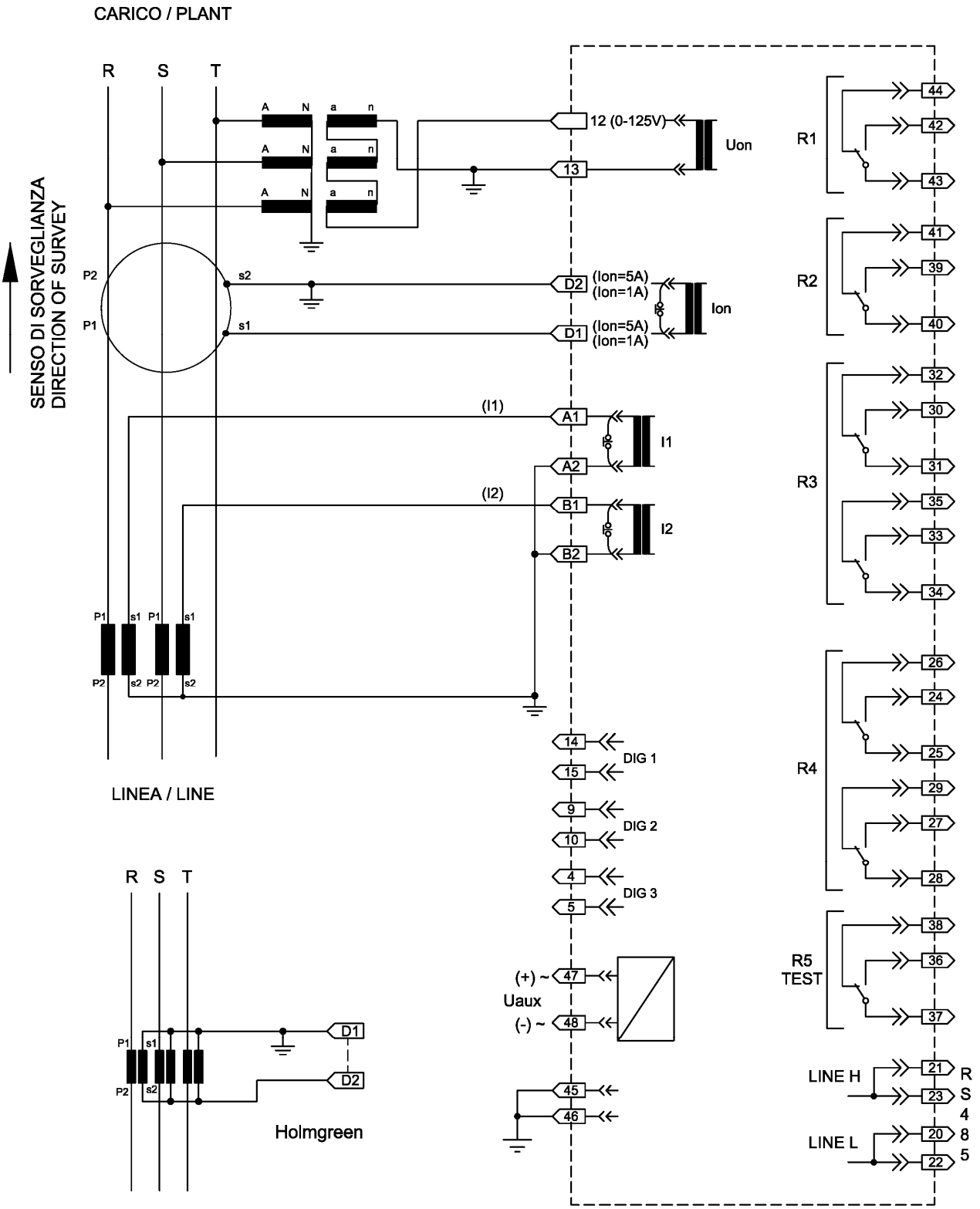
With reference to the insertion diagram in the next page, the voltages measured by the protection relay have the following matching:

Uo	terminals 12 - 13

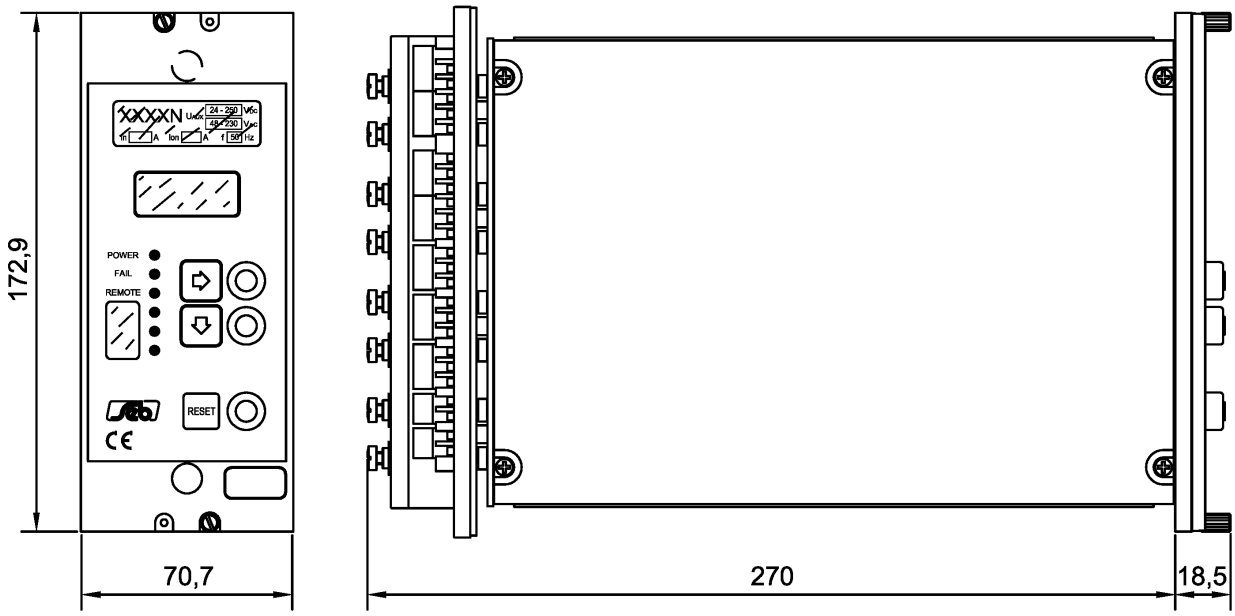
Other circuits (output relays etc.)

It is suggested to terminate the wiring using plug terminals.

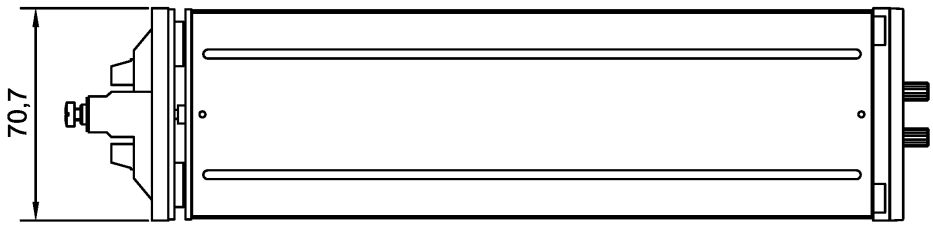
Minimum suggested wire cross section: 1,5 mm^2

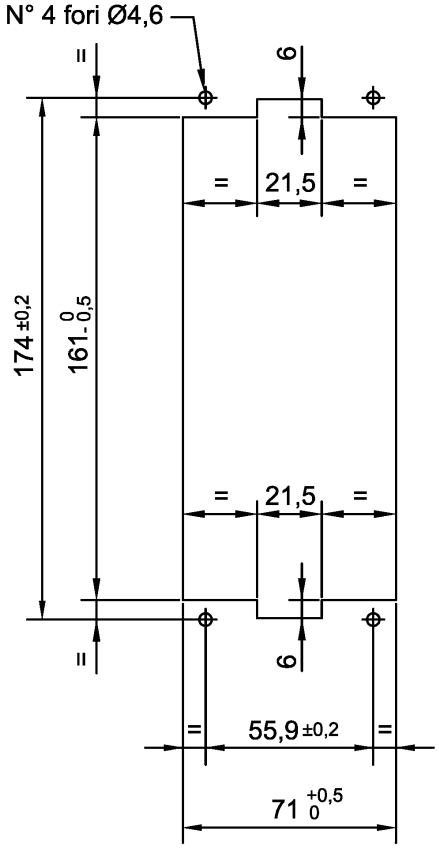

CARICO / PLANT
R S T
A N a n
SENSO DI SORVEGLIANZA
DIRECTION OF SURVEY
P2 P1 s2 s1
12 (0-125V)
13
Uon
D2 D1
(Ion=5A)
(Ion=1A)
Ion
(I1)
A1 A2
I1
(I2)
B1 B2
I2
P1 s1 P1 s1
P2 s2 P2 s2
LINEA / LINE
14 15 DIG 1
9 10 DIG 2
4 5 DIG 3
(+) ~ 47
Uaux
(-) ~ 48
45 46
R1 44 42 43
R2 41 39 40
R3 32 30 31 35 33 34
R4 26 24 25 29 27 28
R5 TEST 38 36 37
LINE H 21 23
LINE L 20 22
R S 4 8 5
R S T
P1 s1 P2 s2
D1 D2
Holmgreen

Insertion



Dimensioni meccaniche
Case outlines





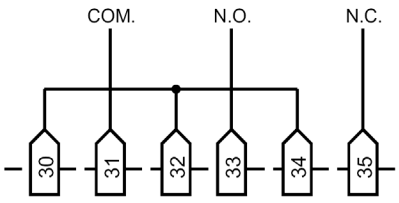
Dima montaggio da incasso
Flush mounting panel cut - out

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

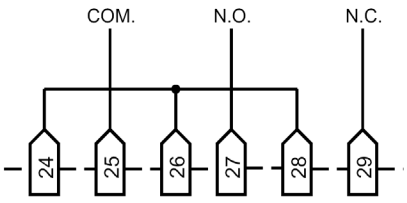
6.3 Relays R3 and R4 - Signaling / Command set-up

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

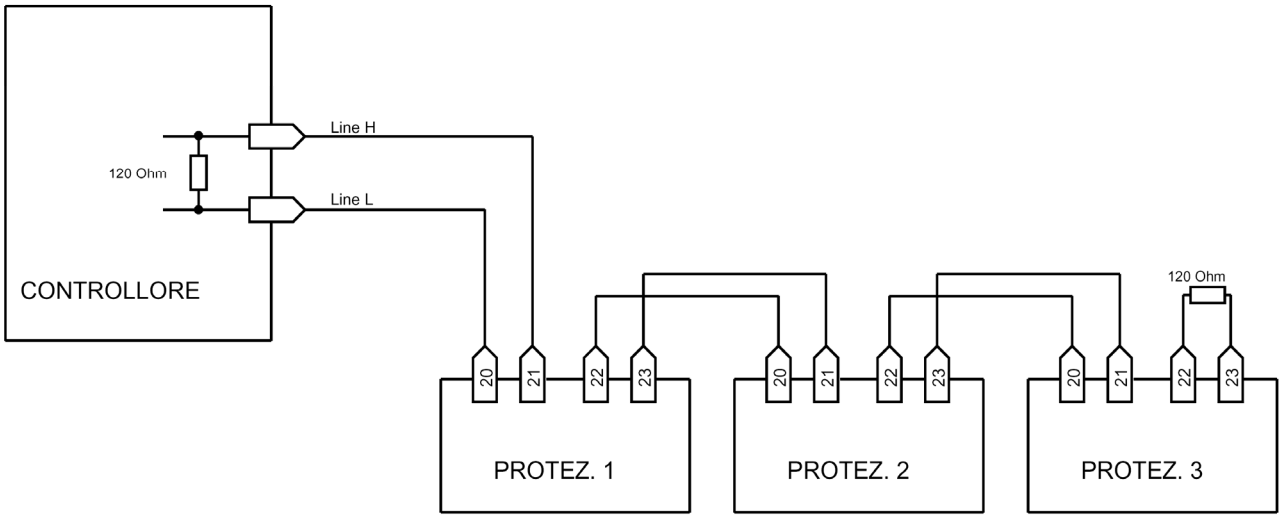
6.4 RS485 serial communication port

The digital protection relay IFD4N presents an insulated serial interface RS485 half-duplex that allow the multi-drop connection up to 31 protection units. There are available 2 selectable communication protocols (ref. B2 paragraph 5.3).

When the MODBUS communication protocol is selected, the transmission speed can be programmed between 300 to 9600 bauds (ref. B3, par. 5.3).

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.

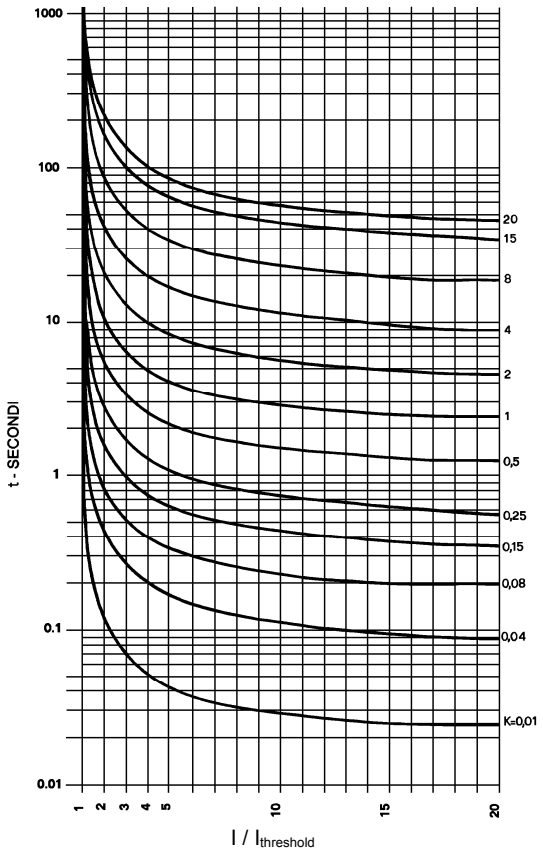
To integrate the protection relay in control systems, the documentation related to the protocol is freely available on request.



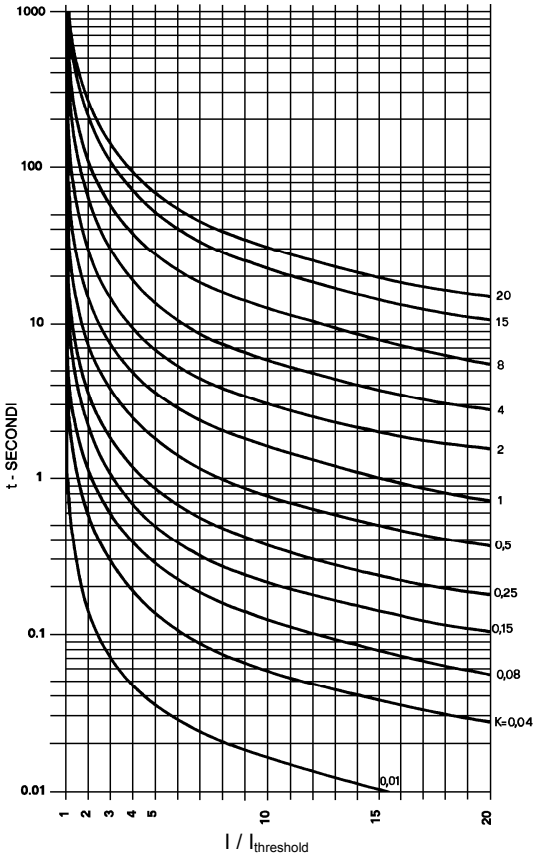
It is suggested to terminate the serial line with a resistance 120 Ω, 1/4 W.

7 TIME DEPENDENT CURVES

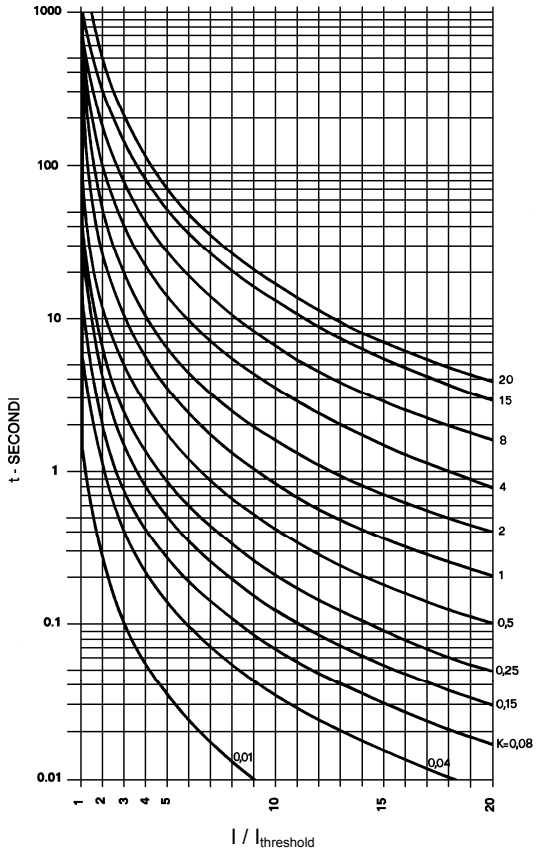
Curva - Curve A



Curva - Curve B



Curva - Curve C



Time dependent characteristic

$$t = \frac{Ki * K}{\left(\frac{I}{I_{soglia}}\right)^{\alpha} - 1} + 0.02s$$

Curve IEC 255-4	**A**	**B**	**C**
Ki	0.14	13.5	80
α	0.02	1	2
K	Parameter 0.01 ÷ 20.00 s		
I / $I_{threshold}$	Ratio between the greatest measured current and the threshold current		

8 TECHNICAL CHARACTERISTICS

Measuring inputs

Rated phase current (In)	1 A / 5 A programmable
Rated earth current (Ion)	1 A or 5 A
Thermal withstand continuously	4 In / Ion
Thermal withstand for 1 s	100 In / Ion
Rated residual voltage (Uon) programmable	57,73 - 63,50 - 72,16 - 100 - 110 - 125 V
Thermal withstand continuously	2 Un
Thermal withstand for 1 s	2 Un
Rated frequency	50 / 60 Hz
Primary CT's current	1 ÷ 18500 A
Primary VT's voltage	1 ÷ 999999 V

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	RS-485 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	IP 52
(optional)	(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

9 TABLES

Table A Thresholds and time delays

THRESHOLDS		**DIRECTIONAL EARTH FAULT 67**
		ON / OFF
Is	Setting Resolution	0.002 ÷ 5.000 Ion 0.001 Ion
Us	Setting Resolution	0.004 ÷ 1.000 Uon 0.001 Uon
Characteristic angle Φ	Setting Resolution	-180° ÷ +180° 1°
Sector width DΦ	Setting Resolution	15° ÷ 180° 1°
THRESHOLDS		**PHASE OVERCURRENT 51** **EARTH FAULT OVERCURRENT 51N**
		ON / OFF
51.S1	Setting Resolution	0.1 ÷ 5.00 In 0.01 In
51.S2, 51.S3	Setting Resolution	0.1 ÷ 40.00 In 0.01 In
51.N1	Setting Resolution	0.002 ÷ 5.000 Ion 0.001 Ion
51.N2, 51.N3	Setting Resolution	0.002 ÷ 9.999 Ion 0.001 Ion
THRESHOLD		**POLE WEARING INDEX**
		ON / OFF
Pole wearing index	Setting Resolution	0.0 ÷ 9999.999 kA^2s 0.001 kA^2s
TPolo (Circuit breaker opening time)	Setting Resolution	0.0 ÷ 9.999 s 0.001 s
Time delays		
Definite time	Setting Resolution	0.02 ÷ 99.99 s 0.01 s
Dependent time (only 51.S1 - 67.S1 - 51.N1)	Characteristic Curve (as IEC 255-4)	A, B, C
	Characteristic constant Resolution	0.01 ÷ 20 s 0.01 s
Drop-off ratio		≥ 0.95
Hysteresis of directional detection		≤ 3°
Overshoot time		≤ 30 ms
Burden referred to rated value		0.3 VA

Output relay R1, R2, R3, R4	Programmable for each threshold START / TRIP and normally ON / OFF
Additional delay	0.00 ÷ 99.99 s

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