DIVISIONE ELETTRONICA E SISTEMI

IDG8N

DIGITAL PERCENTAGE BIASED GENERATOR DIFFERENTIAL PROTECTION RELAY

USER MANUAL

P501D806 **September 2004**

INDEX

1 GENERAL CHARACTERISTICS

The protection relay IDG8N performs function as three-poles percentage biased generator differential protection relay (ANSI 87G) and/or selective earth fault protection relay (ANSI 64Ss); the user can select one of the functions listed in the table below.

FUNCTIONS	ANSI
Three-poles percentage biased differential protection for generators or motors	87G
Selective earth fault protection (percentage biased differential)	64Ss

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 following thresholds are available:

- 1 differential percentage biased threshold (two branches)
- 1 absolute value differential threshold
- 1 earth-fault differential percentage biased threshold (two branches)
- 1 absolute value earth-fault differential threshold

The tripping characteristic for each threshold is presented in figure A.

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

TRIP DELAYS - All the thresholds are time definite and each threshold time delay TI can be combined with an additional time delay (TA); the additional time delay is added to time delay TI. The additional time delay activation is controlled by the digital inputs.

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

OUTPUT RELAYS - the IDG8N 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 current or parameter exceeds the programmed threshold value

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 6 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 digital input 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 differential current or of a stabilizing current (primary values or relative values); all the measured currents 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 currents, 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 currents 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 visualize the relay set-up but changes of parameters are disabled (ENTER and ⊕ buttons disabled).

1.1 Operation of the differential thresholds

The IDG8N relay performs functions as percentage biased differential protection relay; the tripping characteristic for the ANSI 87G function (equivalent characteristic applies to ANSI 64Ss) is presented in figure A.

A differential protection relay operates on the principle of current comparison and with a healthy protected object the current leaving is the same as that which entered it. Any measured current difference is a clear indication of a fault condition within the protected zone.

The digital percentage biased generator differential relay can be used to protect high voltage cables (maximum length about 1 km); it **cannot be used** as transformer differential protection relay and for this application please refer to IDT8N model (transformer differential protection relay).

Id - differential current - vectorial difference between the input current and the output current of the protected object

$$\left|Id_1\right| = \left|I_{1'} - I_{1''}\right|$$

Three differential current values are computed, one for each phase; the differential thresholds are verified for each differential current.

Ia - stabilizing current - half-sum of the vectors of the input and output currents of the protected object used to stabilize the protection relay operations in presence of faults external to the protected zone.

$$\left|Ia_1\right| = \frac{\left|I_{1'} + I_{1''}\right|}{2}$$

When short-circuit currents due to faults external to the protected zone are flowing through the protected object it is possible to have measured differential currents due to current transformer errors or saturation. The stabilizing current is used to stabilize the protection relay operation in these conditions.

Differential thresholds
Two differential thresholds are available:

Id> percentage biased differential threshold

Id>> second differential threshold (absolute value)

The relay operates when:

threshold Id>> the following disequation is verified

$$|Id| \geq Id >>$$

threshold Id> ALL the following disequations are verified:

$$|Id| \geq Ib >$$

$$|Id| \geq (P1 * |Ia|)$$

$$|Id| \geq (P2 * |Ia| - DI)$$

where:

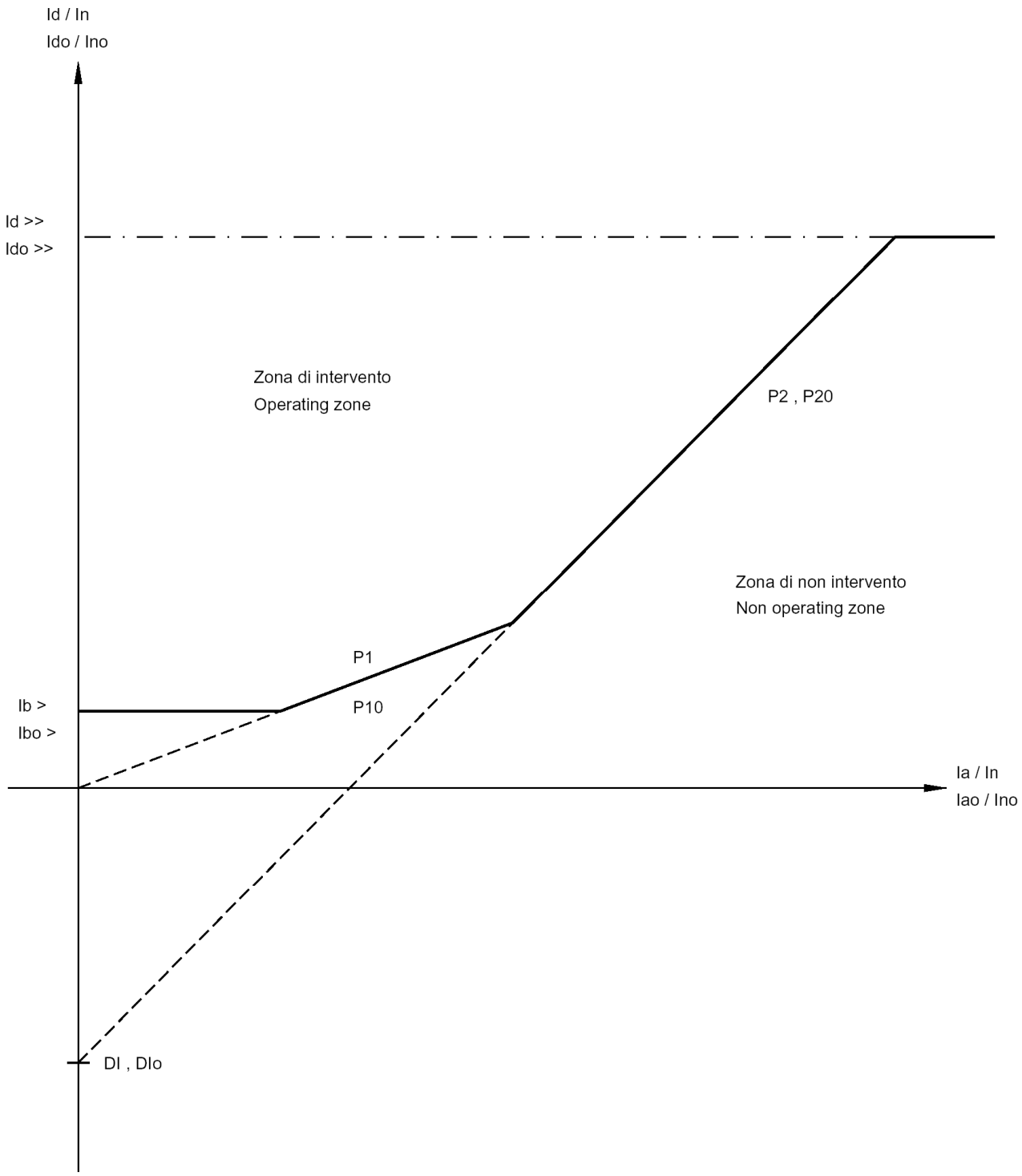
|Id|	module of the differential current
|Ia|	module of the stabilizing current
Ib>	insensibility threshold
P1, P2	slopes of the tripping characteristic
DI	intersection of the P2 straight line with Id/In axis

The listed disequations define the operating characteristic as presented in figure A and they are verified with all the differential currents (and their stabilizing currents) related to phase currents (ANSI 87G) and earth current (ANSI 64Ss).

The differential threshold **Id>>** and the second branch of the operating characteristic related to **Id>** threshold (**slope P2**) can be programmed ON/OFF.

All the differential thresholds are definite time (0.02 ÷ 99.99 s) and each of them can be combined with an additional timer controlled by the digital inputs.

The minimum activation time of the output relay is programmable in order to avoid short commands to switchgears when CT's saturate.



Operating characteristic - figure A

1.2 Generator differential protection (ANSI 87G)

The protection relay IDG8N has been designed to provide three-poles percentage biased differential protection function to generators and motors; the operating characteristic reduces the sensibility to currents due to fault conditions outside the protected zone.

The insertion of the protection relay is presented in figure 4. The CT's installed on the star-point side (**I'**) and on busbars side (**I"**) must have the same ratios and characteristics.

1.3 Differential earth fault protection (ANSI 64Ss)

The protection relay IDG8N has been designed to provide differential protection against earth faults in the following applications:

- selective protection against stator earth faults (restricted earth fault protection) for generators with earthed neutral point during operating with other generators on the same busbars
- selective protection against earth fault on star connected windings of a transformer
- earth fault protection on reactors

The insertion of the protection relay is presented in figure 5; if connection to busbars is not carried out by cable, it can be used an Holmgreen connection of 3 CT's. All the CT's must have the same characteristics.

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 shown 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 (verde)	⊗	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
Id> (red)	⊗	trip condition on Id> threshold (ANSI 87G)
Id>> (red)	⊗	trip condition on Id>> threshold (ANSI 87G)
Ido (red)	⊗	trip condition on Ido> or Ido>> thresholds (ANSI 64Ss)

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 and 3 at the following references:

B2 ÷ B7	relay address (RS485) and date/time
C1	relay functions
D1 ÷ D6	nominal values, contrast etc
E1 ÷ E9	thresholds and time delays Id> percentage biased differential threshold (and Ido> threshold)
F1 ÷ F6	thresholds and time delays Id>> threshold (and Ido>> threshold)
G1 ÷ G6	output relays functions
H1 ÷ H6	digital input functions
S1 ÷ S8	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. 1, ref. J1) within 5 minutes depressing the push-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. G6) 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 and 3; 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 main functions (87G - 64Ss).

Measured current and parameters - the display shows one of the differential currents (d1, d2, d3, do) or the stabilizing currents (a1, a2, a3, ao); the information to be visualized is selected by operator (ref. D4).

The currents are visualized as primary value and relative value (In or Ion); if the selection of the current to be visualized refers to a current not measured (depending on FUCTION SELECTION) no values are presented.

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 Id>	TRIP Id>>	TRIP Ido>	TRIP Ido>>

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.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

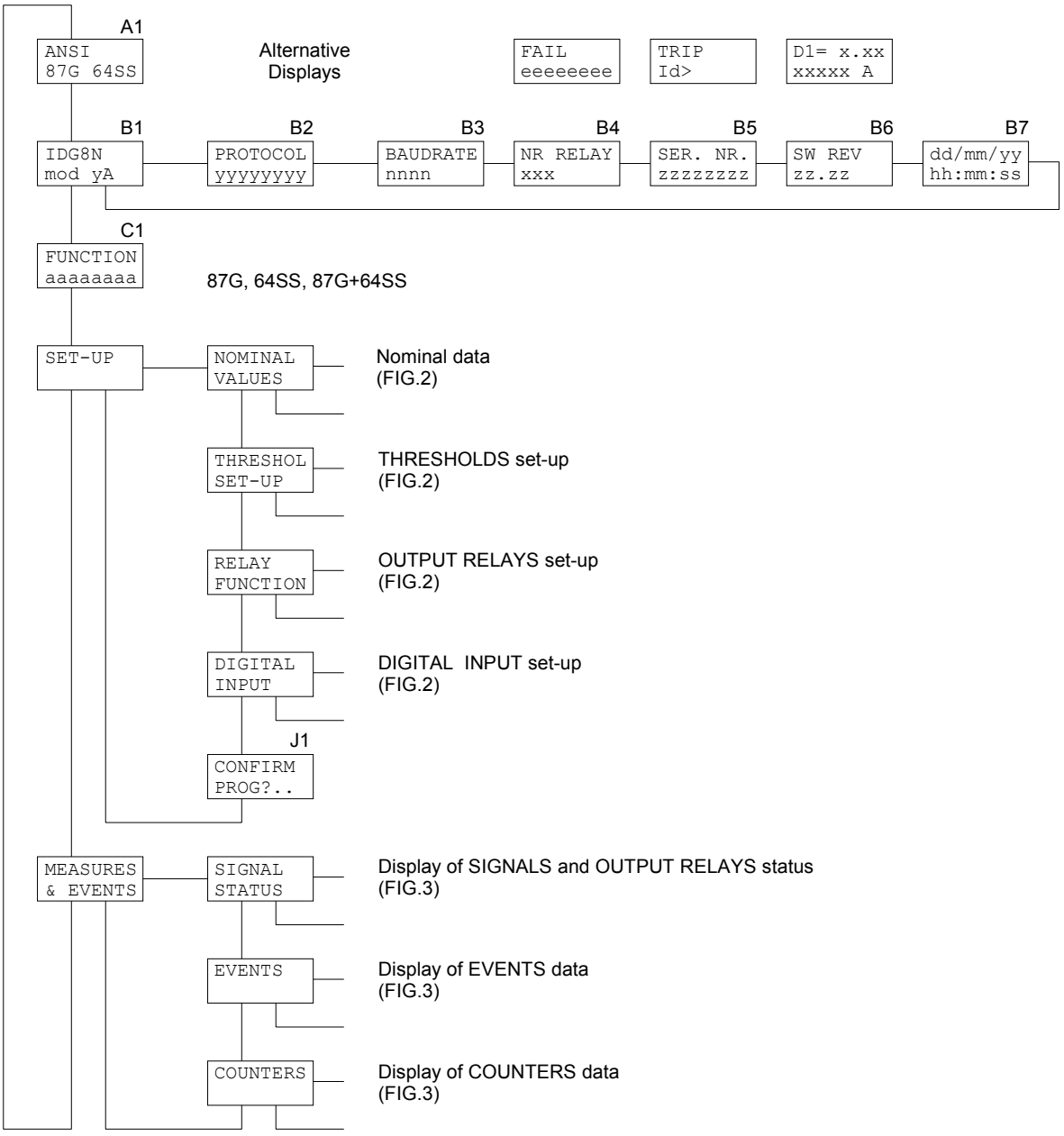


Figure 1

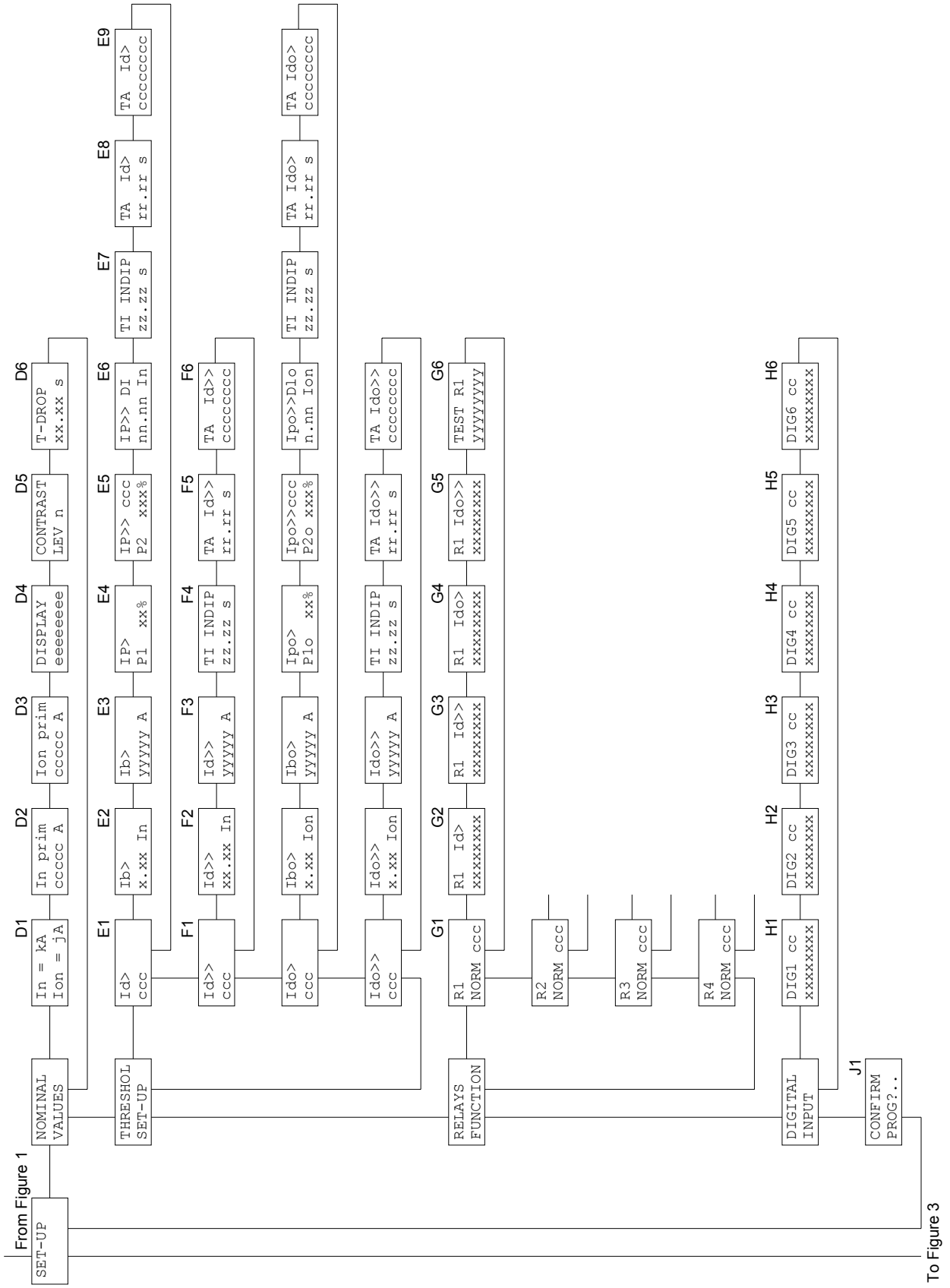

From Figure 1
SET-UP
NOMINAL VALUES
In = kA
Ion = jA
In prim
ccccc A
Ion prim
ccccc A
DISPLAY
eeeeeeee
CONTRAST
LEV n
T-DROP
xx.xx s
THRESHOL SET-UP
Id>
ccc
Ib>
x.xx In
Ib>
yyyyy A
IP>
P1 xx%
IP>> ccc
P2 xxx%
IP>> DI
nn.nn In
TI INDIP
zz.zz s
TA Id>
rr.rr s
TA Id>
ccccccc
Id>>
ccc
Id>>
xx.xx In
Id>>
yyyyy A
TI INDIP
zz.zz s
TA Id>>
rr.rr s
TA Id>>
ccccccc
Ido>
ccc
Ibo>
x.xx Ion
Ibo>
yyyyy A
Ipo>
P1o xx%
Ipo>>ccc
P2o xxx%
Ipo>>Dlo
n.nn Ion
TI INDIP
zz.zz s
TA Ido>
rr.rr s
TA Ido>
ccccccc
Ido>>
ccc
Ido>>
x.xx Ion
Ido>>
yyyyy A
TI INDIP
zz.zz s
TA Ido>>
rr.rr s
TA Ido>>
ccccccc
RELAYS FUNCTION
R1
NORM ccc
R1 Id>
xxxxxxxx
R1 Id>>
xxxxxxxx
R1 Ido>
xxxxxxxx
R1 Ido>>
xxxxxxxx
TEST R1
yyyyyyyy
R2
NORM ccc
R3
NORM ccc
R4
NORM ccc
DIGITAL INPUT
DIG1 cc
xxxxxxxx
DIG2 cc
xxxxxxxx
DIG3 cc
xxxxxxxx
DIG4 cc
xxxxxxxx
DIG5 cc
xxxxxxxx
DIG6 cc
xxxxxxxx
J1
CONFIRM PROG?..
To Figure 3
D1
D2
D3
D4
D5
D6
E1
E2
E3
E4
E5
E6
E7
E8
E9
F1
F2
F3
F4
F5
F6
G1
G2
G3
G4
G5
G6
H1
H2
H3
H4
H5
H6

Figure 2

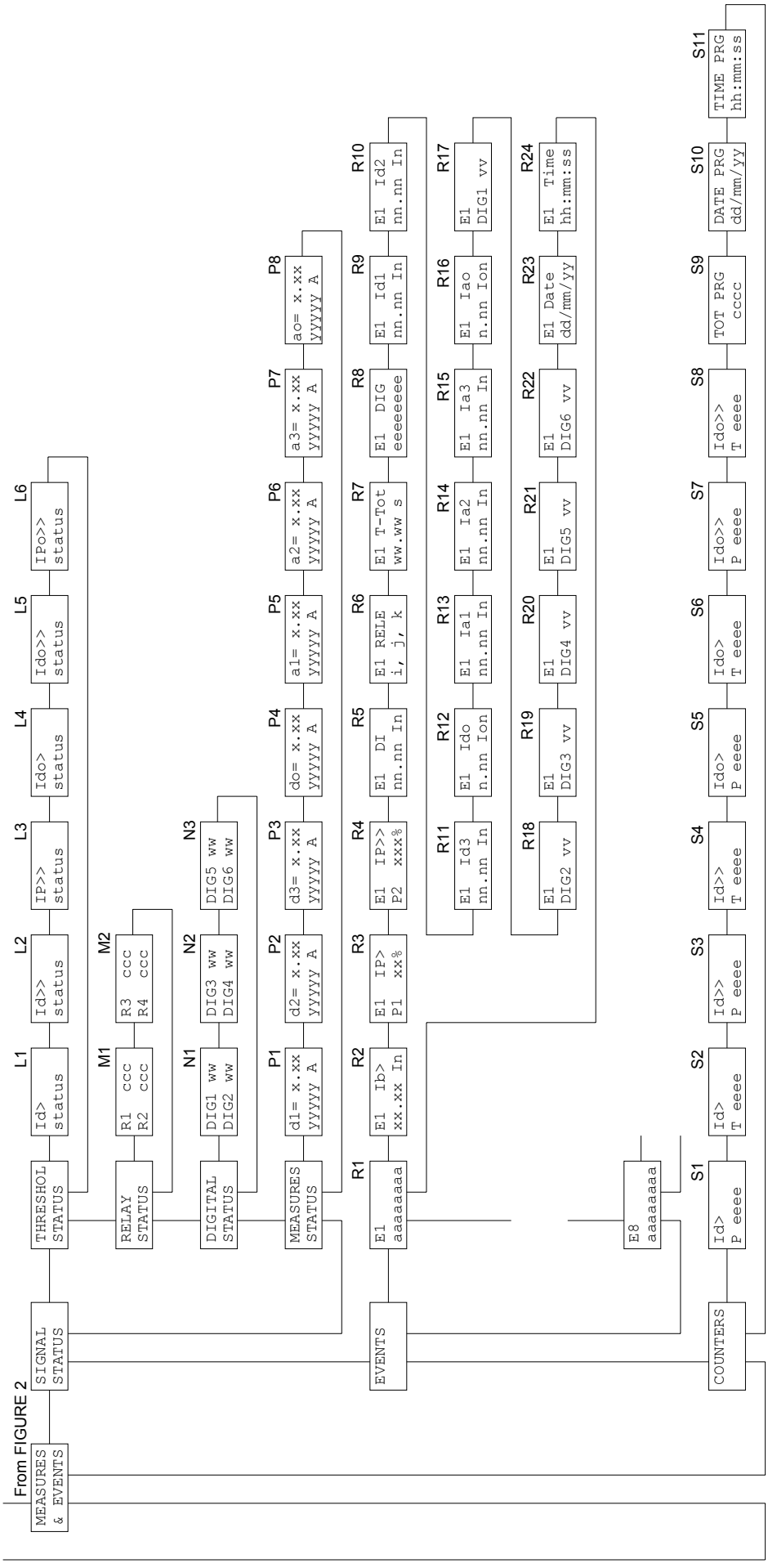

From FIGURE 2
MEASURES & EVENTS
SIGNAL STATUS
THRESHOL STATUS
L1 Id> status
L2 Id>> status
L3 IP>> status
L4 Ido> status
L5 Ido>> status
L6 IPo>> status
RELAY STATUS
M1 R1 ccc R2 ccc
M2 R3 ccc R4 ccc
DIGITAL STATUS
N1 DIG1 ww DIG2 ww
N2 DIG3 ww DIG4 ww
N3 DIG5 ww DIG6 ww
MEASURES STATUS
P1 d1= x.xx yyyyy A
P2 d2= x.xx yyyyy A
P3 d3= x.xx yyyyy A
P4 do= x.xx yyyyy A
P5 a1= x.xx yyyyy A
P6 a2= x.xx yyyyy A
P7 a3= x.xx yyyyy A
P8 ao= x.xx yyyyy A
EVENTS
R1 E1 aaaaaaaa
R2 E1 Ib> xx.xx In
R3 E1 IP> P1 xx%
R4 E1 IP>> P2 xxx%
R5 E1 DI nn.nn In
R6 E1 RELE i, j, k
R7 E1 T-Tot ww.ww s
R8 E1 DIG eeeeeeee
R9 E1 Id1 nn.nn In
R10 E1 Id2 nn.nn In
R11 E1 Id3 nn.nn In
R12 E1 Ido n.nn Ion
R13 E1 Ia1 nn.nn In
R14 E1 Ia2 nn.nn In
R15 E1 Ia3 nn.nn In
R16 E1 Iao n.nn Ion
R17 E1 DIG1 vv
R18 E1 DIG2 vv
R19 E1 DIG3 vv
R20 E1 DIG4 vv
R21 E1 DIG5 vv
R22 E1 DIG6 vv
R23 E1 Date dd/mm/yy
R24 E1 Time hh:mm:ss
E8 aaaaaaaa
COUNTERS
S1 Id> P eeee
S2 Id> T eeee
S3 Id>> P eeee
S4 Id>> T eeee
S5 Ido> P eeee
S6 Ido> T eeee
S7 Ido>> P eeee
S8 Ido>> T eeee
S9 TOT PRG cccc
S10 DATE PRG dd/mm/yy
S11 TIME PRG hh:mm:ss

Figure 3

5.3 Address and time (fig. 1)

B1 - RELAY MODEL (not programmable)

```
IDG8N
mod. nn
```

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

The nominal phase current is programmable 1 or 5 A

B2 - B3 - 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 Function selection (fig. 1)

C1 - FUNCTION SELECTION (programmable)

```
FUNCTION
xxxxxxxx
```

The functions performed by protection relay are selectable between the followings:

87G	Generator differential
64Ss	Differential earth fault
87G+64Ss	Generator differential and differential earth fault

Examples:

```
FUNCTION
87G
```

```
FUNCTION
87G+64SS
```

5.5 Nominal values set-up (fig. 2)

D1 - NOMINAL CURRENT SELECTION In (programmable)

```
In = x A
Ion= 1 A
```

```
In = x A
Ion= 5 A
```

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

Ion = 5 A - IDG8N model A5
Ion = 1 A - IDG8N model A1

D2 - PRIMARY PHASE CURRENT (programmable)

```
In prim
xxxxx A
```

Primary phase current value of the installed phase CTs; the value is programmable from 0001 to 18500 A.

D3 - PRIMARY EARTH CURRENT (programmable)

```
Ion prim
xxxxx A
```

Primary current value of the installed earth CT; the value is programmable from 0001 to 18500 A.

D4 - 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:

ANSI	displays of ANSI code
Id1	displays differential current phase 1
Id2	displays differential current phase 2
Id3	displays differential current phase 3
Ido	displays of the earth differential current

The list of the selectable currents depends on the programmed FUNCTION SELECTION (ref. C1); the current is displayed in primary values (the value depends on D2 and D3 set-ups) and relative value (in terms of In or Ion).

Selection examples:

```
DISPLAY
ANSI
```

```
DISPLAY
Id1
```

```
DISPLAY
Ido
```

D5 - 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.

D6 - OUTPUT RELAY MINIMUM ACTIVATION TIME (programmable)

```
T-DROP
xx.xx s
```

The minimum output relay activation time can be programmed; the setting applies to all the output relays.

The activation time is programmable from 00.10 to 99.99 seconds.

Example:

```
T-DROP
01.00 s
```

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

5.6.1 Percentage biased differential thresholds (Id>, Ido>) (fig. 2)

The information and set-ups related to threshold **Id>** in the following points are effective for the threshold **Ido>** (if not specifically written) just taking into consideration the change of the threshold identification.

E1
```
Id>
ccc
```

E2
```
Ib>
n.nn  In
```

E3
```
Ib>
xxxxx A
```

E1 - ON / OFF PERCENTAGE BIASED DIFFERENTIAL THRESHOLD (programmable)

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

E2 - INSENSIBILITY THRESHOLD SET-UP (programmable)

n.nn threshold level expressed in terms of In (0.04 ÷ 1.00)

E3 - INSENSIBILITY THRESHOLD IN PRIMARY VALUE (non programmable)

xxxxxx: threshold level expressed in Amperes (primary values)
NON PROGRAMMABLE as function of ref. D2 and E2 set-up

Example:

E1
```
Id>
ON
```

E2
```
Ib>
0.20  In
```

E3
```
Ib>
    60 A
```

E4
```
IP>
P1  xx%
```

E5
```
IP>> ccc
P2  xxx%
```

E6
```
IP>>  DI
nn.nn In
```

E4 - SLOPE OF THE FIRST PERCENTAGE BRANCH (programmable)

Slope of the first percentage branch expressed in terms of %.

xx slope value of the first percentage branch (0 ÷ 50 %)

E5 - ON/OFF SECOND PERCENTAGE BRANCH (programmable)

ccc ON enabled branch
OFF disabled branch

xxx slope value of the second percentage branch (0 ÷ 100 %)

E6 - BASE POINT OF THE SECOND PERCENTAGE BRANCH WITH Id/In AXIS (programmable)

Value of the intersection of the straight line P2 with the Id/In axis (see fig. A).

nn.nn intersection value expressed in terms of differential current (0.00 ÷ 20.00 In).

Example:

E4

```
IP>
P1  20%
```

E5

```
IP>>  ON
P2  55%
```

E6

```
IP>>  DI
 3.50 In
```

E7 - TIME DELAY SET-UP (programmable)

E7

```
TI eeeee
zz.zz  s
```

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

zz.zz time delay programmable from 00.02 to 99.99 s

Example:

```
TI INDIP
00.04 s
```

E8 - E9 - ADDITIONAL TIME DELAY SET-UP (E8 - programmable, E9 - non programmable)

E8

```
TA   Id>
xx.xx  s
```

E9

```
TA   Id>
cccccccc
```

The selection allows to program an additional time delay TA from 00.00 to 99.99 seconds; please note that at least one of the digital inputs should be programmed to activate time delay function (ref. H1 ÷ H6 - paragraph 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 display E9 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:

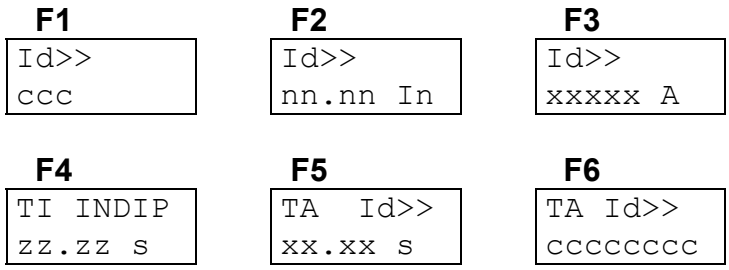
DISABLED	none of the digital inputs has been programmed to activate an additional time delay related to threshold Id>
DIG1	digital input DIG1 activates the TA delay on threshold Id>
DIG2	digital input DIG2 activates the TA delay on threshold Id>
DIG3	digital input DIG3 activates the TA delay on threshold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

DIG4	digital input DIG4 activates the TA delay on threshold Id>
DIG5	digital input DIG5 activates the TA delay on threshold Id>
DIG6	digital input DIG6 activates the TA delay on threshold Id>

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

5.6.2 Second differential thresholds (Id>>, Ido>>) (fig. 2)

The information and set-ups related to threshold Id>> in the following points are effective for the threshold **Ido>>** (if not specifically written) just taking into consideration the change of the threshold identification.



F1 - ON / OFF PHASE OVERCURRENT THRESHOLD (programmable)

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

F2 - THRESHOLD LEVEL SET-UP (programmable)

nn.nn threshold level Id>> expressed in terms of In (0.10 ÷ 20.00)
n.nn threshold level Ido>> expressed in terms of In (0.10 ÷ 2.00)

F3 - THRESHOLD LEVEL IN PRIMARY VALUE (non programmable)

xxxxxx: threshold level expressed in amperes (primary values)
NON PROGRAMMABLE as function of ref. D2 and D3 set-up

F4 - TIME DELAY SET-UP (programmable)

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

zz.zz time delay programmable from 00.02 to 99.99 s

F5 - F6 - ADDITIONAL TIME DELAY SET-UP (programmable) (F5 - programmable, F6 - non programmable)

The selection allows to program an additional time delay TA from 00.00 to 99.99 seconds; please note that at least one of the digital inputs should be programmed to activate time delay function (ref. H1 ÷ H6 - paragraph 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 display E9 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 Id>
DIG1	digital input DIG1 activates the TA delay on threshold Id>
DIG2	digital input DIG2 activates the TA delay on threshold Id>
DIG3	digital input DIG3 activates the TA delay on threshold Id>
DIG4	digital input DIG4 activates the TA delay on threshold Id>
DIG5	digital input DIG5 activates the TA delay on threshold Id>
DIG6	digital input DIG6 activates the TA delay on threshold Id>

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

Example:

F1	F2	F3
Id>> ON	Id>> 6.00 In	Id>> 1200 A

F4	F5	F6
TI INDIP 00.02 s	TA Id>> 00.00 s	TA Id>> DISABIL

5.7 Output relays programming (fig. 2)

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 active thresholds depending on selections in the THRESHOLD SET-UP paragraph (paragraph 5.6).

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)

Example:

```
R1
NORM OFF
```

G2 ÷ G5 - OUTPUT RELAY ACTIVATION ON THRESHOLDS Id>, Id>>, Ido>, Ido>> (programmable)

G2	G3	G4	G5
R1 Id> xxxxxxxx	R1 Id>> xxxxxxxx	R1 Ido> xxxxxxxx	R1 Ido>> xxxxxxxx

Programming of the R1 output relay activation (TRIP) on the Id>, Id>>, Ido>, Ido>> thresholds.

The parameter xxxxxxxx is selectable as the following:

START	instantaneous output relay R1 activation when one of the measured currents exceeds the programmed threshold
TRIP	output relay R1 activation when one of the measured currents exceeds the programmed threshold level for at least TI or TI+TA seconds
NONE	no activations related to thresholds

Examples (related to several relays)

G2	G3	G4	G5
R1 Id> START	R2 Id>> TRIP	R1 Ido> TRIP	R4 Ido>> NO AZION

G6 - TEST OF OUTPUT RELAY R1

TEST R1 xxxxxxxx

See paragraph 4.4

5.8 Digital inputs function programming (fig. 2)

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 ref. E6, F6 and G6 in paragraph 5.6.

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 threshold are presented):

NONE	no functions active related to digital input DIG1
TA Id>	additional time delay on the threshold Id>
TA Id>>	additional time delay on the threshold Id>>
TA Ido>	additional time delay on the threshold Ido>
TA Ido>>	additional time delay on the threshold Ido>>
TA ALL	additional time delay on all thresholds
OF Id>	threshold Id> disabled
OF Id>>	threshold Id>> disabled
OF Ido>	threshold Ido> disabled
OF Ido>>	threshold Ido>> disabled
OF IP>>	second percentage slope disabled - threshold Id>>
OF IPo>>	second percentage slope disabled - threshold Ido>>
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. M1) plus the following:

MONITOR - activation of pilot wire monitor function.

H3 ÷ H6 - DIGITAL INPUT DIG3 ÷ DIG6 SET-UP (programmable)

```
DIG3  cc
xxxxxxxx
```

Programming of the function related to digital input channel from 3 (DIG3) to 6 (DIG6); the selections available are the same as presented for DIG1 (ref. H1).

5.9 Parameter values visualization (fig. 3)

L1 - L2 - L3 - L4 - L5 - L6 - THRESHOLDS STATUS

L1	L2	L3
Id> Status	Id>> status	IP>> status

L4	L5	L6
Ido> status	Ido>> status	IPo>> status

The actual status of each threshold is displayed. For each threshold are displayed the threshold identification (Id>, Id>>, 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, E5, F1)
OFF_DIG	threshold programmed active but momentary disabled by a digital input actual status (ref. H1 ÷ H6 - paragraph 5.8).

Examples:

Id> ON	Id2>> ON	IP>> OFF_DIG	IPo>> 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 does not necessary mean energized or de-energized (see ref. M1).

Example:

M1	M2
R1 ON R2 OFF	R3 OFF R4 ON

N1 - N2 - N3 - 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)

Example:

N1

```
DIG1   LO
DIG2   HI
```

N2

```
DIG3   LO
DIG4   HI
```

N3

```
DIG5   LO
DIG6   LO
```

P1 - P2 - P3 - P4 - P5 - P6 - P7 - P8 - MEASUREMENT DISPLAY

The actual values of the differential and stabilizing currents are displayed; the currents related to disabled thresholds are not displayed.

For each current the following information is displayed:

- currents identification
- actual values expressed as In or Ion
- actual primary values expressed as amperes

P1

```
d1=x.xx
yyyyy  A
```

P2

```
d2=x.xx
yyyyy  A
```

P3

```
d3=x.xx
yyyyy  A
```

P4

```
do=x.xx
yyyyy  A
```

P5

```
a1=x.xx
yyyyy  A
```

P6

```
a2=x.xx
yyyyy  A
```

P7

```
a3=x.xx
yyyyy  A
```

P8

```
ao=x.xx
yyyyy  A
```

d1, d2, d3, do	differential currents
a1, a2, a3, ao	stabilizing currents

xx.xx current values as In or Ion

yyyyy actual primary value of the currents (expressed as amperes)

5.10 Events (fig. 3)

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

```
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:

NONE	no event memorized
Id>	event on trip threshold Id>
Id>>	event on trip threshold Id>>
Ido>	event on trip threshold Ido>

Ido>>	event on trip threshold Ido>>
STATUS	information recorded on external command
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 - INSENBITILITY THRESHOLD

It is shown the insensitivity threshold value. This information is not presented on STATUS event.

R2

```
E1  Ib>
0.20  In
```

R3 - PERCENTAGE BIASED DIFFERENTIAL THRESHOLD PARAMETERS

It is shown the parameters related to the percentage biased differential threshold. This information is not presented on STATUS event.

R3

```
E1  IP>
P1  xx%
```

R4 - R5 - SECOND DIFFERENTIAL THRESHOLD PARAMETERS

It is shown the parameters related to the second differential threshold. This information is not presented on STATUS event.

R4

```
E1  IP>>
P2 xxx%
```

R5

```
E1  DI
nn.nn In
```

R6 - 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
```

R7 - 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 overcurrent 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
```

R8 - DIGITAL CHANNELS RELATED TO MEMORIZED EVENT

```
E1 DIG
1, 3, 4
```

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

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

R9 ÷ R16 - MEMORIZED DIFFERENTIAL AND STABILIZING CURRENTS

```
E1   Id1
yy.yy In
```

```
E1   Id2
yy.yy In
```

```
E1   Id3
yy.yy In
```

```
E1   Ido
y.yy Ion
```

```
E1   Ia1
yy.yy In
```

```
E1   Ia2
yy.yy In
```

```
E1   Ia3
yy.yy In
```

```
E1   Iao
y.yy Ion
```

The values of the measured differential and stabilizing currents at the event are displayed; the values are expressed as In and Ion terms.

There are presented only the currents measured coherently with the selection at ref. C1 - paragraph 5.4.

d1, d2, d3, do	differential currents
a1, a2, a3, ao	stabilizing currents

R17 ÷ R22 - DIGITAL INPUTS STATUS ON EVENT

```
E1
DIG1  vv
```

```
E1
DIG2  vv
```

```
E1
DIG3  vv
```

```
E1
DIG4  vv
```

```
E1
DIG5  vv
```

```
E1
DIG6  vv
```

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

The parameter vv can assume the value HI or LO.

R23 - R24 - 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 Trips counters (fig. 3)

In this section are displayed the total and partial counters of the output relay activations (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).

S1 ÷ S8 - TRIP COUNTERS

S1	**S2**
Id> P cccc	Id> 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 (Id>, Id>>, Ido>, Ido>>); there are presented only the counters related to the active thresholds.

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

S9 ÷ S11 - TOTAL PROGRAMMING SESSIONS AND DATE/TIME OF THE LAST PROGRAMMING SESSION

TOT PRG eeee	DATE PRG dd/mm/yy	TIME PRG 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

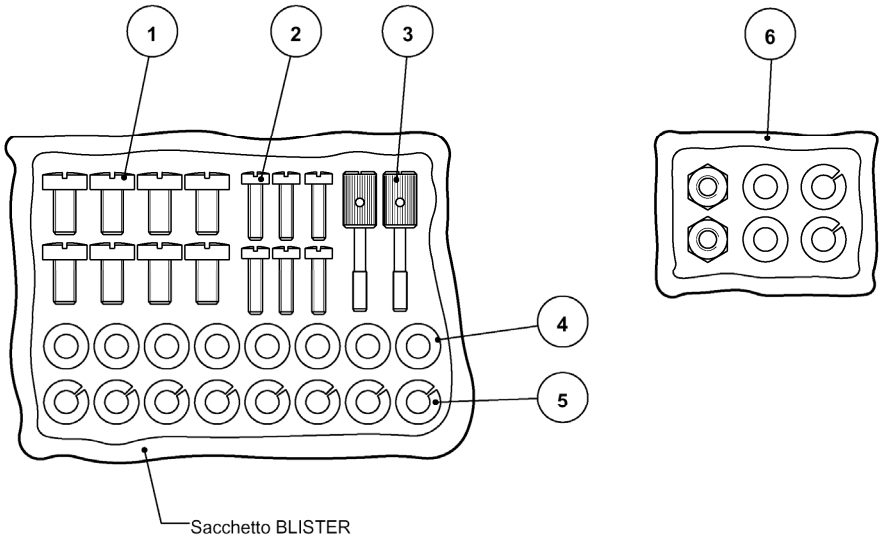
6.1 Supplied kit

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

- protection relay module IDG8N with 2 rear sockets
- transparent front panel with push-buttons
- transparent front panel without push-buttons
- blister with items 1-2-3-4-5

MR VERSION - mini-rack installation

- mini-rack
- protection relay module IDG8N with 2 rear sockets
- transparent front panel with push-buttons
- transparent front panel without push-buttons
- blister with items 1-2-3-4-5



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 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 terminals (current)
5) n° 8 growers to be used to fix wire terminals (current)
6) items to fix the brackets for flush mounting (not applicable)

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

INSERTIONS

Generator differential	(ANSI 87G)	figure 4
Earth fault differential	(ANSI 64Ss)	figure 5

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

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

Other circuits (output relays etc.)
It is suggested to terminate the current wiring using plug terminals.

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

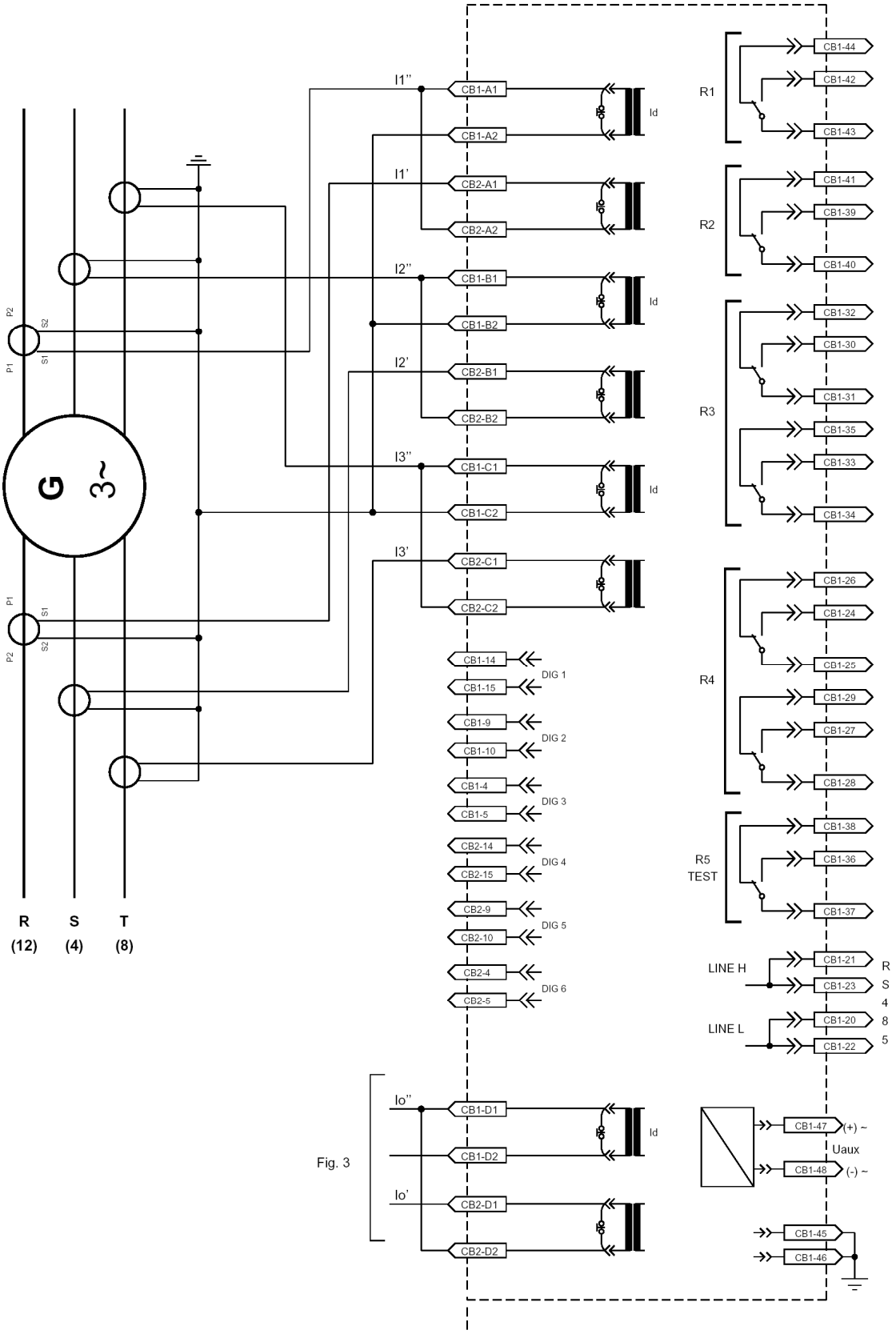
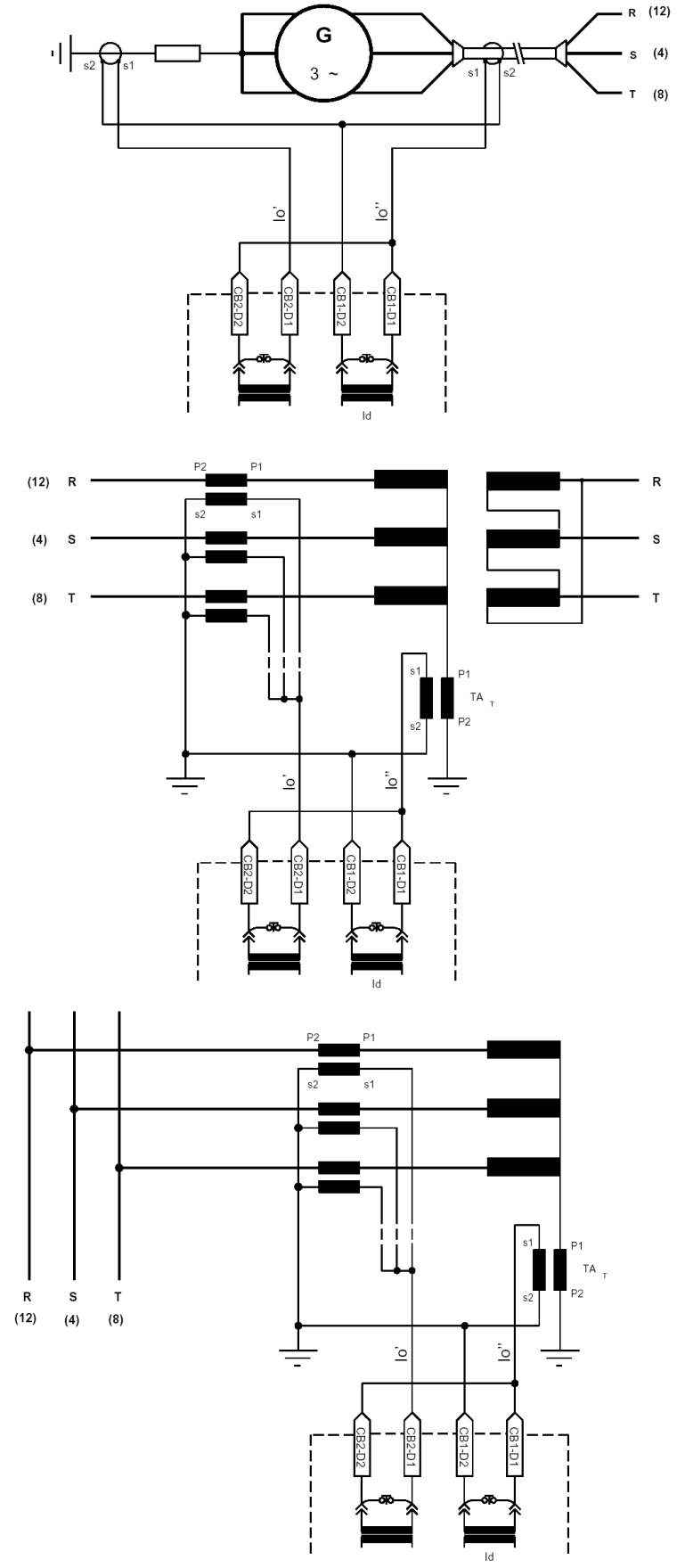
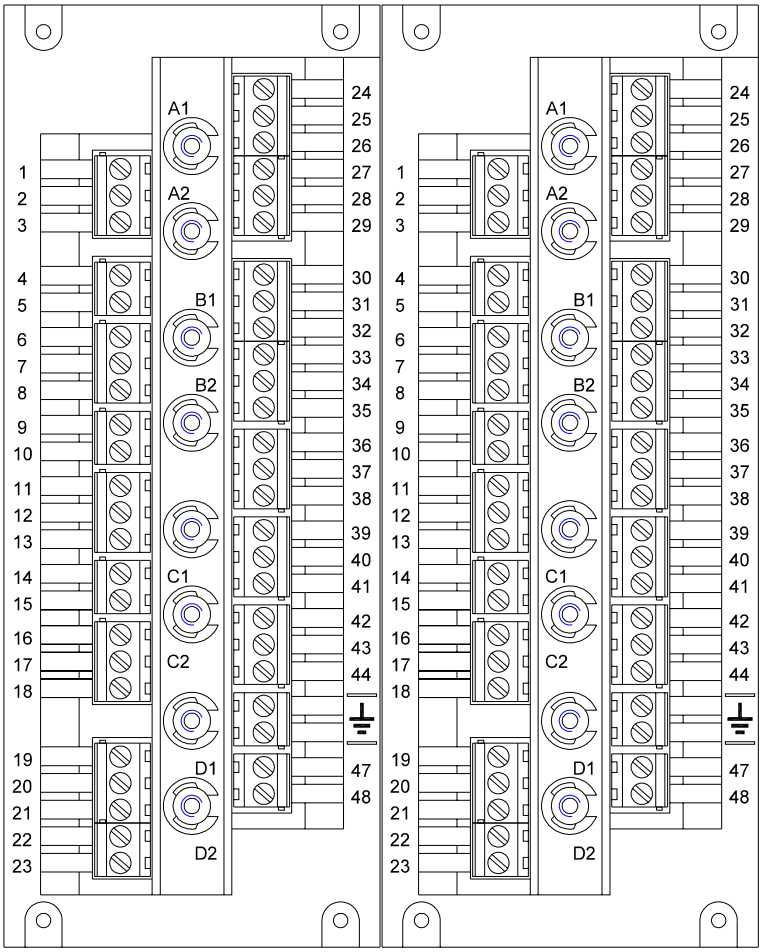


Fig. 3

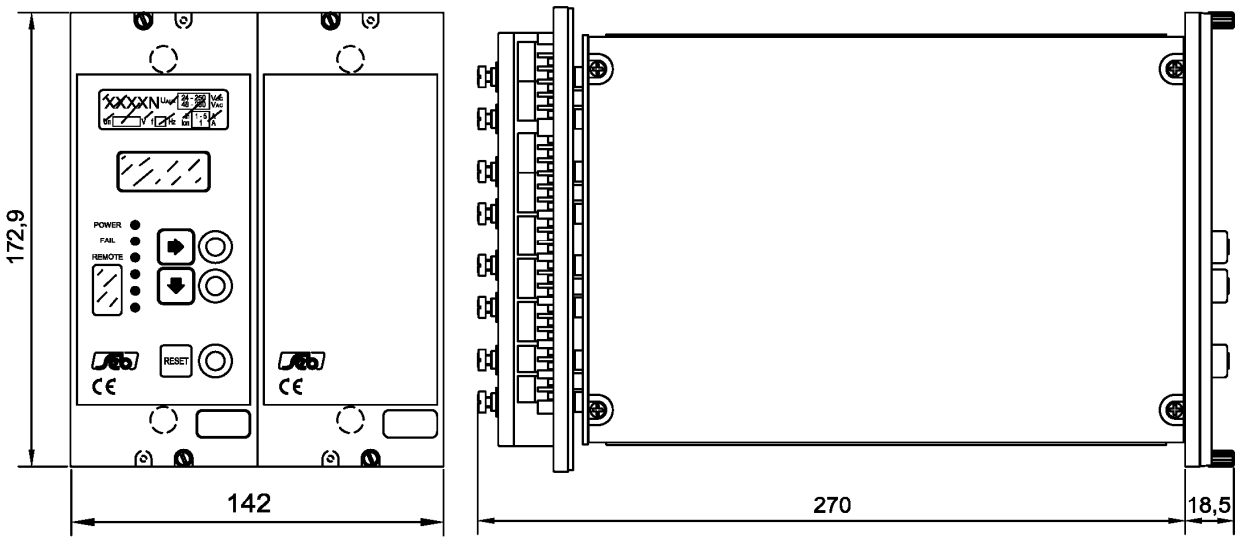
Insertion - ANSI 87G - fig. 4

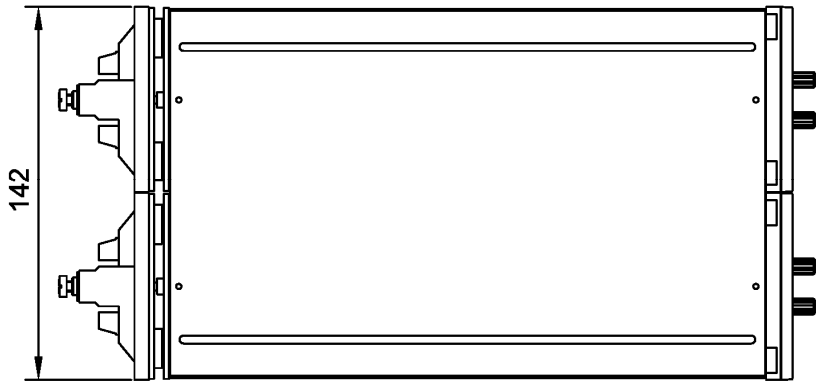


Insertion - ANSI 64Ss - fig. 5

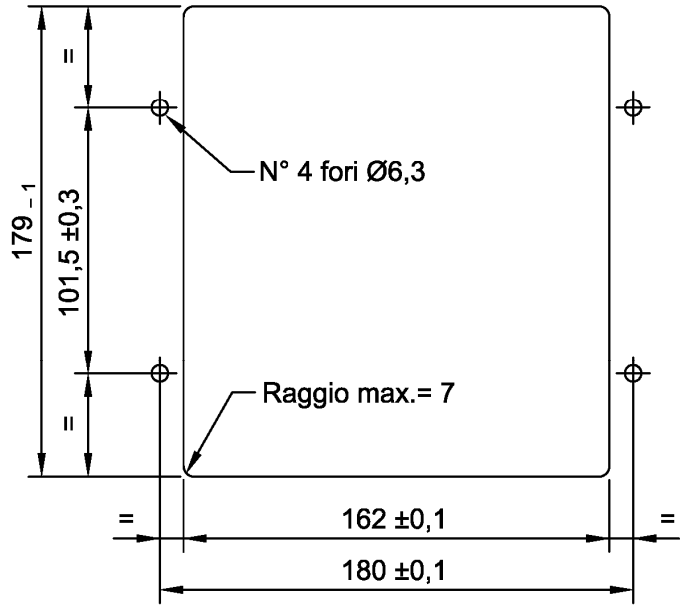


REAR VIEW - Figure 6





Dimensioni
meccaniche
Case outlines



Dima montaggio da incasso
Flush mounting panel cut - out

Dimensioni frontali mini-rack per incasso
Mini-rack front sizes (flush mounting)
198.2 x 177 (4U) 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:

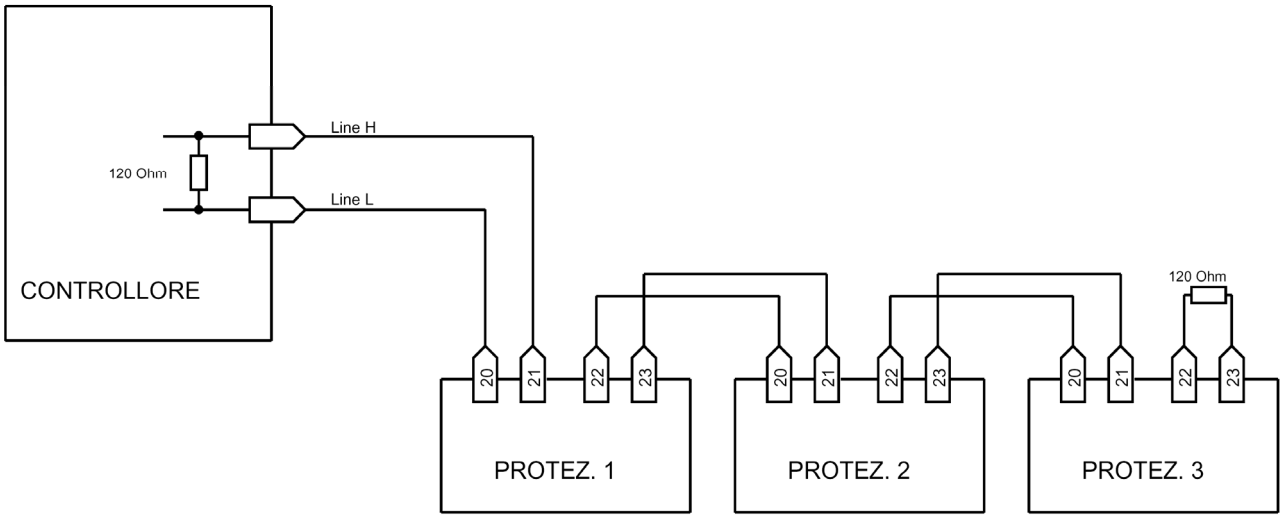
6.4 RS485 serial communication port

The digital protection relay IDG84N presents an insulated serial interface RS485 half-duplex that allow the multi-drop connection up to 31 protection units. There are available two selectable communication protocols (ref. B2, paragraph 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.

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

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 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 frequency	50 / 60 Hz
Primary CT's current	1 - 18500 A

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	6
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	fibre optic 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	IP 31
Weight	3.5 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 TABLE

Table A Settings

ANSI	THRESHOLDS		Setting	Resolution
87G	Ib>	Insensibility threshold	0.04 ÷ 1.00 In	0.01 In
	P1	Slope of the first percentage branch	0 ÷ 50 %	1%
	P2	Slope of the second percentage branch	0 ÷ 100 %	1%
	DI	Base point of the second branch	0.00 ÷ 20.00 In	0.01 In
	Id>>	Second differential threshold	0.10 ÷ 20.00 In	0.01 In
64Ss	Ibo>	Insensibility threshold	0.02 ÷ 1.00 Ion	0.01 Ion
	Po1	Slope of the first percentage branch	0 ÷ 50 %	1%
	Po2	Slope of the second percentage branch	0 ÷ 100 %	1%
	DIo	Base point of the second branch	0.00 ÷ 2.00 Ion	0.01 Ion
	Ido>>	Second differential threshold	0.10 ÷ 2.00 Ion	0.01 Ion
Delays			**Setting**	**Resolution**
Definite time		All thresholds 87G - 64Ss	0.02 ÷ 99.99 s	0.01 s
All thresholds		Additional delay	0.00 ÷ 99.99 s	0.01 s
All thresholds		Output relay minimum activation time	0.10 ÷ 99.99 s	0.01 s

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