



DIVISIONE ELETTRONICA E SISTEMI

IMT4N

**DIGITAL MULTIFUNCTION
MOTOR PROTECTION RELAY**

USER MANUAL

P500D808

April 2005

INDEX

1	GENERAL CHARACTERISTICS	1
1.1	Descriptions of the available functions	3
1.1.1	Thermal overload (ANSI 49)	3
1.1.2	Overcurrent protection (ANSI 50)	4
1.1.3	Earth fault overcurrent (ANSI 51N)	4
1.1.4	Unbalanced load – Loss of Phase (ANSI 46)	5
1.1.5	Locked rotor – Excessive start-up time (ANSI 51R)	5
1.1.6	Undercurrent – Loss of load protection (ANSI 37)	5
1.1.7	Limitation of motor start-up (ANSI 66)	5
2	FRONT PANEL KEYS	6
3	FRONT PANEL LED SIGNALLING	7
4	PROGRAMMING AND TEST	8
4.1	How to program the protection relay	8
4.2	How to modify a visualized parameter	9
4.3	Reset	10
4.4	Test of output relays	10
5	DISPLAY AND PROGRAMMING	11
5.1	Standard display	11
5.2	Visualization structure	12
5.3	Address and time (fig. 1)	16
5.4	Protection insertion (fig. 1)	17
5.5	Nominal values set-up (fig. 2)	17
5.6	Thresholds and time delay set-up	18
5.6.1	Thermal overload thresholds (fig. 2)	18
5.6.2	Phase overcurrent - locked rotor ANSI 51R (fig. 2)	21
5.6.3	Phase overcurrent - short circuit ANSI 50 (fig. 2)	22
5.6.4	Earth - fault overcurrent ANSI 51N (fig. 2)	23
5.6.5	Negative sequence overcurrent ANSI 46 (fig. 2)	24
5.6.6	Number of motor start-up limitation ANSI 66 (fig. 2)	25
5.6.7	Undercurrent - loss of load ANSI 37 (fig. 2)	26
5.7	Output relays programming (fig. 3)	27
5.8	Digital inputs function programming (fig. 3)	29
5.9	Parameter values visualization (fig. 4)	31
5.10	Events (fig. 4)	33
5.11	Trips counters (fig. 4)	35
6	INSTALLATION	37
6.1	Supplied kit	37
6.2	Cabling	38
6.3	Relays R3 and R4 - Signaling / Command set-up	41
6.4	RS485 serial communication port	41
7	THERMAL OVERLOAD CURVES - ANSI 49	42
8	TIME DEPENDENT CURVES - ANSI 46	43
9	TECHNICAL CHARACTERISTIC	44
10	TABLES	45

Information printed in this manual subject to change without prior notice.

This manual must not be reproduced in whole or in part, in any form or by any means without the express written permission of SEB Divisione Elettronica e Sistemi.

1 GENERAL CHARACTERISTICS

The protection relay IMT4N is designed to protect HV or MV motors; the user can select one of the functions listed in the table below.

Functions	ANSI	Measured currents
Thermal overload	49	I_A, I_B, I_C or I_A, I_B
Phase overcurrent	50	
Unbalanced load / loss of phase	46	
Locked rotor / excessive start-up time	51 R	
Undercurrent / loss of load	37	
Earth-fault overcurrent	51N	I_o
Numbers of motor start-up limitation	66	not applicable

The wide range of the programmable heating time constant allows to use the relay for thermal protection of transformer and cable also.

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:

- 3 thermal overload thresholds
- overcurrent threshold for phase currents
- earth-fault overcurrent threshold
- unbalanced load / loss of phase threshold
- locked rotor / excessive motor start-up time
- undercurrent or loss of load threshold
- number of motor start-up limitation

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

TRIP DELAYS - The thermal overload thresholds (ANSI 49) and the unbalanced load threshold (ANSI 46) are time dependent, while the remaining thresholds are time independent.

Each definite time threshold delay 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 to allow the use of the IMT4N relay with cooperating protection relays.

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

OUTPUT RELAYS - the IMT4N 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

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.

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 Descriptions of the available functions

1.1.1 Thermal overload (ANSI 49)

The IMT4N protection relay performs the function of thermal overload protection under all the operating conditions by creating a mathematical model of the thermal behavior of the motor.

The positive sequence current (**I1**) and the negative sequence current (**I2**) of the motor are measured by the protection relay and combined to obtain an equivalent current **Ieq** used in the mathematical model to compute the thermal overload.

The equivalent current Ieq is computed using the following formula:

$$I_{eq} = \sqrt{I_1^2 + K_s * I_2^2} \quad (1)$$

where **Ks** is a programmable coefficient from 0 to 10 used to modify the heating effect produced by the negative sequence current as its effect is much higher (due to eddy currents induced in the rotor at double frequency); for standard motors **Ks** = 6.

The protection relay computes the thermal overload of the motor and when the value exceeds one of the programmed thresholds (**T°>**, **T°>>**, **T°>>>**) the related output relays trip.

The tripping time (**t**) of the thermal overload function, according to IEC 255-8 and IEC 255-17 standards, is defined by the formula:

$$t = TC1 * \ln \frac{I_{eq}^2 - I_p^2}{I_{eq}^2 - I_b^2} \quad (2)$$

where:

TC1 heating time constant (programmable)
Ieq computed equivalent current
I_p equivalent current before overload
I_b base current

I_b is programmable from **0.40** to **2.00 I_n** and it represents the equivalent current **Ieq** for which the relay will NOT OPERATE.

In paragraph 7 are shown the characteristic curves representing the operating time as function of different load currents (**I_p**) before the overload condition and when the overload current is constant.

After the trip condition the protection relay continues to compute the cooling of the motor using the cooling time constant **TC2** (programmable from **1** to **10** times the **TC1** value to compensate the absence of the forced cooling); when all the measured currents are lower than **0.05 I_n** the motor is considered stopped.

Thermal restart inhibition - it is available a thermal threshold **QTM_{inh}**; it prevents motor start-up attempts (temporary latch of the output relays related to the thermal thresholds **T°>**, **T°>>**, **T°>>>**) until the computed thermal overload has decreased to a level below the programmed threshold.

Loss of auxiliary supply - whenever powered up the relay assumes the motor to be heated up to a level equals to the programmable **QTM0** value (programmable from 50% to 100% - default value 100 %).

1.1.2 Overcurrent protection (ANSI 50)

It is available a time definite overcurrent threshold programmable from 1.00 to 20.00 I_n.

1.1.3 Earth fault overcurrent (ANSI 51N)

It is available a time definite earth-fault overcurrent threshold programmable from 0.01 to 2.00 I_{on}.

1.1.4 Unbalanced load – Loss of Phase (ANSI 46)

Unbalanced conditions can be severe (loss-of-phase or phase reversal) or less severe (unbalanced load or voltages); for this reason is available a time dependent negative sequence current threshold according to IEC 255-4 standard.

When the 2-phase insertion is used, for the correct protection against unbalanced loads must be programmed the ANSI 51N protection function.

1.1.5 Locked rotor – Excessive start-up time (ANSI 51R)

It is available a time definite overcurrent threshold programmable from 1.00 to 20.00 In to protect the motor against stalling condition.

The threshold is inhibited during the programmable starting time t_{avv} ; the timer starts when the running condition of the motor is picked-up (one of the currents exceeds the value 0.05 In).

1.1.6 Undercurrent – Loss of load protection (ANSI 37)

It is available a time definite undercurrent threshold programmable from 0.10 to 1.00 In to detect a sudden loss of the load.

1.1.7 Limitation of motor start-up (ANSI 66)

It is available a function that limits the **NAV** number of motor start-up within a programmable period **TLIM**; it is possible to define a period **TBLK** during which the start-up of the motor is inhibited.

The start-up inhibition is obtained with a temporary latch of the output relays related to ANSI 66 function.

2 FRONT PANEL KEYS

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



right arrow



down arrow



programming session activation or parameter confirmation



change or increment of the selected parameter




reset of the protection relay (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 Fig. 1, 2, 3 and 4.
- 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 SIGNALLING

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
T°> (red)	⊗ trip condition on T°>, T°>>, T°>>> thresholds (ANSI 49)
I> I>> Io> (red)	⊗ trip condition on I> (ANSI 51R), I>> (ANSI 50), Io> (ANSI 51N) thresholds
I2> I< N> (red)	⊗ trip condition on I2> (ANSI 46), I< (ANSI 37), limitation of motor start-up (ANSI 66) thresholds

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

4 PROGRAMMING AND TEST

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

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


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

4.1 How to program the protection relay

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

B2 ÷ B7	relay address (RS485) and date/time
C1	relay insertion
D1 ÷ D5	nominal values, contrast etc
E1 ÷ E10	thresholds and time delays thermal overload (ANSI 49)
F1 ÷ F5	thresholds and time delays locked rotor (ANSI 51R)
G1 ÷ G4	thresholds and time delays phase overcurrent (ANSI 50)
H1 ÷ H4	thresholds and time delays earth-fault overcurrent (ANSI 51N)
L1 ÷ L3	thresholds and time delays unbalanced load / negative sequence overcurrent (ANSI 46)
M1 ÷ M4	Limitation of motor start-up function (ANSI 66)
N1 ÷ N4	thresholds and time delays undercurrent (ANSI 37)
P1 ÷ P12	output relays functions
Q1 ÷ Q3	digital input functions
Z1 ÷ Z18	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. 2, ref. J1) within 5 minutes depressing the push-buttons buttons [ENTER],  up to visualize **YES** and [ENTER] again to confirm.

NOTE: The protection relay continues to operate using the previous set-up until the new set-up is confirmed as at point 5) above; the visualization of the modified parameters

before the new set-up confirmation is only temporary to allow an easy definition of the new protection set-up.

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

NOTE: If the thermal restart inhibition threshold **QTMinh** is higher of one of the thermal overload thresholds ($T^{\circ}>$, $T^{\circ}>>$, $T^{\circ}>>>$) the following message is showed:

Data Error

and the new programmed set is not accepted; the value of the QTMinh threshold (ref. E7 - fig. 2) or the values of the lower overload thresholds ($T^{\circ}>$, $T^{\circ}>>$, $T^{\circ}>>>$ - ref. E8, E9, E10 fig. 2) must be modified.

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:

- a) reset of glowing LED's
- b) drop-off of tripped relays
- c) reset of any parameter changed but not confirmed (parameters are shown as confirmed at the end of the last programming session)
- d) 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. 3, ref. P12) it is possible to command an output relay (one at the time) to trip from the current status allowing functional tests on electrical plants.

The output relays are activated with the following sequence:

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

TEST R1
OFF


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

- 3) **PRESS** ; and the message on the display will change as:

TEST R1
ON

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

The relay will stay on the new condition until:

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

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

5 DISPLAY AND PROGRAMMING

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

5.1 Standard display

A1 - STANDARD DISPLAY

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

The displayed information is function of the protection relay status.

NORMAL 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 (49 - 51 - 46 - 37).
- **Measured current and parameters** - the display shows one of the measured currents (IA, IB, IC, Io) or computed ones (I2 - negative sequence current, Ieq - equivalent current) or the thermal overload value (QTM - presented as percentage); the information to be visualized is selected by operator (ref. D4).

The measured currents are visualized as primary value; if the selection of the current to be visualized refers to a current not measured (depending on FUNCTION 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 T°>	TRIP I>>	TRIP I2>	TRIP Io>
-------------	-------------	-------------	-------------

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 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

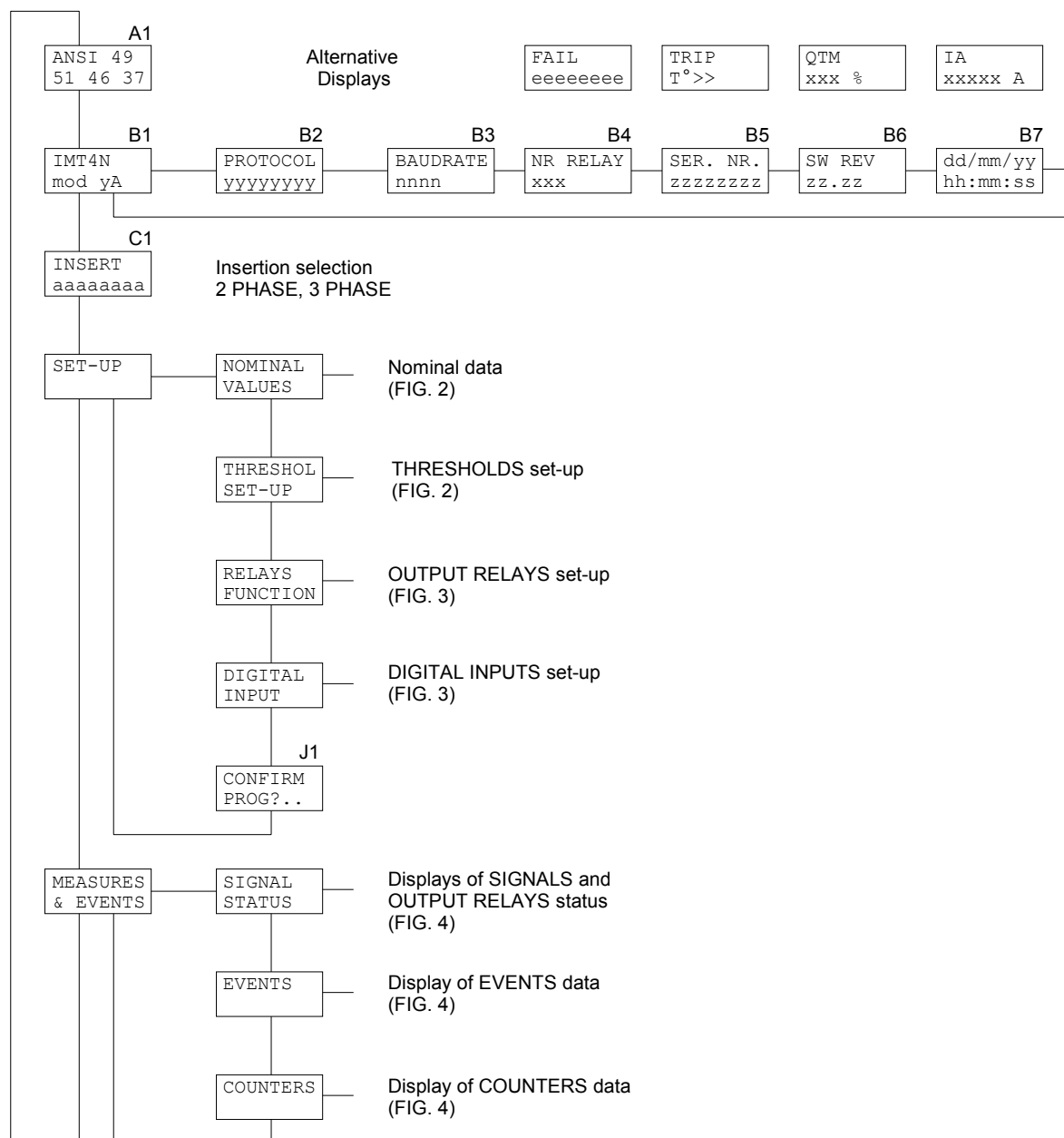


Figure 1

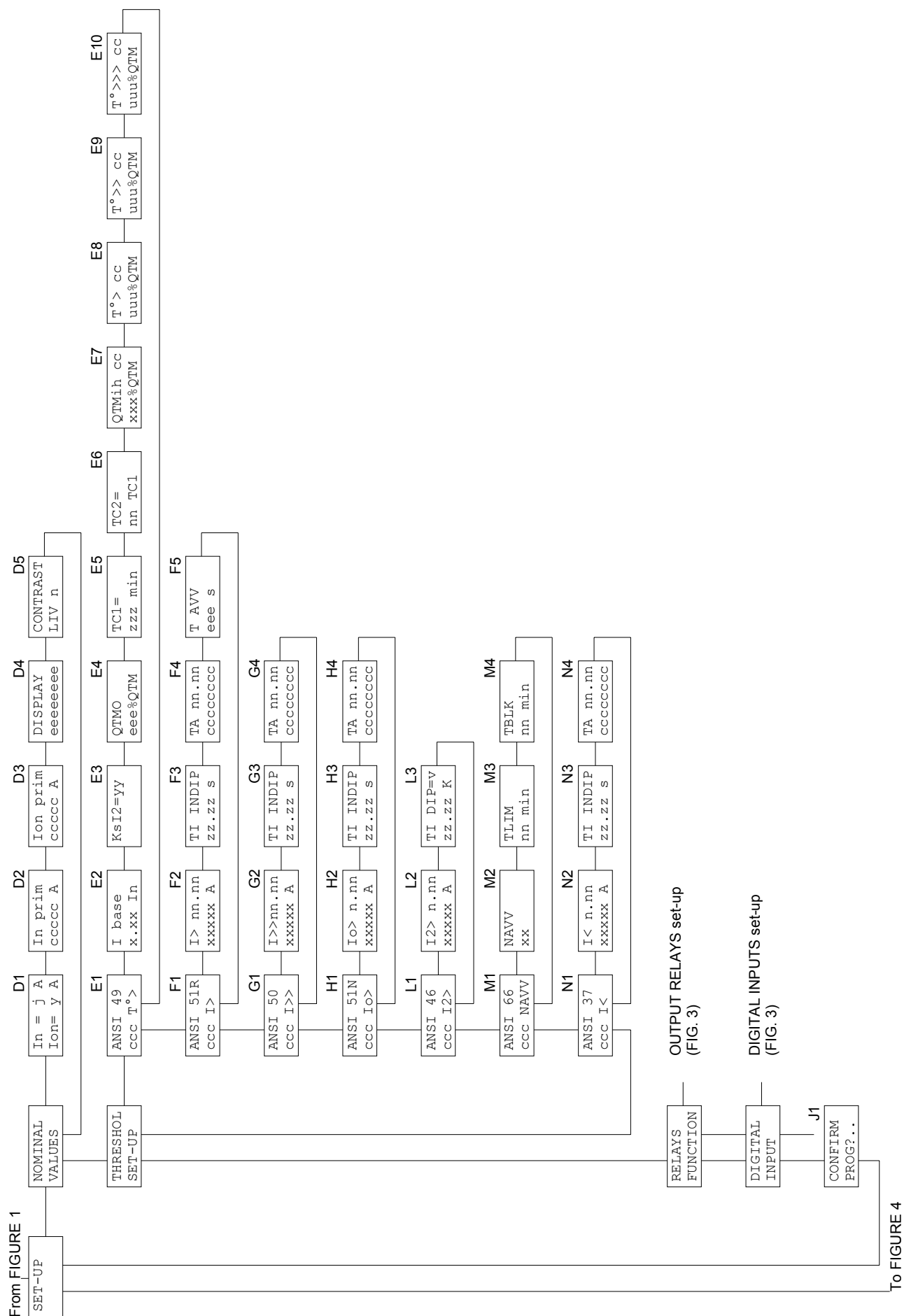


Figure 2

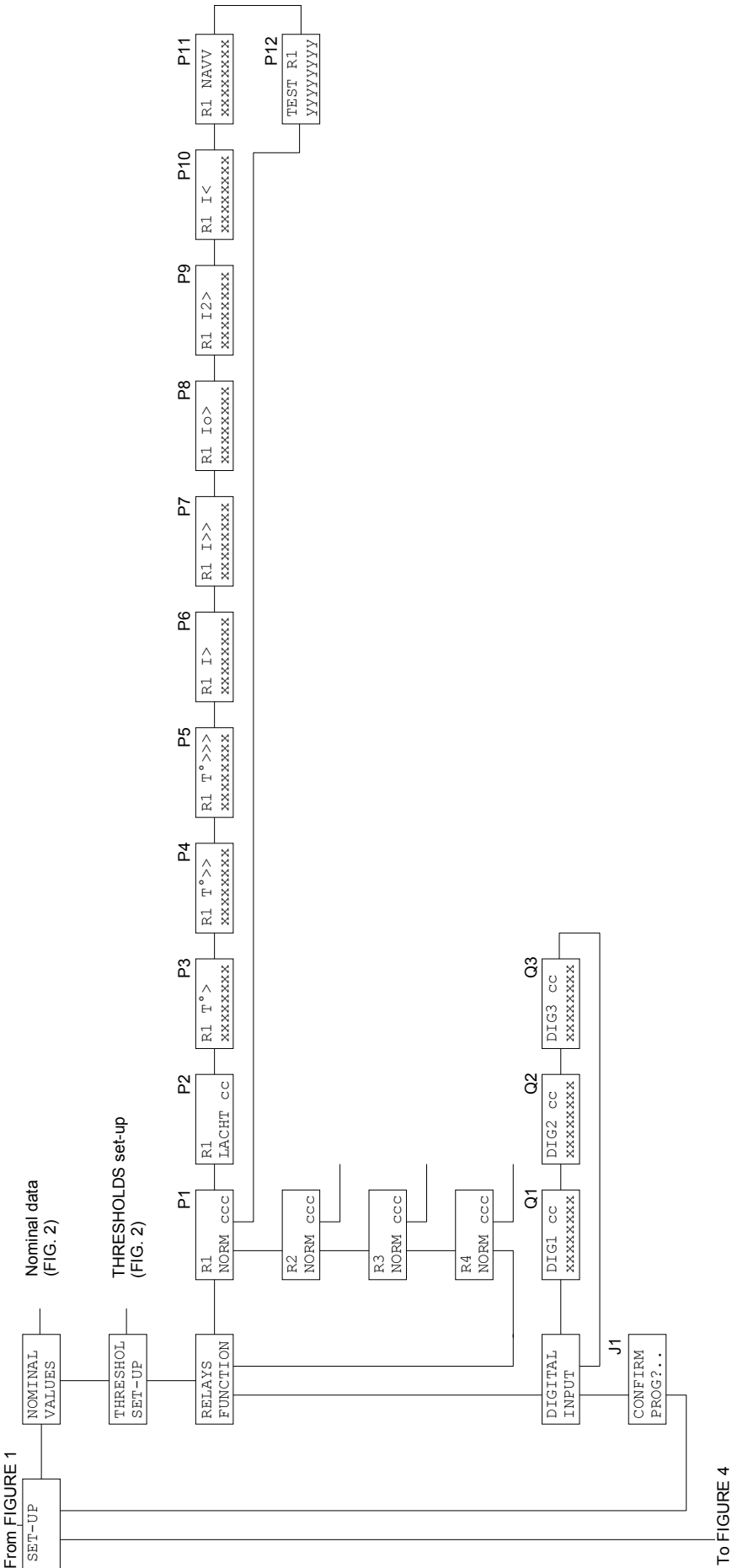
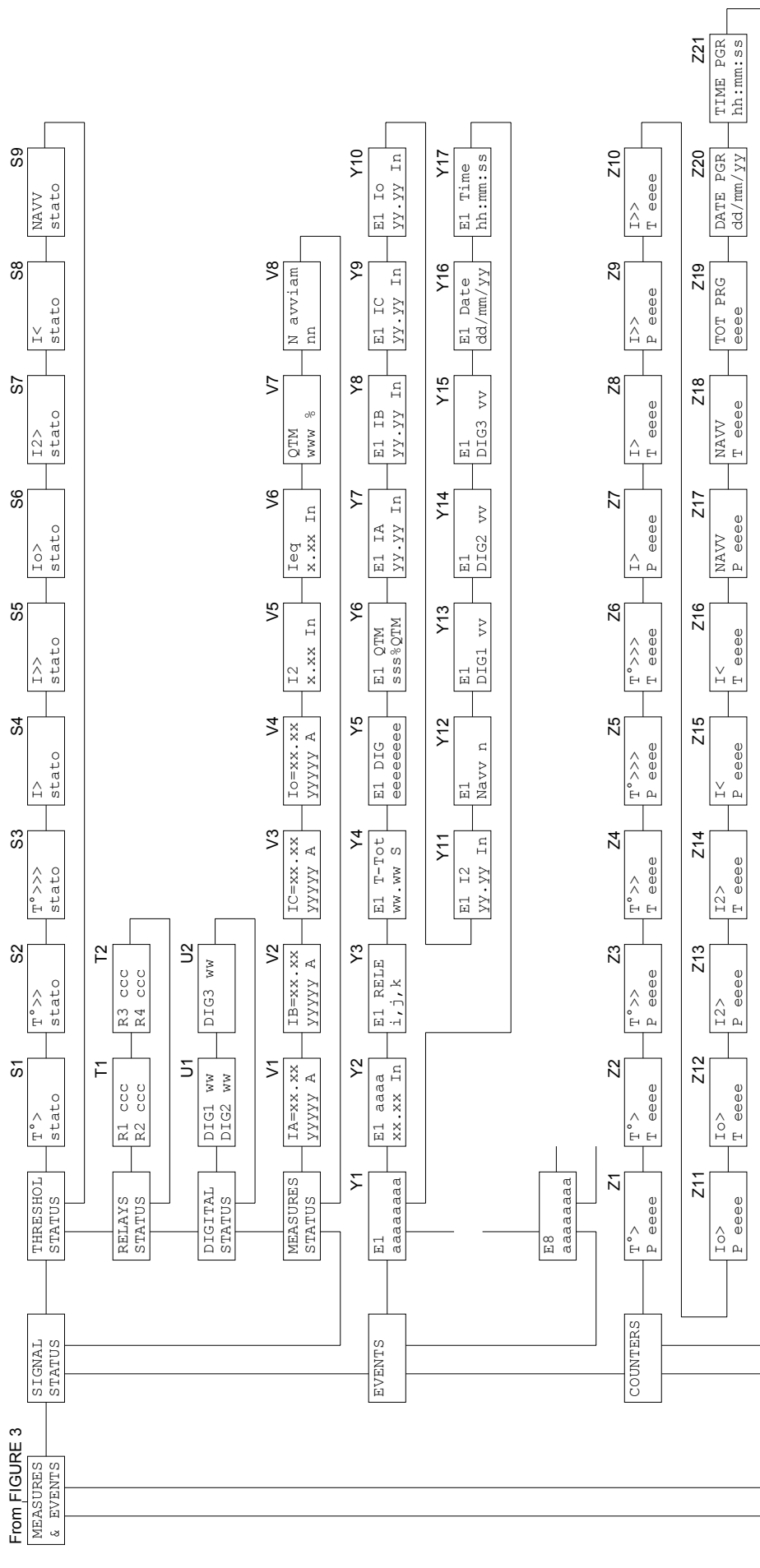


Figure 3



5.3 Address and time (fig. 1)

B1 - RELAY MODEL (not programmable)

IMT4N mod. A5

Models: A5 (nominal earth fault current = 5 A)
A1 (nominal earth fault current = 1 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 – B6 - RELAY SERIAL NUMBER and SOFTWARE REVISION (not programmable)

SER. NR 0012345

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 insertion (fig. 1)**C1 - INSERTION SELECTION (programmable)**

INSERT.
xxxxxxxx

The insertion of the protection relay is selectable between the followings:

2 PHASE	Two phase insertion
3 PHASE	Three phase insertion

Examples:

INSERT.
2 PHASE

INSERT.
3 PHASE

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 A or 5 A

Ion nominal earth current (defined by models - manufacturer set-up)

Ion = 5 A IMT4N model A5
Ion = 1 A IMT4N model A1

D2 - D3 - PRIMARY PHASE AND EARTH CURRENT (programmable)

In prim
xxxxxx A

Ion prim
xxxxxx A

Primary phase current value of the installed phase CT's; 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
IA	displays measured phase current I1
IB	displays measured phase current I2
IC	displays measured phase current I3
Io	displays measured earth current Io
I2	displays negative sequence current (presented as In terms)
Ieq	displays computed equivalent current (ref. Paragraph 1.1.1 - formula 1, presented in terms of In)
QTM%	displays computed motor over temperature (0 ÷ 120 %)

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

Selection examples:

DISPLAY
ANSI

DISPLAY
I1

DISPLAY
QTM%

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.

5.6 Thresholds and time delay set-up**5.6.1 Thermal overload thresholds (fig. 2)****E1 - ON / OFF THERMAL OVERLOAD THRESHOLD (programmable)**

ANSI	49
ccc	T°>

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

E2 - BASE CURRENT Ib (programmable)

I base
x.xx In

The base current **I_{base}** represents the equivalent current **I_{eq}** for which the relays will NOT OPERATE (ref. paragraph 1.1.1 - formula 2).

x.xx current value expressed in terms of relative values (I_n)

Example:

I base
1.25 I _n

E3 - K_s COEFFICIENT (programmable)

K _s I ₂ = yy

K_s is a programmable coefficient used to modify the weight of the negative sequence current in the computing of the equivalent current **I_{eq}** (ref. paragraph 1.1.1 - formula 1).

yy programmable value from 0 to 10 (for standard motors K_s = 6)

Example:

K _s I ₂ = 06

E4 - INITIAL THERMAL OVERLOAD QTM0 (programmable)

QTM0
eee% QTM

Whenever powered up the relay assumes the motor to be heated up to a level equals to the programmable QTM0 value.

The initial thermal overload is expressed in percentage of the allowed motor thermal overload QTM.

eee programmable value from 50% to 100% - default value 100 %

Example:

QTM0
050% QTM

E5 - MOTOR HEATING TIME CONSTANT TC1 (programmable)

TC1 =
zzz min

TC1 represents the motor heating time constant used to compute the operating time (TRIP condition) of the thermal overload thresholds (ref. paragraph 1.1.1 - formula 2). The heating constant is expressed in minutes.

zzz programmable value from 1 to 500 minutes

Example:

TC1 = 010 min

E6 - MOTOR COOLING TIME CONSTANT TC2 (programmable)

TC2 = nn TC2

TC2 represents the motor cooling time constant expressed in terms of 1 or more times the value of the motor heating time constant to take into consideration the absence of the forced cooling.

nn programmable value from 1 to 10 times TC1

NOTE when all the measured currents are less than 0.05 In the motor is considered stopped.

Example:

TC2 = 04 TC1

E7 - THERMAL OVERLOAD MOTOR RESTART INHIBITION (programmable)

QTMIn cc xxx% QTM

The thermal threshold QTMInh prevents motor start-up attempts (temporary latch of the output relays related to the thermal thresholds $T^>$, $T^>>$, $T^>>>$) until the computed thermal overload has decreased to a level below the programmed threshold.

cc ON enabled threshold
OF disabled threshold (available but not active)

eee programmable threshold value from 50% to 100% (default 100%)

Example:

QTMIn cc 095% QTM

E8 - E9 - E10 - THERMAL OVERLOAD THRESHOLDS $T^>$, $T^>>$, $T^>>>$ (programmable)

$T^>$ cc uuu% QTM

$T^>>$ cc uuu% QTM

$T^>>>$ cc uuu% QTM

Thermal overload thresholds $T^>$, $T^>>$, $T^>>>$ programming; the three thresholds are independently programmable.

cc ON enabled threshold
OF disabled threshold (available but not active)

uuu thermal overload threshold values from 50% to 120% QTM
(QTM - motor thermal capacity)

Example:

T°> ON 085% QTM

T°>> ON 103% QTM

T°>>> OF 115% QTM

5.6.2 Phase overcurrent - locked rotor ANSI 51R (fig. 2)

F1	F2	F3	F4	F5
ANSI 51R ccc I>	I> nn.nn xxxxxx A	TI INDIP zz.zz s	TA nn.nn cccccccc	T AVV eee s

F1 - ON / OFF THRESHOLD ANSI 51R (programmable)

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

F2 - THRESHOLD LEVEL SET-UP (programmable)

nn.nn threshold level expressed in terms of In (1.00 ÷ 20.00)

xxxxxx: threshold level expressed in Amperes (primary values) NOT PROGRAMMABLE as function of ref. D2 set-up

F3 - TIME DELAY SET-UP (programmable)

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

zz.zz: time delay value programmable from 00.02 to 99.99 seconds

F4 - ADDITIONAL TIME DELAY SET-UP (programmable)

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 time delay function (ref. Q1, Q2, Q3 – paragraph 5.8).

nn.nn: time delay value programmable from 00.02 to 99.99 seconds

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 parameter eeeeeeee shows the digital input programmed to activate the additional time delay TA on the threshold I>.

The parameter eeeeeeee is not programmable and 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 I>
DIG1	digital input DIG1 activates the TA delay on the threshold I>
DIG2	digital input DIG2 activates the TA delay on the threshold I>
DIG3	digital input DIG3 activates the TA delay on the threshold I>

More than one digital input channel can activate the same TA (es. DIG 1,3).

F5 - MOTOR START UP TIME (programmable)

T	AVV
yyy	s

During the motor start up time the ANSI 51R threshold (**I>**) is inhibited; the motor start up time is activated when the equivalent current **leq** exceeds the value **0.05 In**.

When the motor start up time expires the ANSI 51R threshold is activated.

yyy time delay value programmable from 1 to 999 seconds

Example:

F1	F2	F3	F4	F5
ANSI 51R ON I>	I> 03.20 00640 A	TI INDIP 05.00 s	TA 10.00 DIG1	T AVV 025 s

5.6.3 Phase overcurrent - short circuit ANSI 50 (fig. 2)

G1	G2	G3	G4
ANSI 50 ccc I>>	I>>nn.nn xxxxx A	TI INDIP zz.zz s	TA nn.nn eeeeeeee

G1 - ON / OFF THRESHOLD ANSI 50 (programmable)

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

G2 - THRESHOLD LEVEL SET-UP (programmable)

nn.nn threshold level expressed in terms of In (1.00 ÷ 20.00)

xxxxxx: threshold level expressed in Amperes (primary values)
NOT PROGRAMMABLE as function of ref. **D2** set-up

G3 - TIME DELAY SET-UP (programmable)

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

zz.zz time delay value programmable from 00.02 to 99.99 seconds

G4 - ADDITIONAL TIME DELAY SET-UP (programmable)

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 time delay function (ref. Q1, Q2, Q3 - paragraph 5.8).

nn.nn time delay value programmable from 00.02 to 99.99 seconds

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).

The parameter **eeeeeeee** shows the digital input programmed to activate the additional time delay TA on the threshold I>>.

The parameter **eeeeeeee** is not programmable and 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 I>>
DIG1	digital input DIG1 activates the TA delay on the threshold I>>
DIG2	digital input DIG2 activates the TA delay on the threshold I>>
DIG3	digital input DIG3 activates the TA delay on the threshold I>>

More than one digital input channel can activate the same TA (es. DIG 1,3).

Example:

G1	G2	G3	G4
ANSI 50 ON I>>	I>>10.00 02000 A	TI INDIP 00.80 s	TA 00.50 DIG2

5.6.4 Earth - fault overcurrent ANSI 51N (fig. 2)

H1	H2	H3	H4
ANSI 51N ccc Io>	Io> n.nn xxxxx A	TI INDIP zz.zz s	TA nn.nn eeeeeeee

H1 - ON / OFF THRESHOLD ANSI 51N (programmable)

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

H2 - THRESHOLD LEVEL SET-UP (programmable)

n.nn threshold level expressed in terms of I_{on} (0.01 ÷ 2.00)

xxxxxx: threshold level expressed in Amperes (primary values)
NOT PROGRAMMABLE as function of ref. **D3** set-up

H3 - TIME DELAY SET-UP (programmable)

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

zz.zz time delay value programmable from 00.02 to 99.99 seconds

H4 - ADDITIONAL TIME DELAY SET-UP (programmable)

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 time delay function (ref. Q1, Q2, Q3 - paragraph 5.8).

nn.nn time delay value programmable from 00.02 to 99.99 seconds

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)

The parameter **eeeeeeee** shows the digital input programmed to activate the additional time delay TA on the threshold Io>.

The parameter **eeeeeeee** is not programmable and 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 Io>
DIG1	digital input DIG1 activates the TA delay on the threshold Io>
DIG2	digital input DIG2 activates the TA delay on the threshold Io>
DIG3	digital input DIG3 activates the TA delay on the threshold Io>

More than one digital input channel can activate the same TA (es. DIG 1,3).

Example:

H1	H2	H3	H4
ANSI 51N ON Io>	Io> 0.30 00015 A	TI INDIP 02.00 s	TA 00.00 DISABLED

5.6.5 Negative sequence overcurrent ANSI 46 (fig. 2)

L1	L2	L3
ANSI 46 ccc I2>	I2> n.nn xxxxx A	TI DIP=v zz.zz K

L1 - ON / OFF THRESHOLD ANSI 46 (programmable)

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

L2 - THRESHOLD LEVEL SET-UP (programmable)

n.nn threshold level expressed in terms of In (0.10 ÷ 1.00)

xxxxxx: threshold level expressed in Amperes (primary values)
NOT PROGRAMMABLE as function of ref. **D2** set-up

L3 - TIME DELAY SET-UP (programmable)

Set-up of time-delay to the activation (TRIP) of the programmed output relays when the negative sequence current computed from the measured phase and earth currents exceeds the threshold level.

The parameter **v** can be programmed to value A, B or C.

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)

zz.zz value of the programmed parameter K used in the formulas related to curves A, B and C as showed in paragraph 8 (programmable from 0.01 to 20.00 s).

Example:

L1	L2	L3
ANSI 46 OF I2>	I2> 0.20 0020 A	TI DIP=B 04.00 K

5.6.6 Number of motor start-up limitation ANSI 66 (fig. 2)

M1	M2	M3	M4
ANSI 66 ccc NAVV	NAVV xx	TLIM nn min	TBLK nn min

M1 - ON / OFF THRESHOLD ANSI 66 (programmable)

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

NOTE: the function of the number of motor start-up limitation must use a digital input channel programmed to the function **CMDAVV** (see paragraph 5.8 - ref. Q1, Q2 and Q3) which must be connected to an auxiliary contact related to the motor switch-gear.

M2 - NUMBER OF MOTOR START-UP THRESHOLD (programmable)

xx threshold level expressed in terms of motor start-up ($1 \div 20$)

NAVV represents the maximum allowed number of motor start-up within the time period **TLIM**.

M3 - START-UP PERIOD (programmable)

nn time period expressed in minutes ($1 \div 99$)

TLIM defines the time period during which the maximum number **NAVV** of motor start-up is allowed.

M4 - START-UP INHIBITION PERIOD (programmable)

nn time period expressed in minutes ($1 \div 99$)

TBLK defines the time period during which no more motor start-up attempts are allowed.

The start-up inhibition is obtained with a temporary latch of the output relays related to ANSI 66 function.

Example:

M1	M2	M3	M4
ANSI 66 OFF NAVV	NAVV 04	TLIM 05 min	TBLK 10 min

5.6.7 Undercurrent - loss of load ANSI 37 (fig. 2)

N1	N2	N3	N4
ANSI 37 ccc I<	I< n.nn xxxxx A	TI INDIP zz.zz s	TA nn.nn eeeeeeee

N1 - ON / OFF THRESHOLD ANSI 37 (programmable)

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

N2 - THRESHOLD LEVEL SET-UP (programmable)

n.nn threshold level expressed in terms of I_n (0.10 ÷ 1.00)

xxxxxx: threshold level expressed in amperes (primary values)
NOT PROGRAMMABLE as function of ref. **D2** set-up

N3 - TIME DELAY SET-UP (programmable)

Set-up of time-delay to the activation (TRIP) of the programmed output relays when one of the measured phase current is lower than the threshold level.

zz.zz time delay value programmable from 00.02 to 99.99 seconds

N4 - ADDITIONAL TIME DELAY SET-UP (programmable)

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 time delay function (ref. Q1, Q2, Q3 - paragraph 5.8).

nn.nn time delay value programmable from 00.02 to 99.99 seconds

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)

The parameter **eeeeeeee** shows the digital input programmed to activate the additional time delay TA on the threshold I<.

The parameter **eeeeeeee** is not programmable and 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 I<
 DIG1 digital input DIG1 activates the TA delay on the threshold I<
 DIG2 digital input DIG2 activates the TA delay on the threshold I<
 DIG3 digital input DIG3 activates the TA delay on the threshold I<

More than one digital input channel can activate the same TA (es. DIG 1,3).

Example:

N1	N2	N3	N4
ANSI 37 ON I<	I< 0.50 00500 A	TI INDIP 05.00 s	TA 00.00 DISABLED

5.7 Output relays programming (fig. 3)

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

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.

NOTE - the output relays related to the thermal overload thresholds ($T^{\circ}>$, $T^{\circ}>>$ and $T^{\circ}>>>$), the undercurrent threshold (I<) and the number of motor start-up limitation (NAV) do not have the START function.

P1 - 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

P2 - LATCH OF THE OUTPUT RELAYS (programmable)

R1
LATCH cc

Programming of the LATCH function on the output relay R1 when the relay has been activated on a START or TRIP condition.

cc ON LATCH function enabled
 OF LATCH function disabled

When the LATCH function has been activated the tripped relay will drop-off only when:

- RESET command on front panel
- RESET command from a specifically programmed digital input (ref. paragraph 5.8)
- RESET command through serial interface

P3 - P4 - P5 - OUTPUT RELAY ACTIVATION ON THERMAL OVERLOAD THRESHOLDS (T[°]>, T[°]>>, T[°]>>>) (programmable)

P3	P4	P5
R1 T [°] > xxxxxxxx	R1 T [°] >> xxxxxxxx	R1 T [°] >>> xxxxxxxx

Programming of the R1 output relay activation (TRIP) on the thermal overload thresholds.

The parameter xxxxxxxx is selectable as the following:

TRIP R1 output relay activation on the thermal overload thresholds
 NONE no activation related to thermal thresholds

Example:

P3	P4	P5
R1 T [°] > TRIP	R1 T [°] >> TRIP	R1 T [°] >>> NONE

P6 ÷ P9 - OUTPUT RELAY ACTIVATION ON THRESHOLDS I>, I>>, Io>, I2> (programmable)

P6	P7	P8	P9
R1 I> xxxxxxxx	R1 I>> xxxxxxxx	R1 Io> xxxxxxxx	R1 I2> xxxxxxxx

Programming of the R1 output relay activation (START / TRIP / NONE) on the thresholds I>, I>>, Io> and I2>.

The parameter xxxxx is selectable as the following:

START R1 output relay instantaneous activation on I>, I>>, Io> and I2> thresholds
 TRIP R1 output relay activation on I>, I>>, Io> and I2> thresholds
 NONE no activation related to thresholds I>, I>>, Io> and I2>

Example:

P6	P7	P8	P9
R1 I> START	R1 I>> TRIP	R1 Io> TRIP	R1 I2> NONE

P10 - OUTPUT RELAY ACTIVATION ON THRESHOLD I< (programmable)

R1 I< xxxxxxxx

Programming of the R1 output relay activation (TRIP / NONE) on the thresholds I<.

The parameter xxxxxxxx is selectable as the following:

TRIP	R1 output relay activation on the I< threshold
NONE	no activation related to I< threshold

P11 - OUTPUT RELAY ACTIVATION ON THRESHOLD NAVV (programmable)

R1 NAVV xxxxxxxx

Programming of the R1 output relay activation (TRIP / NONE) on the threshold NAVV.

The parameter xxxxxxxx is selectable as the following:

TRIP	R1 output relay activation on the NAVV threshold
NONE:	no activation related to NAVV threshold

P12 - TEST OF OUTPUT RELAY R1

TEST R1 xxxxxxxx

See paragraph 4.4

5.8 Digital inputs function programming (fig. 3)

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

- additional time delay (related to one or more thresholds - only time definite threshold)
- ON / OFF threshold
- STATUS function (recording of measures on external command)
- pilot wire fault monitoring (only DIG2 monitors DIG1).
- RESET output relay with active LATCH function
- Motor start-up signal acquisition

When function a) is programmed, a message is displayed at ref. F4, G4, H4 and N4 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.

Q1 - 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 xxxxxx: 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 I>	additional time delay on the threshold I>
TA I>>	additional time delay on the threshold I>>
TA Io>	additional time delay on the threshold Io>
TA I<	additional time delay on the threshold I<
TA ALL	additional time delay on all thresholds
OF T°>	threshold T°> disabled
OF T°>>	threshold T°>> disabled
OF T°>>>	threshold T°>>> disabled
OF I>	threshold I> disabled
OF I>>	threshold I>> disabled
OF Io>	threshold Io> disabled
OF I2>	threshold I2> disabled
OF I<	threshold I< disabled
OF NAVV	threshold NAVV disabled
OF ALL	all thresholds disabled
STATUS	activation of status function (see paragraph 1.)
RST RELE	RESET output relay with active LATCH function
CMDAVV	motor start-up signal acquisition

Q2 - DIGITAL INPUT DIG2 SET-UP (programmable)

DIG2	cc
xxxxxxxx	

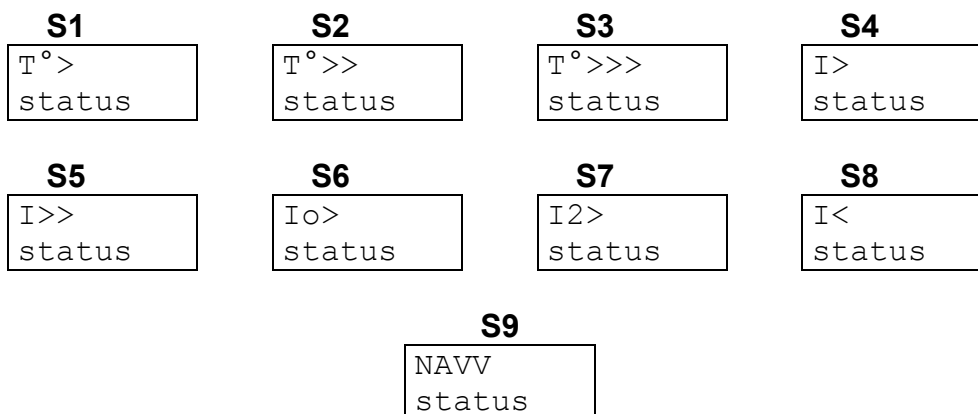
Programming of the function related to digital input channel 2 (DIG2); the selections available are the same as presented for DIG1 (ref. Q1) plus the following:

MONITOR	activation of pilot wire monitor function.
---------	--

Q3 - 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. Q1).

5.9 Parameter values visualization (fig. 4)**S1 - S2 - S3 - S4 - S5 - S6 - S7 - S8 - S9 - THRESHOLDS STATUS**

The actual status of each threshold is displayed. For each threshold are displayed the threshold identification (I>, I>> 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, F1, G1, H1, L1, M1, N1 - see par. 5.6)
OFF_DIG	threshold programmed active but momentary disabled by a digital input actual status (ref. Q1, Q2, Q3 see par. 5.8).

Examples:

**T1 - T2 - 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 - not activated)

NOTE that ON/OFF do not necessary mean energized or de-energized (see ref. P1).

Example:

T1		T2	
R1	ON	R3	OFF
R2	OFF	R4	ON

U1 - U2 - 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:

U1		U2	
DIG1	LO	DIG3	LO
DIG2	HI		

V1 - V2 - V3 - V4 - V5 - V6 - V7 - V8 - MEASUREMENT DISPLAY

The actual values of the measured currents and of the computed parameters are displayed; the parameters related to disabled thresholds are not displayed.

For each current the following information is displayed:

- currents or parameters identification (IA, IB, IC, Io, I2, Ieq, QTM, N avviam)
- actual values expressed as In, Ion or %
- actual primary value expressed as Amperes (only IA, IB, IC and Io)

V1	V2	V3	V4
IA=xx.xx yyyyy A	IB=xx.xx yyyyy A	IC=xx.xx yyyyy A	Io=xx.xx yyyyy A
V5	V6	V7	V8
I2 zz.zz In	Ieq hh.hh In	QTM www %	N avviam nn

xx.xx: current values as In or Ion (from 00.00 to 50.00 In or from 00.00 to 10.00 Ion)

yyyyy: actual primary value of the currents (expressed as Amperes)

zz.zz: negative sequence current value (from 00.00 to 10.00 In)

hh.hh: equivalent current value (from 00.00 to 99.99 In - computed as formula 1 - par. 1.1.1)

www: thermal overload as % QTM (0 - 130 %)

nn: number of motor start-up in the last TLIM minutes (from 00 to 99)

5.10 Events (fig. 4)

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.

Y1 - 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	
T°>	event on trip threshold T°>	(ANSI 49)
T°>>	event on trip threshold T°>>	(ANSI 49)
T°>>>	event on trip threshold T°>>>	(ANSI 49)
I>	event on trip threshold I>	(ANSI 51R)
I>>	event on trip threshold I>>	(ANSI 50)
I0>	event on trip threshold I0>	(ANSI 51N)
I2>	event on trip threshold I2>	(ANSI 46)
I<	event on trip threshold I<	(ANSI 37)
NAV	event on trip threshold NAV	(ANSI 66)
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 display give more detailed information on the event.

Y2 - TRIP THRESHOLD

It is shown the threshold that caused the TRIP condition and its value. This information is not presented on STATUS event.

Examples:

E1 T°>>> 115% QTM

E1 I> 02.50 In

E4 I2> 0.35 In

E6 NAV 08

Y3 - ACTIVATED OUTPUT RELAYS

E1 RELAY nnnnnnnn

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

Y4 - 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

Y5 - 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 - ref. par. 5.8).

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

Y6 - MEMORIZED MOTOR THERMAL OVERLOAD

E1 QTM
Sss% QTM

The values of the motor thermal overload at the event is displayed; the value is expressed as percentage (%) of the motor thermal capacity.

Y7 - Y8 - Y9 - Y10 - MEMORIZED MEASURED CURRENTS ON EVENT

E1 IA
yy.yy In

E1 IB
yy.yy In

E1 IC
yy.yy In

E1 Io
yy.yy In

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

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

Y11 - MEMORIZED NEGATIVE SEQUENCE CURRENT

E1	I2
xx.xx	In

The values of the negative sequence current at the event is displayed; the value is expressed as In terms.

Y12 - MEMORIZED NUMBER OF MOTOR START-UP

E1	
Navv	nn

The values of the number of motor start-up in the last TLIM minutes before the event is displayed.

Y13 - Y14 - Y15 - 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.

Y16 - Y17 - 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. 4)

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

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

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

Z1 ÷ Z18 - TRIP COUNTERS

Z1		Z2	
T [°] >		T [°] >	
P	cccc	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 (T[°]>>, T[°]>>>, I>, I>>, Io>, I2>, NAVV); 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).

Z19 ÷ Z21 - TOTAL PROGRAMMING SESSIONS AND DATE/TIME OF THE LAST PROGRAMMING SESSION

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

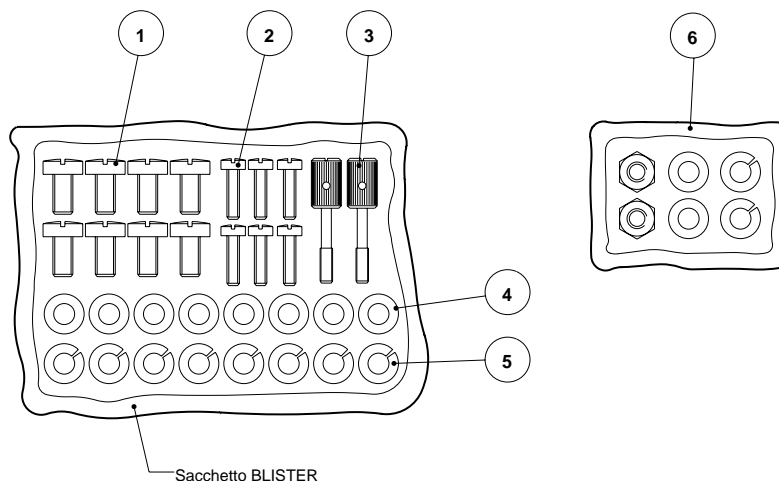
6.1 Supplied kit

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

- protection relay module IMT4N 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 IMT4N 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)
- 3) n° 2 screws to fix (optionally) the protection relay on the front of the 19" rack
- 4) n° 2 knobs to fix the transparent front panel
- 5) n° 8 washers to be used to fix wire terminals (current)
- 6) n° 8 growers to be used to fix wire terminals (current)

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 mm²

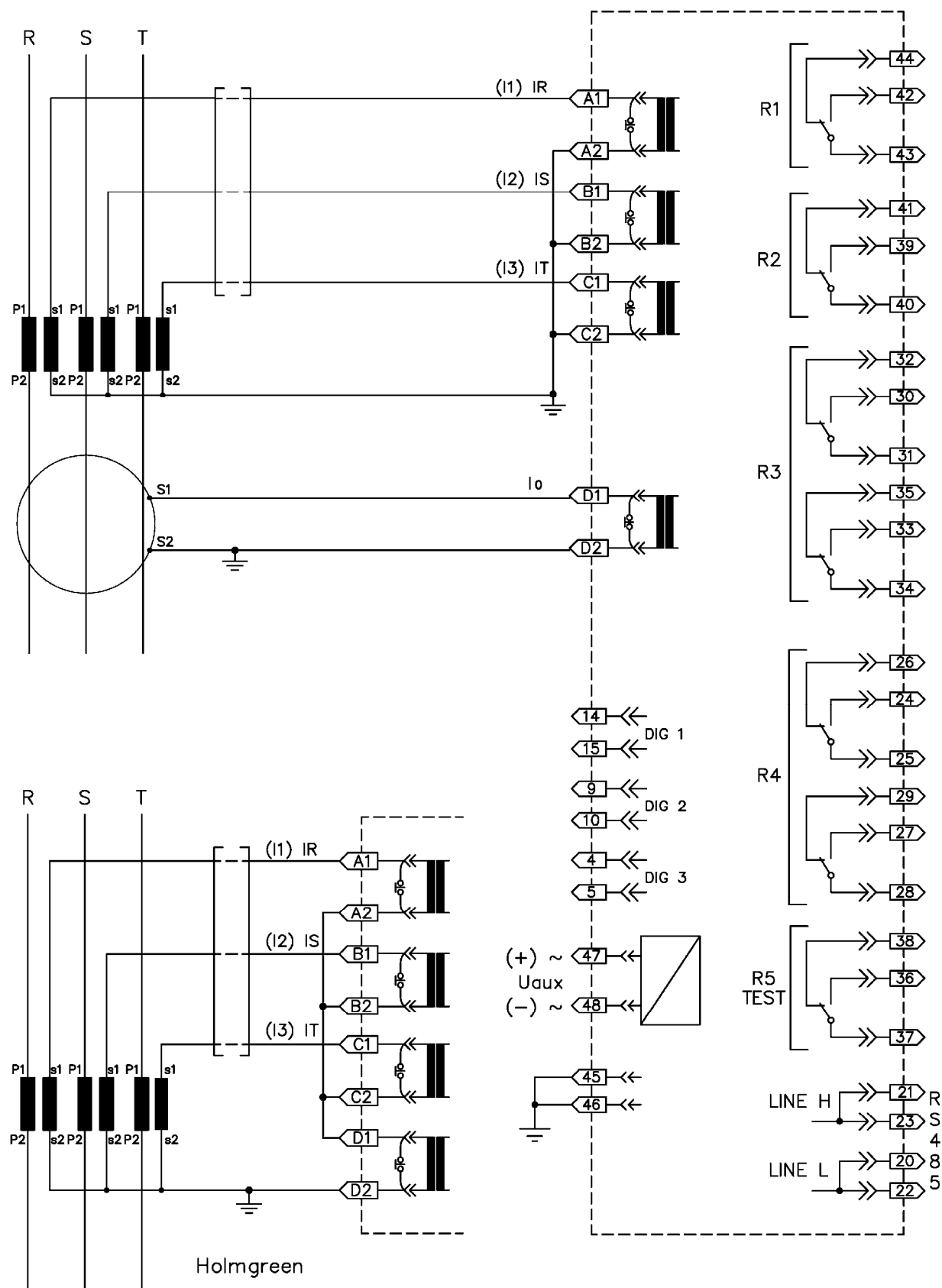
With reference to the insertion diagram in the next page, the currents measured by the protection relay have the following matching:

I1	terminals A1 - A2
I2	terminals B1 - B2
I3	terminals C1 - C2
I0	terminals D1 - D2

Other circuits (output relays etc.)

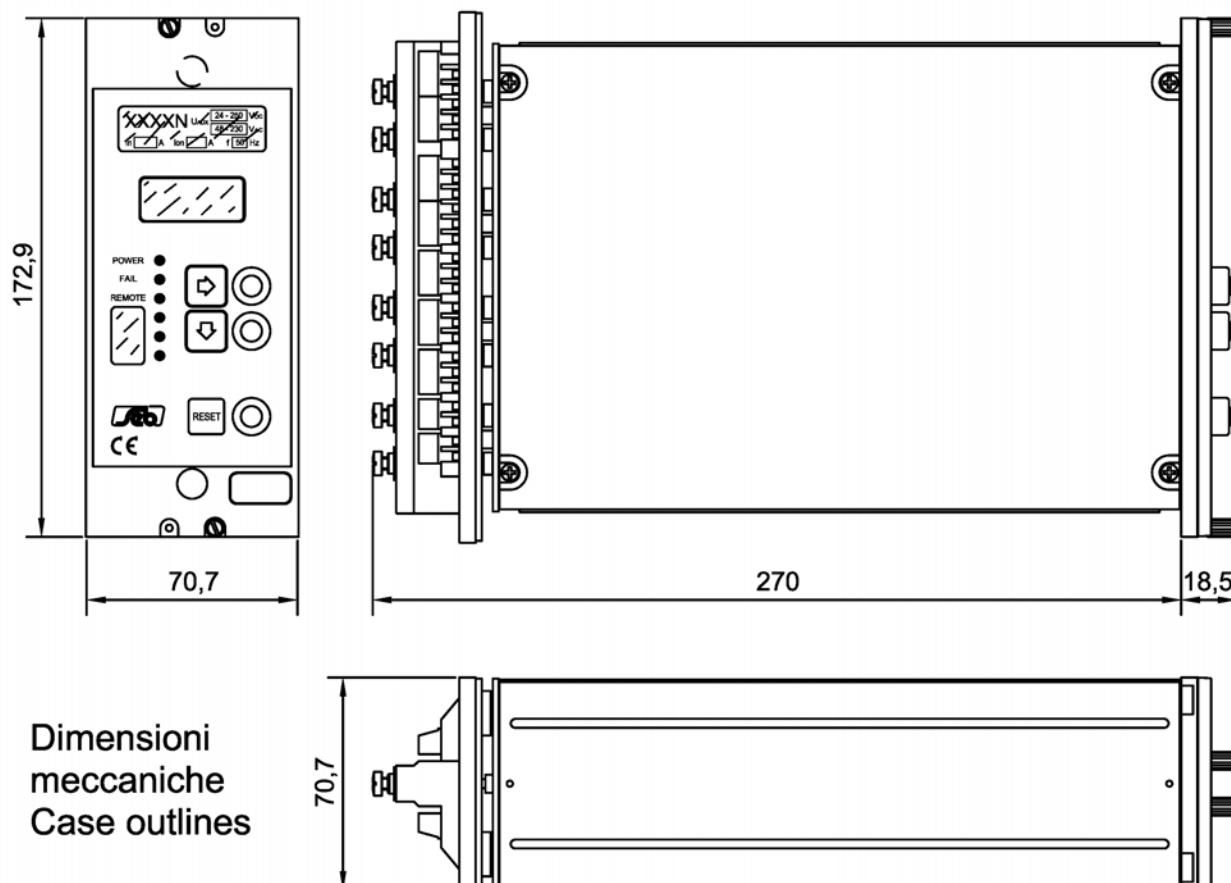
It is suggested to terminate the current wiring using plug terminals.

Minimum suggested wire cross section: 1,5 mm²



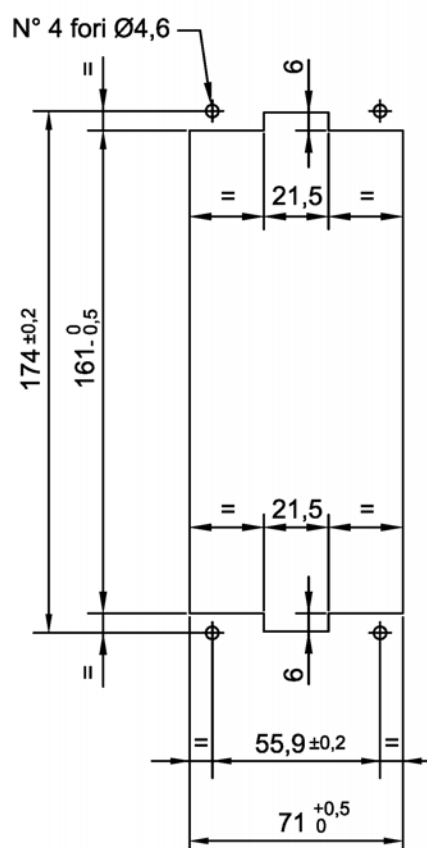
Insertion

Note: with bipolar insertion, do not connect I3 (C1 – C2)



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:

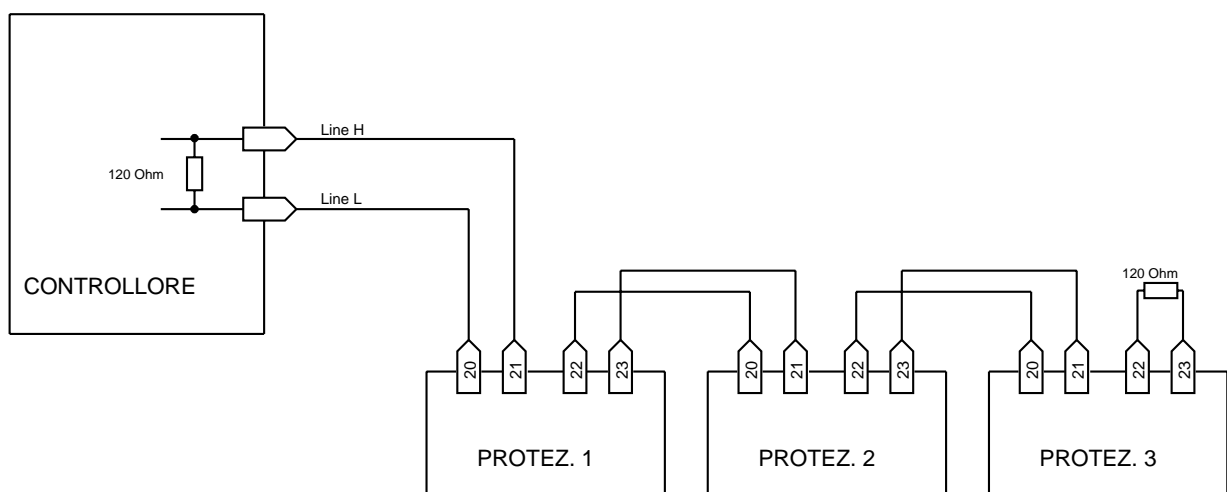


6.4 RS485 serial communication port

The digital protection relay IMT4N presents an insulated serial interface RS485 half-duplex that allow the multi-drop connection up to 31 protection units.

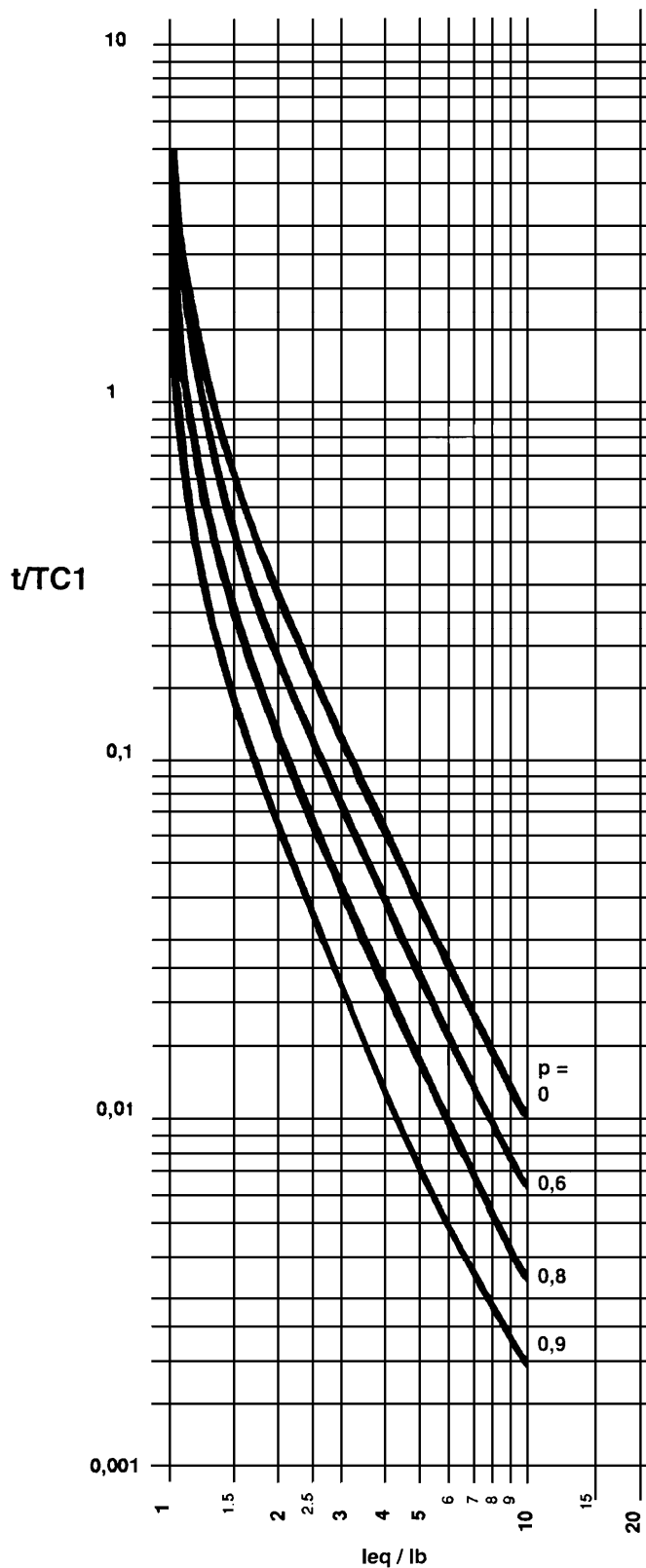
The transmission speed is automatically selected between 300 to 9600 bauds and the protocol is ASCII-HEX; the documentation related to the protocol is freely available on request.

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 THERMAL OVERLOAD CURVES - ANSI 49

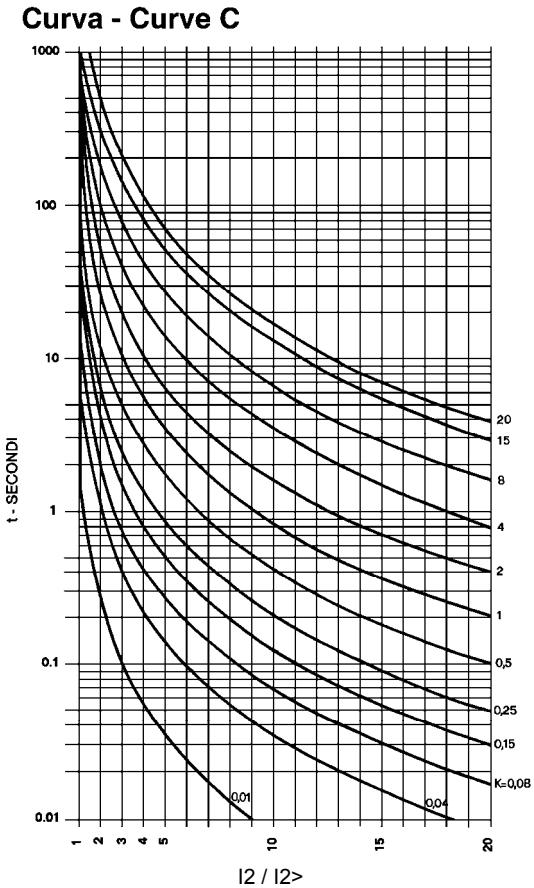
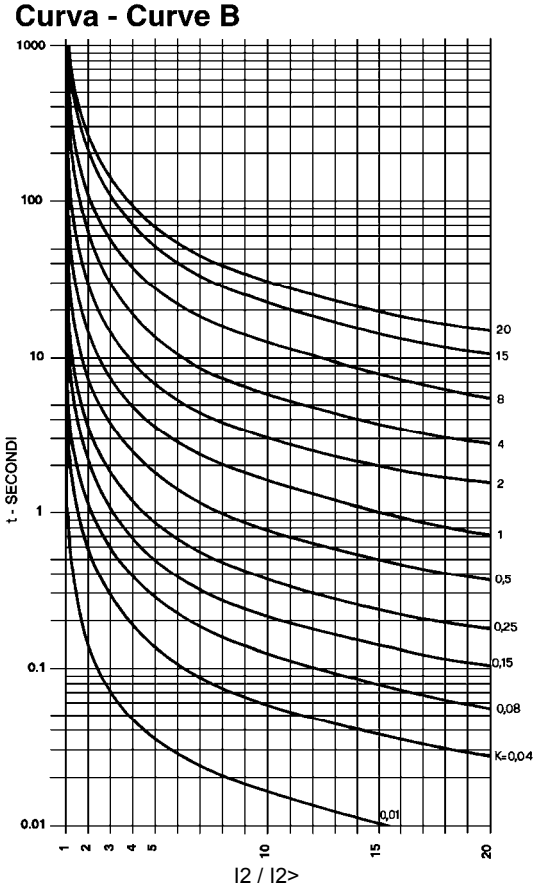
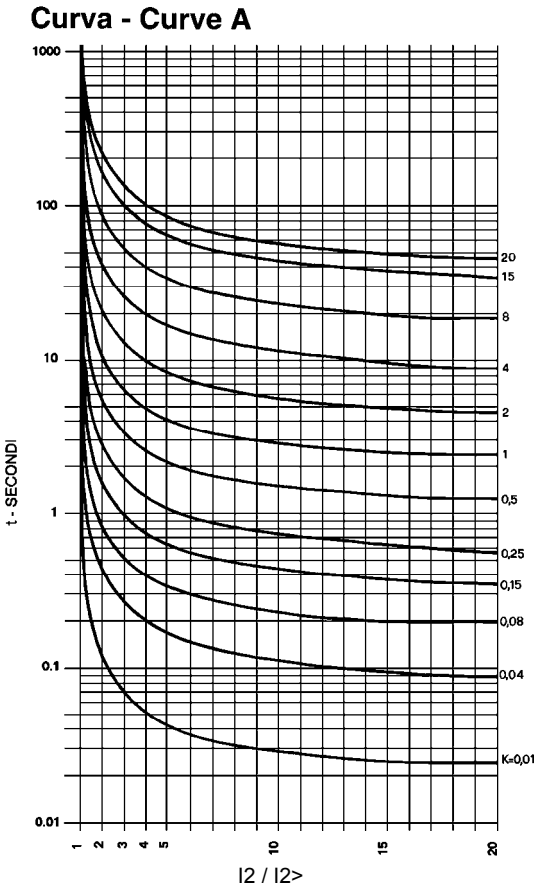


The curves refer to equation (2) and give the value $t/TC1$; the curves are expressed as function of:

- I_{eq}/I_b - ratio between the equivalent current computed as equation (1) and the selected base current (I_b).
- $p = I_p/I_b$ - ratio between the current (I_p) before the overload and the selected base current (I_b).

The operating time t is obtained multiplying the value $t/TC1$ with the programmed heating constant $TC1$.

8 TIME DEPENDENT CURVES - ANSI 46



ANSI 46
Unbalanced load

$$t = \frac{Ki * K}{\left(\frac{I2}{I2>}\right)^{\alpha} - 1} + 0.02s$$

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		
I2 / I2>	Ratio between inverse sequence current (I2) and threshold I2>		

9 TECHNICAL CHARACTERISTIC

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
- signalling 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	fiber 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 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

10 TABLES

Table A Settings

ANSI	THRESHOLDS		Setting	Resolution
49	T°>	Thermal overload	ON / OFF	1 %
	T°>>		50 ÷ 120 %	
	T°>>>			
	Ib	Base current	0.40 ÷ 2.00 I _n	0.01 I _n
	Ks	Negative sequence current weight coefficient (I _{eq} computation)	0 ÷ 10	1
	QTM0	Initial thermal overload (at relay power-up)	50 ÷ 100 %	1 %
	QTMinh	Thermal overload restart inhibit	50 ÷ 100 % ON / OFF	1 %
	TC1	Heating time constant	1 ÷ 500 min	1 min
	TC2	Cooling time constant	1 ÷ 10 TC1	1 TC1
51N	I_o>	Earth fault overcurrent Time delay trip I _o >	0.01 ÷ 2.00 I _{on} / OFF 0.02 ÷ 99.99 s	0.01 I _{on} 0.01 s
51R	I>	Phase overcurrent (locked rotor) Time delay trip I>	1.00 ÷ 20.00 I _n / OFF 0.02 ÷ 99.99 s	0.01 I _n 0.01 s
	T_{avv}	Starting time (threshold I> disabled)	1 ÷ 999 s	1 s
50	I>>	Phase overcurrent (short circuit) Time delay trip I>>	1.00 ÷ 20.00 I _n / OFF 0.02 ÷ 99.99 s	0.01 I _n 0.01 s
46	I₂>	Negative sequence overcurrent (unbalanced load)	0.10 ÷ 1.00 I _n / OFF	0.01 I _n
		Dependent time delay Characteristic curves as IEC 255-4	A, B, C	
		Characteristic constant	0.01 ÷ 20.00 s	0.01 s
37	I<	Undercurrent (loss of load) Time delay trip I<	0.1 ÷ 1.00 I _n / OFF 0.20 ÷ 99.99 s	0.01 I _n 0.01 s
66	NAV_V	Max. number of starts	1 ÷ 20 / OFF	1
	TLIM	Start-up period	1 ÷ 99 min	1 min
	TBLK	Start-up inhibition time	1 ÷ 99 min	1 min
50 – 51N 51R - 37		Additional delay	0.00 ÷ 99.99 s	0.01 s

SEB DIVISIONE ELETTRONICA E SISTEMI - UFFICIO COMMERCIALE
Via Segantini, 5 - 20825 BARLASSINA (MB) - **tel.** +39 0362 5669.1 - **fax** +39 0362 556622
web: www.seb-barlassina.it
mail to: servizio-clienti@seb-barlassina.it