MULTIFUNCTION DUAL LEVEL THREE PHASE OVERCURRENT + EARTH FAULT + THERMAL IMAGE RELAY WITH SERIAL COMMUNICATION PORT

TYPE DIN30-T

OPERATION MANUAL

INDEX

1. GENERAL UTILIZATION AND COMMISSIONING DIRECTIONS

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

1.1 - STORAGE AND TRANSPORTATION,
must comply with the environmental conditions stated on the product's instruction or by the applicable IEC standards.

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

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

1.4 – MEASURING INPUTS AND POWER SUPPLY,
carefully check that the value of input quantities and power supply voltage are proper and within the permissible variation limits.

1.5 – OUTPUTS LOADING,
must be compatible with their declared performance.

1.6 – PROTECTION EARTHING
When earthing is required, carefully check its efficiency.

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

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

1.9 – HANDLING
Notwithstanding the highest practicable protection means used in designing M.S. electronic circuits, the electronic components and semiconductor devices mounted on the modules can be seriously damaged by electrostatic voltage discharge which can be experienced when handling the modules.
The damage caused by electrostatic discharge may not be immediately apparent but the design reliability and the long life of the product will have been reduced. The electronic circuits produced by M.S. are completely safe from electrostatic discharge (15 KV IEC 255.22.2) when housed in their case; withdrawing the modules without proper cautions expose them to the risk of damage.

1.10 – MAINTENANCE

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

1.11 – FAULT DETECTION AND REPAIR

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

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

2. GENERAL CHARACTERISTICS AND OPERATION

2.1 - Input quantities are supplied to four current transformer :

- 3 for phase current measurement rated 5A with burden 2mΩ (≡ 0,05VA @ 5A);
  measurement is linear from 0,1 to 50A with resolution of 0,1A in the calculation of RMS value
  Permissible overload : 10A permanent, 200A for 1s.
  Recommended C.Ts. ≥3VA class 5P10

- 1 for measurement of residual current with taps for rated input Ion = 1 or 5A ;
  measurement is linear from 0,01 to 2 x Ion with resolution 0,004A in the calculation of the RMS value.
  Ion = 1A : burden 10mΩ (0,01VA @ 1A)
  Ion = 5A : burden 3mΩ (0,075VA @ 5A)

  If input is supplied by a core balance CT for high sensitivity Earth Fault detection, it is recommended to select a Ratio 100/1 Burden ≥ 0,1VA

2.2 - Power supply

Power supply input (terminals 1-2) is multivoltage autoranging 2kV isolated has no polarity and can accept any AC or DC voltage in the range a or b - Consumption ≤3VA.

Type a) - ⎧ **24V(-20%) / 110V(+15%) a.c.** / **24V(-20%) / 125V(+20%) d.c.** ⎩

Type b) - ⎧ **80V(-20%) / 220V(+15%) a.c.** / **90V(-20%) / 250V(+20%) d.c.** ⎩

2.3 - Serial Communication

An RS485 serial communication port is available on relays front. The communication is supported by a Jbus/Modbus compatible protocol. The relay can be connected either directly to any IBM compatible P.C. via a dedicated cable or to an RS485 serial bus. The latter configuration allows the user to connect more than one relay to a P.C. via the same physical serial line. A RS485/232 converter is available on request for connection to any IBM compatible P.C. or laptop. A communication software (MODCOM) for Windows 3.11 and Windows 95 is available. Please refer to the MODCOM instruction manual for more information.
The serial port provides the following functions/information.

- Control the test and Reset functions

- Read the actual R.M.S. measurement of the input quantities given as a number to be related to input current (see DATA BASE)

- Read the estimated thermal status given as a percentage of the full load temperature.

- Read the value of the different parameters as set on the rotary switches of relay's front face.

- Monitor the status of the digital input

- Monitor the status of the protection elements (normal/above set level/tripped).

- Monitor the self diagnostic function (E^2P error, Calibration error)

- Modify the following settings:

- **K_1** = Scale coefficient for the setting of the minimum pick-up level [I>] of the low set phase O/C element

$K_1 = 1$ or 5

- **K_2** = Scale coefficient for the setting of the minimum pick-up level [I>>] of the high set phase O/C element

$K_2 = 1$ or 5 or Dis

- **K_0** = Scale coefficient for the setting of the minimum pick-up level [Io>] of the Earth Fault current element

$K_0 = 1$ or 5

- **F(I>)** = Selection of the Time-Current operation characteristic of the how-set O/C element

F(I>) = D, DL, SI, VI, EI

- **F(Io>)** = Selection of the Time-Current operation characteristic of the Earth Fault element

F(Io>) = D, DL, SI, VI, EI

- **DI** = Selection of the operation mode of the Digital Input

- **Ith** = thermal image rated full load current

- **τ** = thermal image time constant

- **F49 output relay(s)** = the thermal image function can be configured to operate R1 and/or R2.

2.3.1 -

DIN30-T : DATA BASE

Word number (.Bit Number)	Type (I, O, I/O)	Meaning	Range	Unit	Factory default
67	O	Phase A current	0..65535	1200 => Phase nominal current[1]	//
68	O	Phase B current	0..65535	1200 => Phase nominal current[1]	//
69	O	Phase C current	0..65535	1200 => Phase nominal current[1]	//
70	O	Thermal status	0..65535	% full load temperature	//
71	O	Zero sequence current	0..65535	11998 => Zero sequence nominal current[2]	//
78.0	O	E2PROM status	0/1	0 => OK 1 => E2PROM error	//
78.1	O	Calibration status	0/1	0 => calibration completed successfully 1 => error during calibration	//
78.2 => 78.15	//	Reserved	//	//	//
80.0	O	Level of test push button	0/1	0 => test push button is depressed 1 => test push button is pressed	//
80.1	O	Level of reset push button	0/1	0 => reset push button is depressed 1 => reset push button is pressed	//
80.2	O	Status of input 15..16	0/1	0 => 15..16 input is active 1 => 15..16 input is active	//
80.3	O	Blocking input status	0/1	0 => 15..16 input is active AND configured as blocking input 1 => 15..16 input is not active OR not configured as blocking input	//
80.4 => 80.15	//	Reserved	//	//	//
80.4	O	Auto reset input status	0/1	0 => 15..16 input is active AND configured as auto reset 1 => 15..16 input is not active OR not configured as auto reset	//
80.5 => 80.9	//	Reserved	//	//	//
80.10	O	Status of output relay #1	0/1	0 => Relay 1 open 1 => Relay 1 closed	
80.11	O	Status of output relay #2	0/1	0 => Relay 2 open 1 => Relay 2 closed	//
80.12 => 80.15	//	Reserved	//	//	//
81.0	O	Trip status, I >	0/1	0 => I > not tripped 1 => I > tripped	//
81.1	O	Trip status, I >>	0/1	0 => I >> not tripped 1 => I >> tripped	//
81.2	O	Trip status, O >	0/1	0 => O > not tripped 1 => O > tripped	//
81.3	O	Trip status, test	0/1	0 => Test trip 1 => No test trip	//
81.4	O	Trip status, F49	0/1	0 => F49 trip 1 => No F49 trip	//
81.5 => 81.15	/	Reserved	/	/	//

Word number (.Bit Number)	Type (I, O, I/O)	Meaning	Range	Unit	Factory default
82.0	O	Led 3 flashing status	0/1	0 => Led 3 not flashing 1 => Led 3 flashing	//
82.1	O	Led 1 flashing status	0/1	0 => Led 1 not flashing 1 => Led 1 flashing	//
82.2	O	Led 2 flashing status	0/1	0 => Led 2 not flashing 1 => Led 2 flashing	//
82.3	O	Led 6 flashing status	0/1	0 => Led 6 not flashing 1 => Led 6 flashing	//
82.4	O	Led 5 flashing status	0/1	0 => Led 5 not flashing 1 => Led 5 flashing	//
82.5	O	Led 4 flashing status	0/1	0 => Led 4 not flashing 1 => Led 4 flashing	//
82.6	O	Led 6 flashing status	0/1	0 => Led 4 not flashing 1 => Led 4 flashing	//
82.7 => 82.15	/	Reserved	/	/	//
84	O	I > tripping level	600..2400	1200 => In^3	//
85	O	I > tripping time	10..175	0.01s	//
86	O	I >> tripping level	1200..12000	1200 => In^3	//
87	O	I >> tripping time	0..90	0.01s	//
88	O	O > tripping level	240..1320	11998 => On^4	//
89	O	O > tripping time	10..100	0.01s	//
90	I/O	Thermal image full load current	50..500	0.01A	100
91	I/O	Thermal image time constant	1..400	1min	1
106.0	I/O	Remote test command	0/1	0 => No Remote Test 1 => Remote Test	//
106.1	I/O	Remote reset command	0/1	0 => No Remote Reset 1 => Remote Reset	//
106.2..106.15	/	Reserved	/	/	//
107	I/O	Blocking input time	0..5	0.1s 0 => Dis	1
108	I/O	Config. word	0..2	0 => I >> Dis. 1 => KI >> = 1 2 => KI >> = 5	1
109, Low byte	I/O	Config. byte	0..5	0 => I > Dis. 1 => I > D 2 => I > DL 3 => I > SI 4 => I > VI 5 => I > EI	1
109, High byte	I/O	Config byte	0..5	0 => O > Dis. 1 => O > D 2 => O > DL 3 => O> SI 4 => O > VI 5 => O > EI	1

Word number (.Bit Number)	Type (I, O, I/O)	Meaning	Range	Unit	Factory default
110.0	I/O	Config bit	0/1	0 => Blocking input doesn't block I > 1 => Blocking input blocks I >	0
110.1	I/O	Config bit	0/1	0 => Blocking input doesn't block O > 1 => Blocking input blocks O >	0
110.2	I/O	Config bit	0/1	0 => Blocking input doesn't block I >> 1 => Blocking input blocks I >>	0
110.3	I/O	Config bit	0/1	0 => 15-16 input => Auto Reset 1 => 15-16 input => Blocking input	0
110.4	I/O	Thermal image operates R1	0/1	0 => Thermal image does not operate R1 1 => Thermal image operates R1	1
110.5	I/O	Thermal image operates R2	0/1	0 => Thermal image does not operate R2 1 => Thermal image operates R2	0
110.6..110.15	I/O	Reserved	//	//	//
111..122	I	Reserved for final factory test and calibration	//	//	
111	O	Id word #1	Constant = 'DI'	ASCII	//
112	O	Id word #2	Constant = 'N3'	ASCII	//
113	O	Id word #3	Constant = '0T'	ASCII	//
114	O	Id word #4	Constant = ' '	ASCII	//
115	O	Id word #5	Constant = ' '	ASCII	//
123	I/O	Node address	1..255	1	//

[1] Phase currents are represented using a conventional unit. A value equal to 1200 corresponds to the nominal phase current (In).

[2] Zero sequence current is represented using a conventional unit. A value equal to 1200 corresponds to the nominal zero sequence current (On).

[3] Phase tripping levels are represented using a conventional unit. A value equal to 1200 corresponds to the nominal phase current (In).

[4] Zero sequence tripping levels are represented using a conventional unit. A value equal to 1200 corresponds to the nominal phase current (In).

2.4 - Digital Input (Terminals 15-16)

It is electrically connected to the power supply and can be operated only by a cold (not energized) contact.
The digital input is activated when its the terminals are shorted.
The function of the Digital Input (D.I.) can be programmed via the serial port as follows:

Programming "AutoReset"

The D.I. is used to control the reset mode of the output relays R1, R2.
If terminals 15-16 are shorted, reset after tripping takes place automatically as soon as the input current drops below the minimum pick-up level (I<[I>], Io<[Io>]).
If terminals 15-16 are open, reset after tripping is controlled via the Reset button on relay's front or via closing a N/O contact connected to terminals 15-16 (Remote Reset).

Programming "Block Input"

The D.I. is used to increase the trip time delay of the relay's functions by the additional programmable time TBI (sec)
[TBI] = 0,1 - 0,2 - 0,3 - 0,4 - 0,5 - Dis.
When programmed TBI = Dis, the pick-up of the output relay is blocked as long as the D.I. is active (terminals 15-16 shorted).
This function can be control one or more of relay's functions according to programming of D.I.:

D.I. = I> : D.I. when active increases the trip time delay of the function I> : tI> = [tI>]+[TI]
D.I. = I>> : as above tI>> = [tI>>]+[TI]
D.I. = Io> : as above tIo> = [tIo>]+[TI]
D.I. = I>+I>> : as above tI> = [tI>]+[TI] and tI>> = [tI>>]+[TI]
D.I. = I>+Io> : as above tI> = [tI>]+[TI] and tIo> = [tIo>]+[TI]
D.I. = I>+I>>+ Io> : as above tI> = [tI>]+[TI] and tI>> = [tI>>]+[TI] and tIo> = [tIo>]+[TI]
D.I. = I>>+ Io> : as above tI>> = [tI>>]+[TI] and tIo> = [tIo>]+[TI]

2.5 - Output relays R1 - R2

Relay R1 is operated by low-set O/C element and by E/F element (tI> and tIo>).
Relay R2 is operated by high set O/C element (tI>>).
The thermal image function can be configured to operate R1 and/or R2 via the serial communication interface.
Two N/O contacts with a common point are controlled by relays R1 and R2 (one for each relay)

- Maximum continuos rating : 5A - 250V
- Maximum switching power : 1250VA (5A resistive)
- Maximum switching voltage : 250Vac - 110Vdc
- Maximum make current : 20A - 0,5s
- Maximum DC brake current : 0,2A - 110Vdc L/R=40ms

2.6 - Signalizations and controls (see Fig. 1)

2.6.1 - Low set phase overcurrent element 1F51

I> = S_1•K_1 : minimum pick-up phase current (input Amps) of relay R1

tI> = t_1 : trip time delay (sec) of relay R1 for phase O/C (*)

-①- 10-step Rotary Switch for setting the value **[S_1];**
the scale coefficient **[K_1]** can be 1 or 5 according to programming (see § 2.3.1)

-②- 10-step Rotary Switch for setting of the trip time delay [tI>] = [t_1]
The operation mode and the time current curve is selected by programming the parameter [FI>]. (see § 2.3.1)

[FI>] = D : standard independent Definite time
Relay's pick-up takes place when the actual current exceeds the set level [I>] for the set time [tI>] = [t_1]

[FI>] = DL : Long independent Definite time :
Relay's pick-up takes place when the actual current exceeds the set level [I>] for the set time [tI>] = 10 • [t_1]

[FI>] = SI : Standard dependent Inverse time :
Element's operation starts when the actual current exceeds the set level [I>] and relay's pick-up time delay tI> depends on the ratio of the actual current I to the set level [I>] :

$$tI >= \frac{10^{0,02}-1}{\left(I/[I>]\right)^{0,02}-1}\bullet[tI>] = \frac{0,047}{\left(I/[I>]\right)^{0,02}-1}\bullet[tI>]$$

[FI>] = VI : dependent Very Inverse time :
Same as for the setting SI with

$$tI >= \frac{10-1}{\left(I/[I>]\right)-1}\bullet[tI>] = \frac{9}{\left(I/[I>]\right)-1}\bullet[tI>]$$

[FI>] = EI : dependent Extremely Inverse time :
Same as for the setting SI with

$$tI >= \frac{10^{2}-1}{\left(I/[I>]\right)^{2}-1}\bullet[tI>] = \frac{99}{\left(I/[I>]\right)^{2}-1}\bullet[tI>]$$

(*) In the dependent time operation mode SI, VI, EI, the set time [t_1] corresponds to the actual relay's pick-up time delay when the fault current I is ten times the set level [I>] :
I = 10[I>] ⇒ tI> = [t_1]

-③- Red signal led F51 - I>
Operates when the actual current I≥[I>]; the led is :
a - Flashing during the trip time delay tI>
b - Illuminated on tripping after tI>
Reset from status - a - is automatic
Reset from status - b - is manual by the Reset button (11)

(*) The status of the LEDs is memorized even on failure of power supply

2.6.2 - High set phase overcurrent element 2F51

I>> = $S_2 \bullet K_2$: minimum pick-up phase current (input Amps) of relay R2

tI>> = t_2 : trip time delay (sec) of relay R2 for phase O/C

-④- 10-step Rotary Switch for setting the value [S_2]
the scale coefficient [K2] can be 1 or 5 or Dis. (= element disactivated) according to programming (see § 2.3.1)

-⑤- 10-step Rotary Switch for setting of the independent definite time delay [tI>>] = [t_2]

-⑥- Red signal Led F51-I>>
Operates when the actual current I≥[I>>]; the led is :
a - Flashing during the trip time delay tI>>
b - Illuminated on tripping after tI>>
Reset from status - a - is automatic
Reset from status - b - is manual by the Reset button (11)

(*) The status of the LEDs is memorized even on failure of power supply

2.6.3 - Earth Fault element F51N

Io> = $S_o \bullet K_o$: minimum pick-up phase current (neutral input Amps) of relay R1

tIo> = t_o : trip time delay (sec) of relay R1 for earth fault (*)

-⑦- 10-step Rotary Switch for setting the value **[S_o];**
the scale coefficient **[K_o]** can be 1 or 5 according to programming (see § 2.3.1)

-⑧- 10-step Rotary Switch for setting of the trip time delay [tIo>] = [t_o]
The operation mode and the time current curve is selected by programming the parameter [FIo>]. (see § 2.3.1)

[FIo>] = D : standard independent Definite time
Relay's pick-up takes place when the actual current exceeds the set level [Io>] for the set time [tIo>] = [t_o]

[FIo>] = DL : Long independent Definite time :
Relay's pick-up takes place when the actual current exceeds the set level [Io>] for the set time [tIo>] = 10 • [t_o]

[FIo>] = SI : Standard dependent Inverse time :
Element's operation starts when the actual current exceeds the set level [Io>] and relay's pick-up time delay tIo> depends on the ratio of the actual current Io to the set level [Io>] :

$$tIo >= \frac{10^{0,02}-1}{\left(Io/[Io>]\right)^{0,02}-1} \bullet [tIo >] = \frac{0,047}{\left(Io/[Io>]\right)^{0,02}-1} \bullet [tIo >]$$

[FIo>] = VI : dependent Very Inverse time :
Same as for the setting SI with

$$tIo >= \frac{10-1}{\left(Io/[Io>]\right)-1} \bullet [tIo >] = \frac{9}{\left(Io/[Io>]\right)-1} \bullet [tIo >]$$

[FIo>] = EI : dependent Extremely Inverse time :
Same as for the setting SI with

$$tIo >= \frac{10^{2}-1}{\left(Io/[Io>]\right)^{2}-1} \bullet [tIo >] = \frac{99}{\left(Io/[Io>]\right)^{2}-1} \bullet [tIo >]$$

(*) In the dependent time operation mode SI, VI, EI, the set time [t_o] corresponds to the actual relay's pick-up time delay when the fault current I is ten times the set level [Io>] :
Io = 10[Io>] $\Rightarrow$ tIo> = [t_o]

-⑨- Red signal Led F51N-Io>
Operates when the actual current I≥[Io>]; the led is :
a - Flashing during the trip time delay tIo>
b - Illuminated on tripping after tIo>
Reset from status - a - is automatic
Reset from status - b - is manual by the Reset button (11)

(*) The status of the LEDs is memorized even on failure of power supply

2.6.4 – Thermal image element F49

Ith = (0.5-5)A : rated full load current adjustable via serial port.
τ = (1-400) min : thermal image time constant adjustable via serial port.

See fig. 2 for the element's tripping curve. The term *I* in fig. 1 is the maximum among the three phase currents.

-(14)- Red signal led F49

The led is:
- Flashing in case of thermal overload alarm (actual estimated temperature over 100% full load temperature).
- Illuminated on tripping of the F49 element.

Reset from status - a - is automatic
Reset from status - b - is manual by the Reset button (11) or via the serial communication interface

(*) The status of the LEDs is memorized even on failure of power supply

2.6.5 – Front face general control

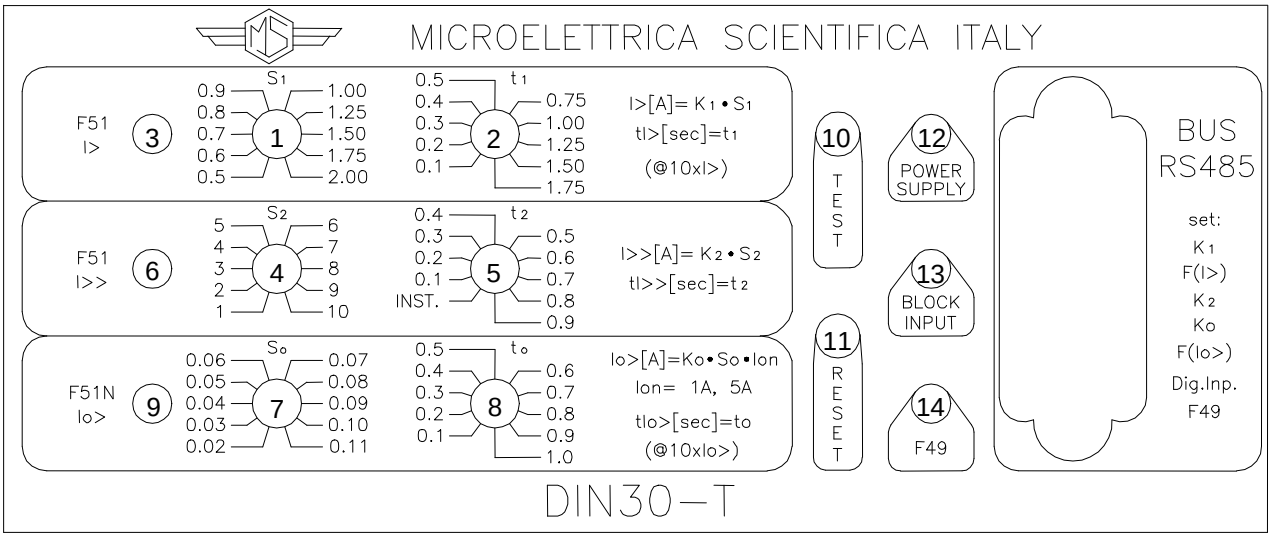
-(10)- Test push button : - When pressed makes all the functions trip and all the leds lit-on

-(11)- Reset push button : - Press to reset the signal leds after functions' tripping.
When Manual Reset is programmed, this button also resets the R1 relay.

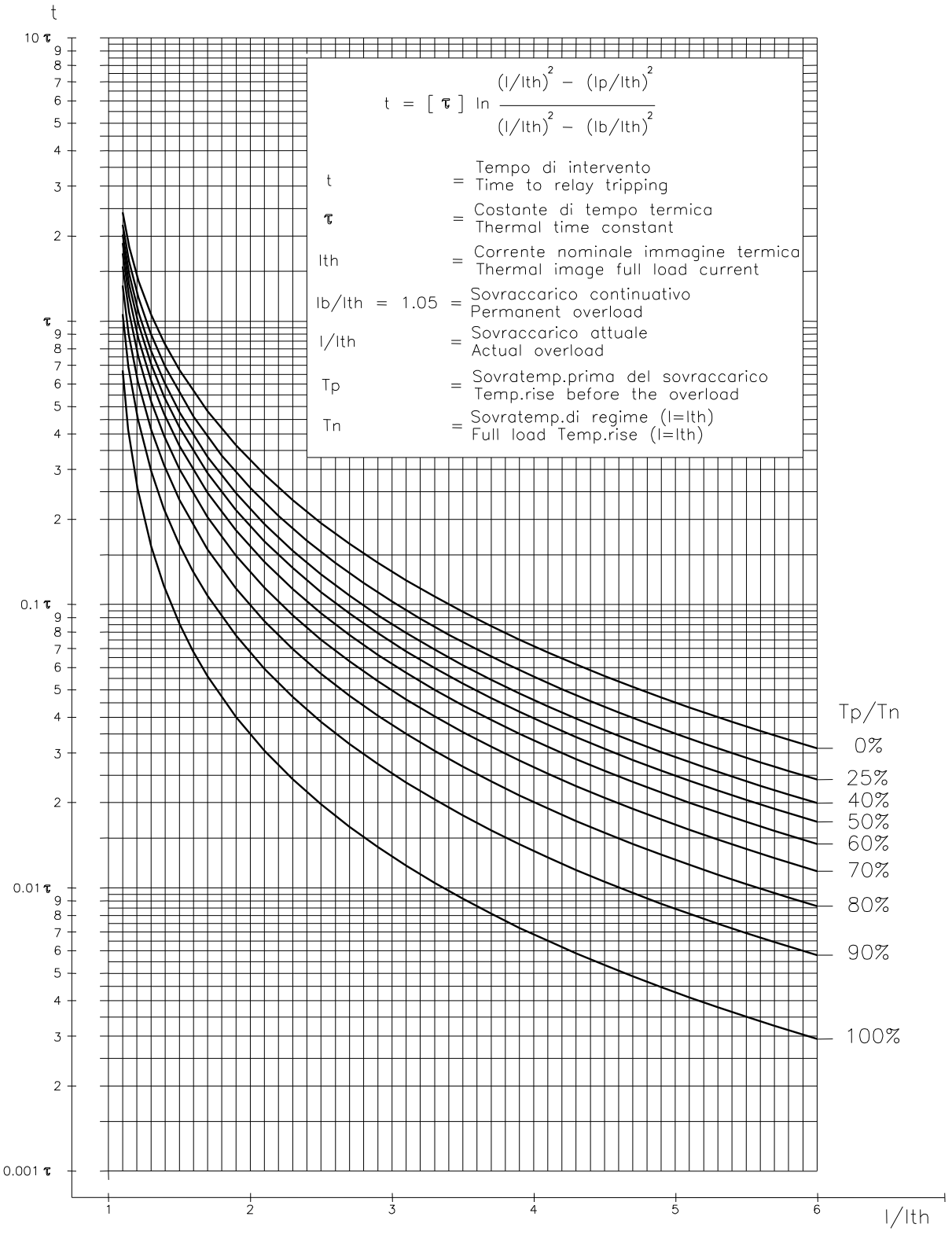
-(12)- Green Led "Power Supply" : - Illuminated in normal operation when power input is energized.
- Flashing when a relay's internal fault is detected by the autodiagnostic function.

-(13)- Yellow Led "Block Input" : -Flashing when terminals 15-16 are shorted

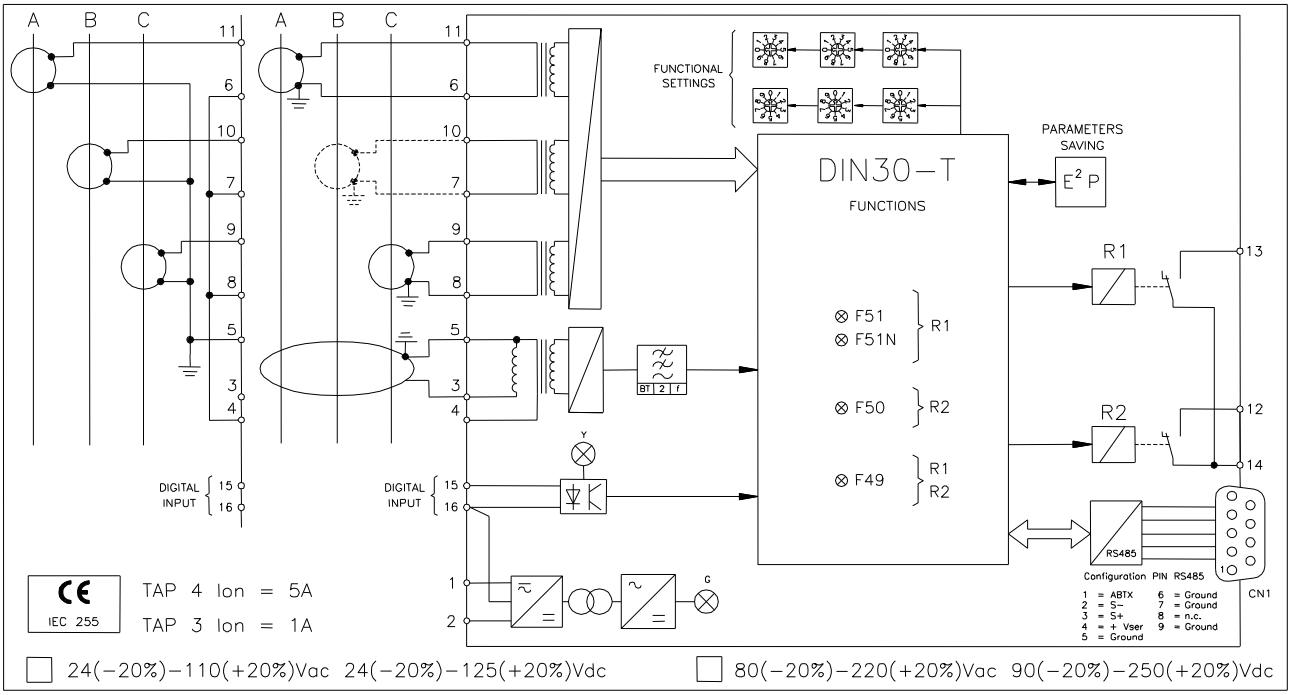
3 - FRONT FACE (TE1189 Rev.0) Fig.1



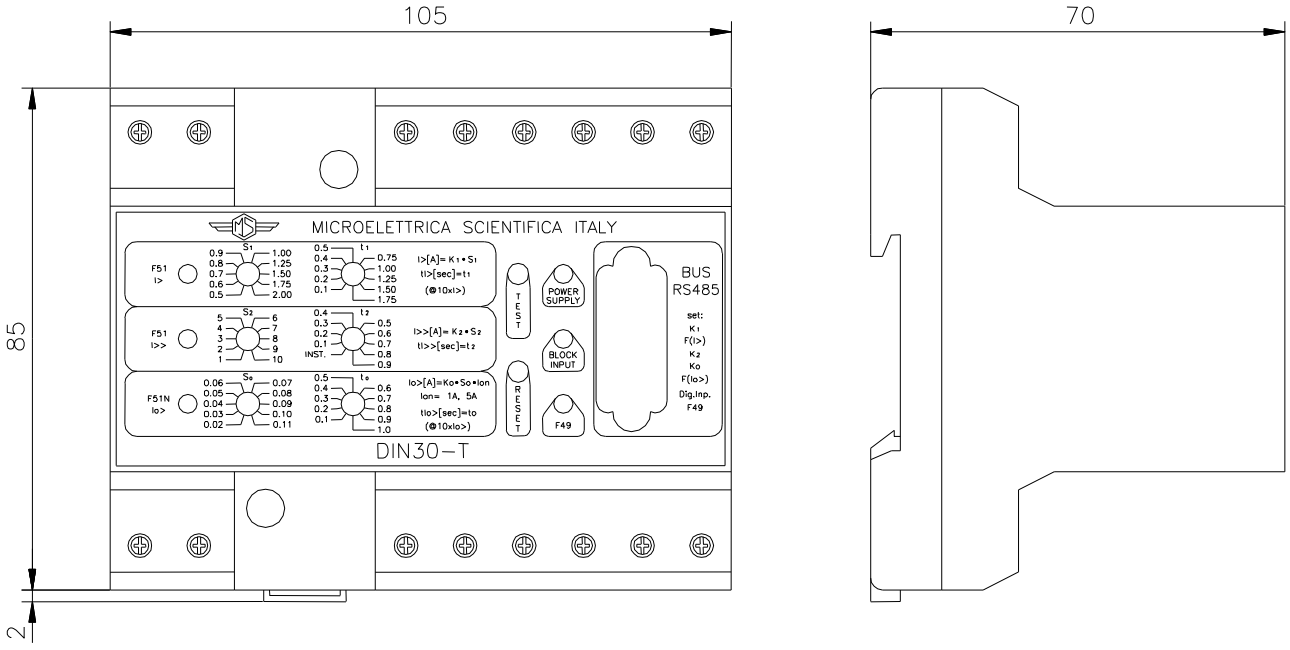
4 - THERMAL IMAGE CURVE (TU0352 Rev.0) Fig.2



5 - CONNECTION DIAGRAM (SCE1521 Rev.0)



6 - OVERALL DIMENSIONS (D46030 Rev.1)



7 - MAINTENANCE

No maintenance is required. Periodically a functional check-out can be made by operating the TEST button on relay's front. In case of malfunctioning please contact Microelettrica Scientifica Service or the local Authorised Dealer mentioning the relay's Serial No reported in the label on relays enclosure.

8 - ELECTRICAL CHARACTERISTICS

Reference standards	IEC 255, 801; CEI 41-1; IEEE C37; CE
Dielectric test voltage	2000 V, 50 Hz, 1 min.
Impulse test voltage	5kV (MC), 1kV (MD) - 1,2/50μμs
Immunity to high frequency burst	1 kV (MC), 0,5 kV (MD) - 0,1 MHz 2,5 kV (MC), 1 kV (MD) - 1 MHz
Immunity to electrostatic discharge	15 kV
Immunity to sinusoidal wave burst	100 V - (0,01-1) MHz
Immunity to radiated E.M. field	10 V/m - (20-1000) MHz
Immunity to 50-60 Hz magnetic field	1000 A/m
Immunity to impulse magnetic field	1000 A/m - 8/20μs
Immunity to magnetic burst	100A/m - (0,1-1) MHz
Resistance to vibration and shocks	10-500 Hz - 1 g - 0,075 mm
Rated current phase input	In = 1 or 5 A
Rated current residual current input	On = 1 or 5 A
Current overload	200 a for 1 sec; 10 A continuos
Burden on current inputs	Z_F=2mΩ phase at In; Z_0=3/10mΩ at On = 1/5A
Average power supply consumption	2,5 VA
Output relays	rating 5 A; 250V AC Max switching power = 1250VA Max switching current = 5A (resistive) Max switching voltage = 250V AC - 110V DC Max make current = 20A, (peak) for 0.5s Max make current = 0.2A, 110Vdc, L/R=40ms
Operation ambient temperature	-20°C / +60°C
Storage temperature	-30°C / +80°C