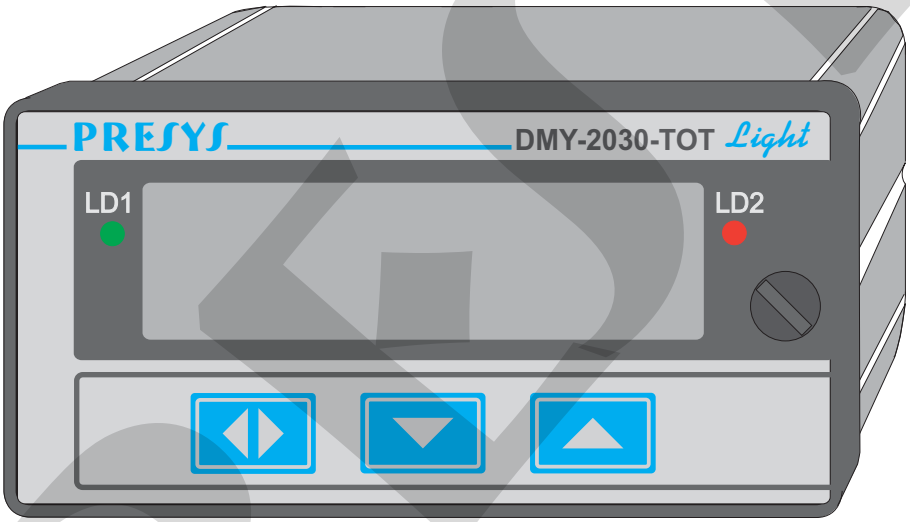
PRESYS | Instruments Inc.

DMY-2030-TOT *Light* Process Indicator and Totalizer



TECHNICAL MANUAL

PRESYS Instruments

CE Declaration of Conformity

Presys unit DMY-2030-TOT *Light* has been designed to comply with the following European Standards:

EN 50081-1: 1992 Electromagnetic Compatibility - Generic emission standard.
EN 50081-2: 1994

EN 50082-1: 1992 Electromagnetic Compatibility - Generic immunity standard.
EN 50082-2: 1995 (Performance criterion B).

EN 61010-1: 1993 Safety Considerations

I have made all reasonable enquiries regarding the unit stated and their conformance to the EU, Low Voltage and EMC Directives. To the best of my knowledge and belief this unit conform to these directives.

This Declaration is controlled under an ISO 9001:2000 system certificated by TÜV Rheinland, certificate number CE, SIQ - 558 - Revision 10.

Signature

Name R. W. Silva

Position Manager

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1.0 - Introduction

1.1 - Description

PRESYS DMY-2030-TOT *Light* Indicator and Totalizer is a microprocessor-based instrument that shows industrial process variables such as pressure, flow, level, etc. and totalizes the indication values. It has non-volatile internal memory (E2PROM) to store calibration values. Its high accuracy is warranted by autocalibration techniques based on high thermal stability voltage reference.

It can communicate with computers by using the optional RS-232 or RS-422/485 communication module.

The Indicator is able to monitor one input and accepts direct connection of current (mAdc) and voltage (mVdc, Vdc). There is a 24Vdc voltage source isolated from output and with short-circuit protection in order to supply transmitters.

The totalization is performed with 8-digit count, configured together with the number of decimals. The totalization counts do not decrease for signals under the zero scale defined by the user, and Reset can be applied to the totalization by means of the Indicator front-panel keys or by the contact input.

Input type is enabled by jumpers and software configuration. All configuration data is stored in non-volatile memory and can be protected by password.

According to modularity concept design, the equipment accepts up to four output cards. The output types are: retransmittion, SPDT relay, SPST relay and solid state relay. The outputs are isolated from the input.

It accepts 90 to 240VAC or 130 to 340VDC (with any polarity) power supply.

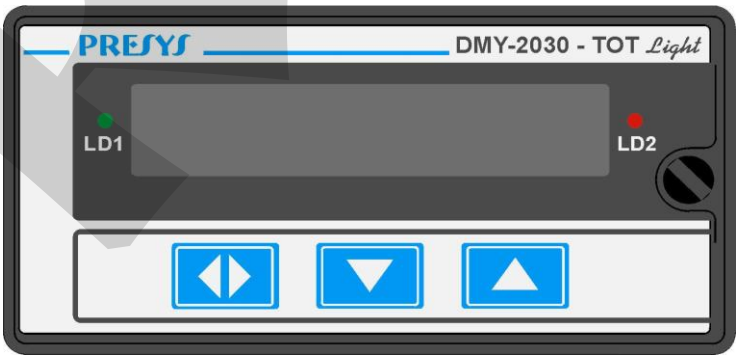


Fig. 1 - DMY-2030-TOT *Light* Indicator and Totalizer Front Panel

The equipment has an extruded aluminum case which avoids electrical noise, electromagnetic interference, radiofrequency interference, etc. and its robust construction makes it tough enough for the most hostile environment.

The front panel has a high visibility display configurable up to 8 digits which can show the process variable, using 4 ½ digits, and the totalization. During configuration, the display shows mnemonics and parameter values. The leds and the display can be used as a visual indication of alarm or they can be associated to the alarm outputs. So, there are up to seven alarm indications available (four alarm modules together with the display and leds). The alarm outputs can be configured, independently, to operate with latch, demanding the operator acknowledge by means of the front panel keys in order to deactivate them after the process variable returns to normal condition.

One retransmitter output is available to provide a linear output signal from 4 to 20 mA, 1 to 5V or 0 to 10V proportional to the input process variable being measured. This signal allows the retransmittion of the variable to a distant location. When using the analog output, up to three alarm modules can be used.

1.2 - Order Code

DMY-2030-TOT *Light* - A - B - C - D - E - F - G

Field A		Output 1
	0	Not used
	1	4 to 20mA
	2	1 to 5V
	3	0 to 10V
	4	SPST relay
	5	Open collector voltage
	6	Solid state relay
Field B		Output 2
	0	Not used
	1	SPST relay
	2	Open collector voltage
	3	Solid state relay
Field C		Output 3
	0	Not used
	1	SPDT relay
	2	Open collector voltage
	3	Solid state relay
Field D		Output 4
	Same code of Output 3	
Field E		Power Supply
	1	90 to 240VAC or 130 to 340VDC (any polarity)
	2	24VAC or 24VDC
	3	12VDC

Field F		Communication
	0	Not used
	1	RS-232
	2	RS-485
	3	RS-422

Field G		Case Protection Grade
	0	General usage, protected place
	1	Front aspersion-proof
	2	Weather-proof

Note 1 - Range and input type, indication, totalization parameters, relay usage as alarms and alarm setpoints are, among other things, items that the user can program through the front panel keys (if wanted, specify such information so that all the configuration can be made by PRESYS).

Note 2 - Other hardware and software features can be available under previous consult.

Code example:

1) DMY - 2030 - TOT *Light* - 0 - 0 - 1 - 1 - 1 - 0 - 0

This code defines a DMY-2030-TOT *Light* Indicator and Totalizer with two SPDT relays which can be used as high and low alarms, 90 to 240VAC or 130 to 340VDC electric power supply, protected field usage.

1.3 - Technical Specifications

Input:

- One input configurable for 4 to 20 mA, 0 to 55 mVdc, 1 to 5 Vdc, 0 to 10 Vdc. 250 Ω input impedance for mA, 10 MΩ for 5 Vdc and 2 MΩ above 5 Vdc. Table 1 shows the resolution for linear input sensors.
- Contact input to reset totalization.

Input sensor	Range	Resolution
Voltage	0 to 55mV	3μV
	0 to 5V	250μV
	0 to 10V	500μV
Current	0 to 20mA	1μA

Table 1 - Measuring ranges for input sensors

Outputs:

- 4 to 20 mA, 1 to 5 Vdc, 0 to 10 Vdc Analog Retransmitter, with connection of one optional module galvanically isolated of 300Vac from power supply and input.
- SPDT relay for alarm rated for 3A at 220Vac, or 10A at 220Vac under order. In this case alarm module is not connected, but soldered to the board. Connection for up to four modules (using both analog output connectors). In case of using the analog output, one can use three alarm modules.
- Logic signal, open collector transistor, 24 Vdc, 40 mA maximum with isolation.
- Solid state relay rated for 2A at 250Vac with isolation.

Serial Communication:

RS-232 or RS-422/485, 50 Vdc isolation, optional module connected to the CPU Board.

Indication:

Indication with -999 to 19999 range.

Totalization:

Input totalization with 0 to 99999999 range, configured with decimal point.

Configuration:

By front-panel pushbuttons and internal jumpers.

Sampling rate:

130 ms for input indication in -999 to 19999 range. The display is updated each second for the indication and each scan for the totalization.

Accuracy:

± 0.1 % of full scale for mA, mV, Vdc input.

± 0.5 % of full scale for analog retransmitter output, 750 Ω maximum load.

Square root extraction:

± 0.5 % of reading, for input above 10 % of span. 0 to 5 % of programmable Cut-off.

Thermal stability:

± 0.005 % / °C of span for 25°C ambient temperature.

Power supply:

90 to 240VAC or 130 to 340VDC (any polarity), 10W nominal; 24VDC, 12VDC and other values are optional.

2-wire transmitter power supply:

24VDC voltage and 50mA maximum, isolated from output, short-circuit protection.

Operating ambient:

0 to 50 °C temperature and 90 % maximum relative humidity.

Dimensions:

1/8 DIN (48 X 96 mm) with 162 mm depth, panel cutout of 45 X 92 mm.

Weight:

0.5 kg approx.

Warranty:

One-year warranty.

2.0 - Installation

2.1 - Mechanical Installation

DMY-2030-TOT *Light* Indicator and Totalizer front panel has 1/8 DIN size (48 X 96 mm).

It is fixed by the rails which press it against the back side of the panel.

After preparing a 45 X 92 mm cut in the panel, remove the rails from the Indicator and slide its rear through the cut until its front reaches the panel. Place the rails again in the Indicator from the back of the panel and tighten the screws as shown in figure 2.

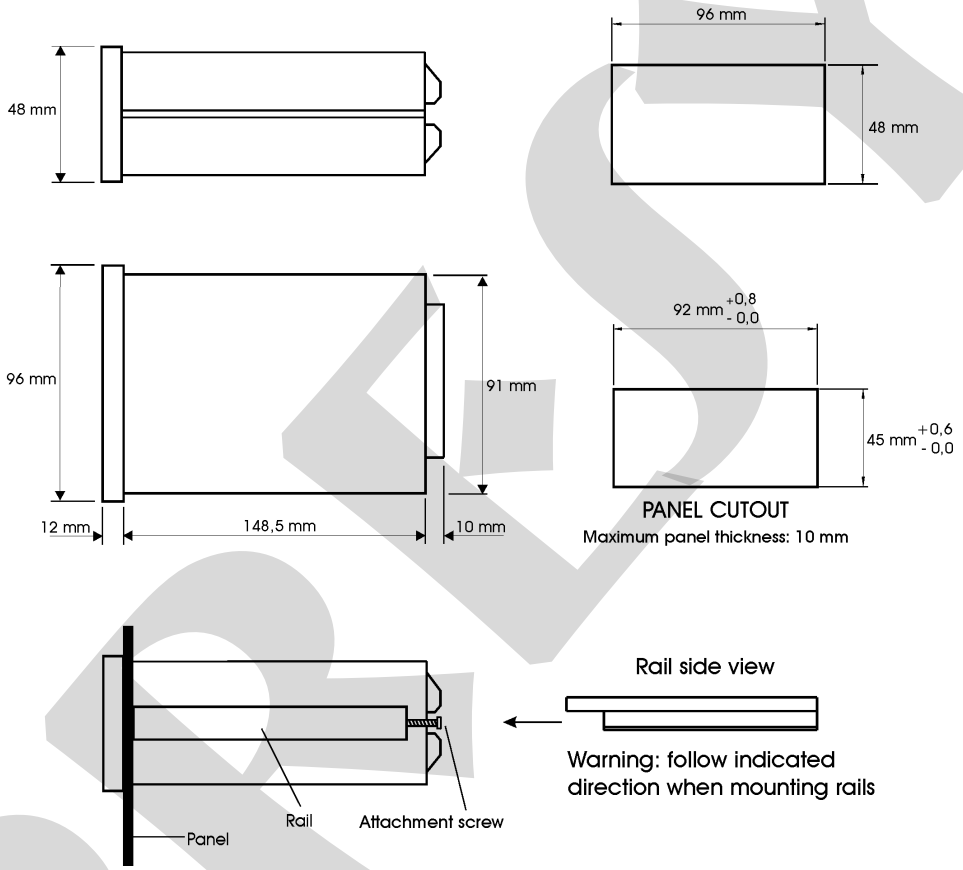


Fig. 2 - Dimensional drawing, panel cutout and side view.

2.2 - Electrical Installation

DMY-2030-TOT *Light* Indicator and Totalizer may be powered by voltage between 90 and 240VAC or 130 to 340VDC, any polarity. Remember that the internal circuit is powered whenever the instrument is connected to the external power supply.

Input and output signals must be connected to the instrument only when it is turned off.

Figure 3 shows the instrument rear terminals for connection of power supply, ground, communication, process input and output signals.

Signal wiring must be kept far away from power wires.

Due to its metal case the instrument ground should be connected to earth ground. Never connect the ground to neutral terminal.

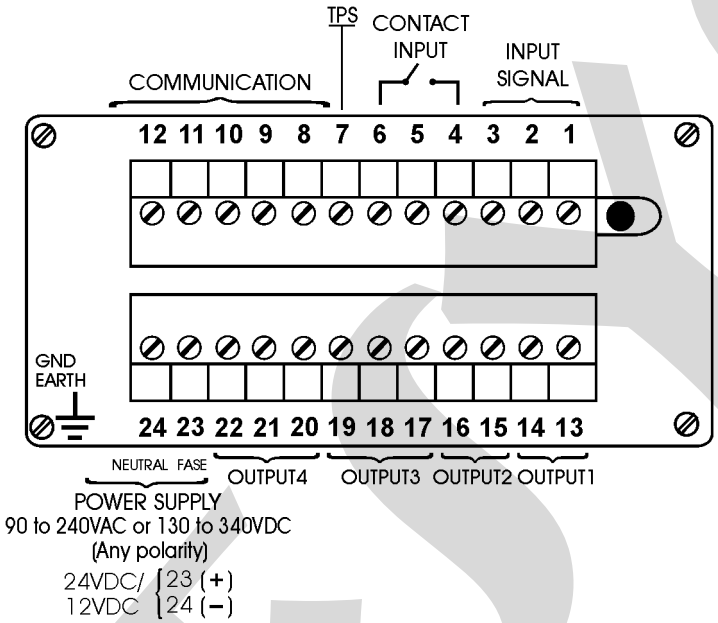


Fig. 3 - Indicator Terminals

2.3 - Process Input Signal Connection

The Indicator input can be connected to current (mA) or voltage (V or mV). See the different types and ranges of input sensors in table 1, section 1.3 on Technical Specifications.

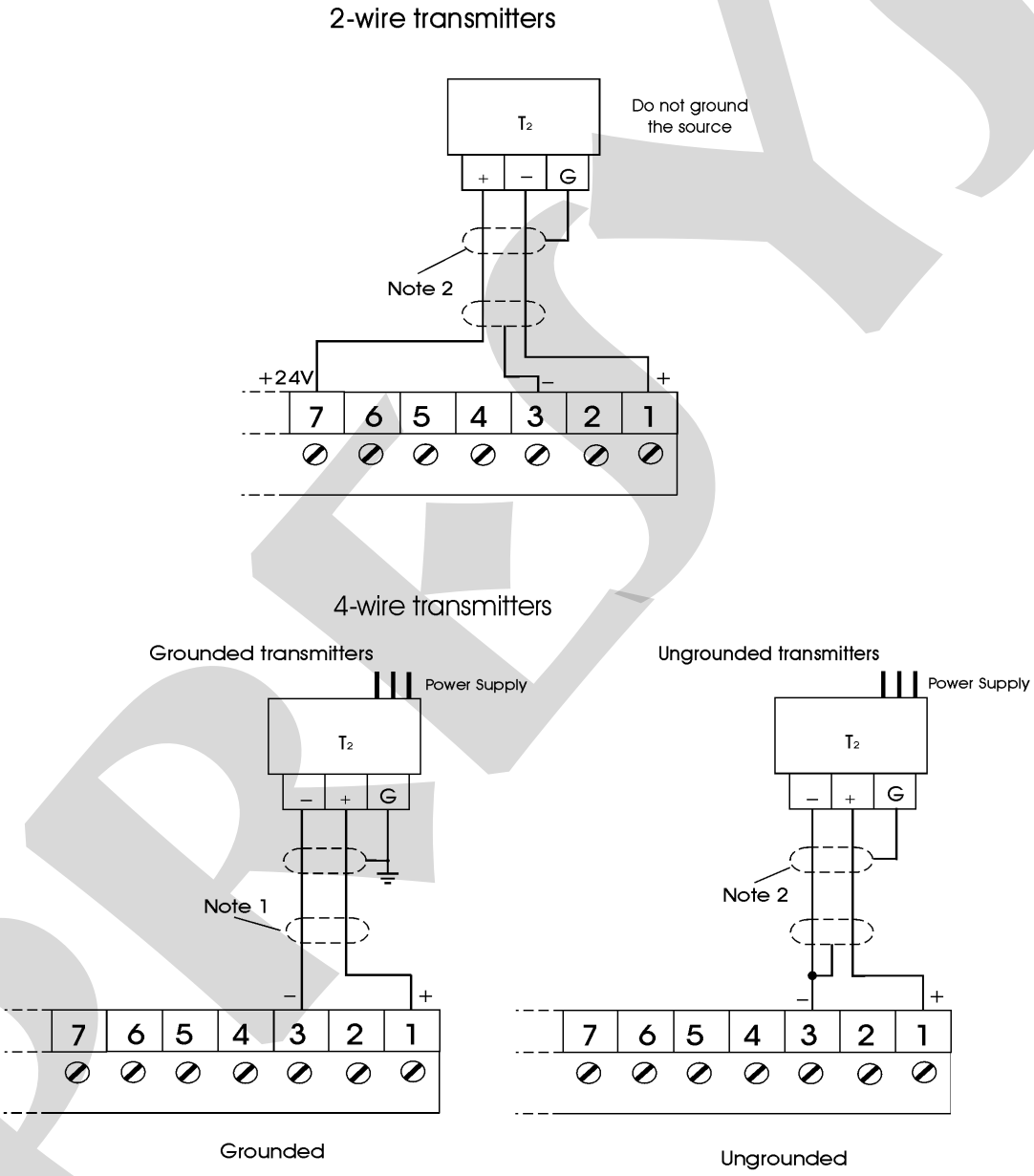
The input sensor is enabled by internal jumpers (see section 4.2 on Hardware Configuration) and by selection of the sensor in the software (see section 3.2 on Configuration). The connections explained below will have the desired result only if the instrument is correctly configured by software and hardware.

In order to avoid noise in the wiring, use twisted pair cable and cross sensor connection wire inside a metallic tube or use shielded cable. Make sure to connect only one shield wire end either to board terminal or to sensor ground, as shown in the next items.

WARNING: GROUNDING TWO SHIELD WIRE ENDS MAY CAUSE NOISE IN THE INDICATOR.

2.3.1 - Milliampere Input

A current source of 4 to 20 mA is applied to terminals 1(+) and 3(-). The current signal can be generated by a transmitter with an external power supply. In case of using the 24 VDC internal voltage source from the Indicator to power a two-wire transmitter, the current is received only by terminal 1(+). Figure 4 shows both possibilities of connection.



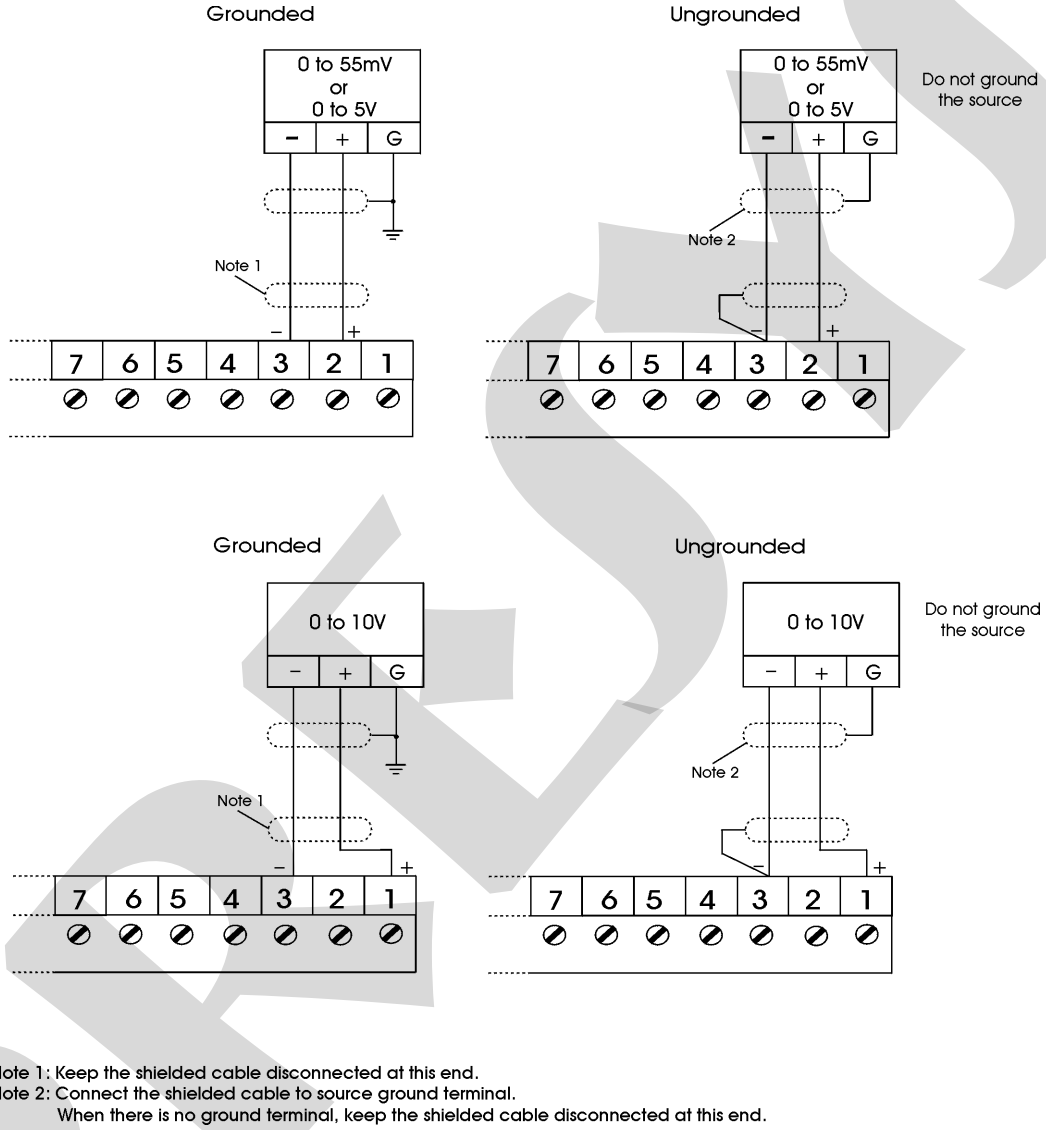
Note 1: Keep the shielded cable disconnected at this end.

Note 2: Connect the shielded cable to transmitter ground terminal.
When there is no ground terminal, keep the shielded cable disconnected at this end.

Fig. 4 - Milliampere Input

2.3.2 - Volt or Millivolt Input

0 to 55 mVDC or to 0 to 5 VDC must be applied to terminals 2 (+) and 3 (-). 0 to 10 VDC must be applied to terminals 1(+) and 3(-). The connections are shown in figure 5.



Note 1: Keep the shielded cable disconnected at this end.
Note 2: Connect the shielded cable to source ground terminal.
When there is no ground terminal, keep the shielded cable disconnected at this end.

Fig. 5 - Volt or millivolt Input

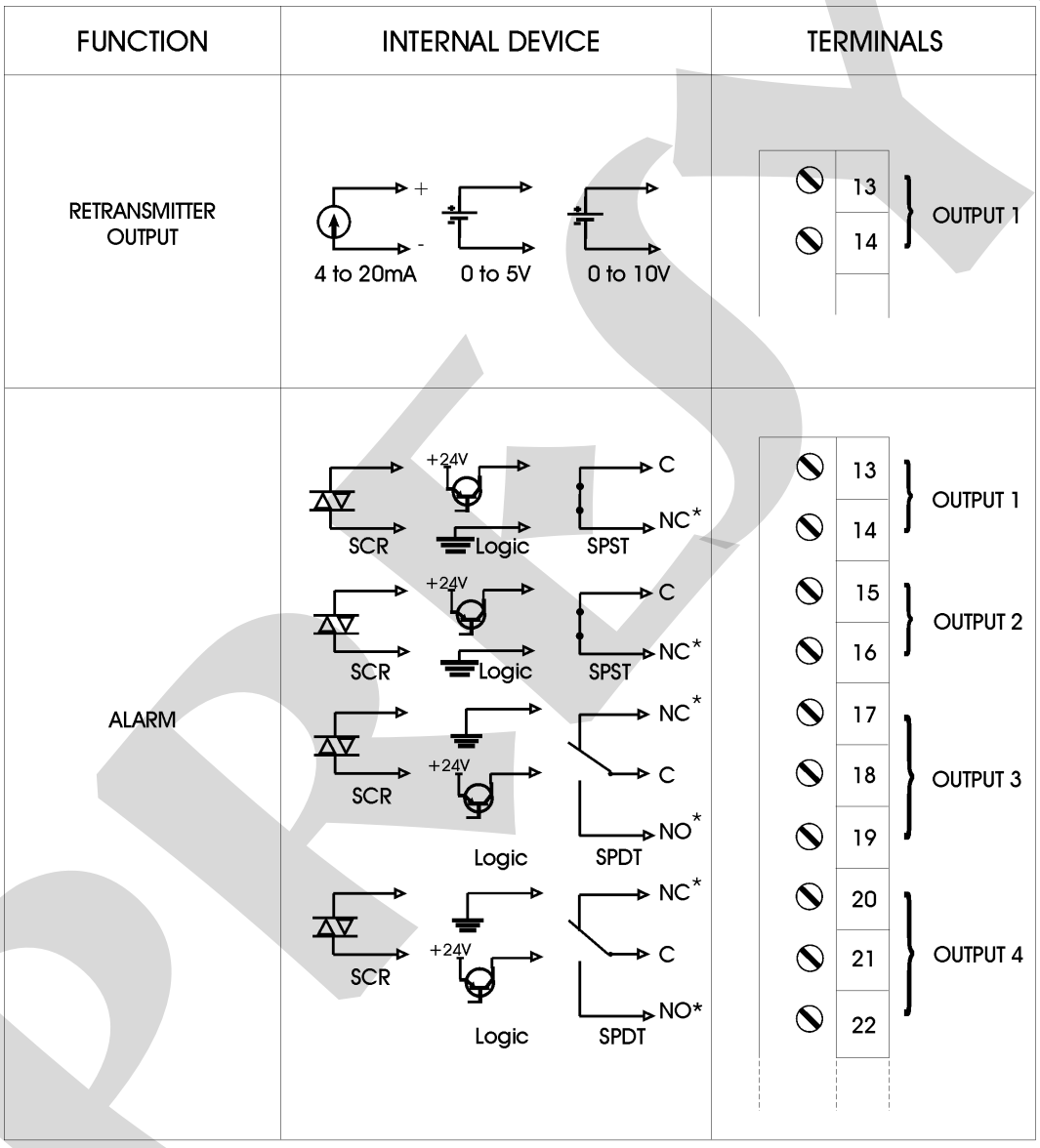
2.4 - Output Signal Connections

The Indicator can have up to four output signals: output 1, output 2, output 3 and output 4. Output 1 is used as retransmitter or alarm output. Outputs 2, 3 and 4 are used only as alarm outputs.

For output 1, there are six different types of outputs available: retransmitter (4 to 20mA, 0 to 5Vdc or 0 to 10Vdc), SPST relay, open collector voltage and solid state relay.

For outputs 2, 3 and 4, there are three different types of outputs: SPST (output 2) or SPDT (outputs 3 and 4) relay, open collector voltage and solid state relay. Figure 6 shows the Indicator output types.

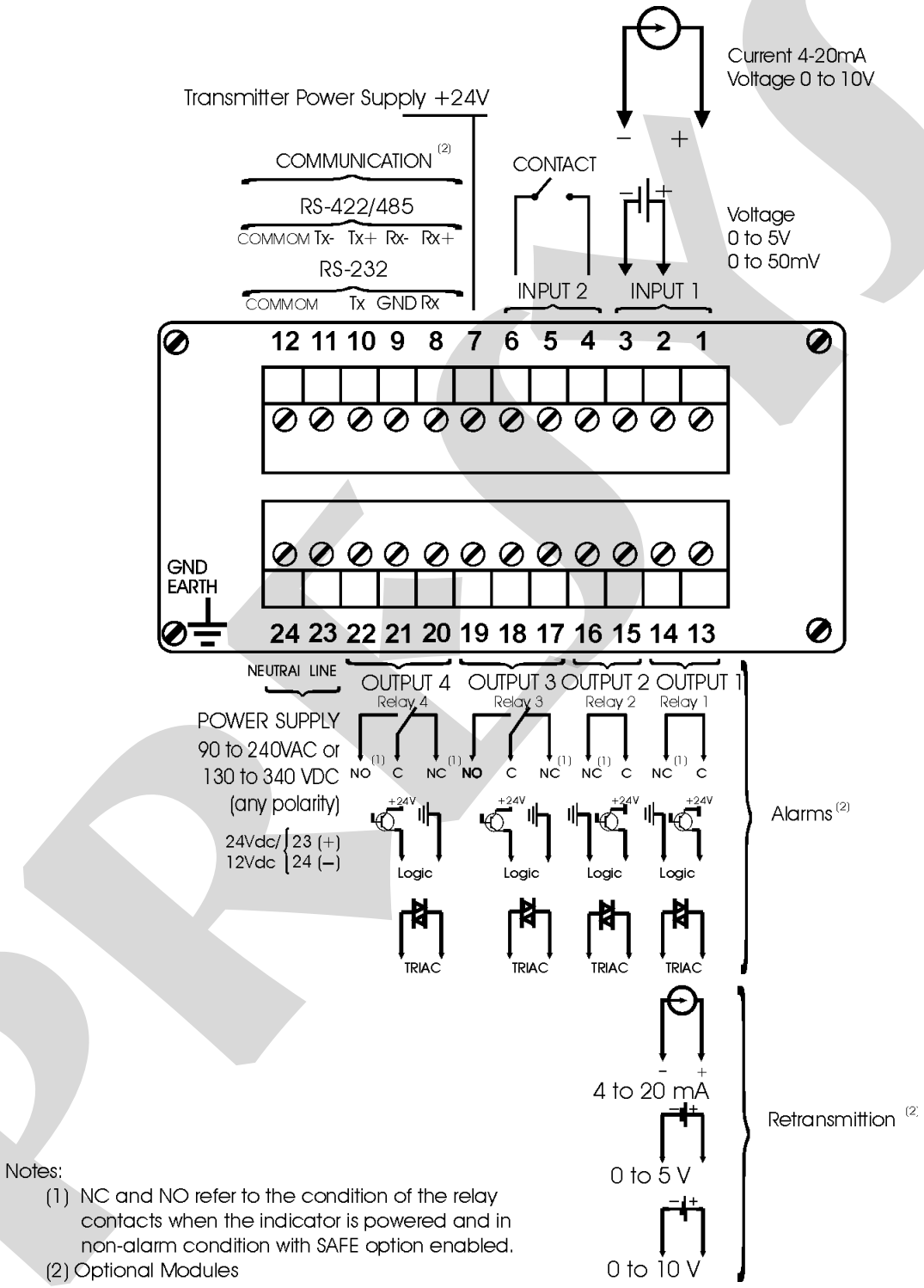
Note that the output terminals will present the corresponding signals only if the optional modules are installed and the output is correctly configured. For analog outputs, refer to section 3.2 on Configuration and section 4.4 on Optional Module Connection for details on installation and configuration of optional modules.



(*) Relay contact states shown are valid for SAFE option selected (see section 3.2 on Configuration), instrument powered on and non-alarm condition. Positions of the contacts are changed in alarm condition (with SAFE option selected) or when the instrument is turned off.

Fig. 6 - Output Connection

2.5 - Connection Diagram



Notes:

(1) NC and NO refer to the condition of the relay contacts when the indicator is powered and in non-alarm condition with SAFE option enabled.

(2) Optional Modules

2.6 - Communication

DMY-2030-TOT *Light* Indicator and Totalizer communicates with computers through RS-232 or RS-422/485 using MODBUS protocol communication software, when the optional communication module is installed and the communication parameters are configured.

Specific information on communication and signal connection is described in the communication manual.

2.7 - Engineering Units

A label with several Engineering Units is supplied with each Indicator. Select the one corresponding to the variable shown on the display and stick it to the front panel of the Indicator.

3.0 - Operation

3.1 - Normal Operation

DMY-2030-TOT *Light* Indicator and Totalizer has two modes of operation: normal operation and configuration mode.

During normal operation, the Indicator monitors the input and shows the totalization, verifies alarm conditions and activates the four outputs if necessary.

Configuration mode is used to select and configure all the Indicator parameters.

The normal operation mode, in which the Indicator is to be found most of the time, is called level zero. In this level, the three front panel keys have the following functions:

ENTER	Key	Changes level zero to level 1 or asks for the password, when configured.
DOWN	Key	Changes the indication presented on the display. When the process variable is shown, after pressing the DOWN key, the display presents the totalization. By pressing again the DOWN key, the indication is shown.
UP	Key	When showing the indication, it presents the alarm outputs which require acknowledgment to return to normal state (*). When showing the totalization, it allows accessing a menu with options for configuring the preset mode (automatic or manual) and preset setpoint, alarm setpoints for the indication alarms already configured, besides applying reset to totalization and to the accumulated totalization (**).

(*) In order to view the monitored variable, continue to press the UP key. In case there are no activated relays, the **No.Ac.** message will be shown.

(**) The presentation of each one of these options (RESET, SP, MODE, AC.TOT. and ALARM mnemonics) in the operation level is configured by the user in the OPER option in GENERAL configuration level. See figure 7 where all the options are selected.

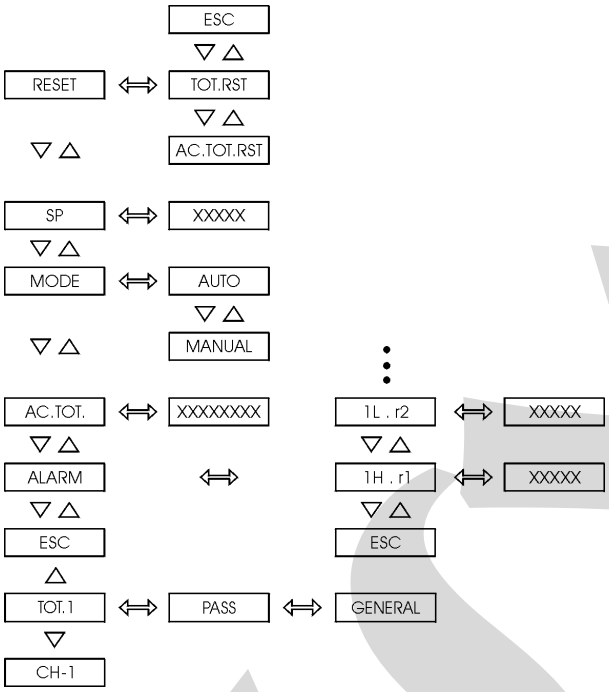


Fig.7 - Options of the operation level with configurable presentation

3.2 - Configuration

In order to access configuration mode the operator is required to provide a password which avoids a non-authorized person to change any critical parameters of the process.

So, when ENTER is pressed within the normal operation mode, one of the following events can happen, depending on the current configuration:

i) To access directly level 1 (GENERAL) of configuration mode, which indicates the instrument was not configured with a password system.

ii) To display the PASS warning, indicating that the instrument is provided with a password system (a key sequence or a value), according to figure 8.

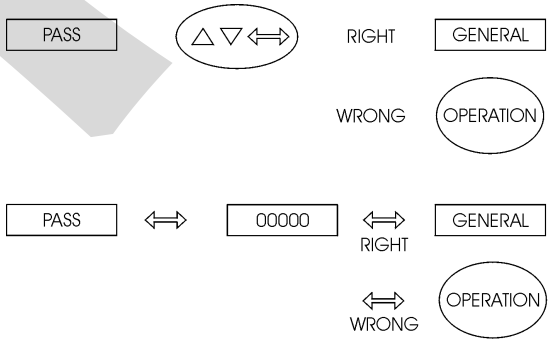


Fig. 8 - Password through key sequence or value

In case of a key sequence password, the user should press the UP, DOWN and ENTER keys (exactly in this order) to access the configuration levels.

For a value password, the user must press the ENTER key for a second time in order to view the number 00000 with the right end digit blinking. The position which is blinking indicates the digit in the number to be changed by the user with the UP and DOWN keys. Move to the digits on the left by pressing ENTER. After entering all digits, press ENTER again. If the password is correct level 1 is accessed; otherwise, it returns to normal operation (see figure 8).

The user can choose also both password systems, key and value. In this case, if the user provides an incorrect sequence of keys, the display goes immediately to the value password system.

The password number may be chosen by the user (personal) or it could be used the number 2030. Note that the number 2030 is always accepted by the value password system, which helps the user in case he forgets his password. In order to enter a number for password or for any other parameter use the Indicator front panel keys with the following functions:

UP	key	Increases values being set
DOWN	key	Decreases values being set
ENTER	key	Changes position to the left digit

The procedure above is valid for providing any other parameter with 5 digits. The only exception is COUNT parameter, in Totalization level, for which it is possible to change all the 8 digits of the display.

All configuration parameters are stored in the non-volatile memory and determine the normal operation of the instrument. With these parameters the user can adjust the instrument to his needs, when it is necessary to change the configuration from factory.

Configuration parameters are distributed in seven hierarchical levels shown in figure 9.

In order to move through the levels and access the parameters of any one of them, use the front panel key which have the following functions:

ENTER	key	Moves into the indicated level
UP	key	Moves to higher levels
DOWN	key	Moves to lower levels

Warning: In the diagrams below, the rectangles represent the display appearance after selection of the ENTER, UP and DOWN keys.

The hierarchical levels are presented in sequence. The options of each level are explained step by step with all their corresponding parameters.

Inside each level, the front panel keys have the following functions:

UP	key	Moves the options in increasing direction
DOWN	key	Moves the options in decreasing direction
ENTER	key	Confirm or advance options inside a level, if the display does not show ESC. When ESC is shown, it goes back one or more positions.

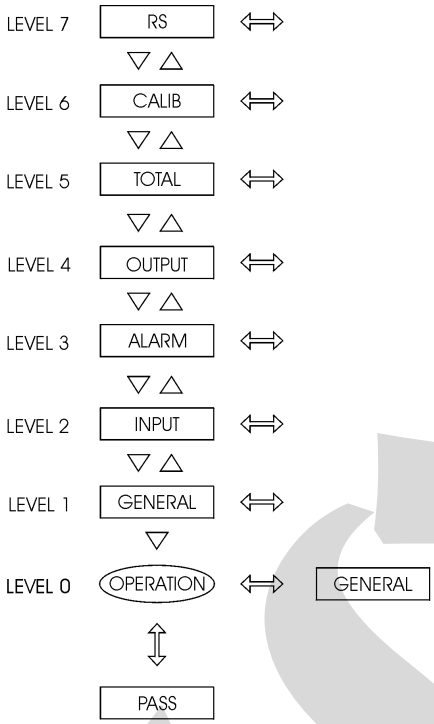


Fig. 9 - Parameter levels diagram

Level 1 - General

Level 1 presents the options: TAG, SOFT, PASS, INDC and OPER (see figure 10).

TAG - consists in an numeric identification for the instrument. The procedure to enter the tag or any other parameter is the same as described previously for the password (refer to value password for the functions of the ENTER, UP and DOWN keys).

SOFT - shows software version.

PASS - allows the user to enable or disable the password system for accessing the configuration mode. The password system may be chosen as a key sequence, a value (number chosen by the user and number 2030) or both. The correct key sequence is obtained by pressing the UP, DOWN and ENTER keys in this order.

INDC - is an option for the visualization of the measured variable and totalization on the display. It allows the user to view the values of the indication and totalization only by pressing the UP and DOWN keys, or it sets the instrument to change automatically the indication and totalization. In order to enable the automatic scan mode, choose the YES option for INDC and provide the exhibition times (given in seconds).

OPER - enables the presentation of each one of its options in operation level, namely, RESET (reset of the totalization and accumulated totalization), SP (preset setpoint), MODE (reset mode for preset), AC.TOT. (indication of accumulated totalization) and ALARM (alarm setpoints). OPER also presents the RESET.REM option which enables the use of the contact input to reset the totalization.

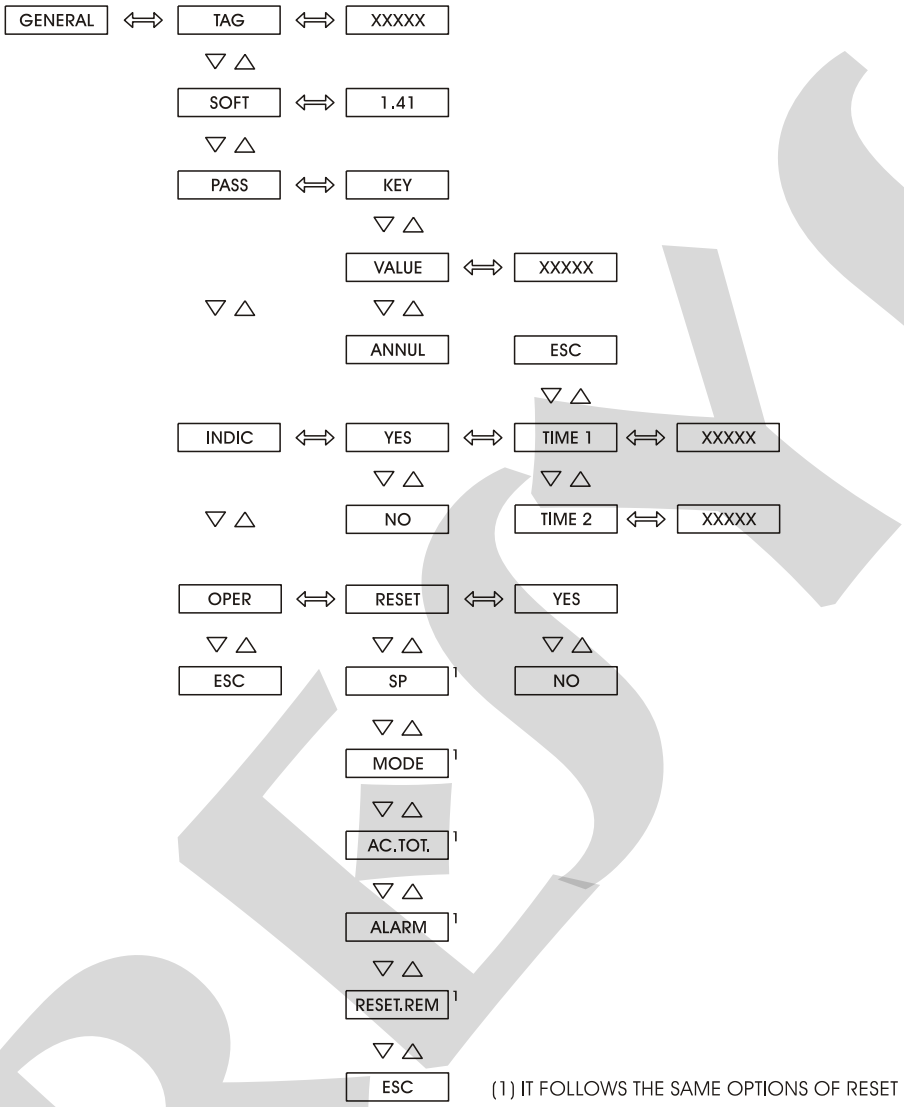


Fig. 10 - GENERAL level options

The table below refers to the ranges of the parameters shown in figure 10.

Mnemonic	Parameter	Range	Factory Value	Units
TAG	instrument identification	0 to 30000	2030	————
SOFT	software version	————	1.41	————
VALUE	user password	-9999 to 30000	0	————
TIME1	process variable exhibition time	0 to 3000	5	seconds
TIME2	totalization exhibition time	0 to 3000	1	seconds

Level 2 - Input

The INPUT Level allows to choose the sensor type for the input (channel 1). The sensor type options are 0 to 5V, 0 to 10V, 0 to 55mV and 0 to 20mA, as illustrated in figure 11.

4 to 20mA input belongs to 20mA option
1 to 5V input belongs to 5V option

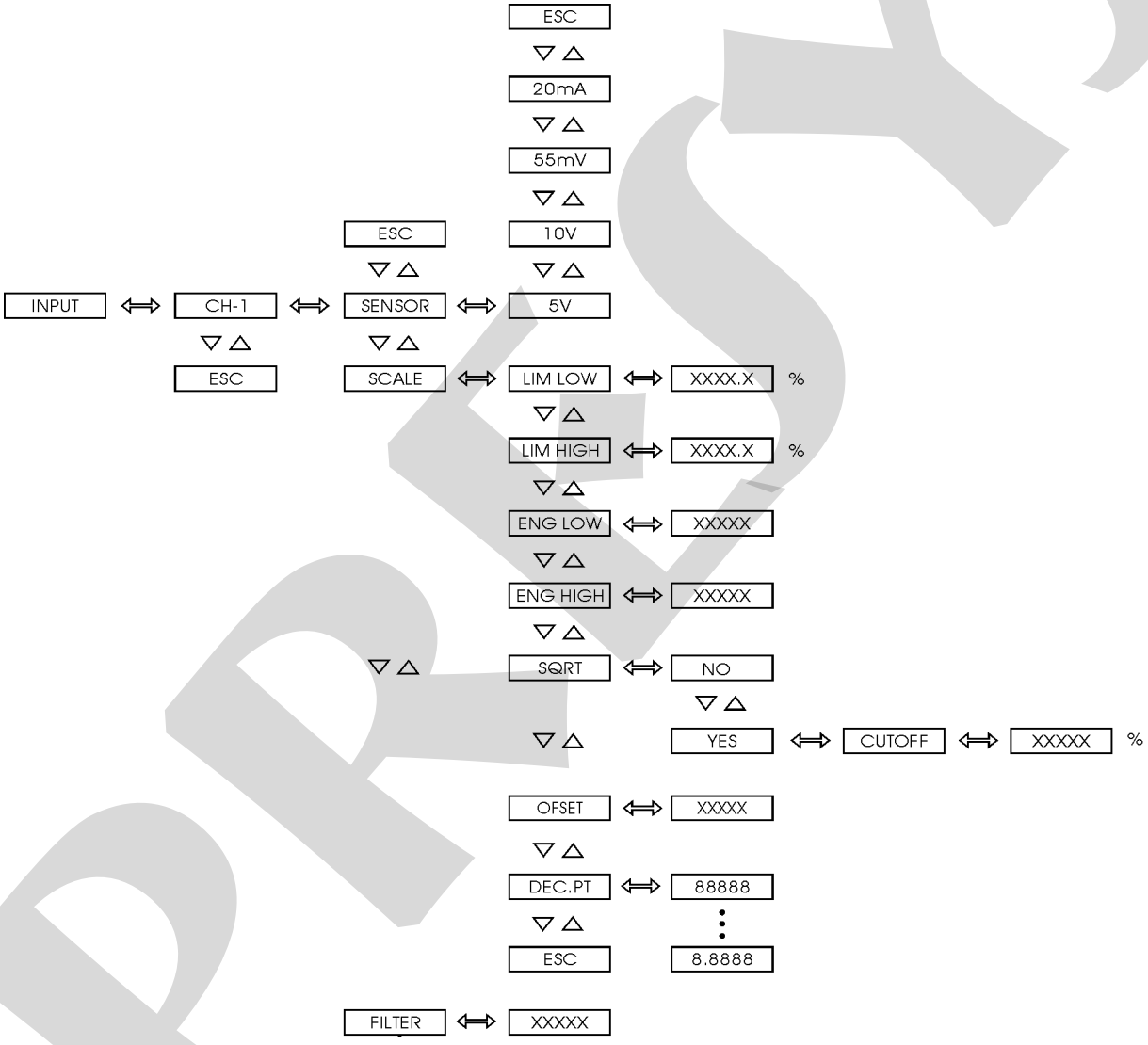


Fig. 11 - INPUT level options

The table below refers to the ranges of the parameters shown in figure 11.

Mnemonic	Parameter	Range	Factory Value	Units
LIM LOW	input signal associated to Eng Low	0.0 to 100.0	0.0	%
LIM HIGH	input signal associated to Eng High	0.0 to 100.0	100.0	%
ENG LOW	display indication associated to Lim Low	-1009 to 20019	0.0	EU*
ENG HIGH	display indication associated to Lim High	-1009 to 20019	100.0	EU*
CUT-OFF	minimum value for square root	0 to 5	0	%
OFFSET	constant added to display indication	-9999 to 30000	0	EU*
FILTER	time constant of 1st order digital filter	0.0 to 25.0	0.0	seconds

(*) EU - Engineering Unit.

When selecting a linear sensor one must configure its scale (SCALE option). Define two points P1 (Lim Low, Eng Low) and P2 (Lim High, Eng High), as illustrated in figure 12. Lim Low represents the value of the electrical signal given in % of full scale associated to the Eng Low indication on the display, and Lim High corresponds to the value of the electrical signal given in % of full scale associated to the Eng High indication on the display.

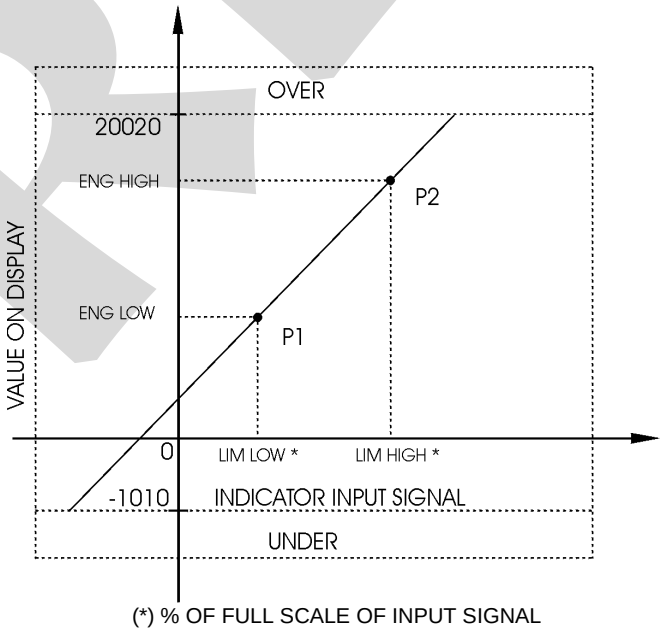


Fig. 12 - Linear input configuration

SQRT - allows presenting on the display the squared root of the linear input signal. The Cut-Off parameter given in % of the input signal makes input values below (Lim Low + Cut Off) be shown as Lim Low. See figure 13.

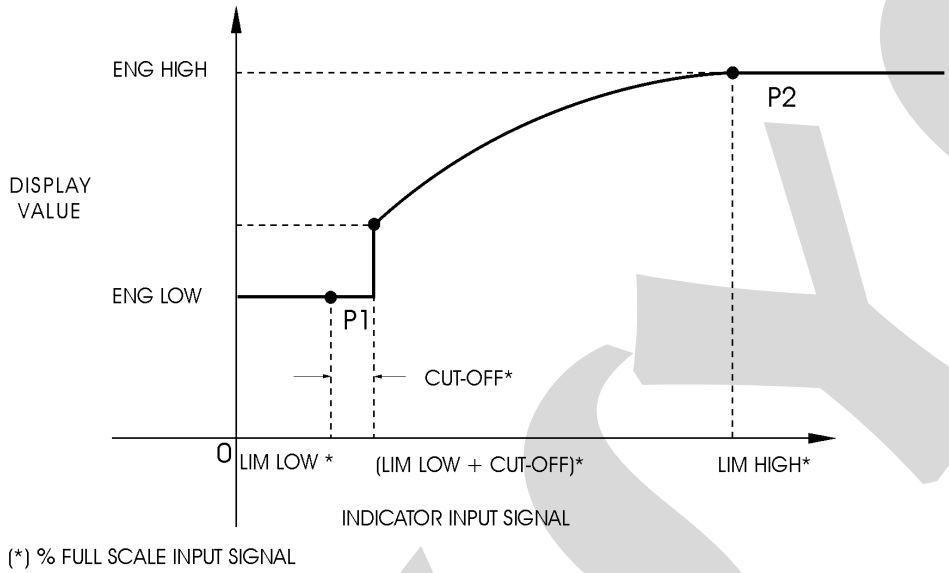


Fig. 13 - Input signal square root

DEC.PT - sets the decimal point position for visualization of Engineering units in display. There are up to four decimal places.

OFSET - allows the user to enter an off-set value in Engineering Units to be added to the measured variable. This parameter can be used to equalize measurements in different instruments.

FILTER - this parameter provides the time constant of a first order digital filter associated to the selected input. In order to leave the signal without filter set this parameter to zero.

Level 3 - Alarm

The Indicator has up to seven alarm devices: four of them are the outputs 1, 2, 3 and 4 used as alarm outputs which are relay 1, relay 2, relay 3 and relay 4. The other three devices are the couple of leds, LED 1 and LED 2, and the display which can operate independently from the relays. In this case, the INDEP option is selected. If the DEPEN option is selected for the leds and display, their operation is associated to that of the relays (but when the relays are configured for preset, as described on level 5 of Totalization, the relay operation is followed only by the leds).

Each alarm module can perform up to two types of alarm: low alarm or high alarm. When configuring the seven independent alarm devices for the indication, there are up to 14 setpoint alarms (SP) and their hysteresis (HYST).

Once the alarm configuration is established (CONF option), it is possible to view or change only the values of alarm setpoints. Press the UP key while CONF option is shown, in order to have a quick access to the setpoints of all alarms already configured. The mnemonics of alarm setpoints have a code which is explained through the two following examples:

S1.H.r1 High-alarm setpoint associated to relay 1.

S1.L.L1 Low-alarm setpoint associated to led 1.

LATCHED - configures the relay to be deactivated only after the end of the alarm condition and the operator has performed the acknowledge of this alarm. The acknowledgment of the alarm condition is performed within the normal operation mode by pressing the UP key until it is shown the mnemonic corresponding to the relay one is looking for. Note that it will be shown only the relays configured with latch operation which require acknowledgment in order to return to normal state. After reaching the relay, press the ENTER key. If there is no alarm condition for this relay, it will change its state. Continue pressing the UP key to return to operation mode.

DELAY - causes the relay to be activated only after a certain time interval defined by the user. Figure 14 below illustrates the delay operation for a high-alarm.

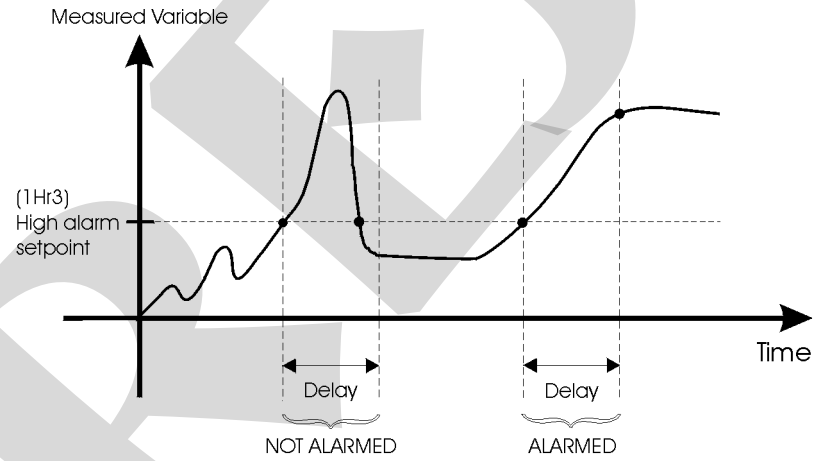


Fig. 14 - Relay with delay

SAFE - provides safety to relays. The safety condition means the relays are powered on when the instrument is on and there is no alarm condition, and the relays are powered off when in alarm condition or in case of power failure.

Note: When replacing an analog output module (see level 4 - Output) by a relay module in the same position on the Power Supply Board, disable the output before installing the relay, otherwise it will be activated and deactivated continuously.

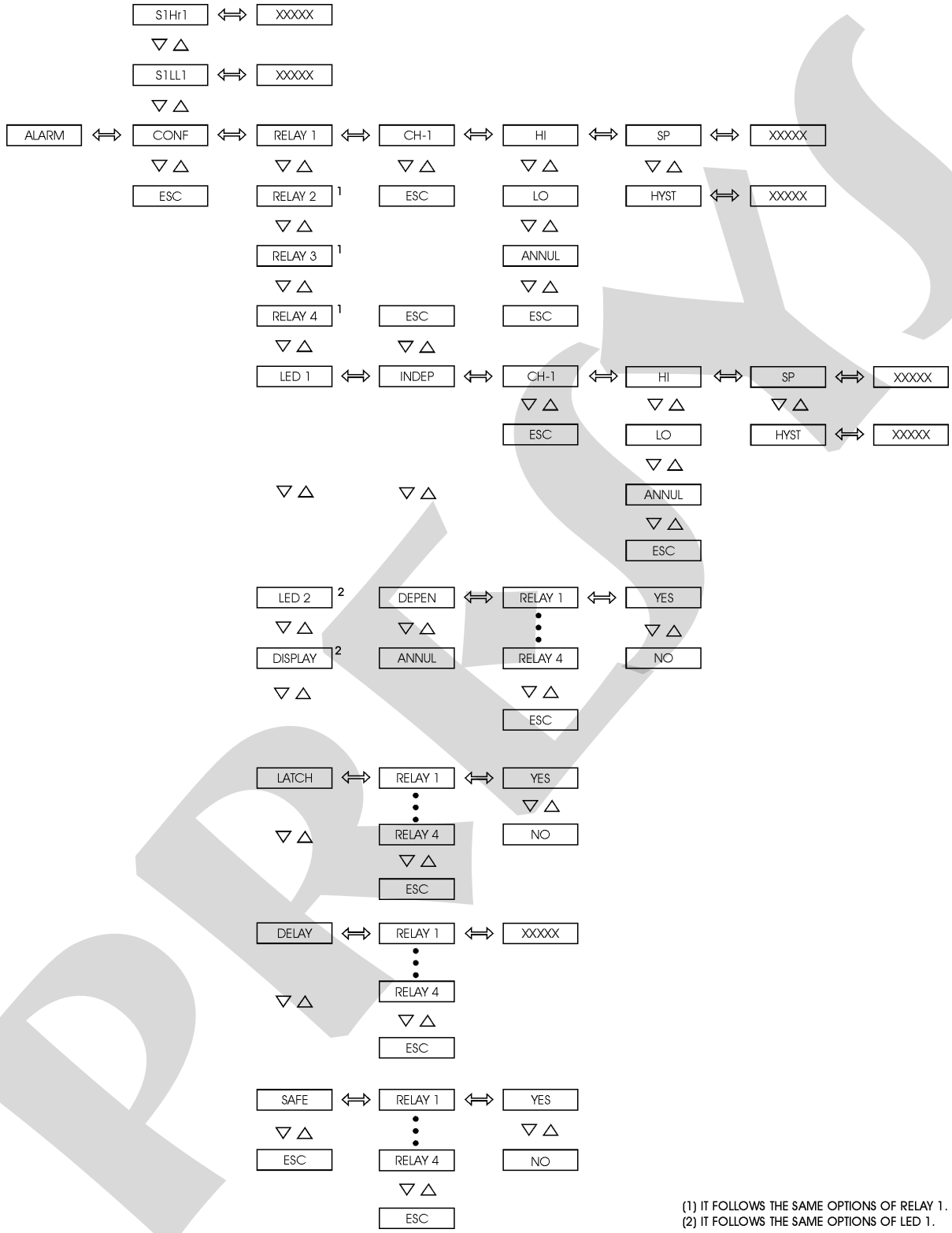


Fig. 15 - ALARM level options

The table below refers to the ranges of the parameters shown in figure 15.

Mnemonic	Parameter	Range	Factory Value	Units
SP	alarm setpoint	-1009 to 20019	25.0 - low alarm 75.0 - high alarm	EU
HYST	alarm hysteresis	0 to 250	1.0	EU
DELAY	delay for activating the relay	0.0 to 3000.0	0.0	seconds

Level 4 - Output

Level 4 allows the configuration of one analog output (Refer to figure 16).

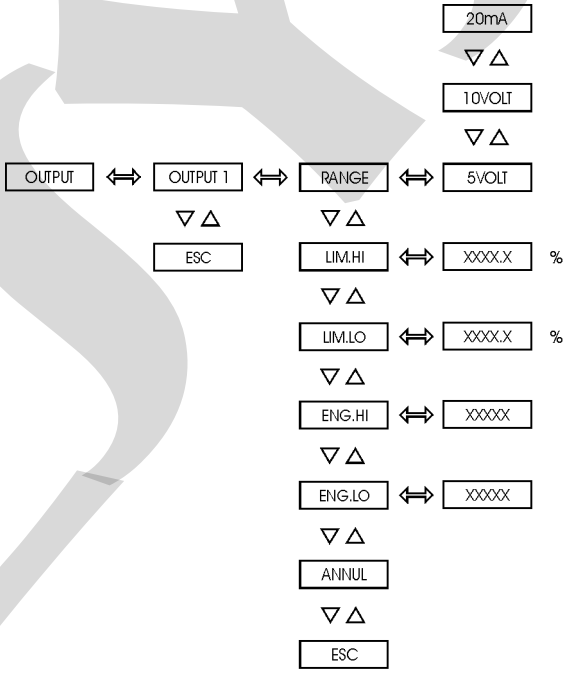


Fig.16 - OUTPUT level options

The table below refers to the ranges of the parameters shown in figure 16.

Mnemonic	Parameters	Range	Factory Value	Unit
LIM LOW	output signal associated to Eng Low	0.0 to 100.0	0.0	%
LIM HIGH	output signal associated to Eng High	0.0 to 100.0	100.0	%
ENG LOW	display indication associated to Lim Low	-1009 to 20019	0.0	EU
ENG HIGH	display indication associated to Lim High	-1009 to 20019	100.0	EU

The analog output is enabled only after selecting the range of output retransmission from the RANGE mnemonic.

RANGE - selects the range of retransmission output as 20mA, 5V or 10V. The relation between the engineering unit and electric signal generated in the terminals is defined in the same way as shown for linear process scale configuration. Define two points P1 (Eng Low, Lim Low) and P2 (Eng High, Lim High) as it is illustrated in figure 17. Eng Low is the indication in the display in engineering units associated to the electric signal Lim Low, and Eng High is the indication in display in engineering units associated to the electric signal Lim High. Note that Lim Low and Lim High are defined in percentage of output range and that the output signal saturates in these points.

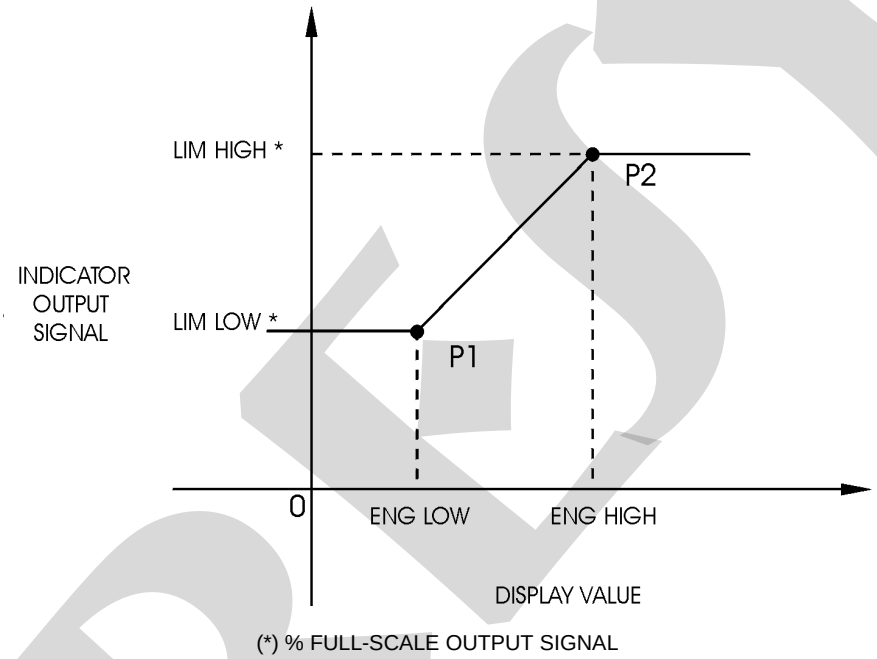


Fig.17 - Analog output configuration

Level 5 - Totalization

In level 5, it is configured the totalization of the process variable for 5V, 10V, 55mV and 20mA linear inputs.

The integration is performed according to the percentage of the input signal in relation to the range limited by the parameters Eng Low and Eng High. In order to determine the totalization of a signal, it is necessary to provide the parameters corresponding to the counts COUNT which results from the integration of an input signal of 100% FS (whose indication is given by Eng High) within an interval of time configured by TIME, given in minutes. COUNT parameter can be configured with 8 digits and decimal point, given by the DEC.PT option. TIME parameter uses up to 5 digits.

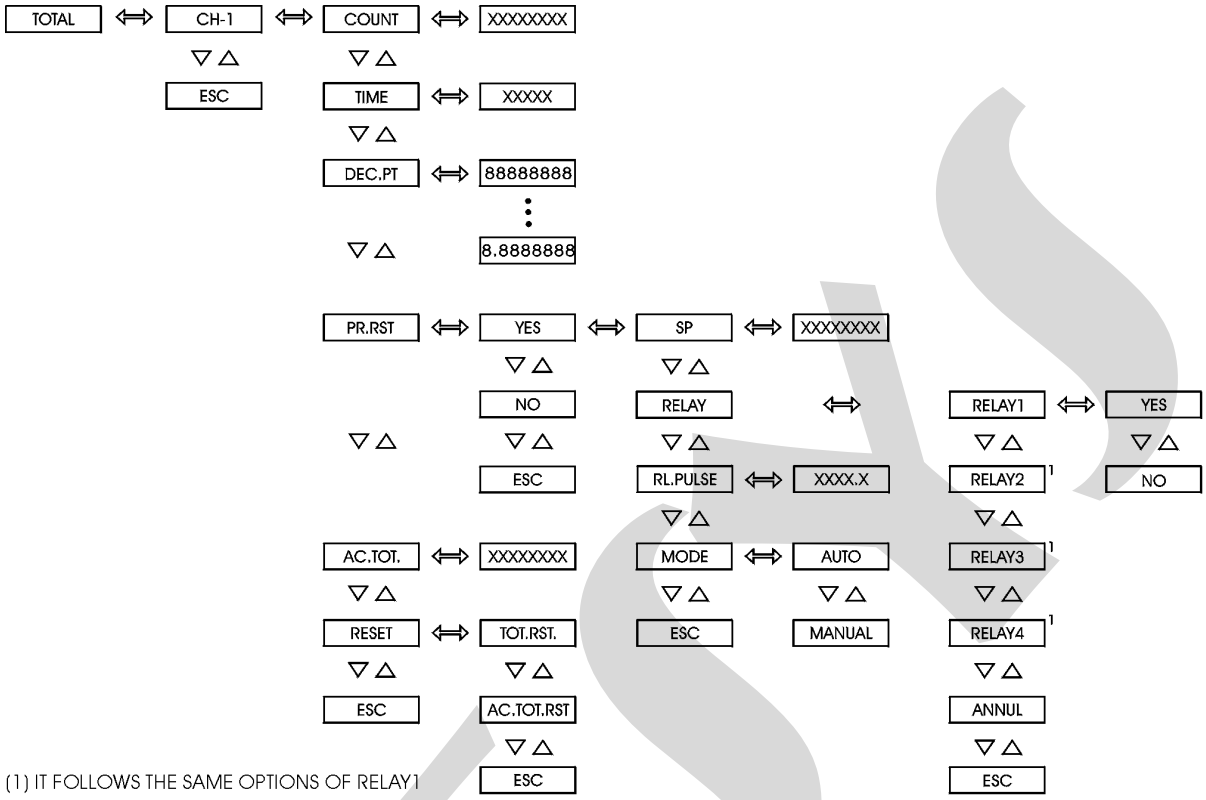


Fig. 18 - TOTALIZATION level options

The table below refers to the ranges of the parameters shown in figure 18.

Mnemonic	Parameter	Range	Factory Value	Unit
COUNT	Counts added to the totalization after an interval of time (TIME), when there is a signal of 100% FS in the input.	0 to 99999999	0	-----
TIME	Interval of time after which the totalization is increased by COUNT, when there is a signal of 100% FS in the input.	0 to 30000	0	min
SP	Count for the preset in order to reset the totalization and activate the relay.	0 to 99999999	0	-----
RL.PULSE	Interval of time during which the relay remains activated after the SP count for the preset was reached (when operating in automatic mode).	0.1 to 3000.0	0.1	s

The integration function is described by:

$$TOTAL(t) = \frac{CONT}{TIME}\int \frac{E(t) - ENGLOW}{ENGHIGH - ENGLOW}dt$$

Notice that any signal under the input zero scale (low limit of the range or Eng Low) is not integrated, that is, the totalization does not decrease.

When exceeding the maximum limit of counts (99999999), the most significant digits which would appear in the totalization are ignored, but it is kept the last increment calculated, in order not to loose precision in the counts after passing by successive "overflows".

The totalization count may be reset by selecting the RST.TOT mnemonic from the RESET option in the Totalization Level or in normal operation level (this option is presented after pressing the UP key while the totalization is shown). Reset is also carried out by closing the contact input (terminals 4 and 6) when the RESET.REM option is enabled in GENERAL level.

In order to disable the totalization, provide the value zero for the TIME parameter.

The PR.RST option for preset allows the configuration of a limit value for the totalization (preset setpoint SP) to activate one or more relays for a certain interval of time.

To associate the relay to the preset function select the YES option for the mnemonics chosen among RELAY1 to RELAY4 in the RELAY option. For the preset to operate without relay, select the ANUL mnemonic.

The preset allows the reset of the totalizaton in automatic or manual mode, configured in the MODE option.

When the totalization reaches the preset setpoint SP in the automatic mode, the totalization is reset and the associated relays are activated during the time interval given by RL.PULSE parameter (in seconds).

In manual mode, the relays chosen in the RELAY option are activated when the totalization reaches the preset setpoint value specified by SP and are deactivated only when the totalization is reset by the operator in the instrument front panel. In this mode, RL.PULSE parameter has no function.

AC.TOT. (accumulated totalization) presents the input totalization performed continuously, i.e., independently from the reset of the totalization value shown in operation level (TOT.1). The accumulated totalization can be seen in operation level by pressing the UP key while the totalization is shown, and it is reset when choosing the RST.AC.TOT. mnemonic in the RESET option.

Note that the presentation of RESET, SP, MODE and AC.TOT. options in normal operation level must be enabled in the OPER option in GENERAL level.

Level 6 - Calibration

Level 6 is described on section 4.5 on Calibration.

Level 7 - RS

Refer to the communication manual.

4.0 - Maintenance

4.1 - Indicator Hardware

The Indicator maintenance requires the user to have access to the hardware of the instrument. The Indicator hardware consists of three main boards: Display Board, CPU Board and Power Supply Board. The three-board-system is fixed to the aluminum case by a screw on the right side of the front-panel. Loosen this screw and pull the Indicator front-panel in order to remove the instrument from case.

The Display Board is located in the Indicator front-panel. The front-panel has four internal staples in its four corners which keep together CPU and Power Supply Boards. The CPU and Power Supply Board are fixed by a spacer.

i) Remove the screw which fixes the spacer placed near the edge of the CPU and Power Supply Boards.

ii) Turn the Indicator so that the display is on the opposite side for reading.

iii) Displace carefully the holder at the right top corner of the front-panel so that the Power Supply Board can be loosen.

iv) Move the Power Supply Board to the right and open the boards according to Figure 19.

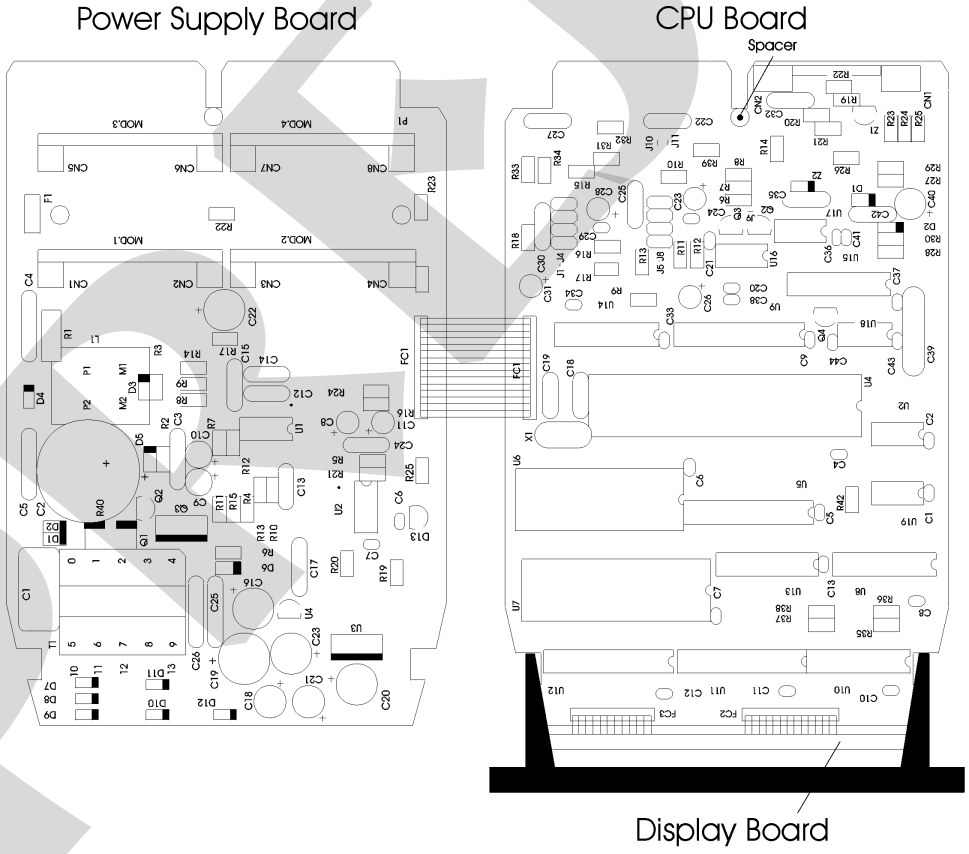


Fig. 19 - Indicator hardware

4.2 - Hardware Configuration

The software configuration level of input (level 2 - Input) must be complemented by hardware configuration, through internal jumpers.

There are four places for installation of jumpers: J5, J6, J7 and J8. They are placed in the CPU Board as shown in figure 20.

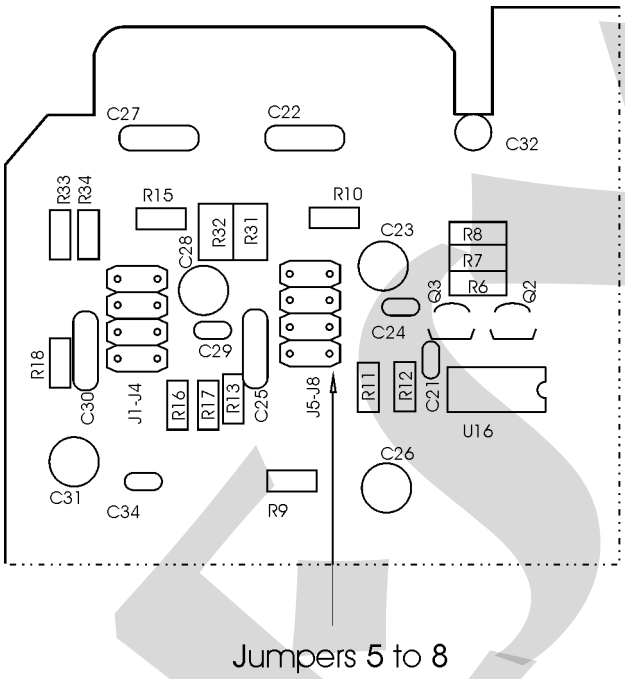


Figure 20 - Location of jumpers in the CPU Board

Table 2 lists the jumpers that must be installed for each type of input. Verify the input type required and place the jumpers as specified below. Make sure to install only the jumpers required for the input.

Input type	**Jumpers**			
	Channel 1			
Voltage (0 to 55mV)	J5		J7	
Voltage (0 to 5V)	J5		J7	
Voltage (0 to 10V)*		J6		
Current (0 to 20mA)		J6	J7	

Table 2 - Jumpers for input type configuration

(*) For 0 to 10V input, the second jumper supplied by the factory must be kept by the user out of the instrument or placed on a conector as shown in Figure 21.

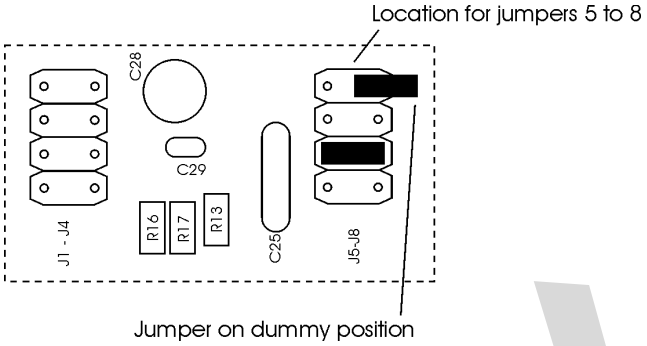


Fig. 21 - Jumpers not used for 0 to 10V input placed in the board conector

4.3 - Snubber use for relay

Relay modules are provided with circuits for eliminating electrical arch (RC snubber). The snubbers are put in parallel with the relay contacts, by placing the jumpers J1 and J2 localized on the back of the relay board. When the jumpers are not placed, the relay contacts are kept without snubbers. The relay module is sent from factory with the jumpers placed.

Note the position of the jumpers in the following figure.

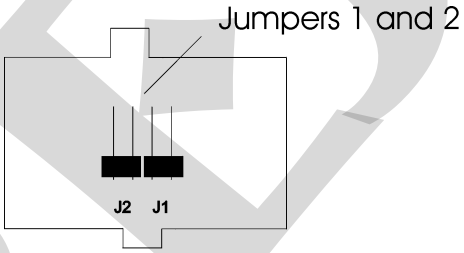


Fig. 22 - Jumpers for selection of snubbers on the relay board

Alarm and control relays are extremely critical in control and safety of industrial processes. In order to ensure the expected relay behavior, consider the following two loading conditions.

- High currents circulating through the relay contacts (from 20mA to 3A). When the relay switches high currents there is the occurrence of electrical arch which damage quickly the relay contacts. Besides, electrical noise is generated. In these conditions, it is recommended to use the RC snubbers which come with the relay module (placed jumpers).

- Low currents circulating through the relay contacts (less than 20mA). The relays could not function properly when the jumpers are placed. In this case, the snubbers maintain a 4.5mAac/9.0mAac current when connected to a 120VAC/220VAC circuit. This current is enough, in certain cases, to power a horn or alarm lamps, preventing their deactivation. In this situation, there is no need to use the snubbers and the jumpers must be removed.

4.4 - Option Module Connection

DMY-2030-TOT *Light* Indicator and Totalizer accepts up to four output devices and communication, which must have the corresponding optional modules installed in the instrument. Open the Indicator as shown in section 4.1 in order to access four connectors in the Power Supply Board and one connector in the CPU board. (Refer to Figure 23).

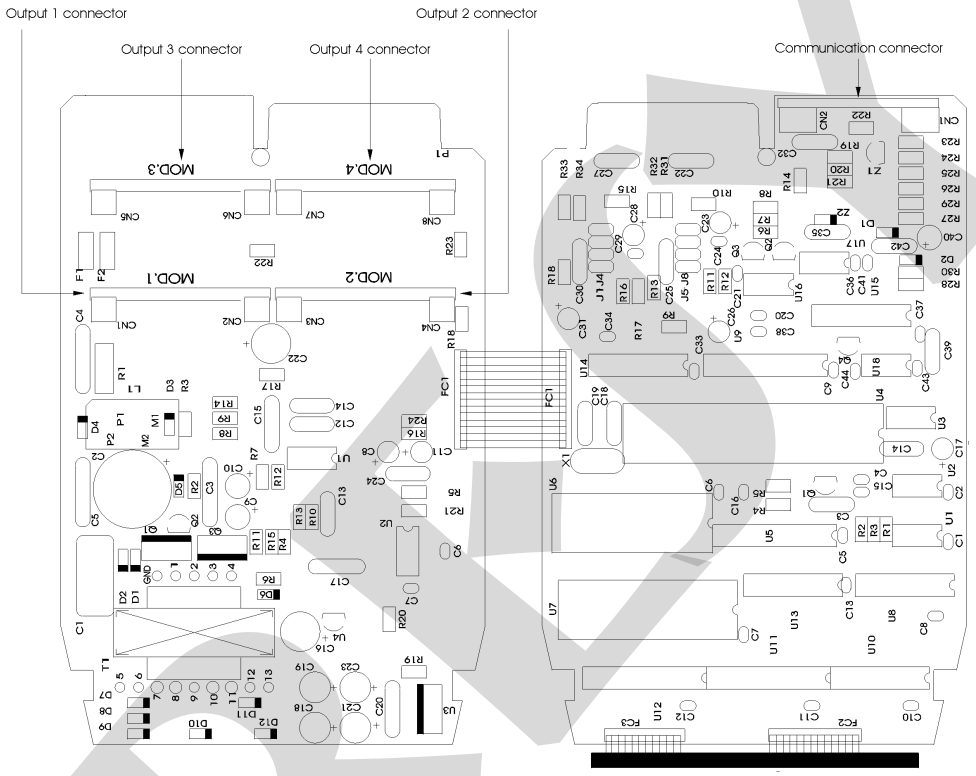


Fig. 23 - Optional module connectors

The connectors in the Power Supply Board are called MOD 1, MOD 2, MOD 3 and MOD 4, and are associated, in this order, to output 1, output 2, output 3 and output 4 signals, in the Indicator output terminals as shown in Figure 3. The connector for the communication module is placed in the CPU Board and has no label. Any optional module must be always installed with the component side in the direction of the Display Board, as shown in figure 24.

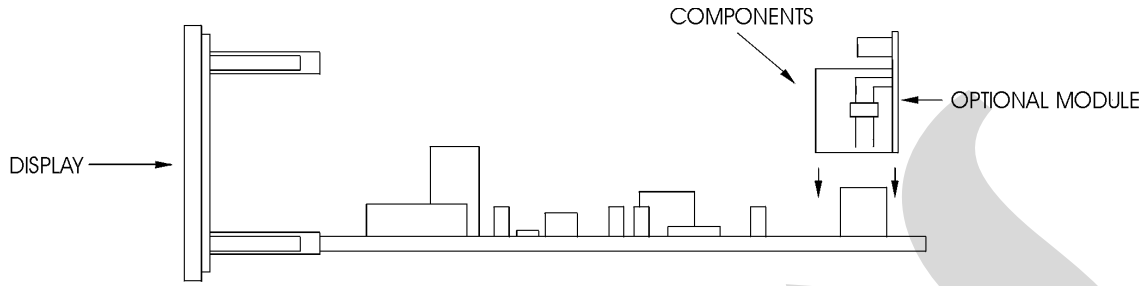


Fig. 24 - Installation of optional modules

Output 1 as retransmitter output (optional module code: MSAN-20)

When it is required output 1 to be a retransmitter output (4 to 20mA, 1 to 5V or 0 to 10V), connect the optional analog output module in the connector called MOD 1.

The output 1 retransmit the measured variable (channel 1).

The optional analog output module has two connectors for installation of jumpers: J1 and J 2, as shown in figure 25.

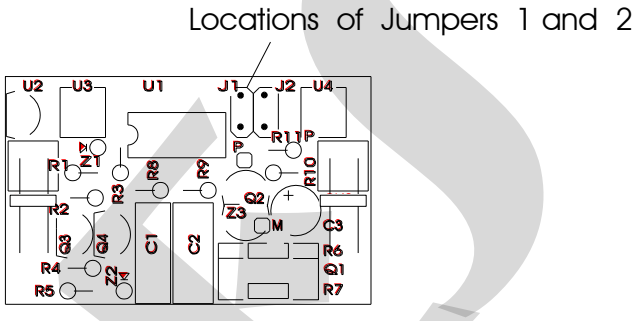


Figure 25 - Place of jumpers in analog output board

In order to configure the optional analog output module as a retransmitter output for 4 to 20mA, 1 to 5V or 0 to 10V, install the jumper according to table 3.

Retransmitter Output Type	Jumpers	
4 to 20mA*		
1 to 5V	J1	
0 to 10V		J2

Table 3 - Jumper for retransmitter output type configuration

(*) In case of 4 to 20mA current retransmitter output, keep the jumper out of the instrument or put it on only one pin of the connector, as shown in Figure 21.

Outputs 1 and 2 as alarm outputs

If output 1 or output 2 is required to operate as alarm, connect the optional module in the connectors called MOD 1 and MOD 2, respectively. The output type depends on the optional module installed in MOD 1 and MOD: SPST relay, the solid

state relay and the open collector voltage. The alarm output type and the optional module code are listed in table 4.

Alarm Output Type	Optional Module Code
SPST Relay	MALRE - 20
Solid state relay	MALRS - 20
Open collector voltage	MSD - 20

Table 4 - Types of alarm output for outputs 1 and 2

Outputs 3 and 4 as alarm outputs

Outputs 3 and 4 are used as alarms when the optional modules corresponding to connectors MOD 3 and MOD 4 are installed. There are three types of alarm output available: SPDT relay, solid state relay and open collector voltage. The Alarm output type and the optional module correspondence are shown in table 5.

Alarm Output Type	Optional Module Code
SPDT Relay	MALRE - 20
Solid state relay	MALRS - 20
Open collector voltage	MSD - 20

Table 5 - Alarm output types for outputs 3 and 4

4.5 - Calibration

DMY-2030 *Light* Indicator and Totalizer is accurately calibrated in factory and does not need periodic calibration in normal conditions. When calibration is required, follow this procedure below.

Disconnect the process signals of I/O terminals.

Before calibrating the instrument, keep it turned on for at least 30 minutes for warm up.

This section contains two parts: input calibration and output calibration.

Input Calibration

This section describes the procedure for calibration of the input (channel 1).

The accuracy and precision of the calibrator used for generating references must be at least two times better than the specifications of the Indicator.

The following tables list the references related to the type of input to be calibrated. The left column shows the mnemonics presented on the display during the calibration process.

Check if the internal input jumpers are properly placed.

To perform the calibration, enter level 6 of Calibration. The calibration level has a password system which avoids someone to enter this level accidentally and damage any calibration parameter. **The password for entering this level is number 5.**

Once the correct password is provided, select the input type to be calibrated. Choose channel 1 by pressing ENTER. The display shows the mnemonics related to the references required for the calibration process. The references must be applied before selecting the corresponding mnemonic shown on display. When the reference is stable, start the calibration by pressing ENTER. At this moment the Indicator begins the calibration process while the mnemonic CAL blinks on the display.

While the display is blinking the reference must remain connect to the input being calibrated.

When the display stops blinking and presents the mnemonic corresponding to the reference, the calibration process of the first calibration point will be finished.

Change to the next reference and press DOWN to select another point. Between any two calibration points wait 1 minute at least. After this time is elapsed, press ENTER to start calibrating this point.

After performing all references on the table related to the input type to be calibrated, the calibration process will be finished.

It is possible to calibrate only one point without rendering invalid the other points already calibrated, in case the calibration of this point was not carried out properly.

In order to return to normal operation move back through the hierarchical levels until reaching level zero.

Figure 26 shows input and output calibration options in level 6 of Calibration.

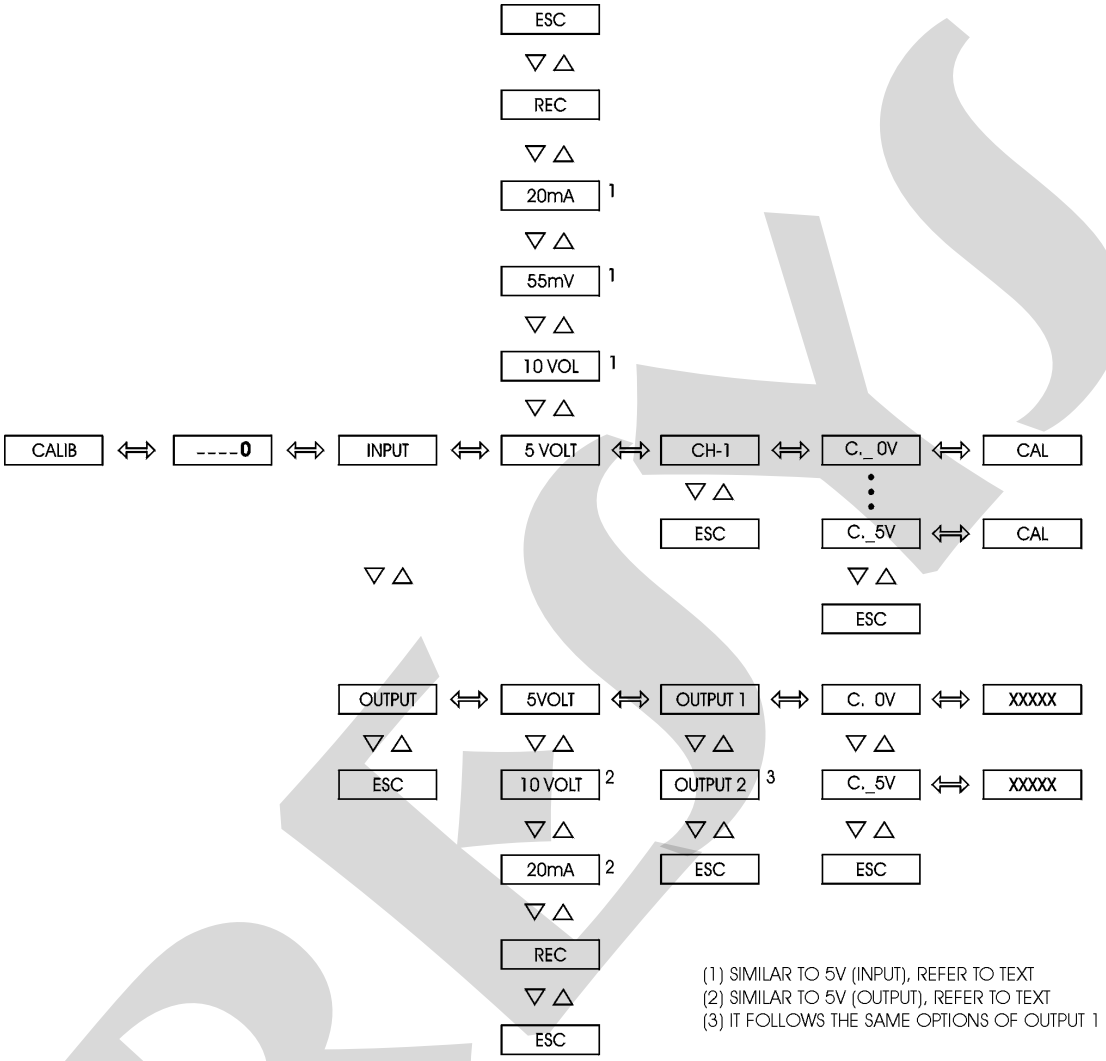


Fig. 26 - CALIBRATION level options

Calibration of voltage input (0 to 55mV)

In a 0 to 55mV voltage input calibration connect a voltage source to terminals 2(+) and 3(-). It is required 6 voltage references listed in table 6.

Reference	Mnemonic
0.000 mV	C. 0nV
10.000 mV	C.10nV
20.000 mV	C.20nV
30.000 mV	C.30nV
40.000 mV	C.40nV
50.000 mV	C.50nV

Table 6 - References for 0 to 55V input calibration

Calibration of voltage input (0 to 5V)

In a 0 to 5V voltage input calibration connect a voltage voltage source to terminals 2(+) and 3(-). It is required 6 voltage references listed in table 7.

Reference	Mnemonic
0.0000V	C. 0V
1.0000V	C. 1V
2.0000V	C. 2V
3.0000V	C. 3V
4.0000V	C. 4V
5.0000V	C. 5V

Table 7 - References for 0 to 5V input calibration

Calibration of voltage input (0 to 10V)

In a 0 to 10V voltage input calibration connect a voltage source to terminals 1(+) and 3(-). It is required 6 voltage references listed in table 8.

Reference	Mnemonic
0.0000V	C. 0V
2.0000V	C. 2V
4.0000V	C. 4V
6.0000V	C. 6V
8.0000V	C. 8V
10.0000V	C.10V

Table 8 - References for 0 to 10V input calibration

Calibration of current input (0 to 20mA)

In a 0 to 20mA current input calibration connect a current source to terminals 1(+) and 3(-). It is required 6 current references listed in table 9.

Reference	Mnemonic
0.000 mA	C. 0nA
4.000 mA	C. 4nA
8.000 mA	C. 8nA
12.000 mA	C.12nA
16.000 mA	C.16nA
20.000 mA	C.20nA

Table 9 - References for 0 to 20mA input calibration

Output Calibration

For the output calibration, follow this procedure for retransmitter output 1.

The retransmitter output can be calibrated by using the Indicator input.

The hardware configuration for the input must be the same chosen for the output (0 to 5V, 0 to 10V or 0 to 20mA) since the Indicator will measure the output signal. Therefore, check if the configurations of internal jumpers from the optional output module and from the CPU board correspond to the same input and output types.

Make sure that the input type was calibrated previously.

Make the connections listed in table 10 according to the output type to be calibrated.

Output Type	Output 1 and Input Terminals
current (0 to 20mA) voltage (0 to 10V)	terminal 13 (+) and 1 (+) terminal 14 (-) and 3 (-)
voltage (0 to 5V)	terminal 13 (+) and 2 (+) terminal 14 (-) and 3 (-)

Table 10 - I/O Terminal Connections for Output Calibration

Enter level 6 of Calibration and select the output to be calibrated. Choose the type of output (0 to 20mA, 0 to 5V or 0 to 10V) and press ENTER.

The display will show the mnemonic related to the first point of calibration. There are only two points for output calibration.

For current output, the mnemonics are related to 0 and 20mA electric signals. For voltage output, the mnemonics are related to 0 and 5V or 0 and 10V signals.

Press ENTER after the display shows the mnemonic related to first or second point of calibration, so that the display starts to show the output value. Then use the UP and DOWN keys to set the output value to the electric level indicated by the mnemonic. After the output value is set, press ENTER. During the first point calibration (0mA, 0V) be careful not to saturate the output signal.

Finally, return to normal mode by moving down through the levels until reaching level zero.

Return to factory calibration

The Indicator stores the factory calibration parameter values on the non-volatile memory, which may be recovered at any time.

In case of a bad performance of the instrument due to an incorrect calibration, use the REC option.

REC - is the option that allows to recover the factory calibration.

Enter level 6 of Calibration, and choose the INPUT or the OUTPUT option. Select the REC option and press ENTER in order to recover the values from factory.

4.6 - Hardware maintenance instructions

Before sending the instrument back to factory check the following probable causes of a malfunctioning Indicator.

Instrument with error indication on display

After turning the instrument on, it tests RAM and E2PROM integrity.

When at least one of these components presents some problem the display shows the following error codes:

Err. 01 - RAM error

Err. 02 - E2PROM error

In case of RAM error, turn the instrument off and on to check if the error message is displayed again. If the error remains, return the instrument to factory.

When there is E2PROM error, press the ENTER key and configure the instrument again. Turn the instrument off and on to check if the error message is displayed again. If the error remains, return the instrument to factory.

During configuration the display can show the Err.03 error message.

This error can happen when trying to assign a different configuration (analog output, alarm or preset) to an output already configured and enabled. In order to avoid this case, do not forget to disable relay 1 before enabling analog output 1 and vice-versa.

Note: When configuring a relay module as an analog output, the relay will be activated and deactivated continuously.

Instrument with the display out

Check if power supply voltage is provided to terminals 23 and 24 of the Indicator.

Verify the integrity of fuse F1 of 2.0 A placed in the Power Supply Board as shown in figure 19. Due to its package it is necessary to check the fuse continuity in order to detect if it is broken.

Instrument malfunction

Check if the Indicator is configured correctly by software and hardware (internal jumpers).

Examine if the optional modules are connected in the right spots.

Check if the voltages on flat cable 1 as shown in figure 27 are close to the values in table 11 and if they reach the CPU Board.

Test points on flat cable 1	Voltage
Between point 1(-) and point 2(+)	5V
Between point 9(-) and point 8(+)	8V
Between point 9(-) and point 1(+)	0V
Between point 9(-) and point 10(+)	- 8V
Between point 9(-) and point 13(+)	24V
Between point 12(-) and point 11(+)	5V

Table 11 - Inspection points of voltage on flat cable 1

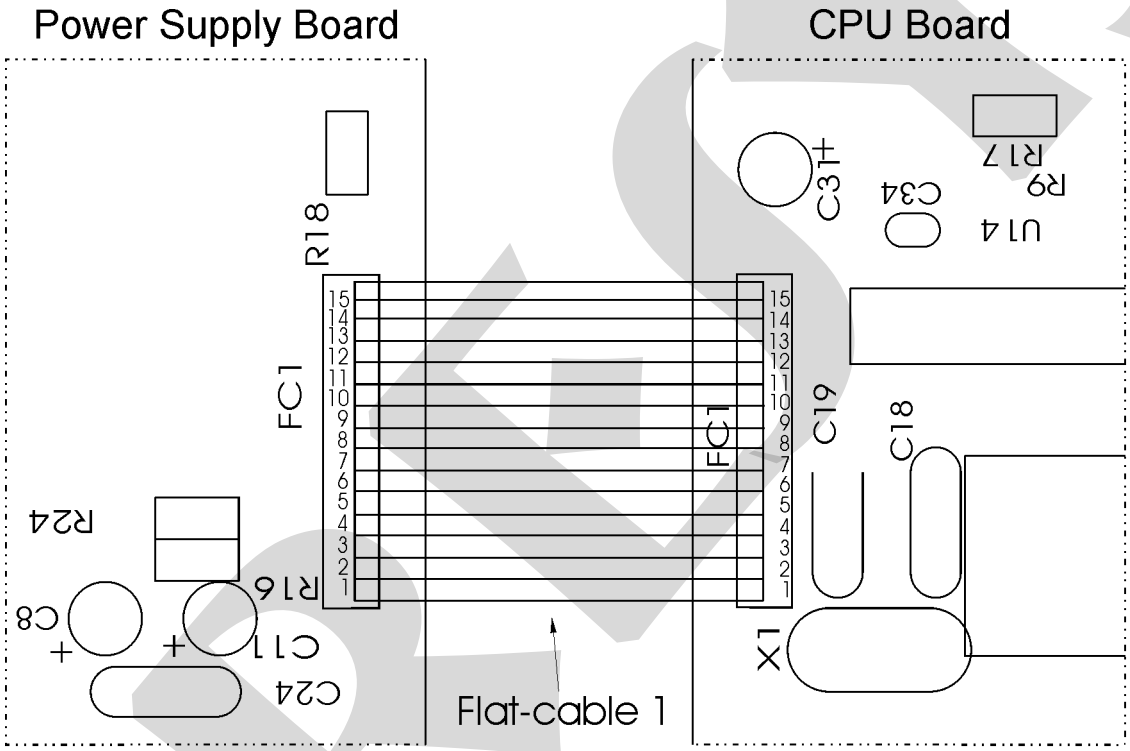


Fig. 27 - Voltage test points of the Indicator

If the cause of the problem was not discovered, the Indicator must be sent to factory.

4.7 - List of components

Display Board

Code	Components	Reference
01.05.0077-20	Display Board - DMY-2030-TOT Light	----------
01.07.0002-21	Display 14mm	DP1,2,3,4,5,6,7,8
01.04.0001-21	Diode 1N4002	D1,2
01.07.0005-21	Led 3mm (red)	D4
01.07.0004-21	Led 3mm (green)	D3
01.09.0013-21	Transistor BC 327	Q1,2,3,4,5,6,7,8
01.02.0074-21	Resistor 470R 5%	R4
01.02.0082-21	Resistor 10K 5%	R5
01.15.0003-21	Push-button	CH1,2,3

Power Supply Board

Code	Components	Reference
01.05.0046-20	Power Supply Board	----------
01.01.0029-21	LM 2940CT - 5.0 V	U3
01.01.0003-21	LM1458N	U2
01.01.0030-21	UC 3842	U1
01.09.0015-21	Transistor BC 337	Q2
01.09.0019-21	Transistor TIP 50	Q1
01.09.0020-21	IRF 822	Q3
01.02.0122-21	Fuse 2A	F1
01.01.0028-21	78L24	U4
01.04.0007-21	Diode 1N4007	D1,2,3,4
01.04.0008-21	Diode 1N4936	D5,6,7,8,9,10,11,12
01.03.0009-21	Ceramic Disc Capacitor 100 pF x 100V	C12,13,14
01.03.0035-21	Ceramic Multilayer Capacitor 0.1µF x 63V	C6,7
01.03.0036-21	Ceramic Multilayer Capacitor 0.01µF x 63V	C24
01.03.0039-21	Polyester Capacitor 0.1 µF x 250 V	C1,3
01.03.0022-21	Polyester Capacitor 0.01 µF x 100 V	C15,17
01.03.0041-21	Polyester Capacitor 0.01 µF x 250 V	C4,5
01.03.0042-21	Radial Electrolytic Capacitor 22 µF x 25 V	C9,C10
01.03.0027-21	Radial Electrolytic Capacitor 100 µF x 25 V	C18,21
01.03.0043-21	Radial Electrolytic Capacitor 100 µF x 35 V	C16,22
01.03.0044-21	Radial Electrolytic Capacitor 220 µF x 10 V	C8,11,20,23
01.03.0045-21	Radial Electrolytic Capacitor 22 µF x 350 V	C2
01.03.0002-21	Radial Electrolytic Capacitor 1000µF x 16V	C19
01.03.0068-21	Polyester Capacitor 4n7 x 400V	C25, 26
01.02.0105-21	Resistor 18R x 2W	R1
01.02.0111-21	Resistor 1R 5%	R15
01.02.0126-21	Resistor 220R 5%	R10
01.02.0114-21	Resistor 270R 5%	R4
01.02.0074-21	Resistor 470R 5%	R17, 18, 22, 23
01.02.0075-21	Resistor 1K 5%	R16, 24
01.02.0080-21	Resistor 4K7 5%	R8, 12
01.02.0082-21	Resistor 10K 5%	R5, 20, 21
01.02.0116-21	Resistor 18K 5%	R7
01.02.0083-21	Resistor 20K 5%	R11
01.02.0110-21	Resistor 27K 5%	R14
01.02.0085-21	Resistor 47K 5%	R3
01.02.0106-21	Resistor 150K 5%	R9
01.02.0088-21	Resistor 470K 5%	R2
01.02.0006-21	Resistor 20R 1%	R6
Code	Components	Reference

01.02.0183-21	Resistor 2K32 1%	R13
01.02.0108-21	Resistor 15K4 1%	R 19
01.06.0003-21	Transformador p/ Fonte 110/220Vca	T 1
01.06.0018-21	Bobina para Fonte	L 1
01.13.0004-21	Conector	CN 1,2,3,4,5,6,7,8

CPU Board

Code	Components	Reference
01.05.0080-20	CPU Board	----------
01.01.0007-21	LM 311	U18
01.01.0016-21	EPROM 27C512	U7
01.01.0017-21	RAM 6516	U6
01.01.0044-21	E2PROM X25C43	U19
01.01.0034-21	NVRAM X24C45P	U2
01.01.0019-21	4051	U14
01.01.0020-21	TC-4053	U15
01.01.0021-21	74HC02	U13
01.01.0022-21	74HC138	U8
01.01.0023-21	74HC365	U10
01.01.0024-21	74HC373	U5,9,11,12
01.01.0045-21	80C32	U4
01.01.0026-21	AD 706	U16
01.01.0027-21	AD 712 JN	U17
01.16.0001-11	Crystal 11.0592 MHz	X1
01.09.0013-21	Transistor BC 327	Q4
01.04.0003-21	Diode 1N4148	D1,2
01.04.0005-21	Reference Diode LM336/5V	Z1
01.04.0006-21	Zener BZX 79/C6V2	Z2
01.03.0067-21	Ceramic Disc Capacitor 56pF x 50 V (4 mm)	C18,19
01.03.0035-21	Ceramic Multilayer Capacitor 0.1µF x 63V	C1,4,5,6,7,8,9,10,11,12, C13,20,21,22,24,25,27, C29,30,32,33,34,35,36, C37,38,41,42,43,44
01.03.0039-21	Polyester Capacitor J(5%) 0.1 µF x 250 V	C39
01.03.0038-21	Radial Electrolytic Capacitor 10µF x 16 V	C28,23,26,31
01.03.0027-21	Radial Electrolytic Capacitor 100µF x 25 V	C40
01.02.0103-21	Resistor 68R1 1%	R24
01.02.0010-21	Resistor 100R 1%	R21,29
01.02.0013-21	Resistor 249R 1%	R32,34
01.02.0102-21	Resistor 442R 1%	R23
01.02.0019-21	Resistor 1K 1%	R6
01.02.0104-21	Resistor 3K32 1%	R25
01.02.0030-21	Resistor 4K42 1%	R8,9
01.02.0031-21	Resistor 4K99 1%	R7
01.02.0036-21	Resistor 8K66 1%	R28
01.02.0038-21	Resistor 10K 1%	R20,39
01.02.0046-21	Resistor 40K2 1%	R26
01.02.0075-21	Resistor 1K 5%	R19,22,30
01.02.0078-21	Resistor 2K 5%	R27
01.02.0082-21	Resistor 10K 5%	R10,13,15,18,35,36,37,38
01.02.0119-21	Resistor 15K 5%	R42
01.02.0089-21	Resistor 1M 5%	R11,12,16,17
01.02.0098-21	Resistor 10M 5%	R31,33
01.17.0002-21	Jumper	----------
01.17.0003-21	Right Angle Pitch Header 2x4	J1-J4, J5-J8

Code	Components	Reference

01.13.0043-21	DIP socket	U7
01.13.0005-21	Connector	CN1,2
01.14.0026-21	Flat Cable 15 Circuits	FC1
01.14.0025-21	Flat Cable 13 Circuits	FC2
01.14.0011-21	Flat Cable 12 Circuits	FC3

I/O Terminal Board

Code	Components	Reference
01.05.0049-20	I/O Terminal Board	----------
01.09.0015-21	BC 337	U1
01.13.0002-21	Terminal Block	CN1,2,3
01.13.0003-21	Board-to-board Connector	P1,2

Analog Output Board

Code	Components	Reference
01.05.0055-20	Analog Output Board	----------
01.01.0060-21	OP200GP	U 2
01.01.0065-21	Optocoupler LTV817	U 1,3
01.09.0006-21	TIP 117	Q 1
01.09.0015-21	Transistor BC 337	Q 2
01.09.0021-21	Transistor BF 245A	Q 3
01.04.0030-21	Zener Diode BZX 79/C3V3	Z 1
01.04.0011-21	Zener Diode BZX79/C3V9	Z 3
01.04.0005-21	Reference Diode LM 336 / 5.0 V	Z 2,4
01.03.0042-21	Radial Electrolytic Capacitor 22 µF x 25 V	C 1
01.03.0035-21	Ceramic Multilayer Capacitor 0,1µF x 63 V	C5,6
01.03.0011-21	Ceramic Multilayer Capacitor 220pF x 63V	C4,7
01.03.0050-21	Tantalo Capacitor 1µF x 35V	C 2, 3
01.02.0008-21	Resistor 49R9 1%	R 4
01.02.0010-21	Resistor 100R 1%	R 5
01.02.0013-21	Resistor 249R 1%	R 10,11
01.02.0115-21	Resistor 402R 1%	R 13
01.02.0024-21	Resistor 2K 1%	R 9
01.02.0029-21	Resistor 4K02 1%	R 2
01.02.0038-21	Resistor 10K 1%	R 3
01.02.0047-21	Resistor 49K9 1%	R 7,8
01.02.0059-21	Resistor 301K 1%	R 12
01.02.0069-21	Resistor 1M 1%	R 6
01.02.0109-21	Resistor 3K3 5%	R 14
01.02.0080-21	Resistor 4K7 5%	R 1
01.17.0001-21	Connector 180º 2x2	J 1,2
01.17.0004-21	Connector 90º 2x2	CN 1,2
01.17.0002-21	Jumper	----------
01.06.0004-21	Coil for Analog Output DMY/TY/DCY	----------

Alarm Board

Code	Components	Reference
01.05.0052-20	Alarm Board	----------
01.01.0033-21	Optical coupler 2502	U3
01.04.0001-21	Diode 1N4002	D1
01.03.0039-21	Polyester Capacitor 0.1 µF x 250 V	C1,2
01.02.0114-21	Resistor 270R 5%	R1
01.02.0072-21	Resistor 100R 5%	R2
01.12.0001-21	Relay 24 V	K1
01.17.0004-21	Connector 90º 2x2	CN3,4

4.8 - List of recommended spare components

List of recommended spare components

Display Board
Display DP1, 2, 3, 4, 5, 6, 7, 8

Power Supply Board

IRF 822	Q3
UC 3842	U1
Fuse 2A	F1
LM 1458N	U2

I/O Terminal Board

BC 337	U1

CPU Board

4051	U14
4053	U15
Reference diode LM336/5V	Z1

Engineering Units Label
Code 02.10.0003.21