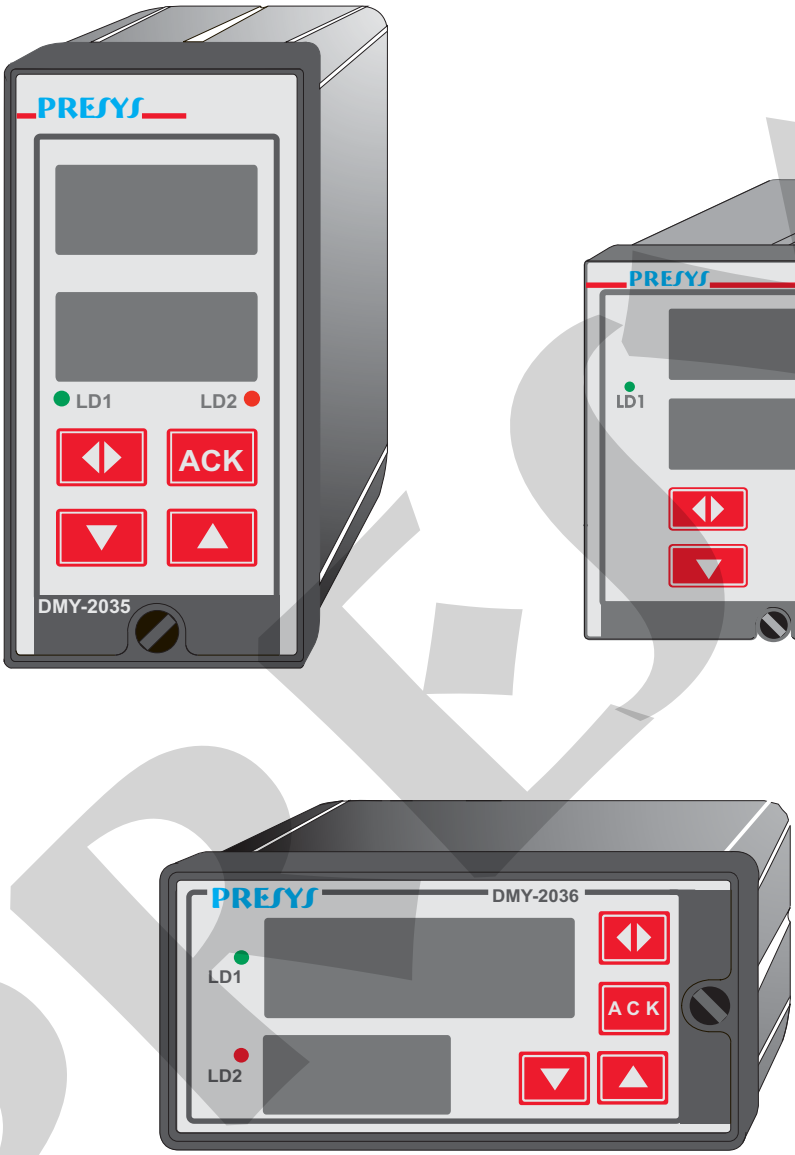
PRESYS | Instruments

DMY-2011 / 2035 / 2036 Universal Process Indicators



TECHNICAL MANUAL

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1 - Introduction

1.1 - Description

PRESYS DMY-2011, 2035 and 2036 Indicators are microprocessor-based instruments that show all kind of industrial process variable, such as: temperature, pressure, flow and level. They have non-volatile internal memory (E2PROM) to store calibration values. Their high accuracy is warranted by autocalibration techniques based on high thermal stability voltage reference.

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

The Indicators are able to monitor two universal standard inputs and accept direct connection of thermocouples, RTD, current (mAdc) and voltage (mVdc, Vdc). Thermocouples and RTD inputs are linearized automatically by tables stored in EPROM memory. A 24Vdc voltage source isolated from output and with short-circuit protection is provided for transmitter power supply.

The type of input selected by the user is enabled by jumpers and by the software configuration. All configuration data can be protected by a password system and are stored in the non-volatile memory in case of power failure.

According to modularity design concept, the instruments accept up to four output modules. The type of outputs are: retransmittion, SPDT relay, SPST relay and solid state relay. The outputs are isolated from the inputs.

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

The equipments have extruded aluminum case which avoids electrical noise, electromagnetic interference, radiofrequency interference, etc. and their robust construction makes them tough enough for the most hostile environments.

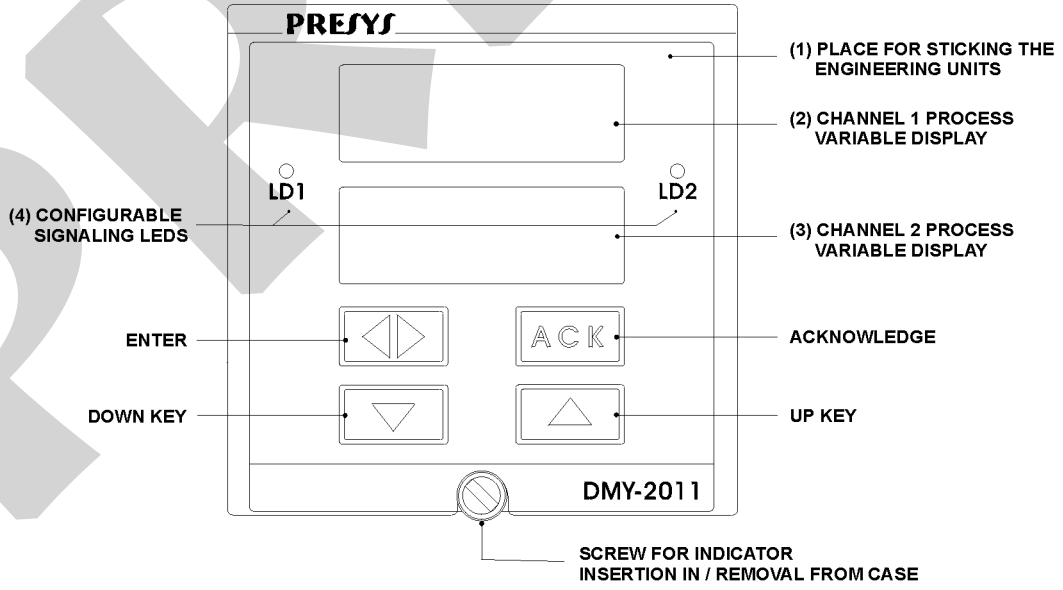


Figure 1 - DMY - 2011 Indicator front panel

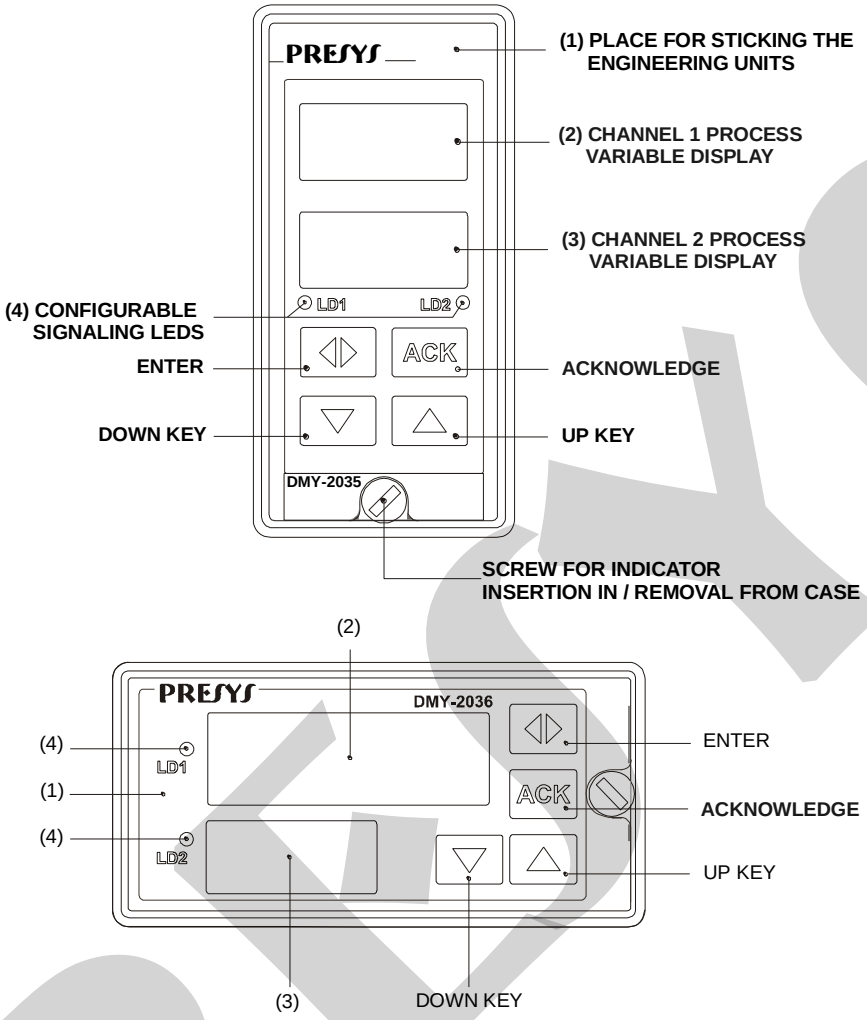


Figure 2 - DMY-2035 and DMY-2036 Indicators front panels

On the front panel of the instruments there are two displays configurable up to four high visibility digits which show the process variables of channel 1 (upper display) and channel 2 (lower display). 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 with 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 acknowledgement by means of the front panel keys in order to deactivate them after the process variable returns to normal condition.

Up to two rettransmitter outputs are 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 retransmissions of the variables to a distant location. When using only one analog output, up to three alarm modules can be used, and when using two analog outputs, up to two alarm modules can be used.

1.2 - Order code

Order Code

DMY - 2011 / 2035 / 2036 - ____ - ____ - ____ - ____ - ____ - ____ - ____

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

Same code of Output 1

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	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 - Ranges and input types, indication, 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 - 2011 - 0 - 0 - 1 - 1 - 1 - 0 - 0

This code defines a DMY-2011 Indicator 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 - Specifications

Inputs:

- Two inputs configurable for thermocouple (J, K, T, E, R, S, under ITS-90), Pt-100 RTD under DIN 43760, 4 to 20mA, 0 to 55mVDC, 1 to 5VDC and 0 to 10VDC. Input impedance of 250Ω for mA, 10MΩ for 5VDC and 2MΩ above 5VDC. Table 1 shows the temperature ranges for thermocouples and RTD and the resolution for linear input sensors.

Input Sensor	**Measuring Range Limits**			
Thermocouple	lower limit °F	higher limit °F	lower limit °C	higher limit °C
Type J	-184	1886.0	-120	1030.0
Type K	-346	2498	-210	1370
Type T	-418	752	-250	400
Type E	-148.0	1436.0	-100.0	780.0
Type R	-58	3200	-50	1760
Type S	-58	3200	-50	1760
RTD 2 or 3-wire Pt-100	-346.0	1256.0	-210.0	680.0*
Linear	Range		Resolution	
Voltage	0 to 55mV		6μV	
	0 to 5V		500μV	
	0 to 10V		1mV	
Current	0 to 20mA		2μA	

(*)including wire resistance

Table 1 - Measuring ranges for input sensors

Outputs:

- 4 to 20 mA, 1 to 5 Vdc, 0 to 10 Vdc Analog Retransmitter, with connection for up to two optional modules galvanically isolated of 300Vac from power supply and inputs.
- 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 one analog output, one can use three alarm modules, or whenever one uses two analog outputs, it is possible to have up to two 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:
Two red display sets with four digits, configured with decimal point.

Configuration:
By front-panel pushbuttons and internal jumpers.

Sampling rate:
120 ms for input indication in -999 to 9999 range. The display is updated each second.

Accuracy:
± 0.1 % of full scale for TC, RTD, mA, mV, Vdc input.
± 0.5 % of full scale for analog retransmitter output, 750 Ω maximum load.

Linearization:
± 0.1 °C for RTD and ± 0.2 °C for TC.

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

Cold junction compensation:
± 2.0 °C in the range from 0 to 50°C ambient temperature.

Thermal stability:
± 0.005 % / °C of span referred to ambient temperature of 25°C

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

Dimensions:

2011	1/4 DIN (96 × 96 mm) with 162 mm depth.
	Panel cut of 92 × 92 mm.
2035/2036	1/8 DIN (48 × 96 mm) with 162 mm depth.
	Panel cut of 45 × 92 mm.

Weight:
0.5 kg approx (DMY-2035/36) / 0.6 kg nominal (DMY-2011).

Warranty:
One-year warranty.

2 - Installation

2.1 - Mechanical Installation

The front panel of the DMY - 2035 / 2036 Indicators has 1/8 DIN size (48 × 96 mm) and the front panel of the DMY - 2011 Indicator has 1/4 DIN size (96 × 96 mm).

The Indicators are fixed by the rails which press them against the back side of the panel.

After preparing a 45 × 92 mm cut in the panel for DMY - 2035 / 2036 or a 92 × 92 mm cut for DMY - 2011, 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 figures 3 and 4.

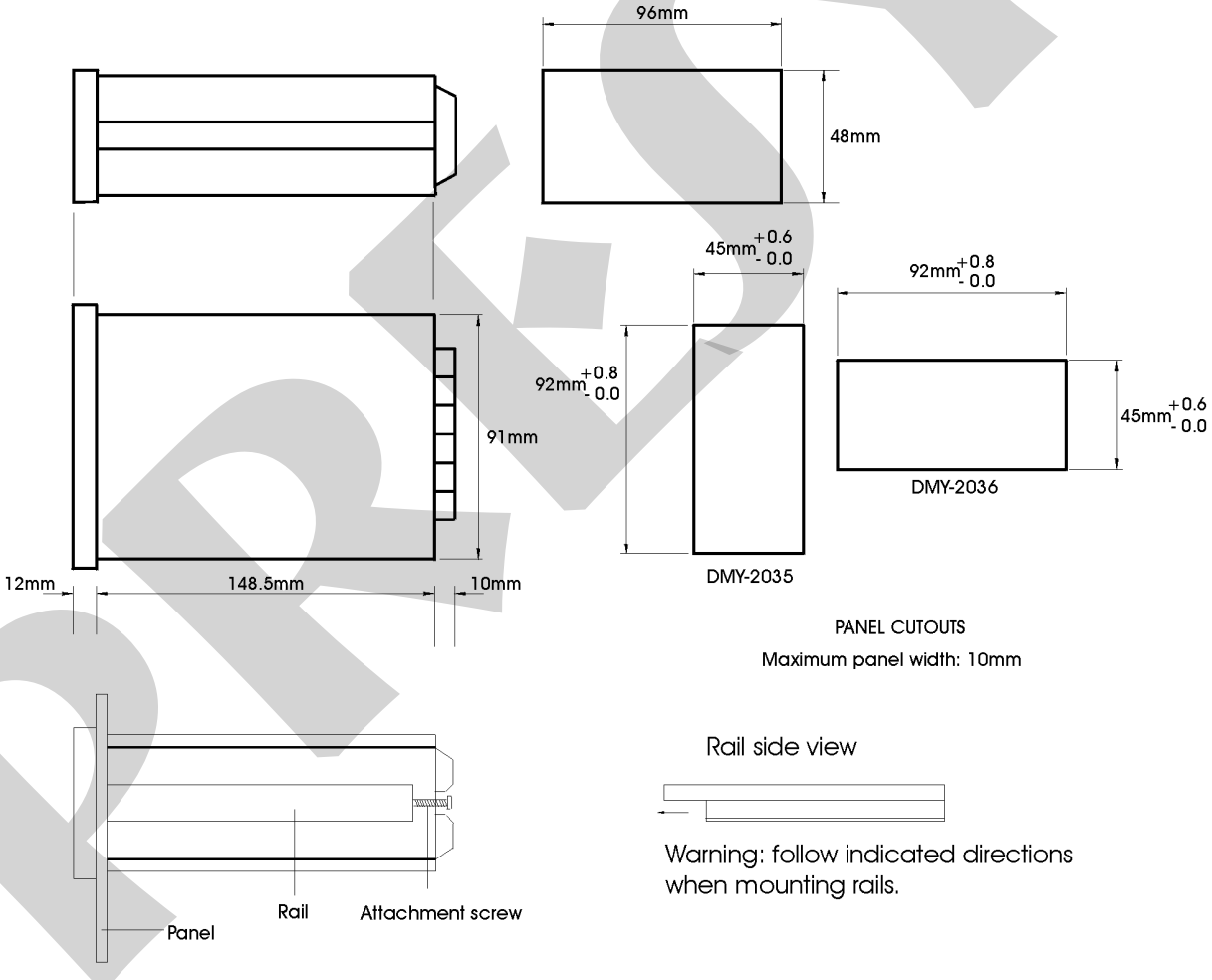


Figure 3 - Dimensional drawing, panel mounting cutout and side view for DMY-2035/2036 Indicators

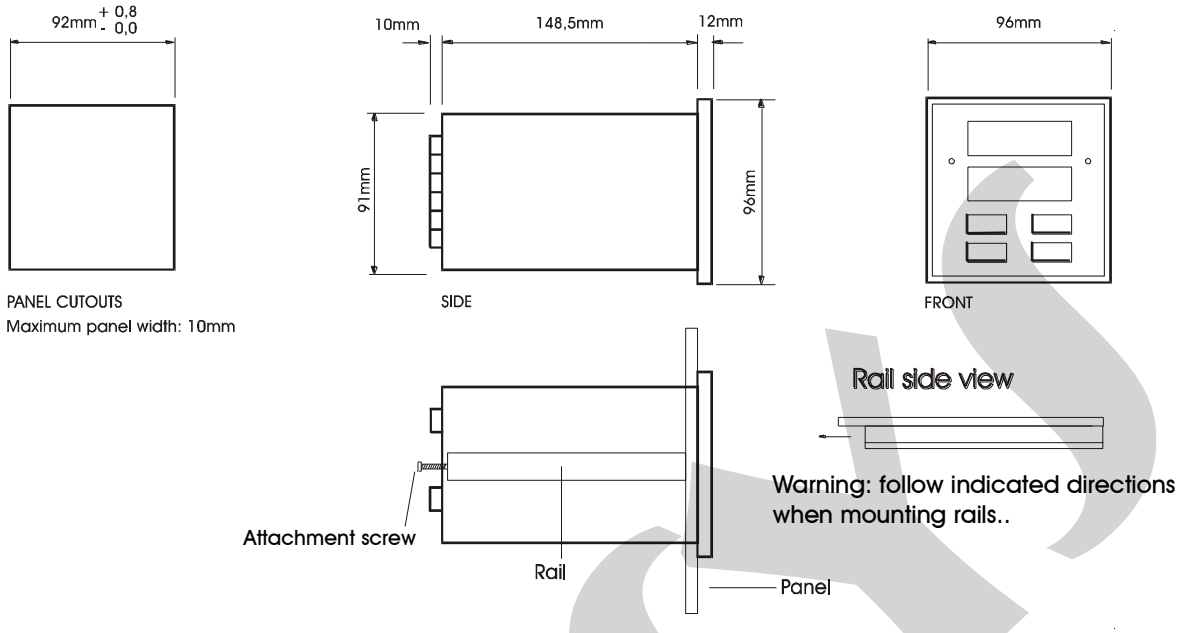


Figure 4 - Dimensional drawing, panel mounting cutout and side view for DMY-2011 Indicator

2.2 - Electrical Installation

DMY - 2011, 2035 and 2036 Indicators 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 mains.

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

Figure 5 shows the instrument rear terminals for connection to 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.

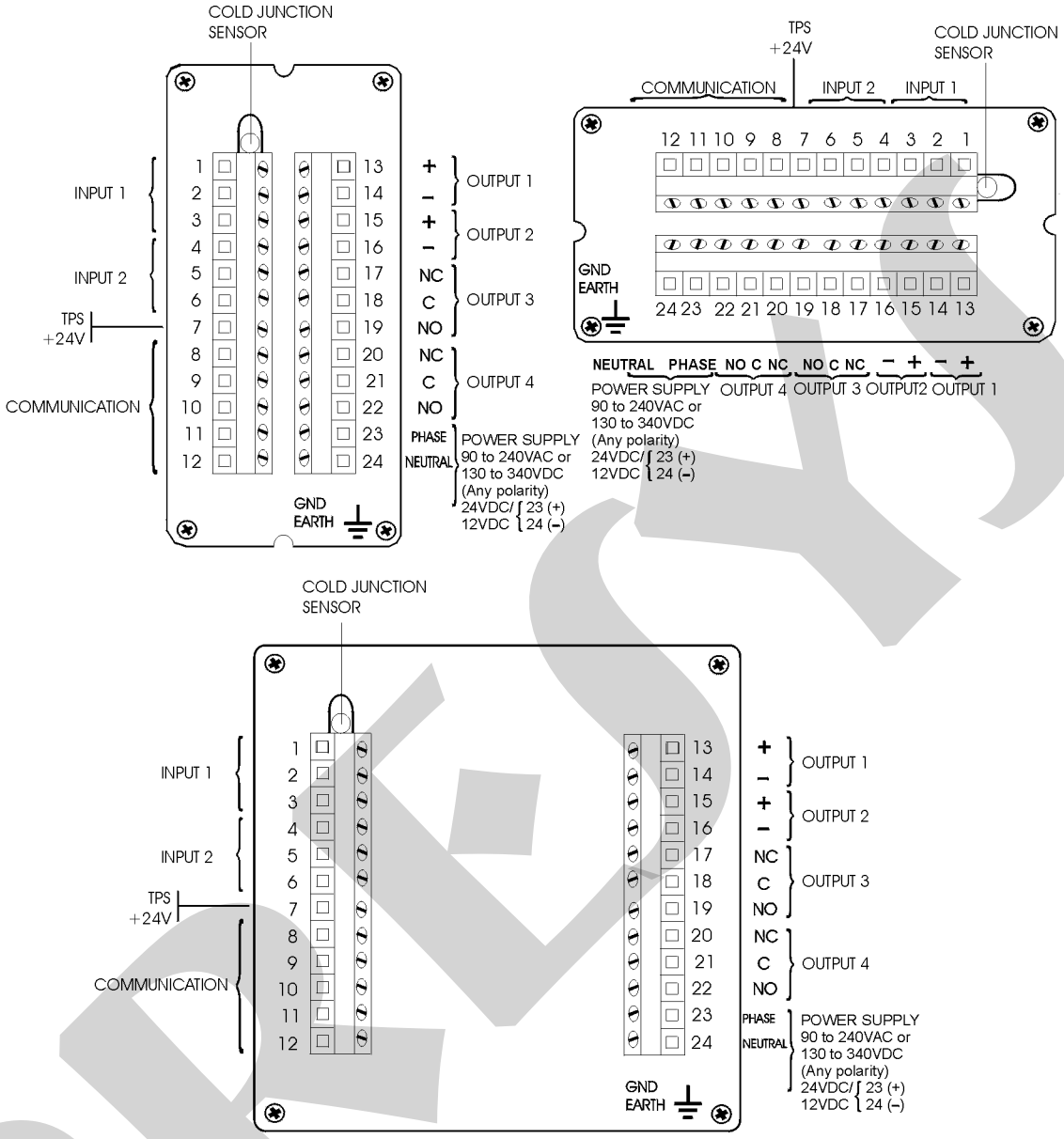


Figure 5 - Indicator Terminals

2.3 - Process Input Signal Connections.

The Indicators accept the connection of thermocouple, 2 or 3-wire RTD, mA, mV or V. 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.

The connection of a certain type of sensor in input 1 does not restrict the use of other sensor in input 2.

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.

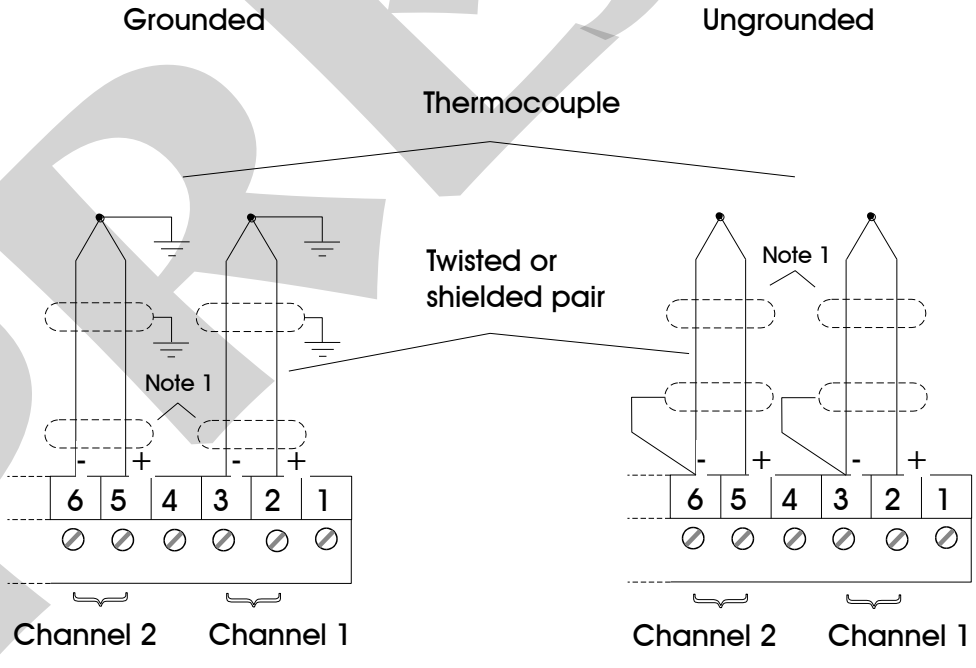
2.3.1 - Thermocouple Input

When using only one thermocouple, connect it to input 1, in order to get a better precision in the temperature measurement, since the cold junction sensor is placed near input 1.

In order to reduce the error due to cold junction compensation, use thermal paste in the rear, at the terminals where the thermocouple is connected to the cold junction sensor.

Connect the thermocouple to terminals 2 (+) and 3 (-) to use input 1 or to terminals 5 (+) and 6 (-) to use input 2 as shown in figure 6.

Use appropriate compensating cables with the same material of the thermocouple in order to connect it to the instrument. Check if the thermocouple polarity is equal to those of the terminals.



Note 1: Keep shielded wire disconnected at this end.

Figure 6 - Thermocouple Input

2.3.2 - RTD Input

An RTD input device may be a 2-wire, 3-wire or 4-wire RTD. All types of connection are shown in figure 7.

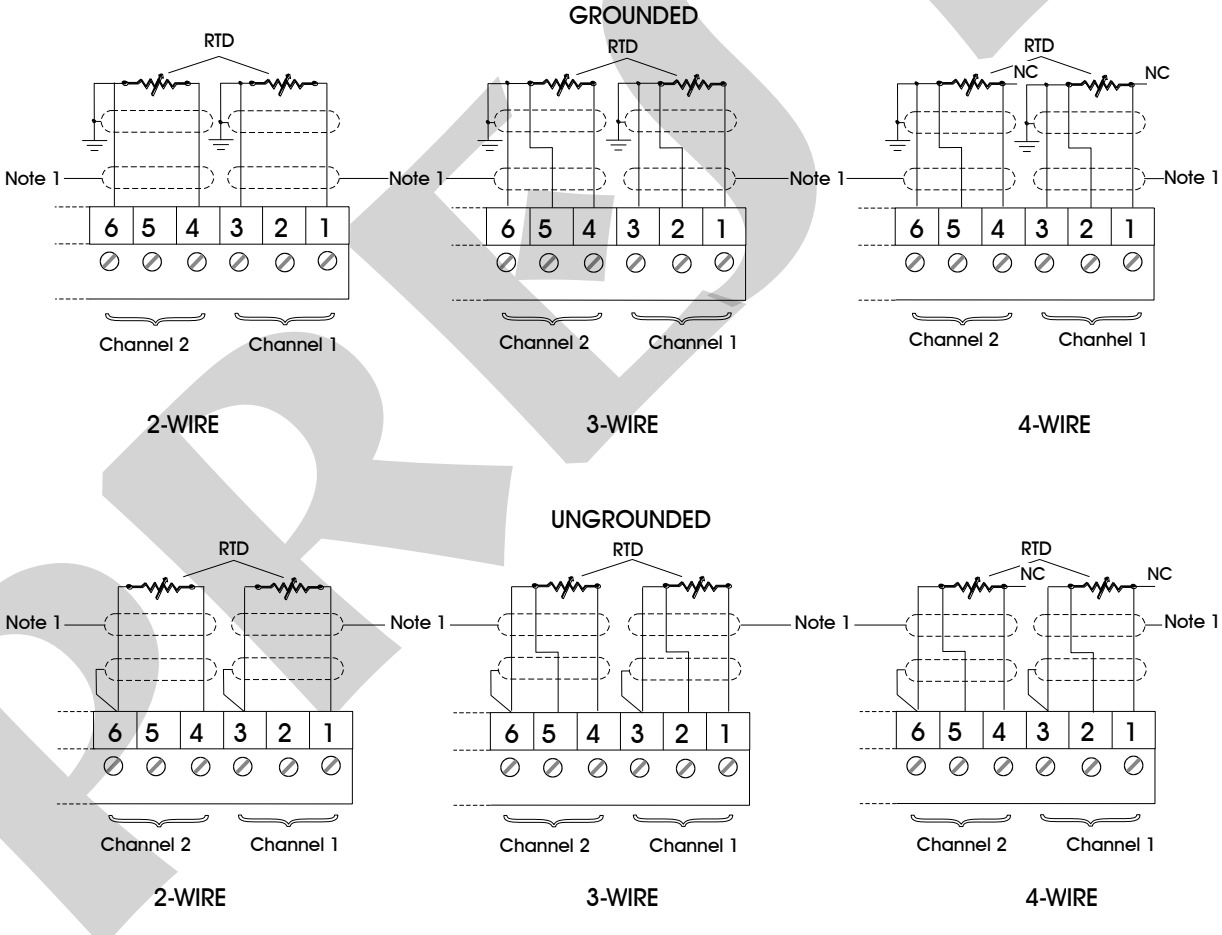
A 2-wire RTD is connected to terminals 1 and 3 when using input 1 and to terminals 4 and 6 when using input 2 as shown in figure 7.

A 3-wire RTD is connected in the same way as explained for a 2-wire RTD, adding the connection of the compensation wire to terminal 2 for input 1 and to terminal 5 for input 2 as shown in figure 7.

Connect a 4-wire RTD as indicated for a 3-wire RTD and keep its forth wire disconnected. See figure 7.

With a 3-wire RTD one gets a better precision than with a 2-wire RTD.

Use wires of same material, gauge and length on all 3 terminals of each channel for compensating resistance. The maximum resistance of each connection wire must be 10 Ω. Use 18 AWG wire (minimum) for distances up to 50 m and 16 AWG for distances greater than 50 m.

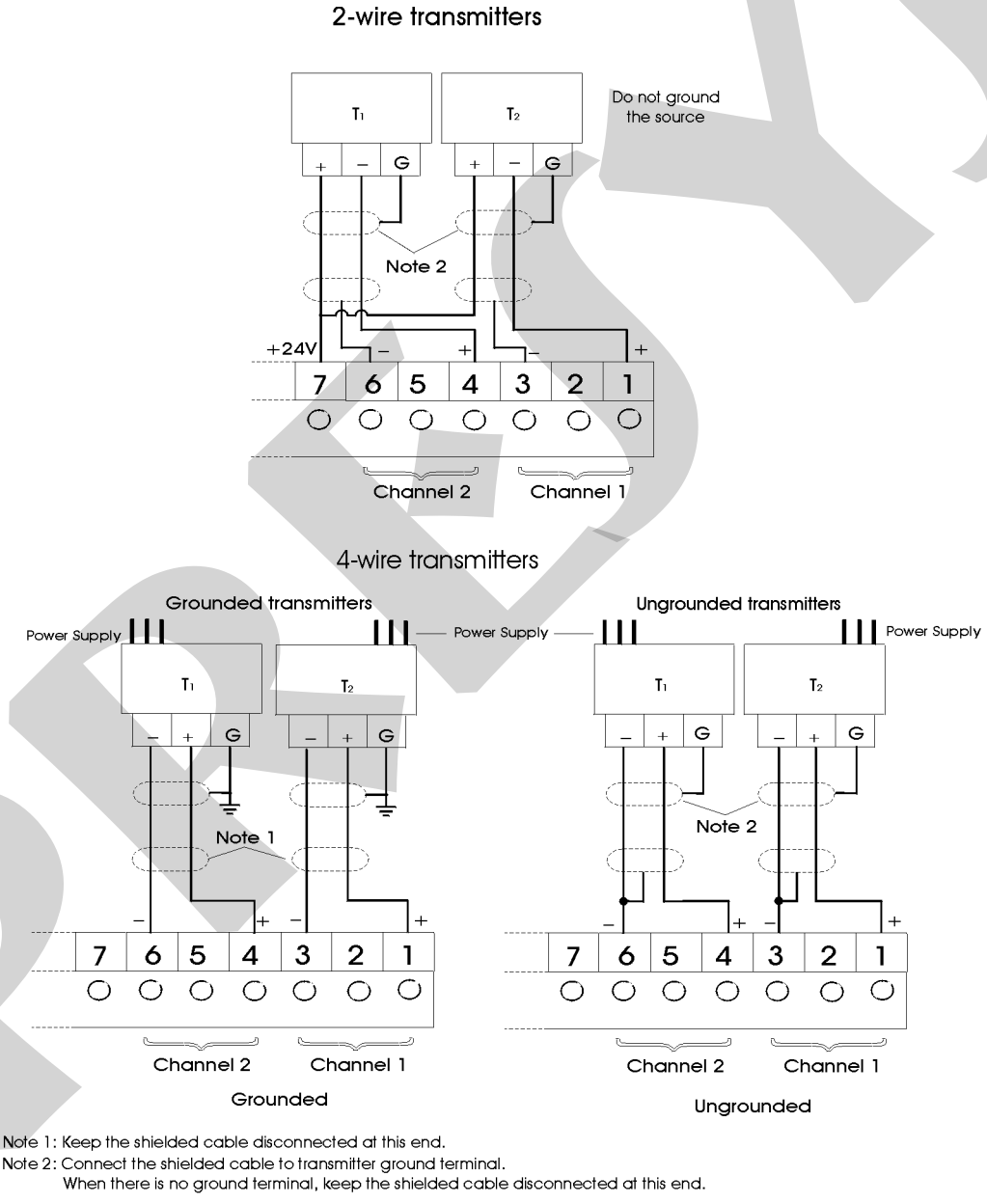


Note 1: Shield to be left unconnected at this end..

Figure 7 - RTD Input

2.3.3 - Milliampere Input

A current source of 4 to 20 mA can be applied to terminals 1(+) and 3(-) for input 1 and to terminals 4(+) and 6(-) for input 2. 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(+) for input 1 and by terminal 4(+) for input 2. Figure 8 shows both possibilities of connection.

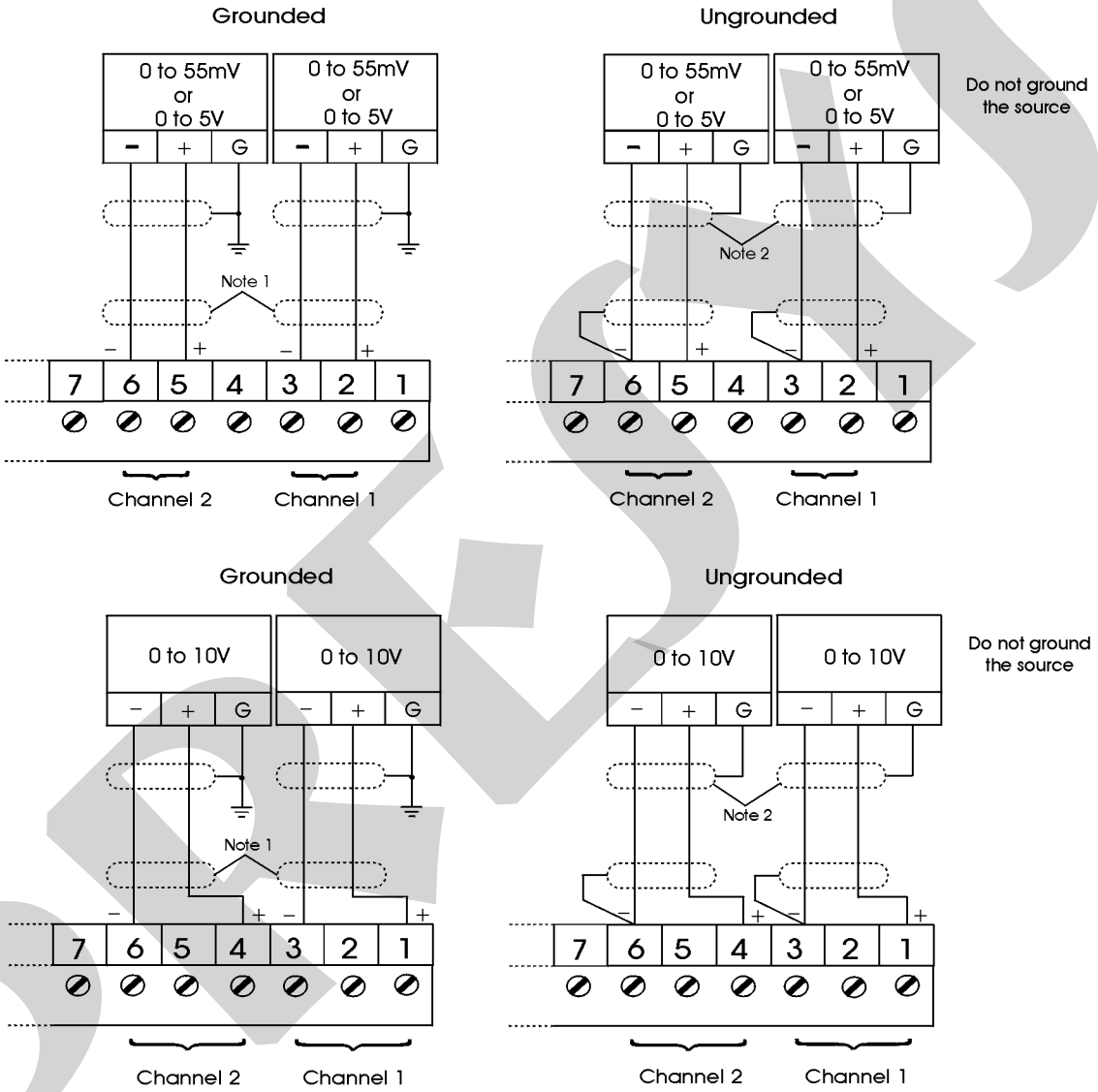


Note 1: Keep the shielded cable disconnected at this end.
Note 2: Connect the shielded cable to transmitter ground terminal.
When there is no ground terminal, keep the shielded cable disconnected at this end.

Figure 8 - Milliampere Input

2.3.4 - Volt or Millivolt Input

0 to 55 mVDC or to 0 to 5 VDC must be applied to terminals 2 (+) and 3 (-) for input 1 and to terminals 5(+) and 6(-) for input 2. 0 to 10 VDC must be applied to terminals 1(+) and 3(-) for input 1 and to terminals 4(+) and 6(-) for input 2. The connections are shown in figure 9.



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.

Figure 9 - Volt or millivolt Input

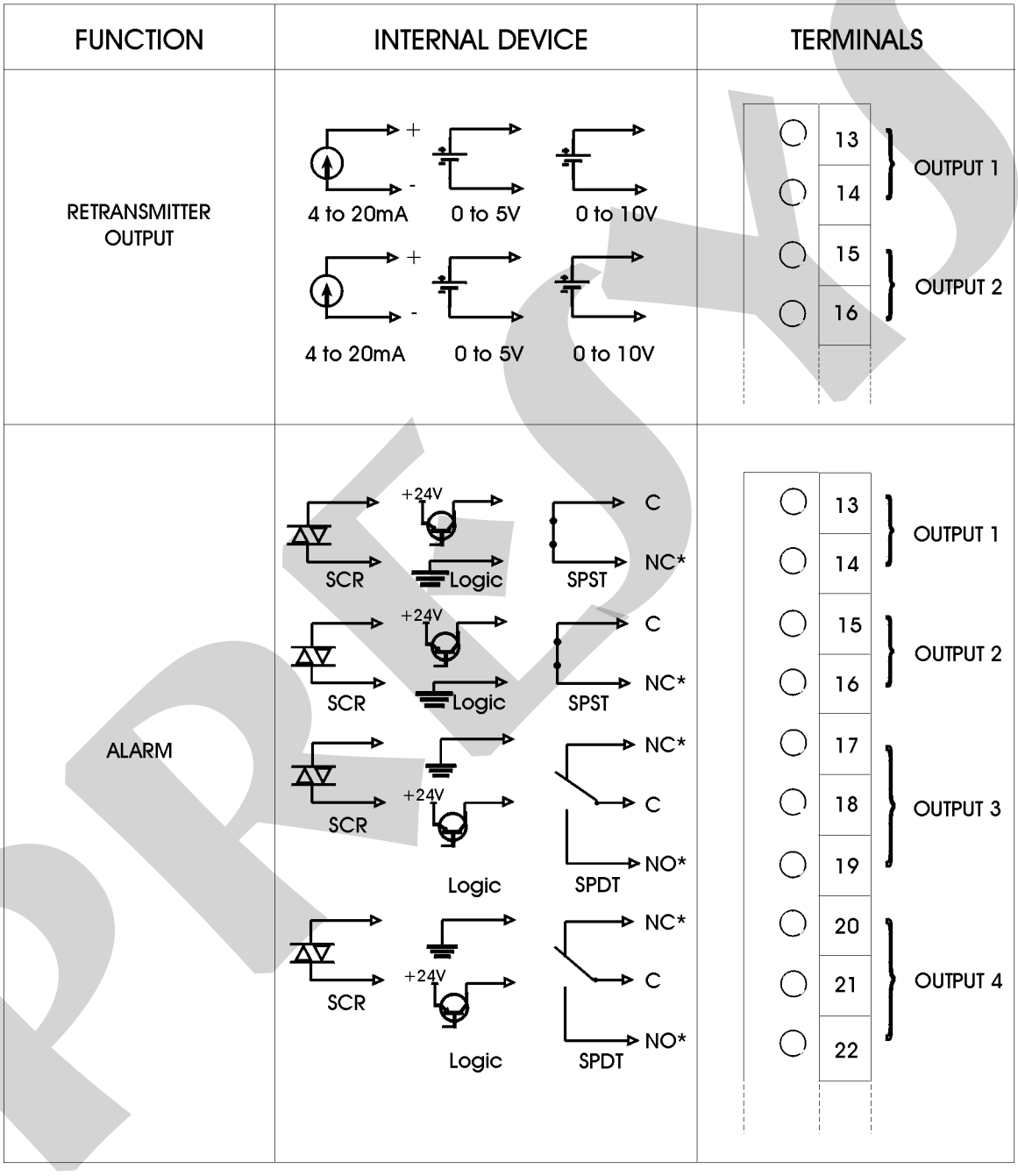
2.4 - Output Signal Connections

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

For outputs 1 and 2, 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 3 and 4, there are three different types of outputs: SPDT relay, open collector voltage and solid state relay. Figure 10 shows the Indicator output types.

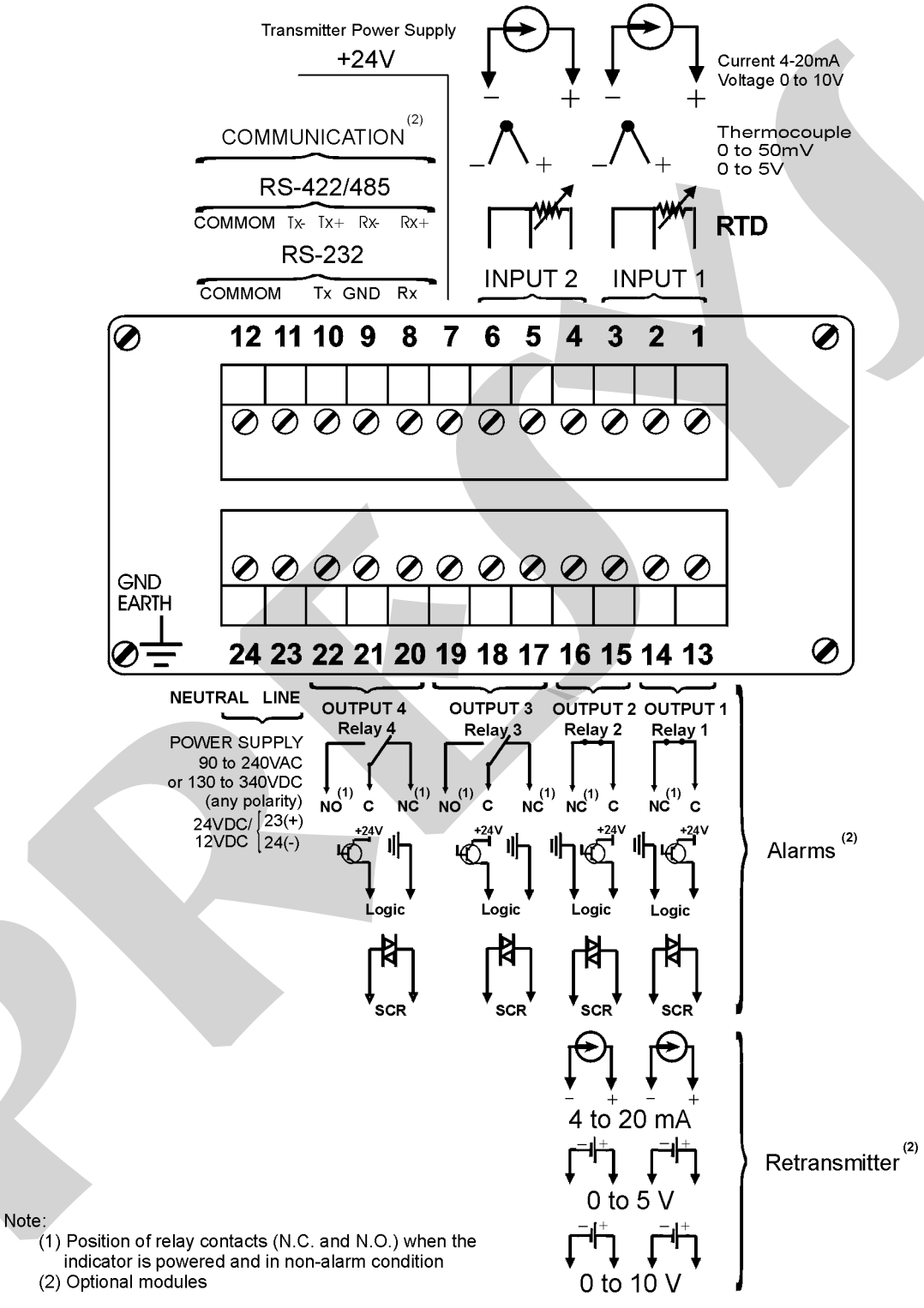
Note that the output terminals will present the corresponding signals only if the optional modules are installed and the output is correctly configured. For analog outputs, refer to section 3.2 on Configuration and section 4.3 on Optional Module Connection for details on installation and configuration of optional modules.



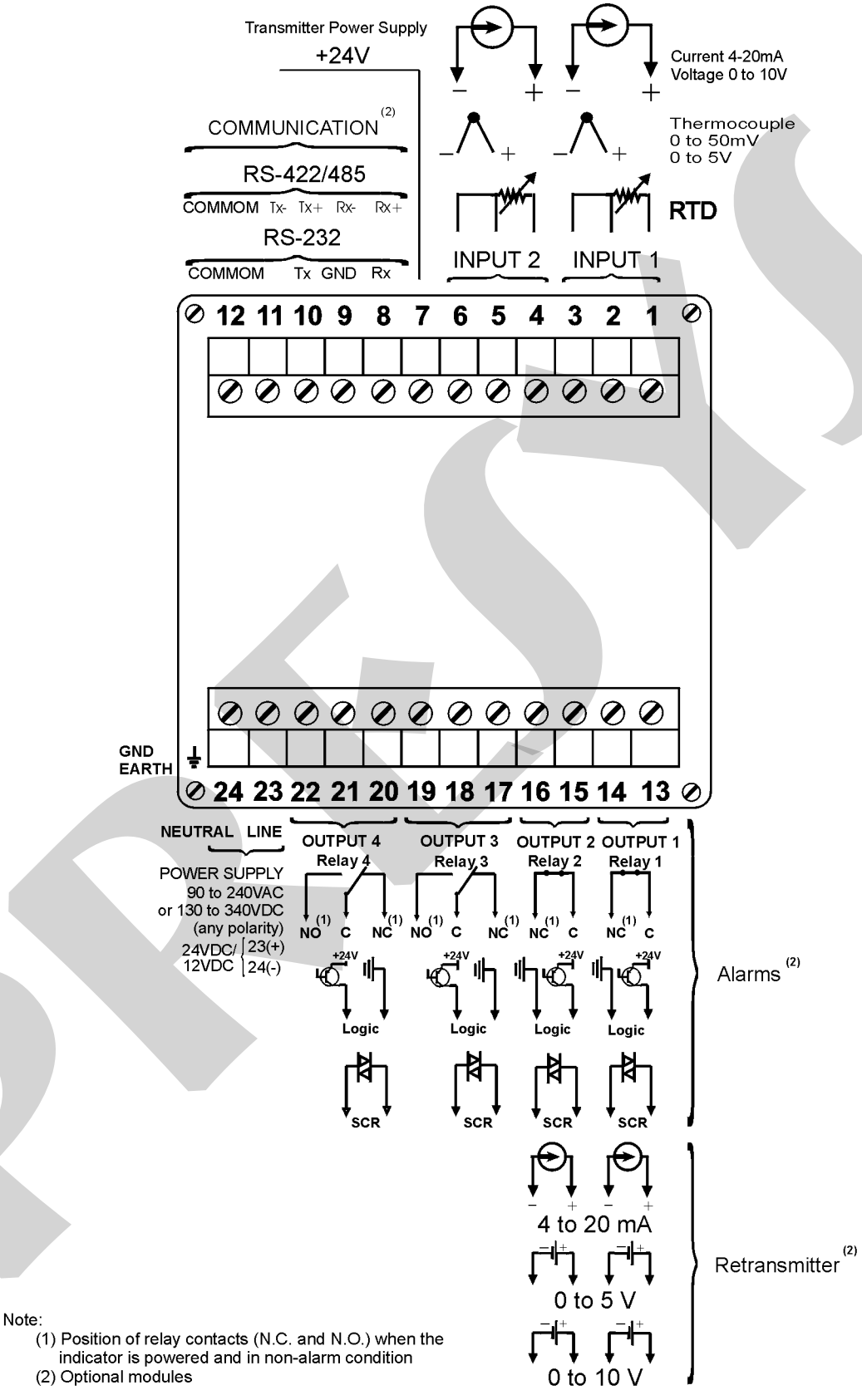
(*) Relay contact states shown are valid for SAFE option selected (see section 3.2 on Configuration), instrument powered on and non-alarm condition. Positions of the contacts are changed in alarm condition (with SAFE option selected) or when the instrument is turned off.

Figure 10 - Output Connection

2.5 - Connection Diagrams



Note:
(1) Position of relay contacts (N.C. and N.O.) when the indicator is powered and in non-alarm condition
(2) Optional modules



Note:
(1) Position of relay contacts (N.C. and N.O.) when the indicator is powered and in non-alarm condition
(2) Optional modules

2.6 - Communication

DMY - 2011, 2035 and 2036 Indicators can communicate 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 - Operation

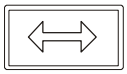
3.1 - Normal Operation

DMY-2011, 2035 and 2036 Indicators have two modes of operation: normal operation and configuration mode.

During normal operation, the Indicators monitor the two inputs and show the totalizations, verify alarm conditions and activate the four outputs if necessary.

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

The normal operation mode, in which the Indicators are 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.
ACK	Key		Presents the alarm outputs which require acknowledgment to return to normal state (*).

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

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 11.

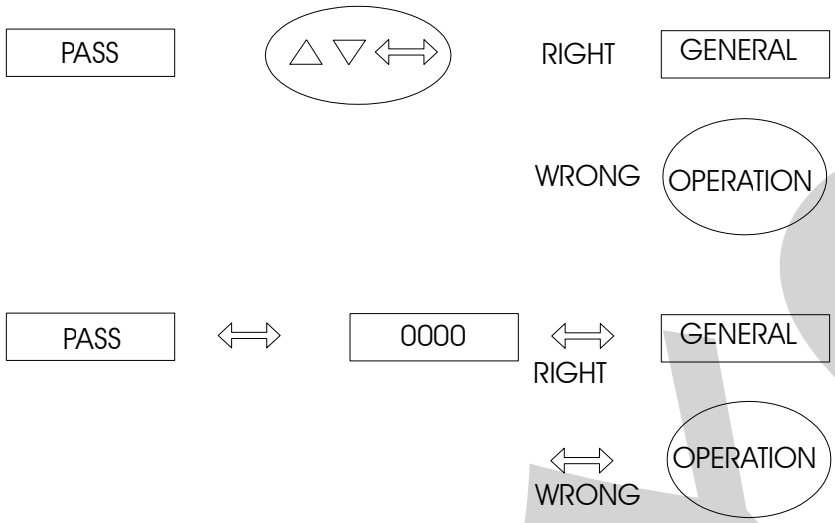


Figure 11 - Password through key sequence or value

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 11).

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 2011, 2035 or 2036, according to the type of Indicator. Note that the number 2011, 2035 or 2036 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

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 six hierarchical levels shown in figure 12.

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

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

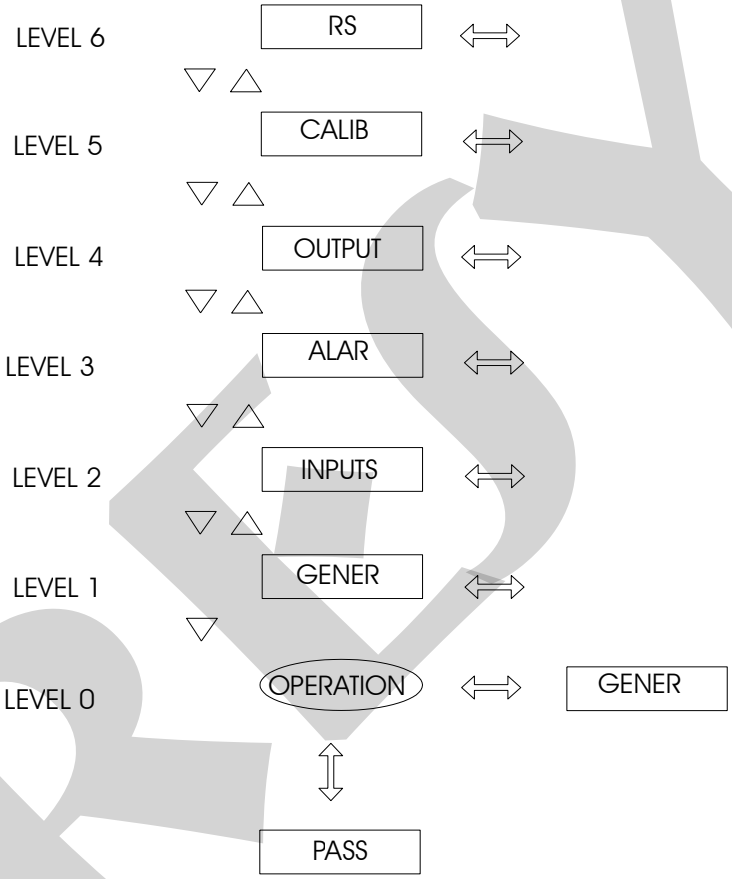


Figure 12 - Parameter levels diagram.

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.

Level 1 - General

Level 1 presents the options: TAG, SOFT and PASS (see figure 13).

TAG - consists in an alphanumeric 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 2011, 2035 or 2036) or both. The correct key sequence is obtained by pressing the UP, DOWN and ENTER keys in this order.

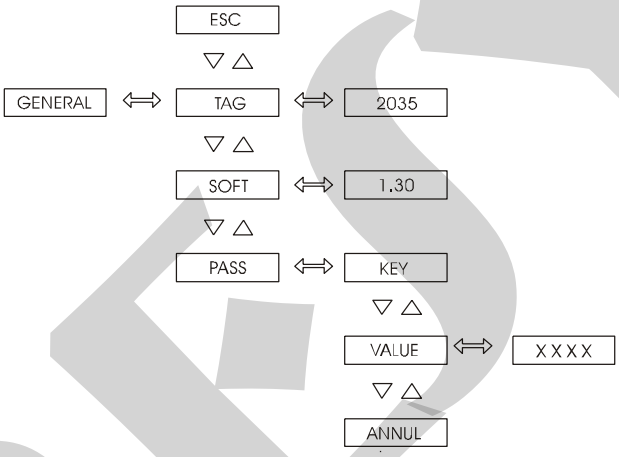


Figure 13 - GENERAL level options

The table below refers to the ranges of the parameters shown in figure 13.

Mnemonic	Parameter	Range	Factory Value	Units
TAG	instrument identification	————	2011 2035 2036	————
SOFT	software version	————	1.30	————
VALUE	user password	-999 to 9999	0	————

Level 2 - Input

Inputs level allows whether to enable or not (by means of the option ANNUL) the type of sensor for input 1 and input 2. For sensor types we have the linear options (0 to 5V, 0 to 55mV and 0 to 20mA) and temperature (option TEMP), as illustrated in figure 14.

Input from 4 to 20 mA belongs to option 20 mA.
Input from 1 to 5 Vac belongs to option 5 Vdc.

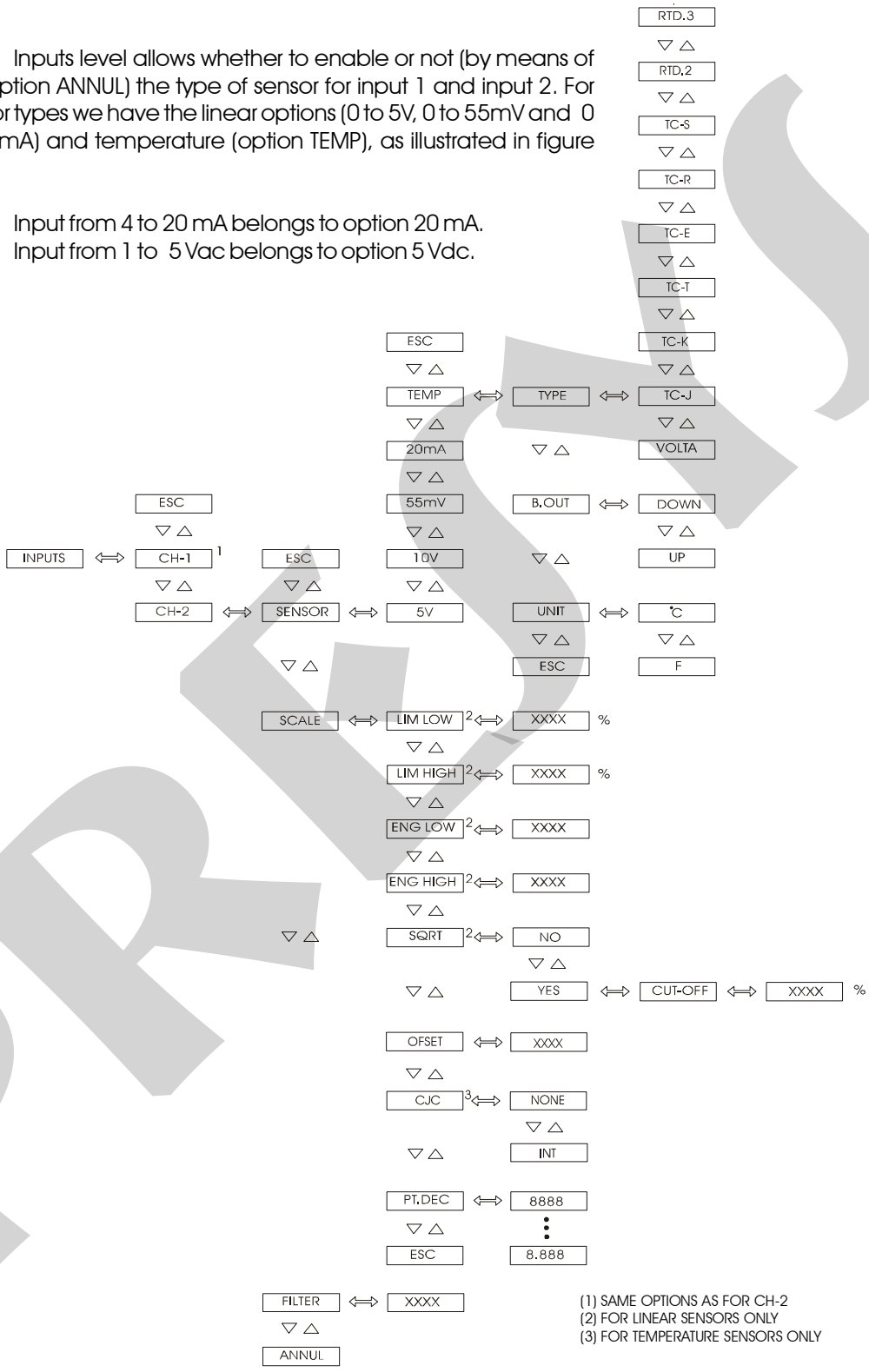


Figure 14 - INPUT level options

The table below refers to the ranges of the parameters shown in figure 14.

Mnemonic	Parameter	Range	Factory Value	Units
LIM LOW	input signal associated with Eng Low	0.0 to 100.0	0.0	%
LIM HIGH	input signal associated with Eng High	0.0 to 100.0	100.0	%
ENG LOW	display indication associated with Lim Low	-999 to 9999	0.0	EU*
ENG HIGH	display indication associated with Lim High	-999 to 9999	100.0	EU*
CUT-OFF	minimum value for square root	0 to 5	0	%
OFFSET	constant added to display indication	-999 to 9999	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 15. 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.

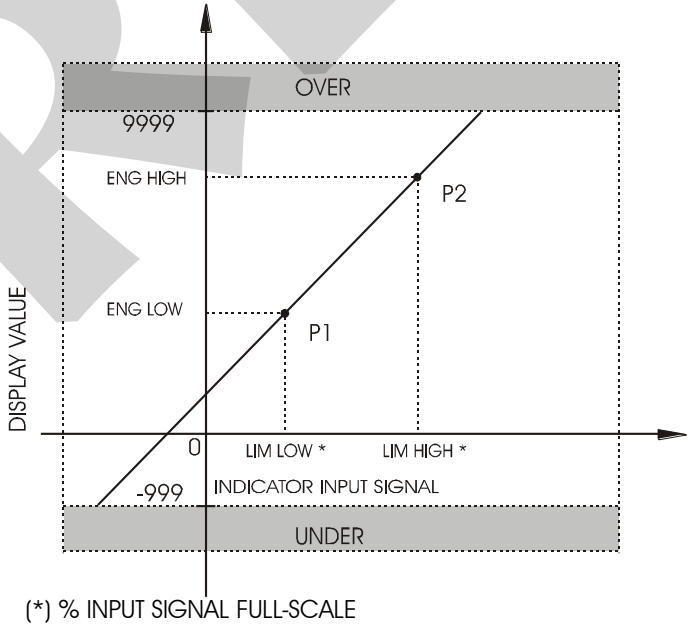


Figure 15 - Linear input configuration

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 16.

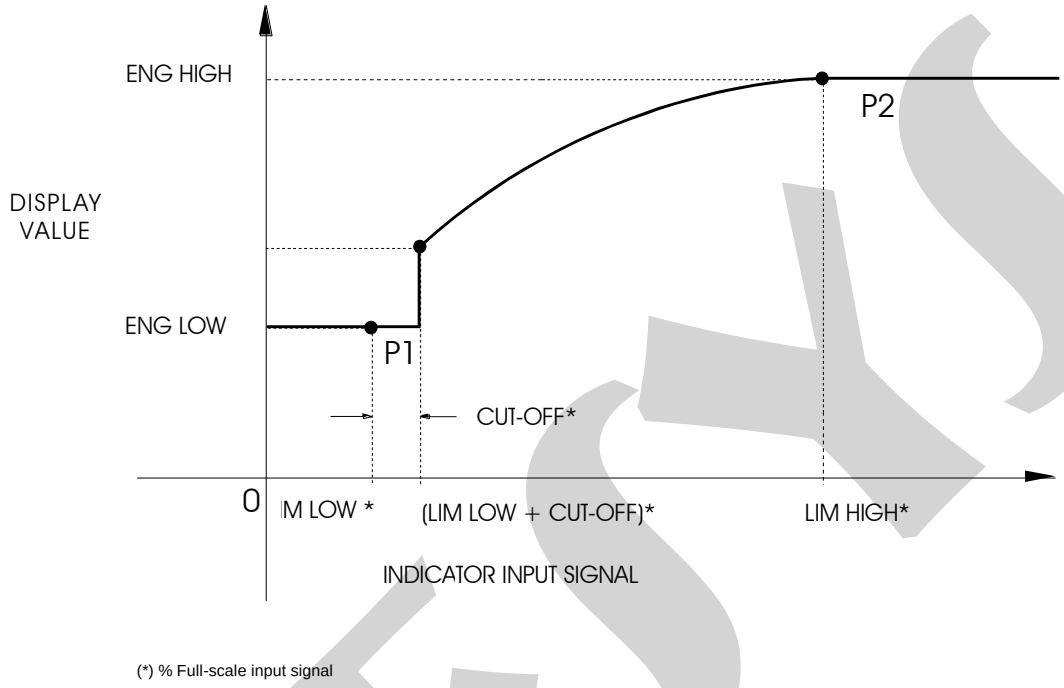


Figure 16 - Input signal square root

DEC.PT - sets the decimal point to exhibit the engineering units on the upper display. Up to three decimal places may be set for linear processes whereas temperature sensors may have one or no decimal place.

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.

CJC - cold junction compensation for thermocouples. Select INT for internal cold junction compensation; otherwise, select NO. Generally INT should be selected.

Input sensor types are described in table - 1 of section 1.3 on Technical Specifications.

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.

B.OUT - When temperature sensors break (thermocouple or RTD) or there are wires disconnected, the display indicates burn-out to the corresponding channel. In this case, choosing the UP option for this parameter activates the high-alarms and the DOWN option activates the low-alarms.

UNITS - selects °C or °F for temperature indication.

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 (see figure 18). 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.

Each alarm module can perform up to four types of alarm: low alarm for channel 1, high alarm for channel 1, low alarm for channel 2 and high alarm for channel 2. When configuring the seven independent alarm devices for the indication, there are up to 28 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:

1.H.r1 Channel 1 high-alarm setpoint associated to relay 1.

2.L.L1 Channel 2 low-alarm setpoint associated to led.

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 ACK 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 ACK key to return to operation mode.

DELAY - causes the relay to be activated only after a certain time interval defined by the user. Figure 17 below illustrates the delay operation for a high-alarm.

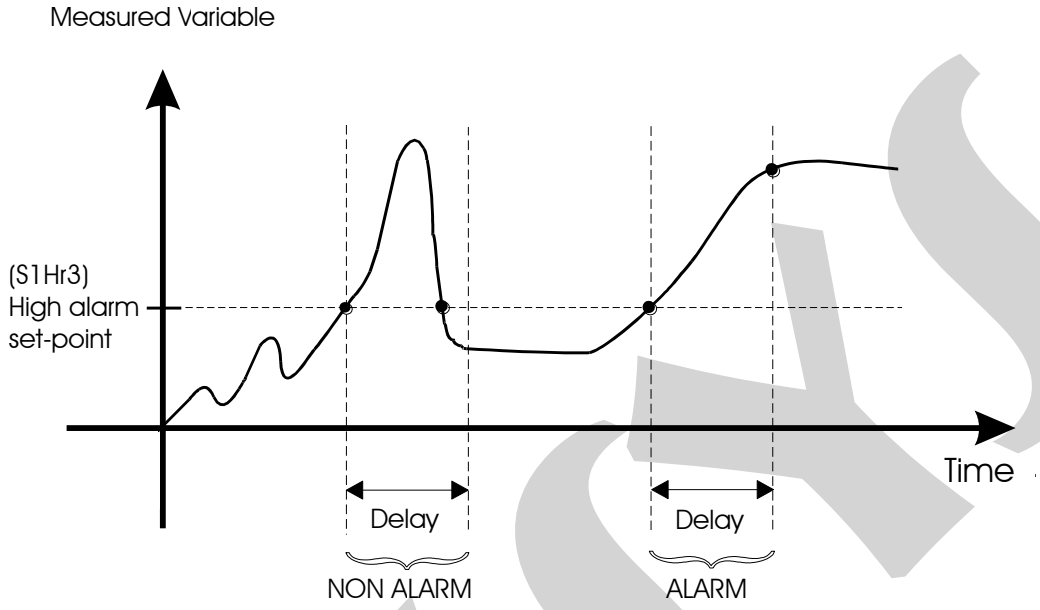


Fig. 17 - Relay with delay

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.

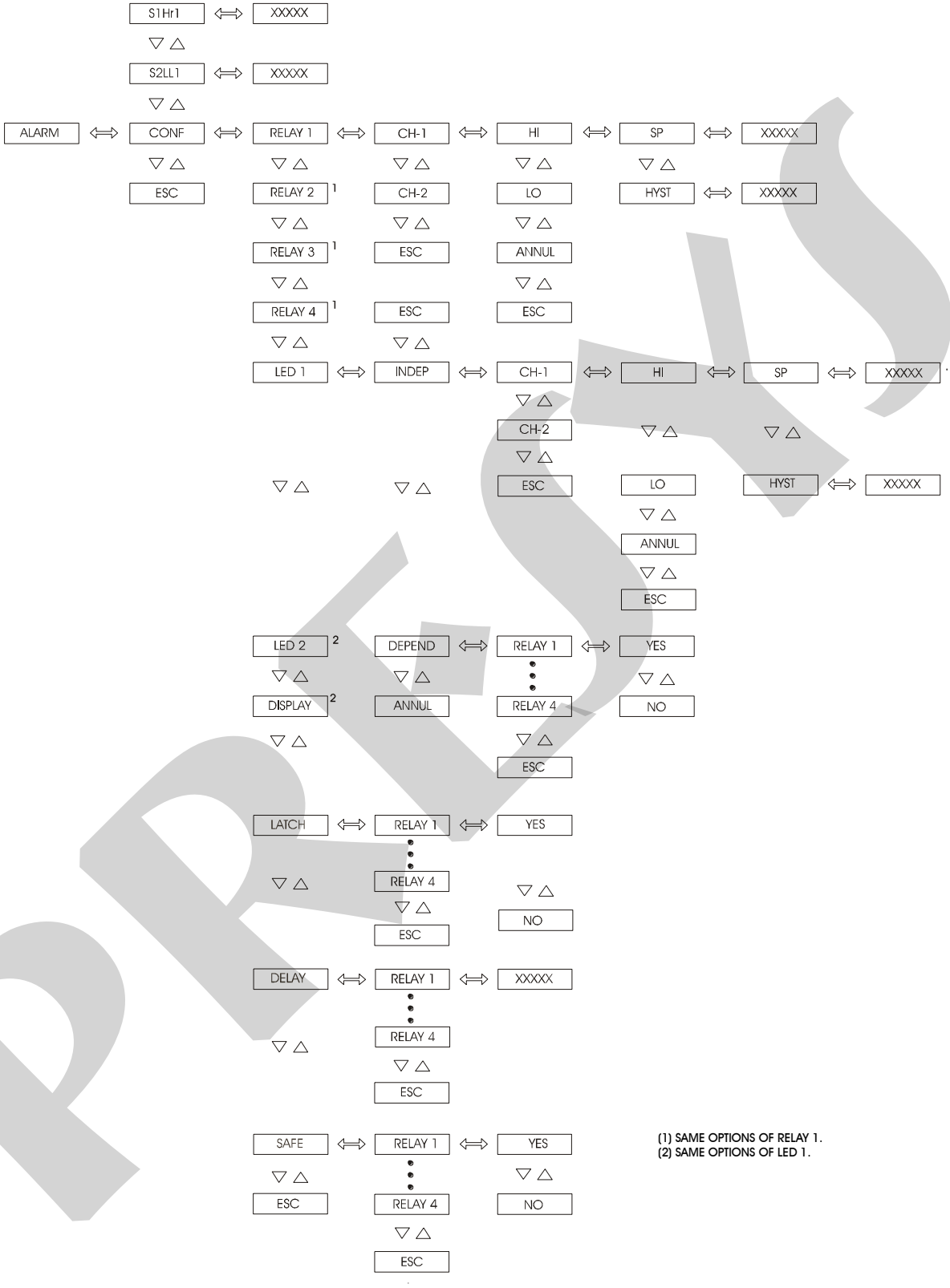


Figure 18 - ALARMS Level Options

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

Mnemonic	Parameter	Range	Factory Value	Units
SP	high or low alarm setpoint	-999 to 9999	75.0	EU
HYST	alarm hysteresis	0 to 250	1.0	EU
DELAY	delay for activating the relay	0.0 to 999.9	0.0	seconds

Level 4 - Output

Level 4 allows the configuration of two analog outputs (Refer to figure 19).

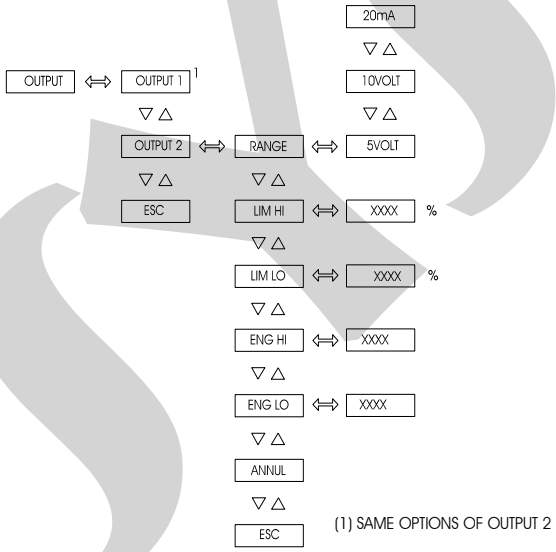


Figure 19 - OUTPUT level options

The table below shows the parameters from figure 19.

Mnemonic	Parameters	Range	Factory value	Unit
LIM LOW	output signal associated with Eng Low	0.0 to 100.0	0.0	%
LIM HIGH	output signal associated with Eng High	0.0 to 100.0	100.0	%
ENG LOW	display indication associated with Lim Low	-999 to 9999	0.0	EU
ENG HIGH	display indication associated with Lim High	-999 to 9999	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 20. 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.

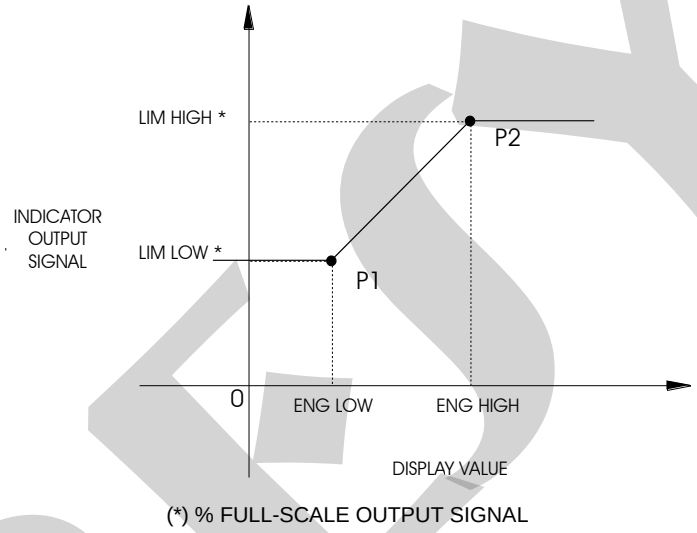


Figure 20 - Analog output configuration

Level 5 - Calibration

Level 5 is described on section 4.5 on Calibration.

Level 6 - RS

Refer to the communication manual.

4 - 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 21.

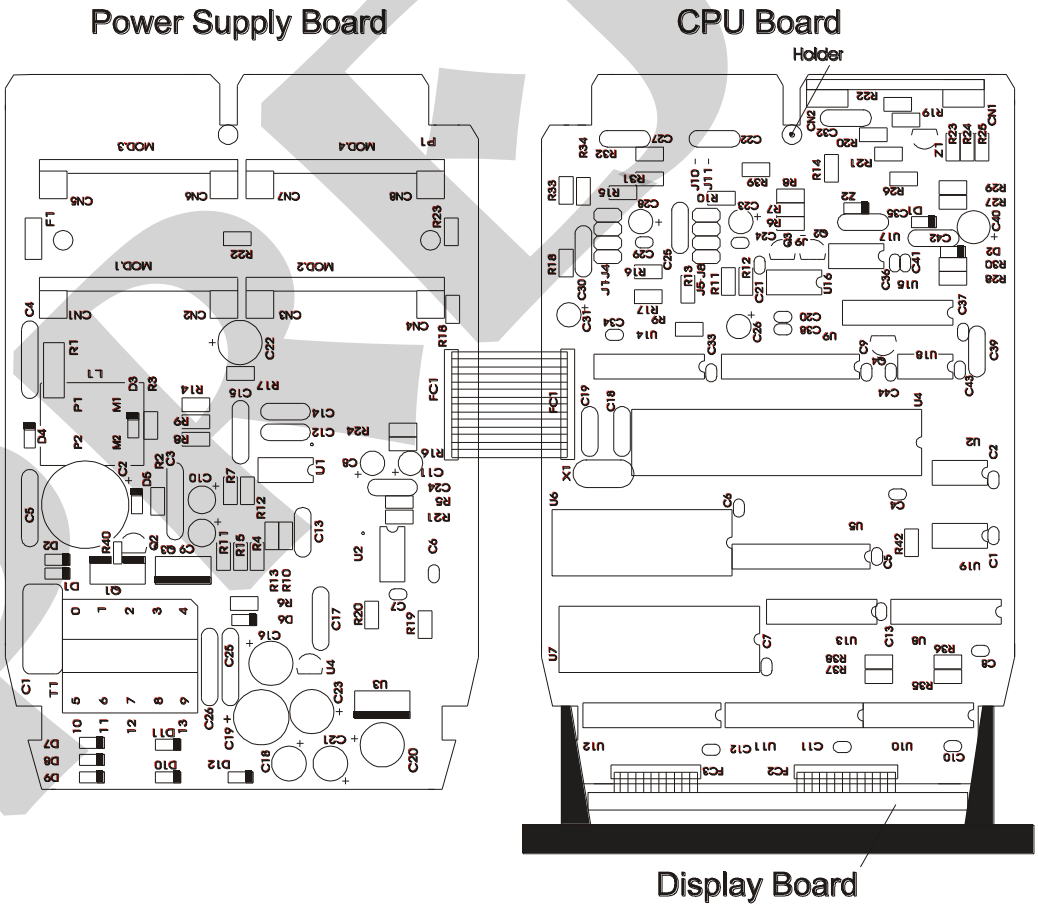


Figure 21 - Indicator hardware

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 for channel 1: J5, J6, J7 and J8; and four places for installation of jumpers for channel 2: J1, J2, J3 and J4. They are placed in the CPU Board as shown in figure 22.

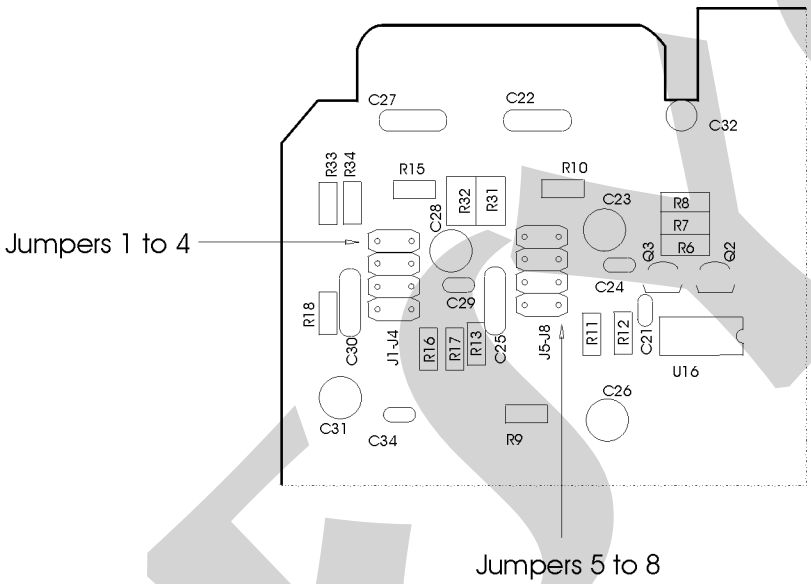


Figure 22 - Location of jumpers in CPU Board

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 2				Channel 1			
Thermocouple	J1			J4	J5		J7	
Voltage (0 to 55mV)	J1			J4	J5		J7	
Voltage (0 to 5V)	J1			J4	J5		J7	
Voltage (0 to 10V)*			J3			J6		
2-wire or 3-wire RTD	J1	J2			J5			J8
Current (0 to 20mA)			J3	J4		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 23.

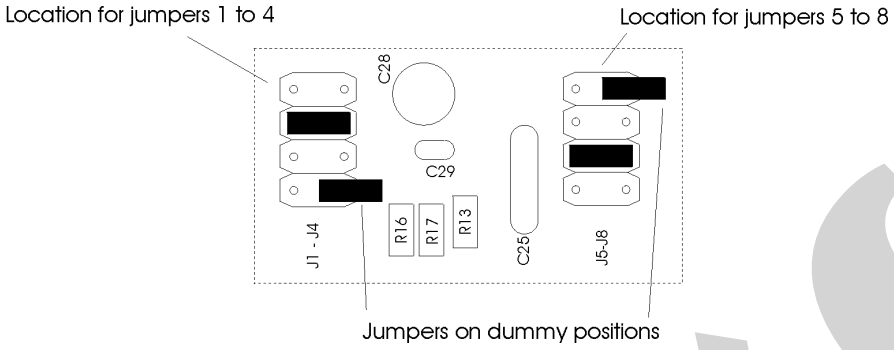


Figure 23 - Jumpers not used for 0 to 10V input placed in the board conector

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. Depending on the relay board version, the jumpers may be on the front or rear side.

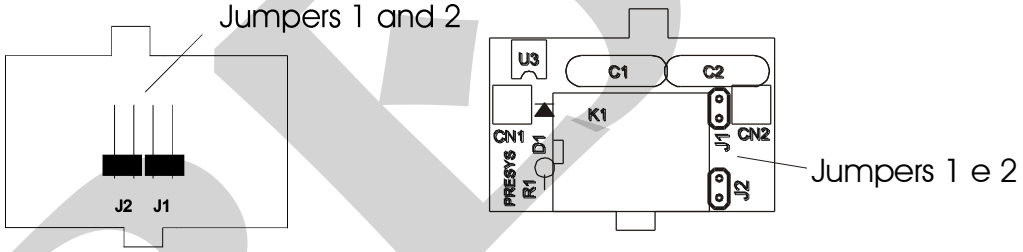


Fig. 24 - Jumpers for selection of snubbers on the relay board

Alarm and control relays are extremely critical in control and safety of industrial processes. In order to ensure the expected relay behaviour, 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 occurence of elecrical 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 mantain a 4.5mAac/9.0mAac current when connected to a 120VAC/220VAC circuit. This current is enough, in certain casses, 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 - Optional Module Connection

DMY-2011, 2035 and 2036 Indicators accept 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 25).

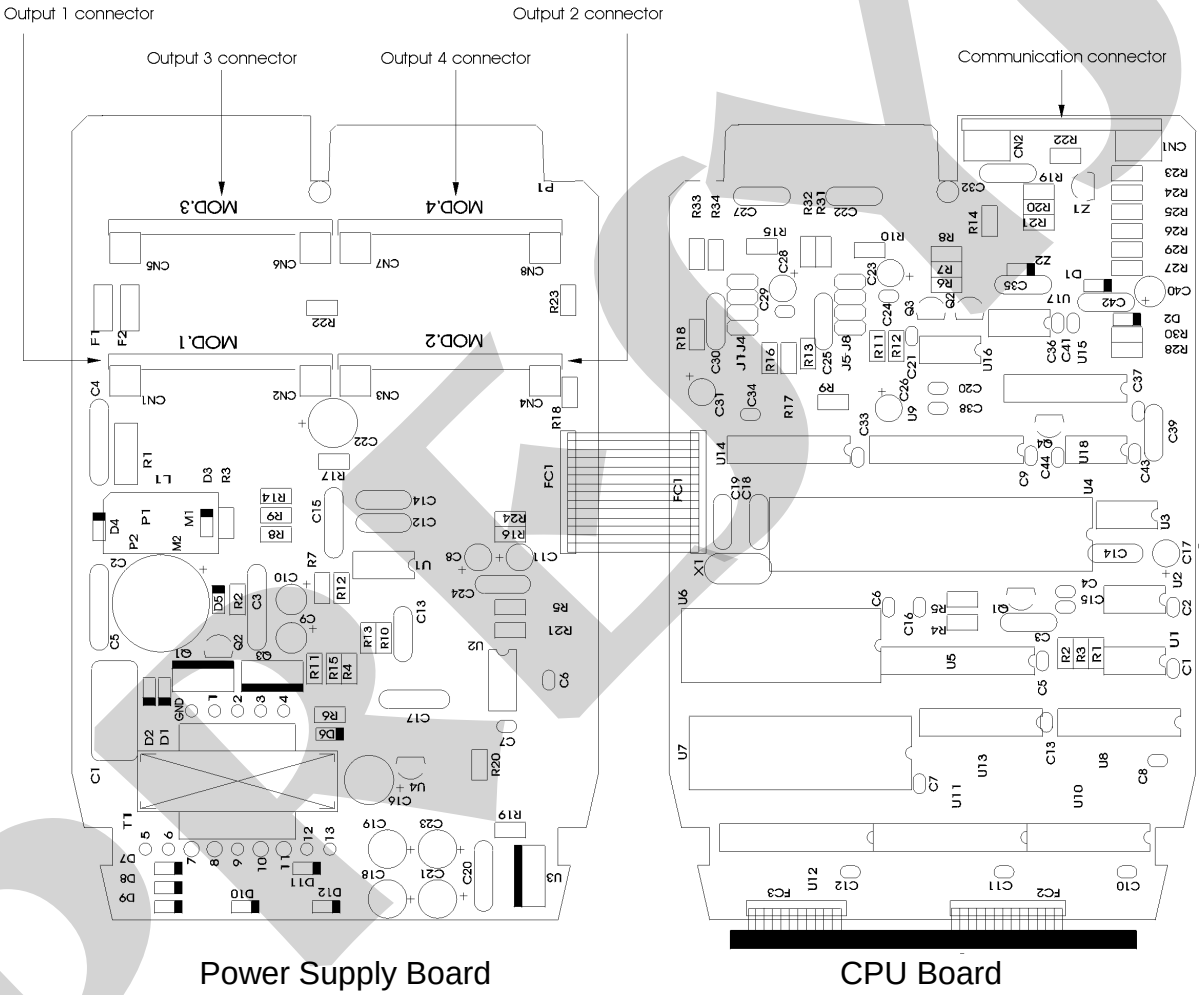


Figure 25 - Optional module connectors

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 26.

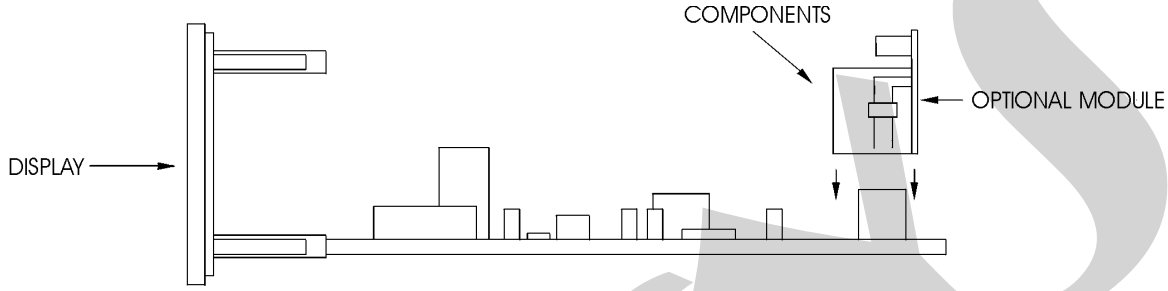


Figure 26 - Installation of optional modules

Outputs 1 and 2 as retransmitter outputs (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. If other retransmitter output is needed, connect the second module in the connector called MOD 2.

The output 1 retransmits the measured variable from input 1 while output 2 retransmits the measured variable from input 2.

The optional analog output module has two connectors for installation of jumpers: J1 and J 2, as shown in figure 27.

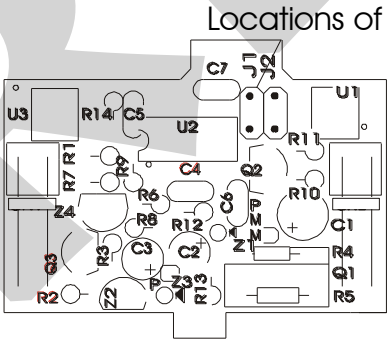


Figure 27 - Place of jumpers in analog output board

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.

Retransmission 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 23.

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

The outputs 3 and 4 work as alarm when one connects the optional module to connectors MOD 3 and MOD 4, in this sequence. There are three types of alarm outputs: SPDT relay, solid state relay and open collector voltage. The Alarm output type and the optional module correspondence are shown in the 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-2011, 2035 and 2036 Indicators are accurately calibrated in factory and do 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 input 1 and input 2.

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 5 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 the channel to be calibrated 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 channel 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 28 shows input and output calibration options in level 5 of Calibration.

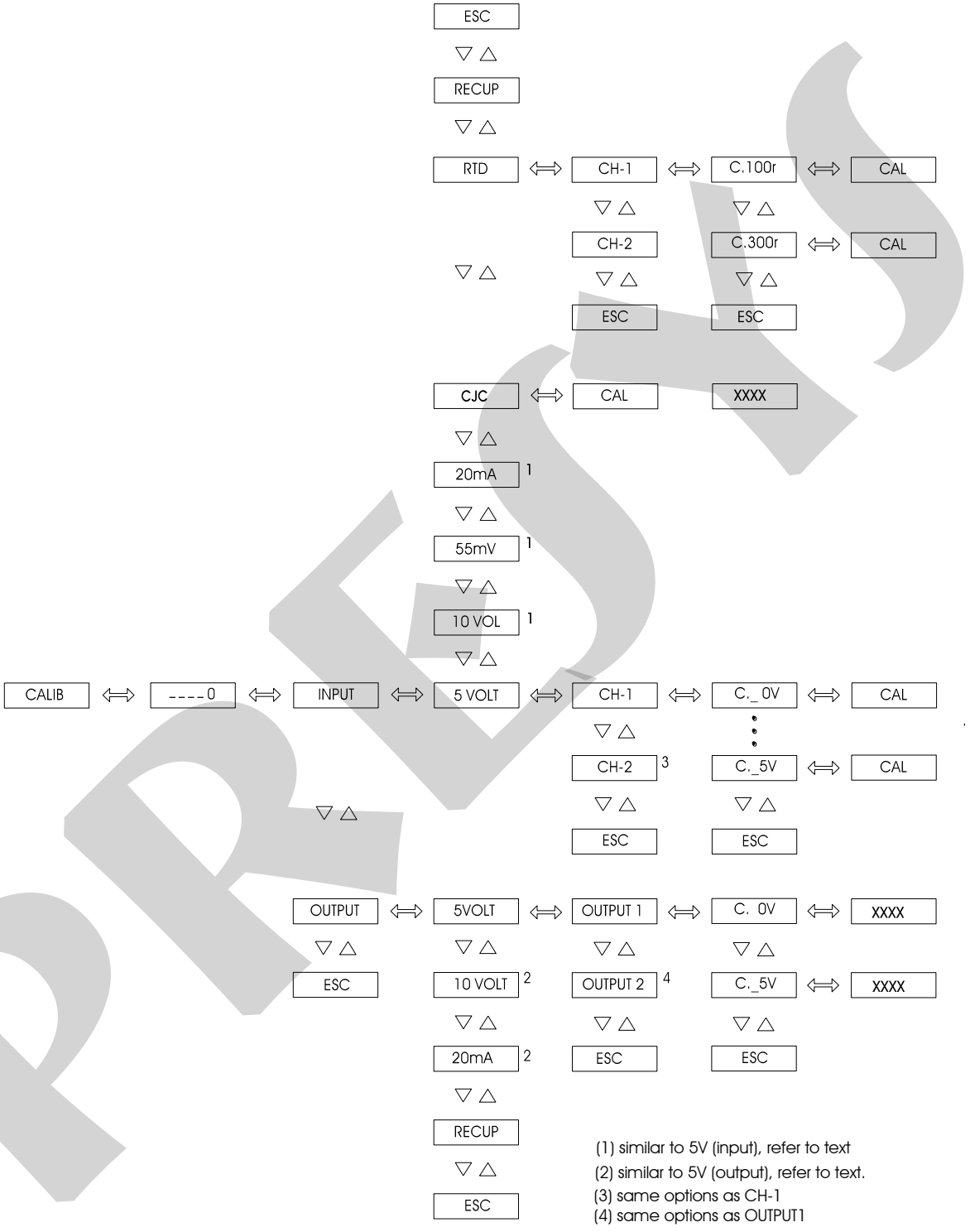


Figure 28 - CALIBRATION Level Options

Calibration of voltage input (0 to 55mV)

In a 0 to 55mV voltage input calibration connect a voltage source to the channel to be calibrated (terminals 2(+) and 3(-) for channel 1 or 5(+) and 6(-) for channel 2). 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 the channel to be calibrated (terminals 2(+) and 3(-) for channel 1 or 5(+) and 6(-) for channel 2). 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 the channel to be calibrated (terminals 1(+) and 3(-) for channel 1 or 4(+) and 6(-) for channel 2). 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 the channel to be calibrated (terminals 1(+) and 3(-) for channel 1 or 4(+) and 6(-) for channel 2). 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

Input Calibration in thermocouple

There are two steps for calibrating the thermocouple input. First, calibrate the 0 to 55mV input and the 0 to 5V input for the channel to be calibrated (terminals 2(+) and 3(-) for channel 1 or 5(+) and 6(-) for channel 2) according to tables 6 and 7. Once the mV calibrations are done, access the CJC mnemonic in the INPUT option of level 5 for cold junction calibration.

The CJC mnemonic corresponds to the cold junction temperature of the Indicator.

By pressing ENTER after the CJC mnemonic is reached the automatic calculation of the cold junction temperature starts. Meanwhile the CAL mnemonic blinks on the display.

After a few seconds, the program finishes the cold junction temperature calculation and the display presents its value given in °C.

This value is a first approximation of the cold junction temperature. The user must measure the temperature I/O terminals and correct the value presented by the program following the same procedure for entering parameter values as explained on section 3.2 of Configuration.

When these two steps are done the input calibration for any type of thermocouple is accomplished.

Then return to normal operation mode moving back until level zero.

Calibration of 2 or 3-wire RTD input

In a 3-wire RTD input calibration connect precision resistances with the values listed in table 10 to the channel to be calibrated (between terminals 1 and 2 with 2 and 3 short-circuited for channel 1 or between terminals 4 and 5 with 5 and 6 short-circuited for channel 2).

When using a resistance decade, make sure the three connection wires must have the same gauge, material and length.

There is no procedure for a 2-wire RTD calibration. It is accomplished together with the 3-wire RTD calibration.

Reference	Mnemonic
100.000 Ω	C.100r
300.000 Ω	C.300r

Table 10 - Resistance references for 3-wire RTD input calibration

Output Calibration

For the output calibration, follow this procedure for retransmitter outputs 1 and 2.

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

The output 1 is calibrated by input 1 and the output 2 is calibrated by input 2.

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 11 according to the output and output type to be calibrated.

Output Type	Output 1 and Input 1	Output 2 and Input 2
current (0 to 20mA) voltage (0 to 10V)	terminal 13 (+) and 1 (+) terminal 14 (-) and 3 (-)	terminal 15 (+) and 4 (+) terminal 16 (-) and 6 (-)
voltage (0 to 5V)	terminal 13 (+) and 2 (+) terminal 14 (-) and 3 (-)	terminal 15 (+) and 5 (+) terminal 16 (-) and 6 (-)

Table 11 - 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 (see figure 28).

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

Enter level 5 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 relays 1 and 2 before enabling analog output 1 and 2 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 21. 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 29 are close to the values in table 12 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 12 - Inspection points of voltage on flat cable 1

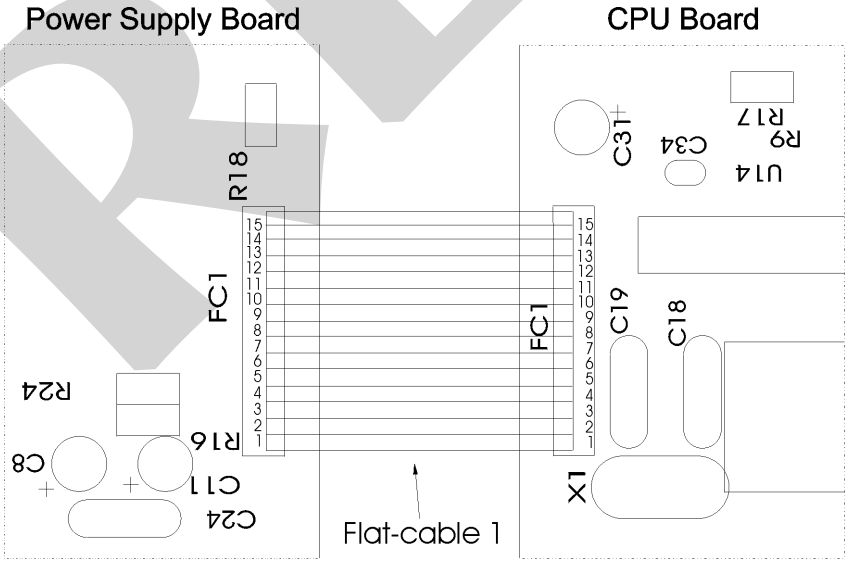


Figure 29 - Voltage test points of the Indicator

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
01.05.0050-20	Display Board - DMY-2011	----------
01.05.0051-20	Display Board - DMY-2035	----------
01.05.0054-20	Display Board - DMY-2036	----------
01.07.0003-21	Display 9mm	----------
01.07.0002-21	Display 14mm	----------
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
01.15.0003-21	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
01.03.0036-21	Ceramic Multilayer Capacitor 0.01µF x 63V	C24
01.03.0035-21	Ceramic Multilayer Capacitor 0.1µF x 63V	C6,7
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
01.03.0038-21	Radial Electrolytic Capacitor 10 µF x 16 V	C8,11
01.03.0042-21	Radial Electrolytic Capacitor 22 µF x 25 V	C9,10
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	C20,23
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

Code	Components	Reference
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
01.02.0183-21	Resistor 2K32 1%	R13
01.02.0108-21	Resistor 15K4 1%	R19
01.06.0003-21	Transformer 110/220Vac	T1
01.06.0004-21	Coil	L1
01.13.0004-21	Connector	CN1,2,3,4,5,6,7,8

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

Code	Components	Reference
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
01.13.0043-21	DIP socket	U7
01.13.0005-21	Connector	CN1,2
01.14.0029-21	Flat Cable 12 wires	FC3
01.14.0030-21	Flat Cable 13 wires	FC2
01.14.0010-21	Flat Cable 15 wires	FC1

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

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