PRESYS®

Universal Smart Transmitter
TY-2090

Technical Manual

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1 - Introduction

1.1 - Description

The PRESYS TY-2090 Transmitter is a microprocessor-based instrument which receives any process variable found in industrial plants as: temperature, pressure, flow, level, etc. It has non-volatile internal memory (E2PROM) for storing calibration values.

It can communicate with computers through the optional Communication Module RS-232 or RS-422/485.

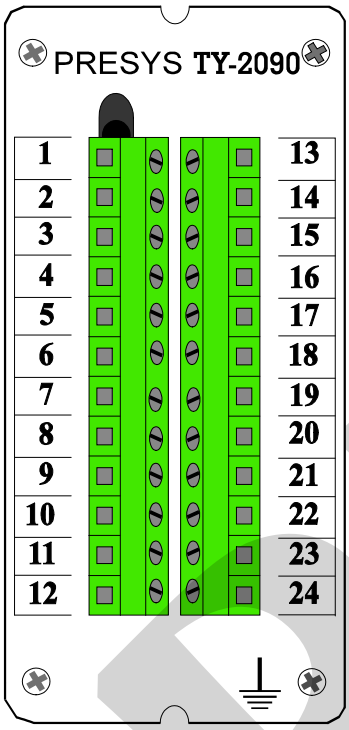


Fig. 1 - Front view of TY-2090 Transmitter

The Transmitter is capable of monitoring two universal standard inputs, accepting direct connection of thermocouples, RTDs, current (mAdc) and voltage (mVdc and Vdc). The thermocouple and RTD inputs are automatically linearized by means of tables stored in the EPROM memory. A 24 Vdc voltage source, output-isolated and with short circuit protection, is provided to power the standard field two-wire transmitters.

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

The Transmitter has been designed with basis on modularity concept and accepts up to 4 output cards. The possible output types are: analog, SPDT relay, solid-state relay and open collection voltage. Outputs are electrically isolated from inputs.

It allows universal power supply from 90 to 240 Vac.

The instrument is housed in an extruded aluminum case which makes it highly immune to electrical noise, electromagnetic interference, and resistant to the most severe conditions of industrial usage.

1.2 - Order Code

Order Code

TY - 2090 - ___ - ___ - ___ - ___ - ___ - ___ - ___

A B C D E F G

Field A Output 1
- 0 Not used
- 1 4 to 20 mA
- 2 1 to 5 V
- 3 0 to 10 V
- 4 SPST Relay
- 5 Open collector voltage
- 6 Solid-state relay

Field B Output 2
Same coding as for 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 coding as for output 3

Field E Power supply
- 1 90 to 240 Vac
- 2 24 Vdc

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

Field G Case protection degree
- 0 General usage, sheltered place, mounting on surface
- 1 General usage, sheltered place, mounting on DIN rail
- 2 Dust proof
- 3 Weather proof

Note - Ranges and input types, the use of relays as alarms and alarm points are, among others, items which the user can program through the MCY-20 Configuration Module (if desired, specify such information so the whole programming may be previously done by PRESYS).
Note: Any other software or hardware characteristic desired may be available upon request.

Code Example:

1) TY-2090 - 1 - 0 - 1 - 0 - 1 - 0 - 0

This code defines a TY-2090 Transmitter with channel 1 output of 4-20 mA, which does not use the channel 2 output, has a SPDT relay for alarming, power supply within the range of 90-240 Vac, does not use RS communication, to be used in sheltered place with surface mounting.

1.3 - Technical Specifications

Inputs:

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

Input Sensor	**Range**			
Thermocouple	lower limit ºF	upper limit ºF	lower limit ºC	upper limit ºC
Type J	-184.0	1886.0	-120.0	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 Pt-100, 2 or 3-wire	-346.0	1256.0	-210	680.0*
Linear	Range		Resolution	
Voltage	0 to 55 mV		3 μV	
	0 to 5 V		250 μV	
	0 to 10 V		500 μV	
Current	0 to 20 mA		1 μV	

(*) including wire resistance

Table 1 - Input Sensor Measuring Range

Note: The specifications contained in Table 1 refer to analog/digital conversion and are accessed by RS232 and RS-422/485 serial communication. For analog output, for example 4-20 mA, the resolution is 0.075 % of full scale.

Outputs:

- Analog output of 4-20 mA, 1 to 5 Vdc, 0 to 10 Vdc, use of optional cards with fitting foreseen for up to two 300 Vac modules galvanically isolated from inputs and power supply.
- Alarm outputs with SPDT relays with capacity of 3 A 220 Vac, or up to 10 A 220 Vac upon order. In such case, the alarm module is not fitted by means of a connector, but is welded on the base board. Up to 4 modules can be fitted.
- Logic Level, through open collector, 24 Vdc, 40 mA maximum with isolation.
- Solid-state relay, 2 a 250 Vac with isolation.

Serial Communication:

RS-232 or RS-422/485 with isolation at 50 Vdc, as an optional module with fitting independent from outputs.

Configuration:

By RS-232 and RS-422/485 serial communication or through the MCY-20 Configuration Module.

Scanning Time:

Standard time of 100 ms.

Accuracy:

± 0.1 % of full scale for input of TC, RTD, mA, mV, Vdc with acquisition through RS-232 and RS-422/485 communication.

± 0.2 % of full scale for analog output and maximum load of 750 Ω.

Linearization:

± 0.1 ºC for RTD and ± 0.2 ºC for TC.

Square Root Extraction:

± 0.5 % of readings for input above 10 % of range.

Cut-off programmable from 0 to 5 %.

Cold Junction Compensation:

± 2.0 ºC at ambient temperature from 0 to 50 ºC.

Stability at ambient temperature:

± 0.005 % per ºC of range referred to an ambient temperature of 25 ºC for acquisition in RS-232 and RS-422/485.

± 0.015 % per ºC of range referred to an ambient temperature of 25 ºC for analog output.

Power Supply:

90 to 240 Vac Universal, (10 W nominal); 24 Vdc or other values are optional.

2 - Wire Transmitter Power Supply:

24 Vdc voltage and 50 mA maximum, isolated from outputs, with short-circuit protection.

Operating ambient:

0 to 50ºC temperature and 90% maximum relative humidity.

Dimensions:

140mm x 53mm x 156mm (height, width, depth).

Weight:

0.5kg nominal.

Warranty:

One year.

2 - Installation

2.1 - Mechanical Installation

The TY-2090 Transmitter can be mounted on a surface or on all types of existing DIN rail, as illustrated in the figure below.

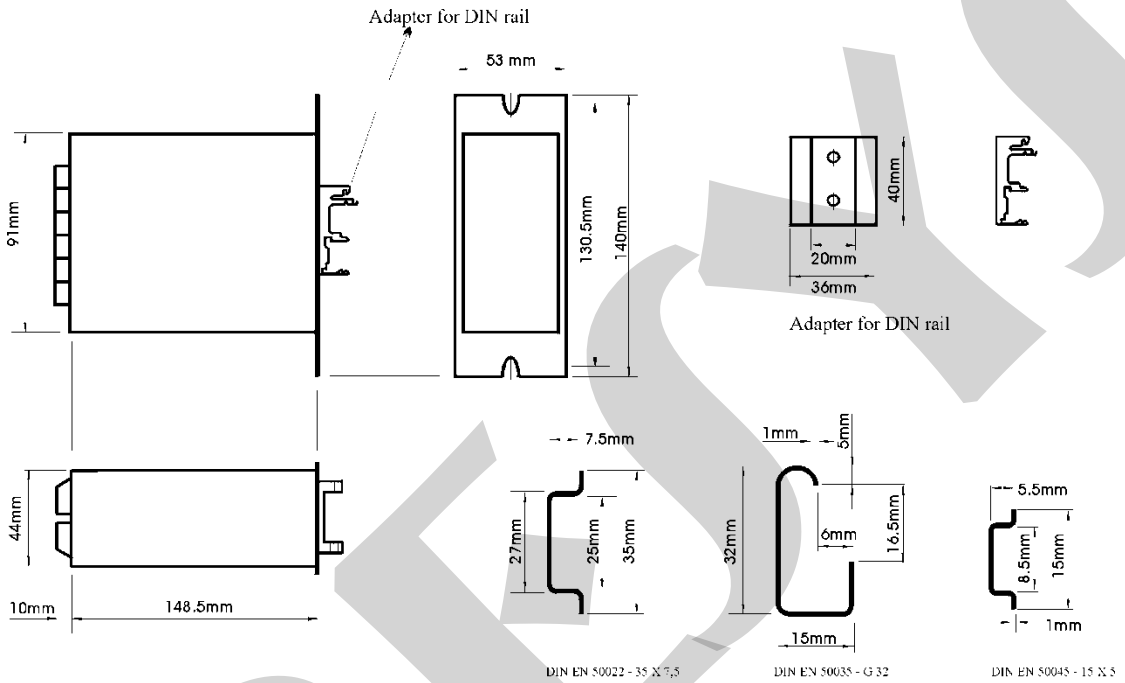


Fig. 2 - Dimensional drawing and detail of the adapter for DIN rail

2.2 - Electrical Installation

The TY-2090 Transmitter can be powered with any voltage between 90 and 240 Vac or Vdc. Note that power is always applied to the internal circuit when the instrument is connected to the AC supply.

Connections of process input and output signals should only be made with the power off.

Figure 3 shows the instrument I/O terminal scheme with all designations for power supply, grounding, communication and process input and output signals.

Signal cables should be kept as far away as possible from power supply cables.

Since the instrument housing is a metallic case, it is necessary to connect the instrument ground terminal (gnd earth) to the local earth ground; this terminal should never be connected to the neutral terminal.

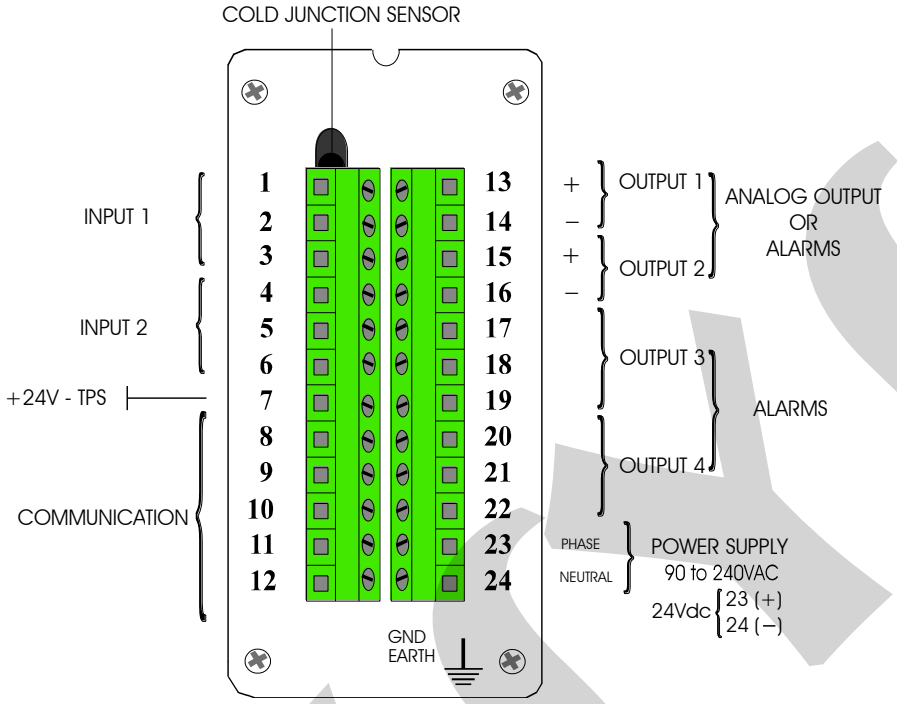


Fig. 3 - Transmitter terminals

2.3 - Process Input Signal Connection

The Transmitter, in its two standard universal inputs, can be connected to thermocouples, 2 or 3-wire RTDs, mA, mV or V. In order to know the input sensor types refer to Table 1, section 1.3 on Technical Specifications.

The enabling of a certain type of input sensor is obtained by means of internal jumpers (refer to section 4.2, Hardware Configuration) and by proper sensor selection in configuration time (refer to section 3.2, Configuration). Therefore, the connections explained below, will only become effective if the instrument is correctly configured in terms of hardware and software.

The wiring of a type of sensor to input 1 does not restrict the simultaneous use of another sensor, of the same type or different type, for input 2.

In order to prevent noise induction in the wire connecting the sensor to the I/O terminal, use twisted pair cable and run the sensor connection wires through a metallic conduit or use a shielded cable. Be sure to connect only one shielded wire end to the negative I/O terminal or to the sensor ground, as outlined in the following items.

WARNING: THE GROUNDING OF THE TWO SHIELDED WIRE ENDS MAY CAUSE DISTURBANCE TO THE TRANSMITTER.

2.3.1 - Thermocouple Connection

Whenever using just one thermocouple, the user should preferably connect it to input 1 of the Transmitter, in order to obtain greater accuracy, since the cold junction sensor is solidly attached to the I/O terminal and closer to input 1.

In order to reduce cold junction compensation error, apply thermal paste from the I/O terminal to the cold junction sensor.

Connect the thermocouple to terminals 2 (+) and 3 (-) in order to use the input 1, or connect to terminals 5 (+) and 6 (-) to use the input 2, as shown in figure 4.

Use compensation cables of the same construction material as the thermocouple to connect the thermocouple to the Transmitter I/O terminals. Check that the thermocouple polarity is the same as that of the I/O terminals.

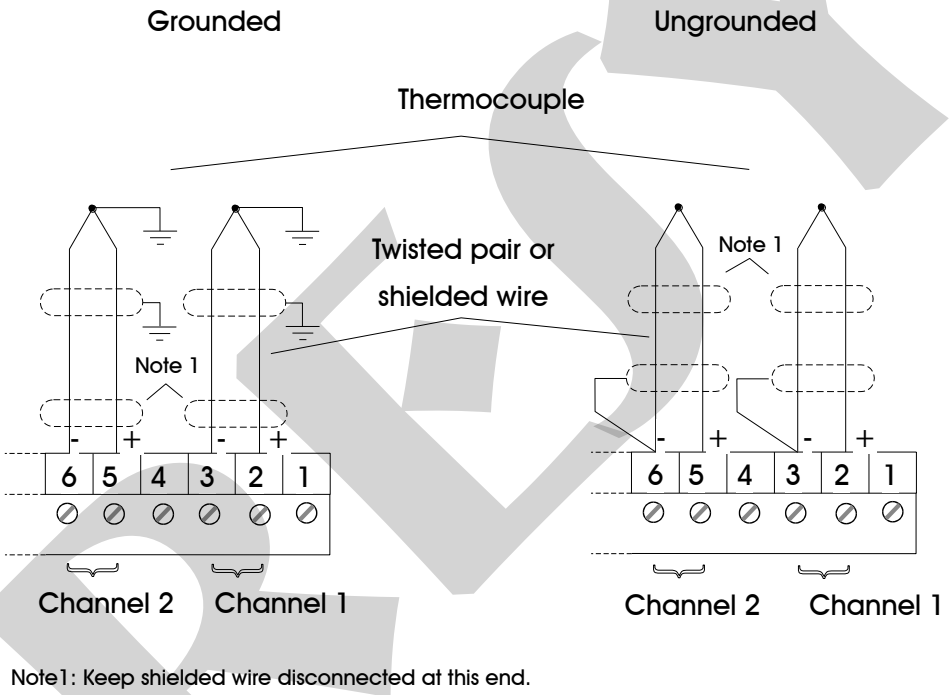


Fig. 4 - Thermocouple Connection

2.3.2 - RTD Connection

The RTD can be connected to 2, 3 or 4 wires. All connection types are shown in figure 5.

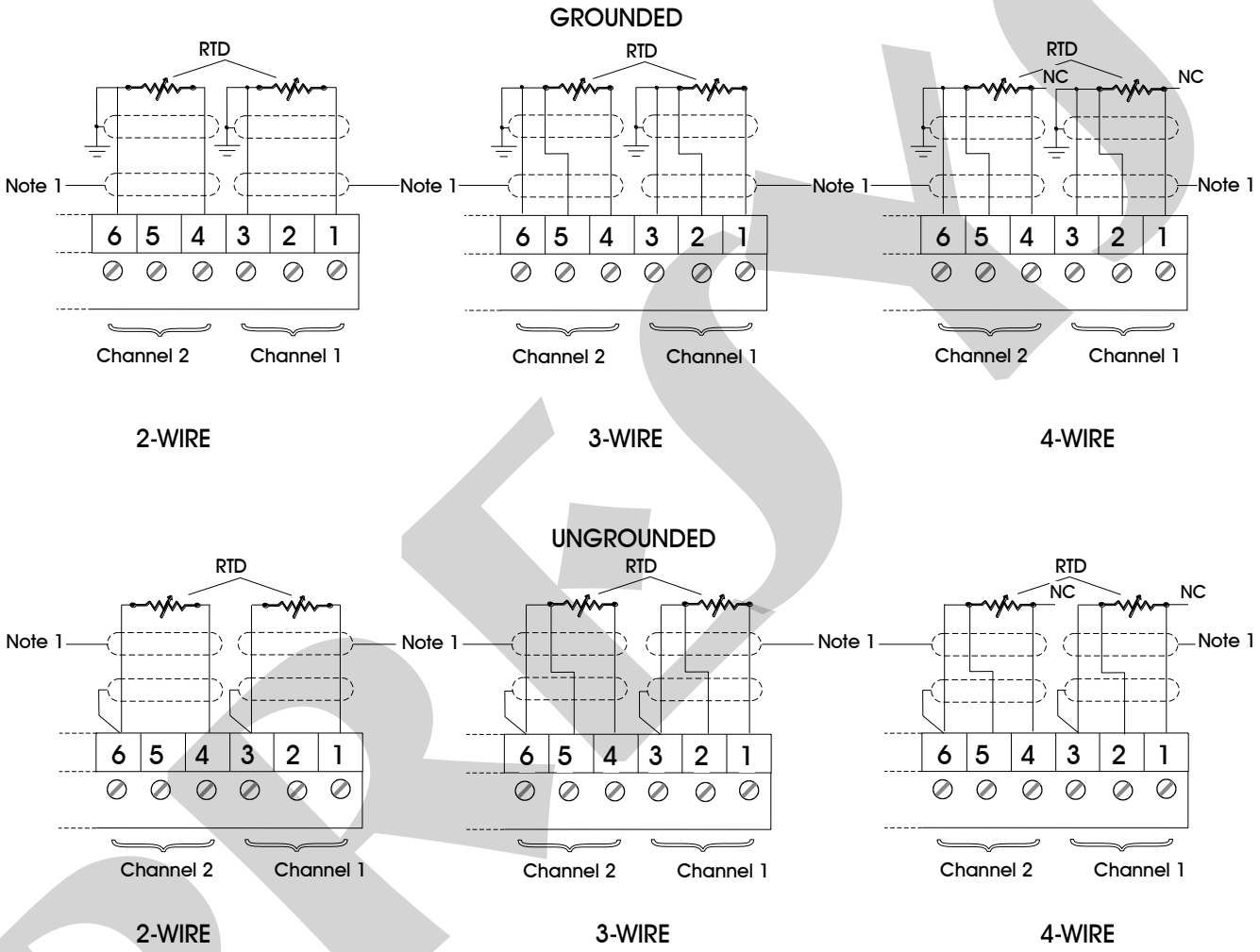
For 2-wire RTD, connect the RTD between I/O terminals 1 and 3 to use input 1, or to terminals 4 and 6 to use input 2, as illustrated in figure 5.

For 3-wire RTD, connect the RTD in the same way as described for a 2-wire connection, and connect the third wire for RTD compensation to terminal 2 in case of input 1, and to terminal 5 in case of input 2, see figure 5.

A 4-wire RTD is connected to the Transmitter in the same way as a 3-wire RTD, except that the fourth wire is disregarded and left disconnected, see figure 5.

A 3-wire RTD provides greater accuracy than a 2-wire RTD.

The RTD wiring should be of the same material, length and gauge to ensure proper resistance compensation of connecting wires. The maximum resistance of connecting wires is 10 Ω per wire. The minimum gauge should be 18 AWG for distances up to 50 meters and 16 AWG for distances superior to 50 meters.



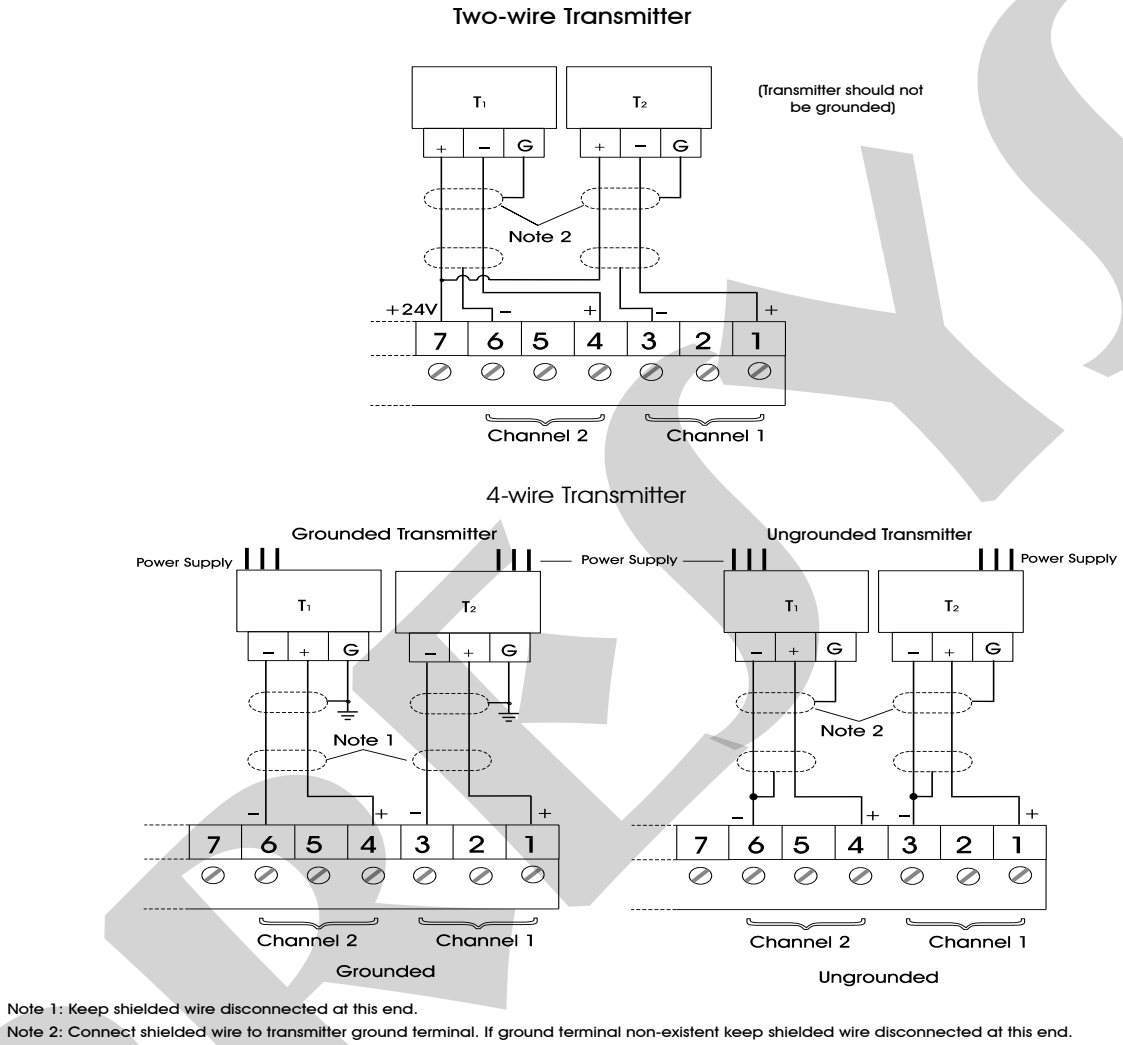
Note 1: Let the shield wire disconnected at this end.

Fig. 5 - RTD Connection

2.3.3 - Milliampere Input

A standard current source of 4 to 20 mA can be applied between terminals 1 (+) and 3 (-) in case of input 1, and between terminals 4 (+) and 6 (-) in case of input 2. Such current can be originated from a transmitter with external power supply.

If the Transmitter internal voltage source of 24 Vdc is used to power a 2-wire transmitter, the current is received only by terminal 1 (+) in case of input 1, and it is received only by terminal 4 (+) in case of input 2. Figure 6 illustrates both possibilities of connection.

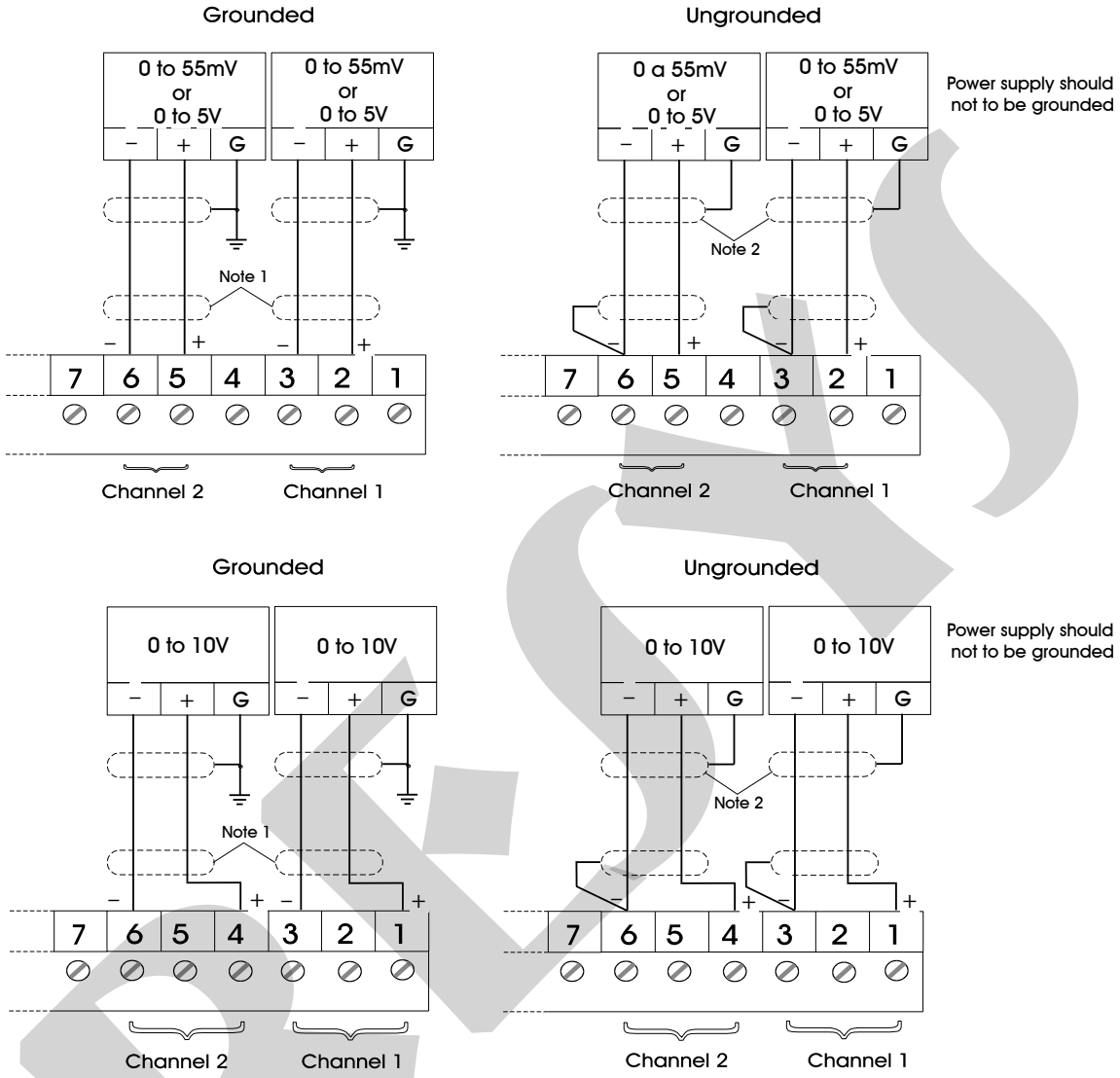


Note 1: Keep shielded wire disconnected at this end.
Note 2: Connect shielded wire to transmitter ground terminal. If ground terminal non-existent keep shielded wire disconnected at this end.

Fig. 6 - Current Source Connection

2.3.4 - Voltage Source Connection in mV or V

Voltages from 0 to 55 mVdc or from 0 to 5 Vdc should be applied between terminals 2 (+) and 3 (-) in case of input 1, and between terminals 5 (+) and 6 (-) in case of input 2. Voltages from 0 to 10 Vdc should be applied between terminals 1 (+) and 3 (-) in case of input 1, and between terminals 4 (+) and 6 (-) in case of input 2. These connections are illustrated in figure 7.



Note 1: Keep shielded wire disconnected at this end.

Note 2: Connect shielded wire to power supply ground terminal. If ground terminal non-existent keep shielded wire disconnected at this end.

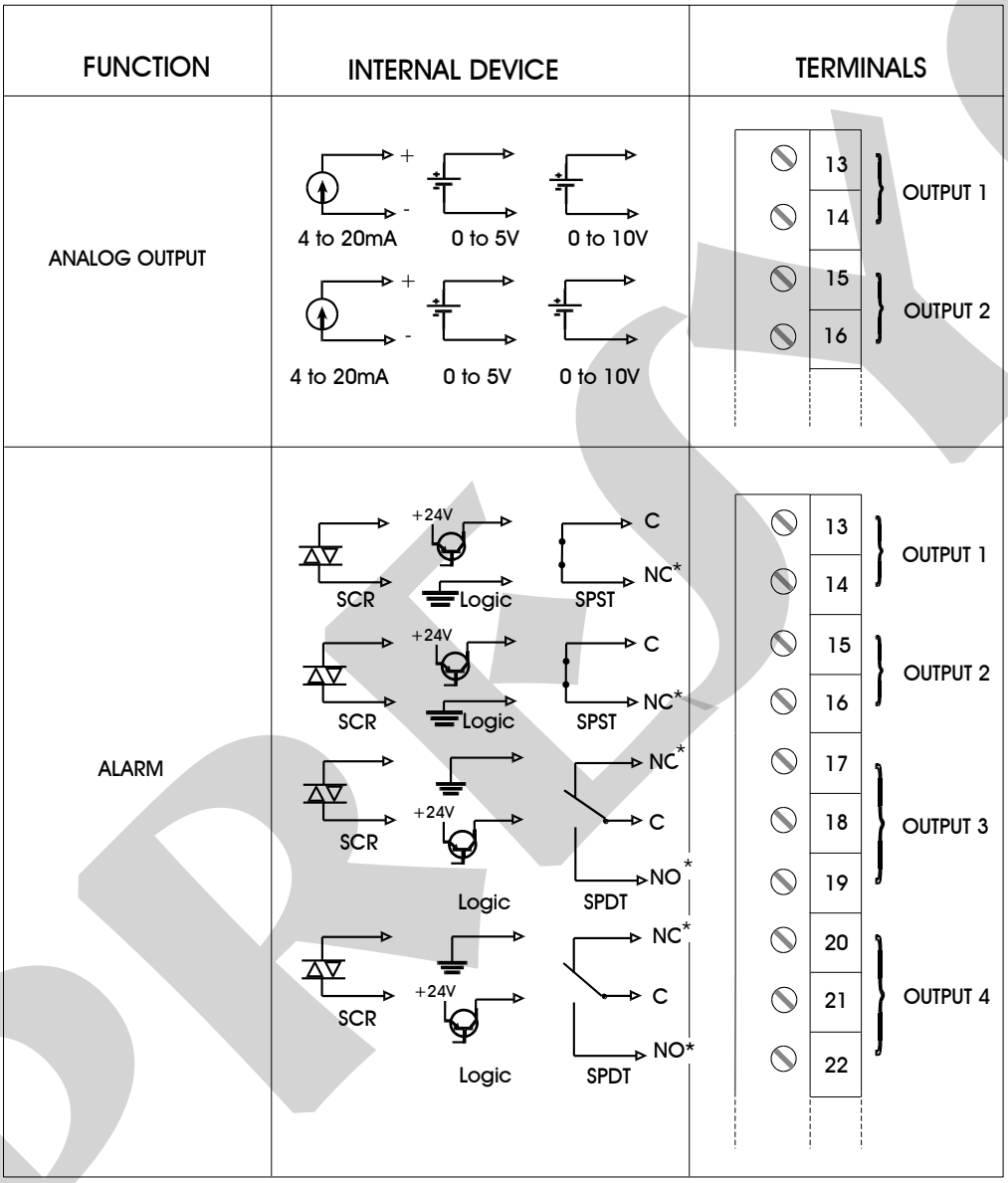
Fig. 7 - Voltage Source Connection

2.4 - Output Signal Connection

The Transmitter, in its most complete version, can be provided with up to four output signals: output 1, output 2, output 3 and output 4. Outputs 1 and 2 are used as retransmission outputs or alarm outputs. Outputs 3 and 4 are used only as alarm outputs.
In case of outputs 1 and 2, there are six different output types, which can be obtained between I/O terminals: retransmission output (4 to 20 mA, 0 to 5 Vdc or to 10 Vdc), SPST relay, open collector voltage and solid-state relay.

For outputs 3 and 4 there are three different output types: SPDT relay, open collector voltage and solid-state relay. Figure 8 shows the Transmitter outputs.

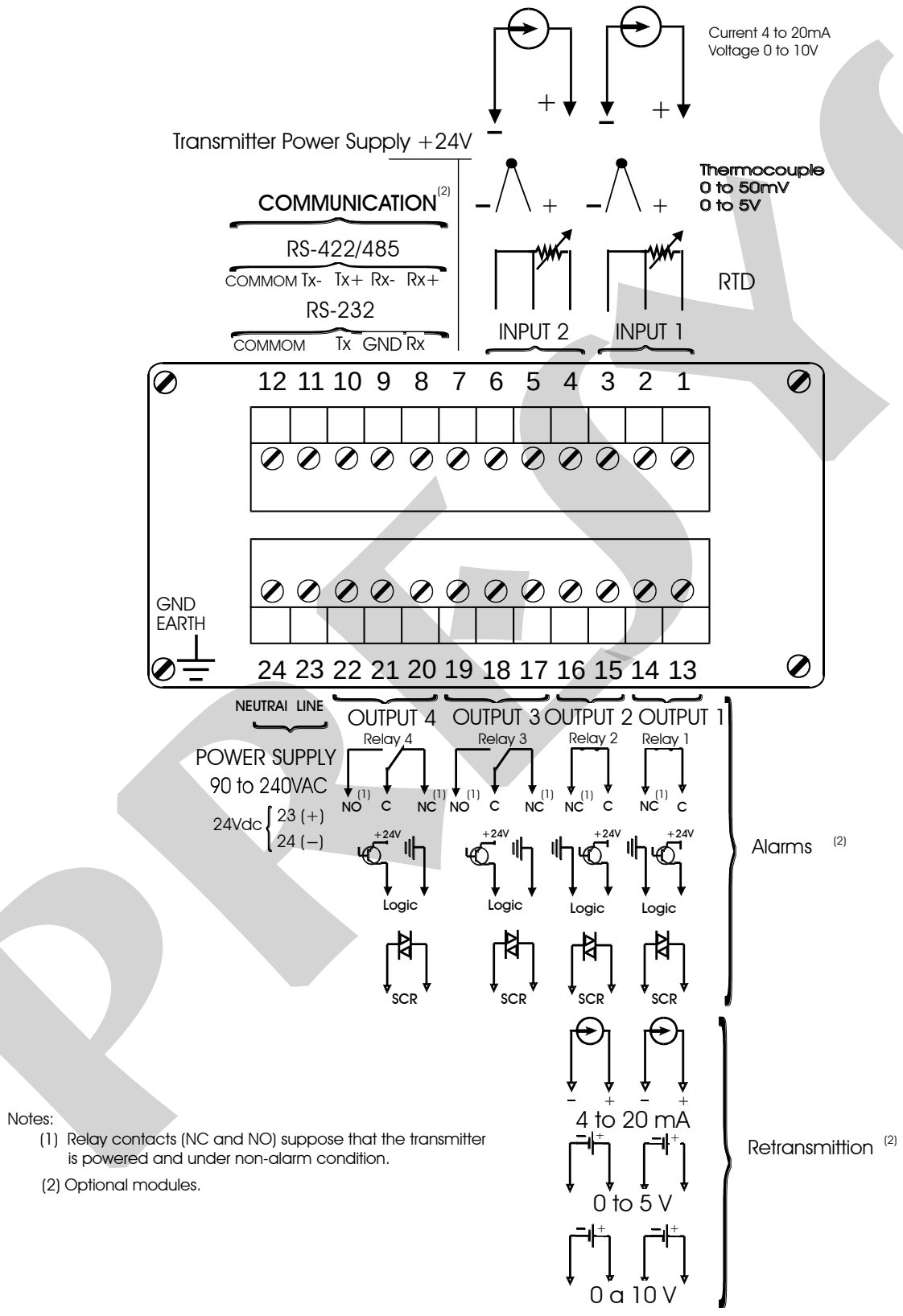
Notice that the I/O terminals will only show output signals if the corresponding optional module is installed and the output is correctly configured. In case of analog outputs, refer to sections 3.2, Configuration, and 4.3, Optional Module Connection, for details on installation and configuration of optional modules.



(*) Relay contacts assume that SAFE condition (see section 3.2 on Configuration) was selected for relays and that the Transmitter is powered and is under non-alarm condition. With no power supply or under alarm condition, contact states change.

Fig. 8 - Output Connections

2.5 - Connection Diagram



Notes:

(1) Relay contacts (NC and NO) suppose that the transmitter is powered and under non-alarm condition.

(2) Optional modules.

2.6 Communication

The TY-2090 Transmitter can communicate with computers via RS-232 or RS-422/485 provided the optional communication module is installed and the proper communication parameters are configured via software.

Specific information about communication and signal connection can be found in the Communication Manual.

3 - Operation

3.1 - Normal Operation

The TY-2090 Transmitter has two operation modes: normal operation and operation in configuration time.

In normal operation the Transmitter retransmits the process variable to a remote point either through its two analog outputs 1 and 2, or via RS-232 or RS-422/485 communication. The analog outputs 1 and 2 can retransmit input 1 as well as input 2. The two analog outputs can even retransmit the same input. Moreover, the Transmitter checks the alarm conditions and activates the alarm outputs 3 and 4 if it is the case.

The Transmitter has a portable configuration unit, MCY-20, which is connected to it by means of a DB-25 connector, as illustrated in figure 9 below.

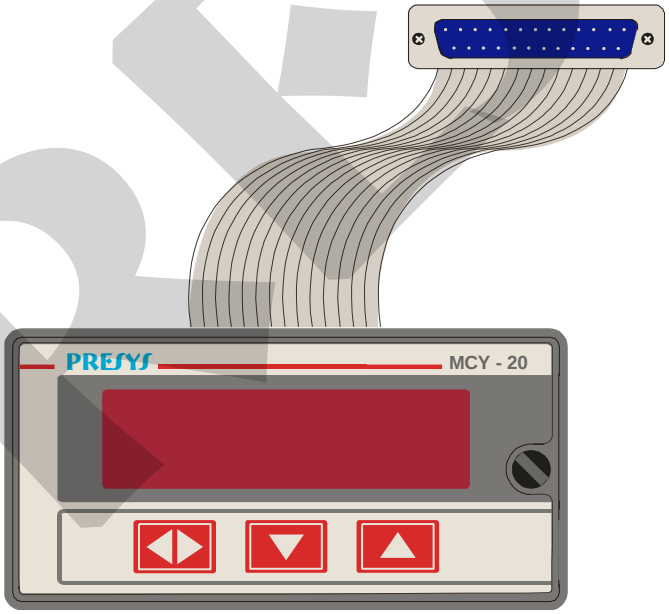
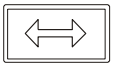
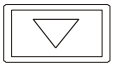


Fig. 9 - MCY-20 Portable Configuration Module

When the MCY-20 Configuration Module is connected to the Transmitter under normal operation, the instrument begins to function as a transmitter and as a process monitor as well, through the Module display.

Under configuration time operation mode the user, through the MCY-20 Configuration Module, selects and assigns values to the parameters which regulate the Transmitter functioning, when in normal operation. Such parameters are, among others, alarm set-point values, retransmission output range, etc.

The normal operation mode, in which the Transmitter operates most of the time, will be named level zero. At this level, the keys on the MCY-20 Configuration Module front panel have the following functions:

ENTER	Key		Switches from level zero to level 1 or asks for the password, depending on the configuration.
DOWN	Key		Changes the channel shown on display. If the display was showing channel 1 (2), after pressing the DOWN key, the display changes for the measured variable of channel 2 (1).

3.2 - Configuration

To gain access to the configuration mode, one should match the password established with the purpose of preventing unauthorized people from altering the critical parameters of the process.

Therefore, whenever the ENTER key is pressed under normal operation mode, one of the following cases might occur:

i) Enter directly into level 1 (GENERAL) of configuration mode, indicating that the instrument was not configured with the password system.

ii) The Module display shows the PASSWORD warning, indicating that the instrument has a password system by key or by value, as illustrated in figure 10.

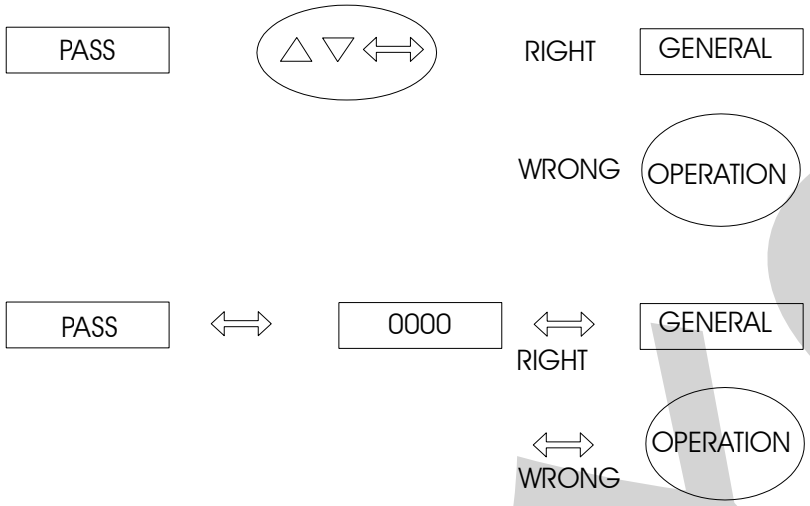


Fig. 10 - Password system by key and by value

In case of password by key, the user should press the UP, DOWN and ENTER keys in sequence to enter the configuration levels.

In case of password by value, the user should press the ENTER key a second time to obtain the number 00000, with the last digit blinking on the right. The blinking digit indicates the position where the digit of a 4-digit number will be entered by the user. In order to move to the next digits on the left, the user should press the ENTER key. After entering all digits, the user can press the ENTER key once more to switch to level 1 in case the password is correct, otherwise the system reverts to normal operation (see figure 10).

The user can even select both password systems, by key and by value. In such case, if upon receiving a request for a password the user enters a wrong key sequence, he will be immediately reverted to password by value.

The password can be a number chosen by the user (customized) or the number 2090. Notice that in case of password by value the number 2090 is always enabled, serving as a help to the user in case he forgets his password. In order to enter a password number or any other parameter value, the user can use the front Module keys, which have the following functions:

UP	Key	Increases the digit
DOWN	Key	Decreases the digit
ENTER	Key	Moves to digit on the left

All configuration parameters are stored in the non-volatile memory and determine the instrument normal operation. Through such parameters the user can adapt the instrument according to his requirements, if he desires to change the factory configuration.

The configuration parameters are distributed over six increasing hierarchical levels, as shown in figure 11.

In order to go through those levels and access the corresponding parameters the user may use the Module front keys with the following functions:

ENTER	Key	Switches into each level
UP	Key	Switches to higher level
DOWN	Key	Switches to a lower level

Note: in the following diagrams, the Module display is represented by rectangles in response to the selection of ENTER, UP and DOWN keys.

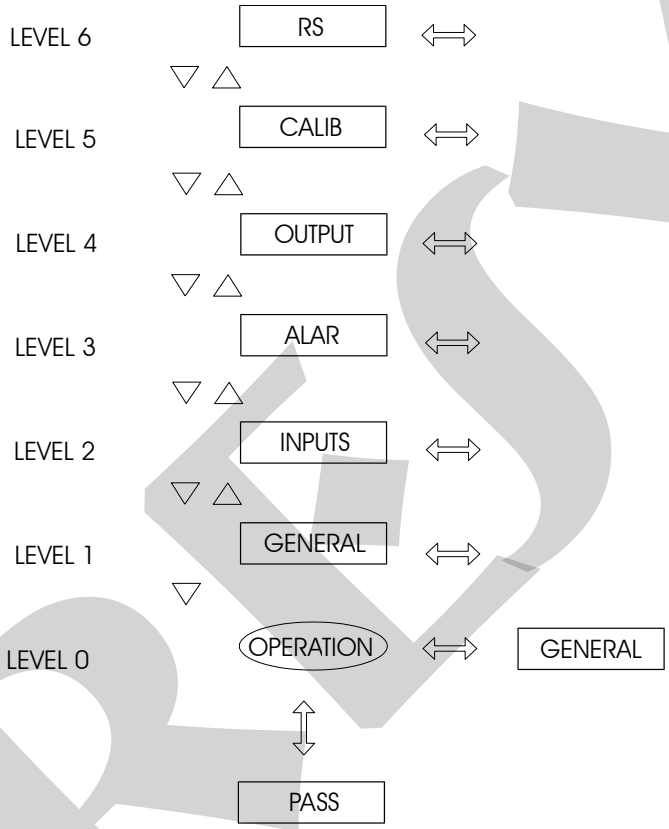


Fig. 11 - Diagram of parameter levels

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

Within each level, the front panel keys of the MCY-20 Configuration Module have the following functions:

UP	Key	Scrolls the options in ascending order
DOWN	Key	Scrolls the options in descending order
ENTER	Key	Confirms or advances the options within the level whenever the display does not show ESC. When the display shows ESC, one goes back one or more positions.

Level 1 - General

In level 1 we have the options: TAG, SOFT, PASSWORD and INDIC (see figure 12).

TAG - Enables an alphanumeric identification for the instrument. The procedure used to enter a TAG or any other parameter is the same as for the previously described password (see the functions of ENTER, UP and DOWN keys under password by value).

SOFT - Shows the software version number.

PASSWORD - Allows whether to define or not a password system to access the configuration mode. The password system can be defined by key, by value (number chosen by the user and the number 2090) or both. The key sequence for defining a password by key is, as explained above, to press the UP, DOWN and ENTER keys in that order.

INDIC - Within the option for the indication of the variable measured on display of MCY-20 Module, it is possible to view the values related to channel 1 and channel 2 by pressing the DOWN key or allowing the instrument to toggle between the measured variable values of each channel. In the first instance, NO is selected for option TWO, and in second instance, YES (automatic scanning mode) is selected for option TWO, together with the display time, in seconds, assigned to each channel.

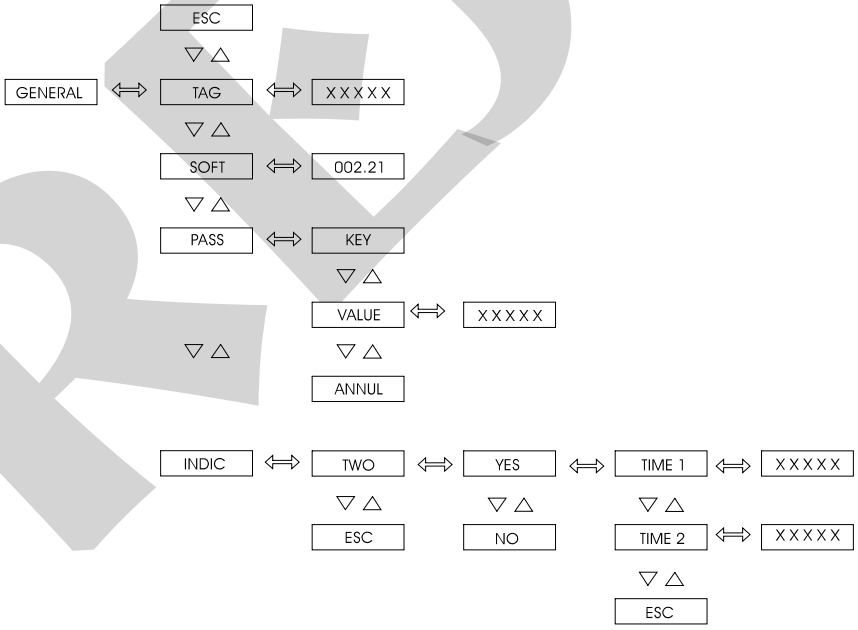


Fig. 12 - GENERAL Level Options

The adjustable parameter range shown in figure 12 is given below.

Mnemonic	Parameter	Adjustable Range	Factory Value	Unit
TAG	instrument identification	-	P2090	-
SOFT	software version	-	T-2.21	-
VALUE	user password	-9999 to 99999	0	-
TIME 1	channel 1 display time	1.0 to 3000.0	5.0	seconds
TIME 2	channel 2 display time	1.0 to 3000.0	1.0	seconds

Level 2 - Inputs

Inputs level allows wheter 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 10v, 0 to 55mv, 0 to 20mA) and temperature (option TEMP), as illustrated in figure 13.

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

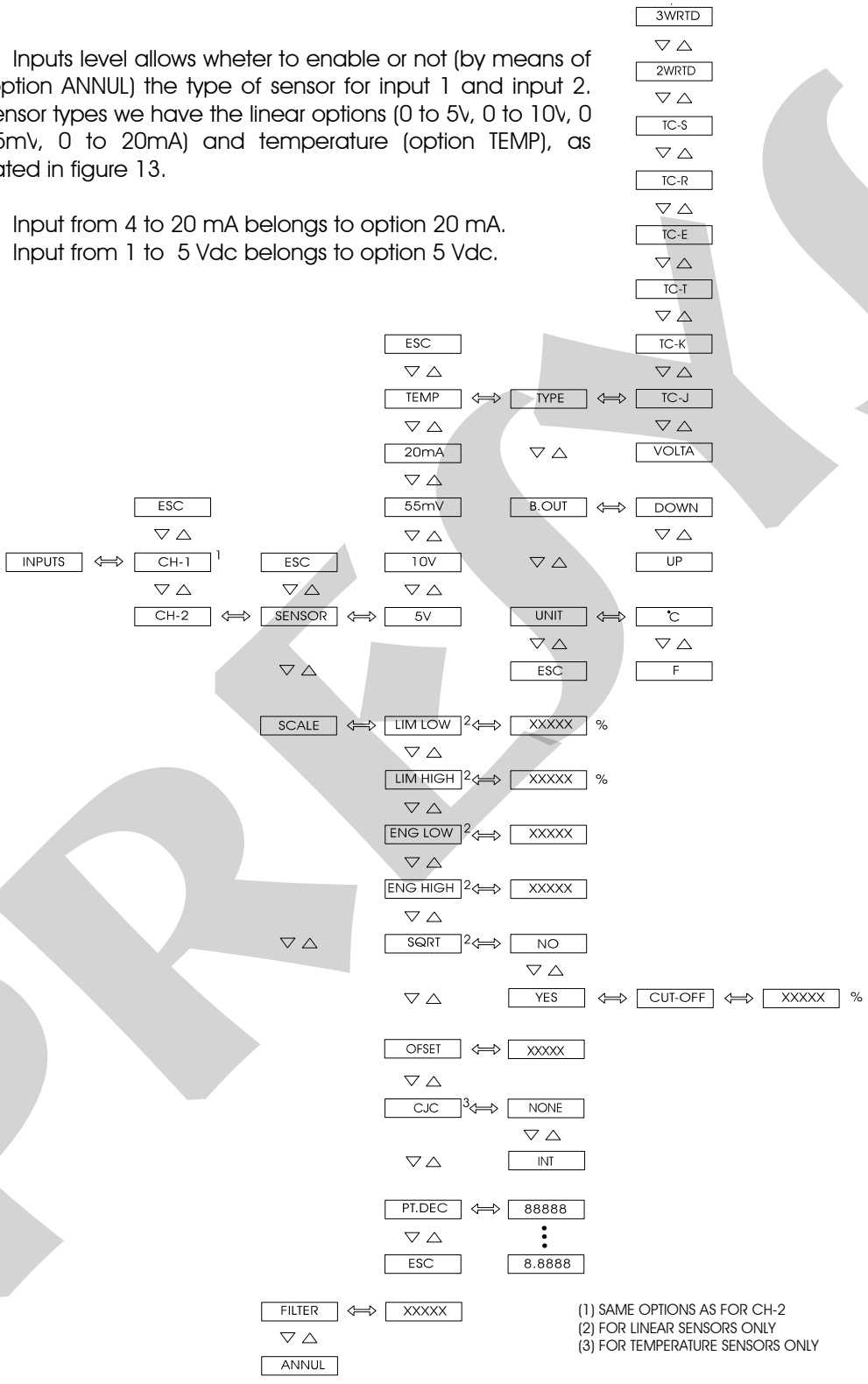


Fig. 13 - INPUTS Level Options

The adjustable parameter range shown in figure 13 is given below.

Mnemonic	Parameter	Adjustable Range	Factory Value	Unit
LIM LOW	input signal corresponding to Eng Low	0.0 to 100.0	0.0	%
LIM HIGH	input signal corresponding 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 extraction	0 to 5	0	%
OFF SET	constant added to display indication	-9999 to 30000	0	EU
FILTER	Time constant of first order digital filter	0.0 to 25.0	0.0	seconds

(*) EU - Engineering Units

Whenever a linear sensor is selected, the scale should be configured (option SCALE). For that purpose it is necessary to define two points: P1 (Lim Low, Eng Low) and P2 (Lim High, Eng High), as illustrated in figure 14. Lim Low represents, in %, the value of the electric signal associated to the “Eng Low” indication on Module display, and Lim High corresponds to the value, in %, of the electric signal associated to the “Eng High” indication on Module display.

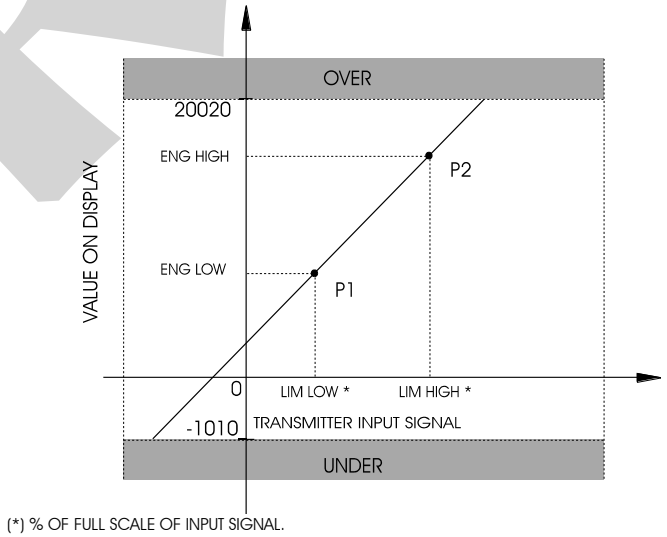


Fig. 14 - Linear Input Configuration

SQRT - Shows the square root of the Transmitter input signal on display. The Cut-Off parameter, expressed as a % of the input signal, forces the lower value inputs (Lim Low + Cut Off) to behave as Lim Low. See illustration on figure 15.

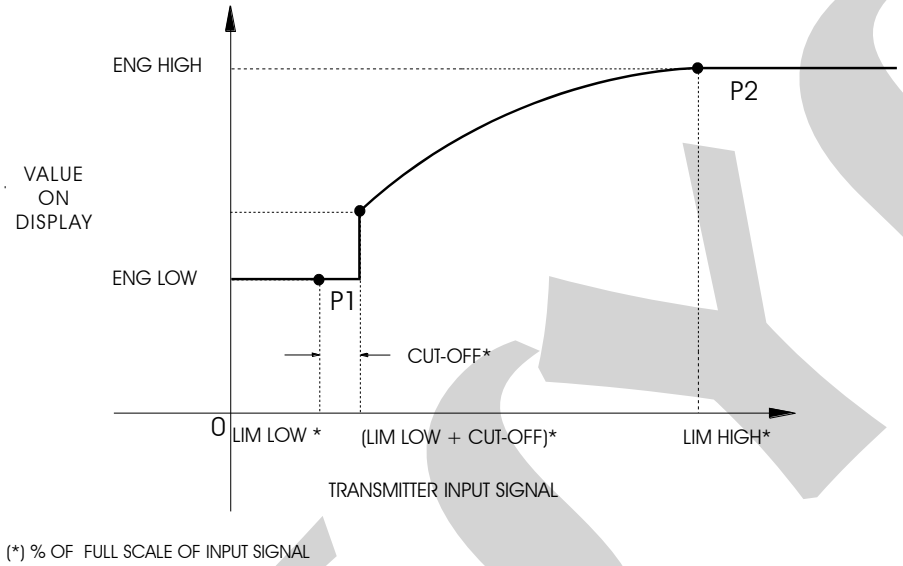


Fig. 15 - Square root of input signal

DEC.PT - Sets the decimal point to exhibit the engineering units on Module display. Up to four decimal digits can be set for linear processes, whereas temperature sensors can have one or no decimal digit.

OFSET - (as shown on Module display) - Allows the user to enter a fixed off-set value, in engineering units, in addition to value shown on display. It is a useful option when we have several instruments monitoring the same process variable, but with slightly different readings. The OFSET parameter can be used to equalize instrument readings.

CJC - An option to select whether or not to enable the cold junction compensation for thermocouple measurements. In case a cold junction compensation is desired, the internal compensation (INT) should be selected, otherwise, NONE should be selected. Usually, INT is selected.

The types of input sensors are described in Table 1 of section 1.3, Technical Specifications.

FILTER - This parameter provides the time constant of a first order digital filter coupled to the selected input. When no filtering of the measured signal is desired, zero should be assigned to this parameter.

B. OUT - In the event of temperature sensor failure (thermocouple or RTD) or an open connection wire, the Module display indicates burn-out for the corresponding channel. In such cases, the UP option within this parameter enables the high alarms, and the DOWN option enables the low alarms.

UNIT - Selects ºC or ºF for temperature indication.

Level 3 - Alarms

The Transmitter can have up to four alarm outputs, using the outputs 1, 2, 3 and 4, which are hence called relay 1, relay 2, relay 3 and relay 4, respectively (see figure 17). In this case, the transmitter will not have retransmission analog output.

Each relay can have up to four alarms associated to itself: low for channel, high for channel 1, low for channel 2 and high for channel 2. Therefore, it is possible to have up to sixteen alarm set-point values (SP) with their respective hysteresis (HYST).

Once the alarms are configured (CONF option), the user can review or readjust only the alarm set-point values. In order to do that, the user should press the UP key to go to CONF option, where he will have quick access to the set-points of all alarms already configured. The alarm set-point mnemonics are coded as explained in the two examples below.

S_1_H_r1	Set point of channel 1 high alarm associated to relay 1.
S_2_L_r4	Set point of channel 2 low alarm associated to relay 4.

DELAY - Causes the alarm operation of each relay to be delayed by a certain period of time defined by the user (DELAY). Figure 16 shows the delay for a high alarm.

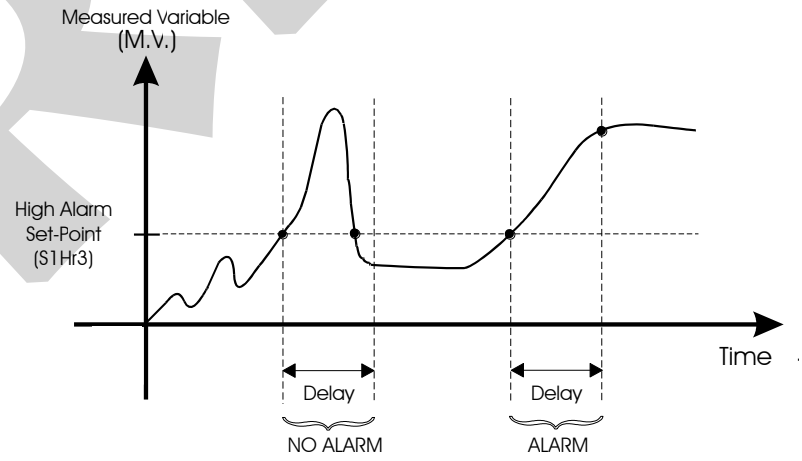


Fig. 16 - Relay with Delay

SAFE - Provides relay safety. Relay safety condition means that relay coils are energized when the instrument is powered and are de-energized under alarm condition or in the event of a power failure.

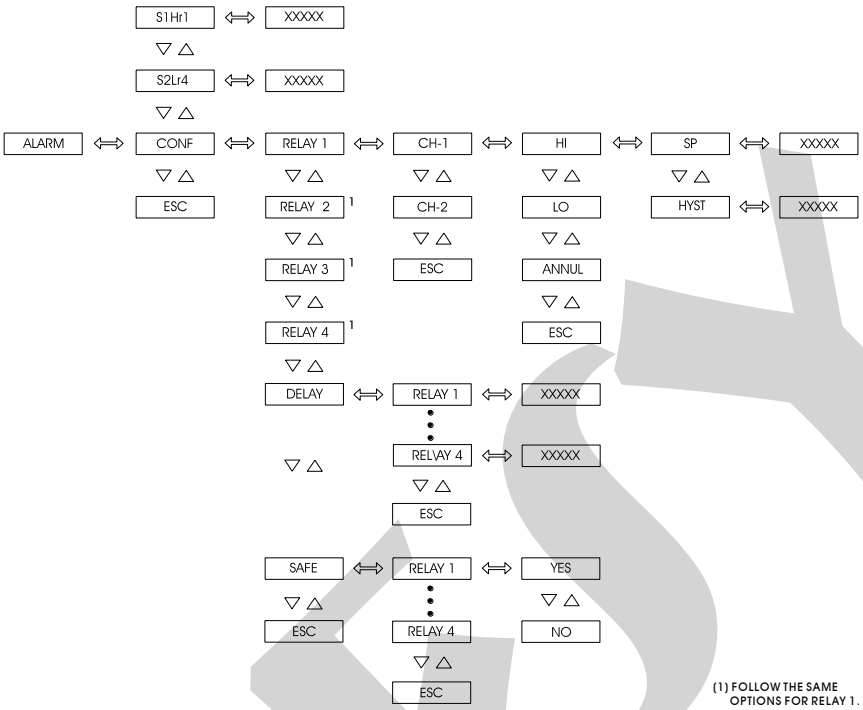


Fig. 17 - Alarm level options

The adjustable parameter range shown in figure 17 is given below.

Mnemonic	Parameter	Adjustable Range	Factory Value	Unit
SP	alarm set-point	-1009 to 20019	25.0 - low alarm 75.0 - high alarm	EU
HOST	alarm hysteresis	0 to 250	1.0	EU
DELAY	delay for relay activation	0.0 to 3000.0	0.0	seconds

Level 4 - Outputs

Level 4 allows the configuration of two possible analog outputs (see figure 18).

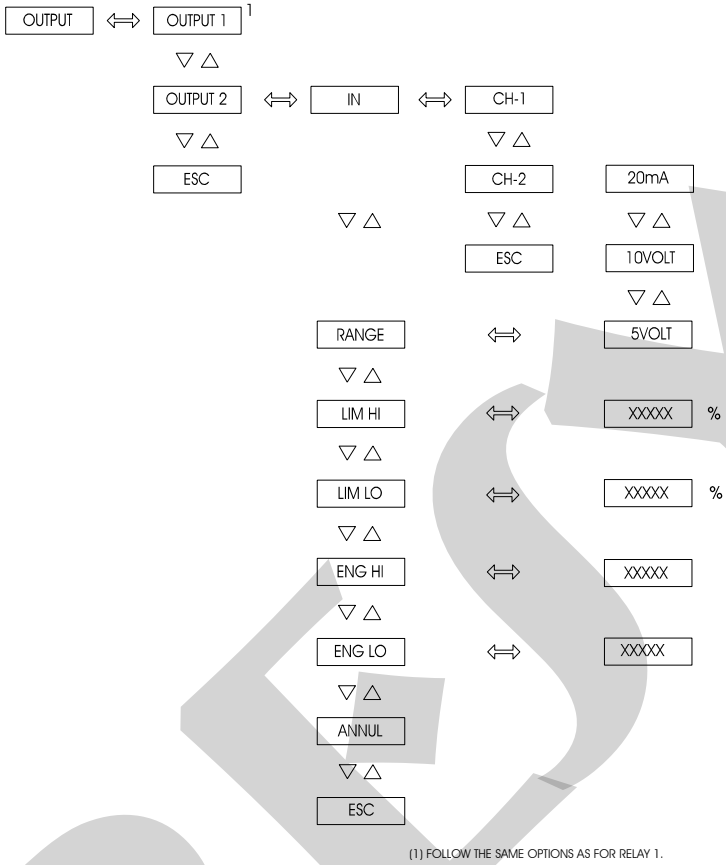


Fig. 18 - OUTPUT level options

The adjustable parameter range shown in figure 18 is given below.

Mnemonic	Parameter	Adjustable Range	Factory Value	Unit
LIM LOW	output signal corresponding to Eng Low	0.0 to 100.0	0.0	%
LIM HIGH	output signal corresponding 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

IN - Associates analog output 1 or 2 with input 1 or 2 which will be retransmitted. Notice that outputs 1 and 2 can be retransmitting the same input (1 or 2).

The analog output is enabled only after the retransmission output range is selected by the RANGE mnemonic.

RANGE - Selects the retransmission output range for 20 mA, 5 V and 10 V. The relationship between the engineering unit and the electric signal which comes from the Transmitter I/O terminals is defined similarly to the linear process scale configuration. In this case, the points P1 (Eng Low, Lim Low) and P2 (Eng High, Lim High) are also defined, as illustrated in figure 19. Eng Low is the indication on Module display, in engineering units, associated to the Lim Low electric signal and Eng High is the indication on display, in engineering units, associated to the Lim High electric signal. Notice that Lim Low and Lim High are expressed in percentage of output range and the output signal saturates at those points.

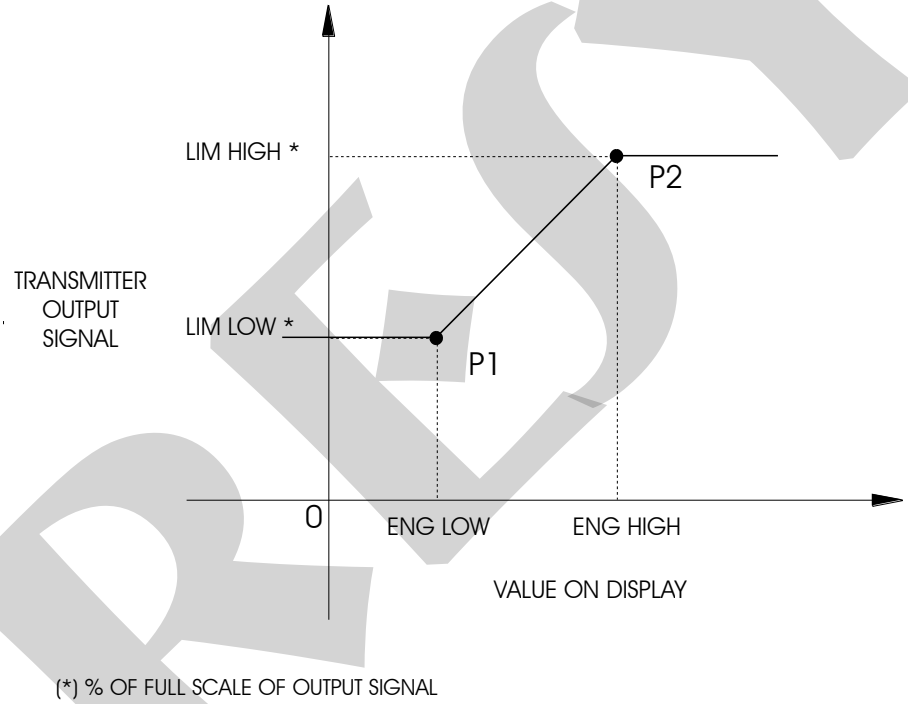


Fig. 19 - Analog Output Configuration

Level 5 - Calibration

Level 5 is described in section 4.3, Calibration.

Level 6 - RS

Refer to the Communication Manual.

4 - Maintenance

4.1 - Transmitter Hardware

Transmitter maintenance requires the user to have access to the instrument hardware. The instrument hardware is divided in three main circuit boards: Display Circuit Board, CPU Circuit Board and Power Source Circuit Board. The Display Circuit Board is located inside the MCY-20 Configuration Module. The CPU and Power Source Circuit Boards are located inside the TY-2090 Transmitter.

To gain access to the CPU and Power Source Circuit Boards, follow the instructions below:

i) Remove all screws indicated by a dashed line according to figure 20 below, totaling 10 screws.

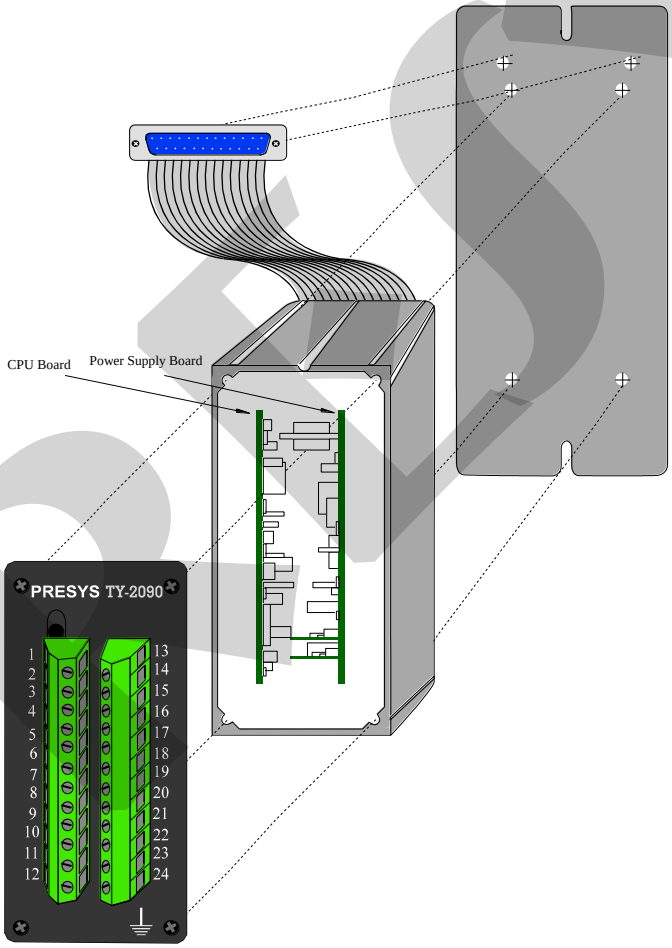


Fig. 20 - Transmitter Dismounting Scheme

ii) Slide the CPU and Power Source Circuit Boards out of the aluminum case, together with the DB-25 Terminal. Notice that both circuit boards are united by a screwed spacer between them. Remove the screw which fastens one of the holder sides and open the boards as illustrated in figure 21.

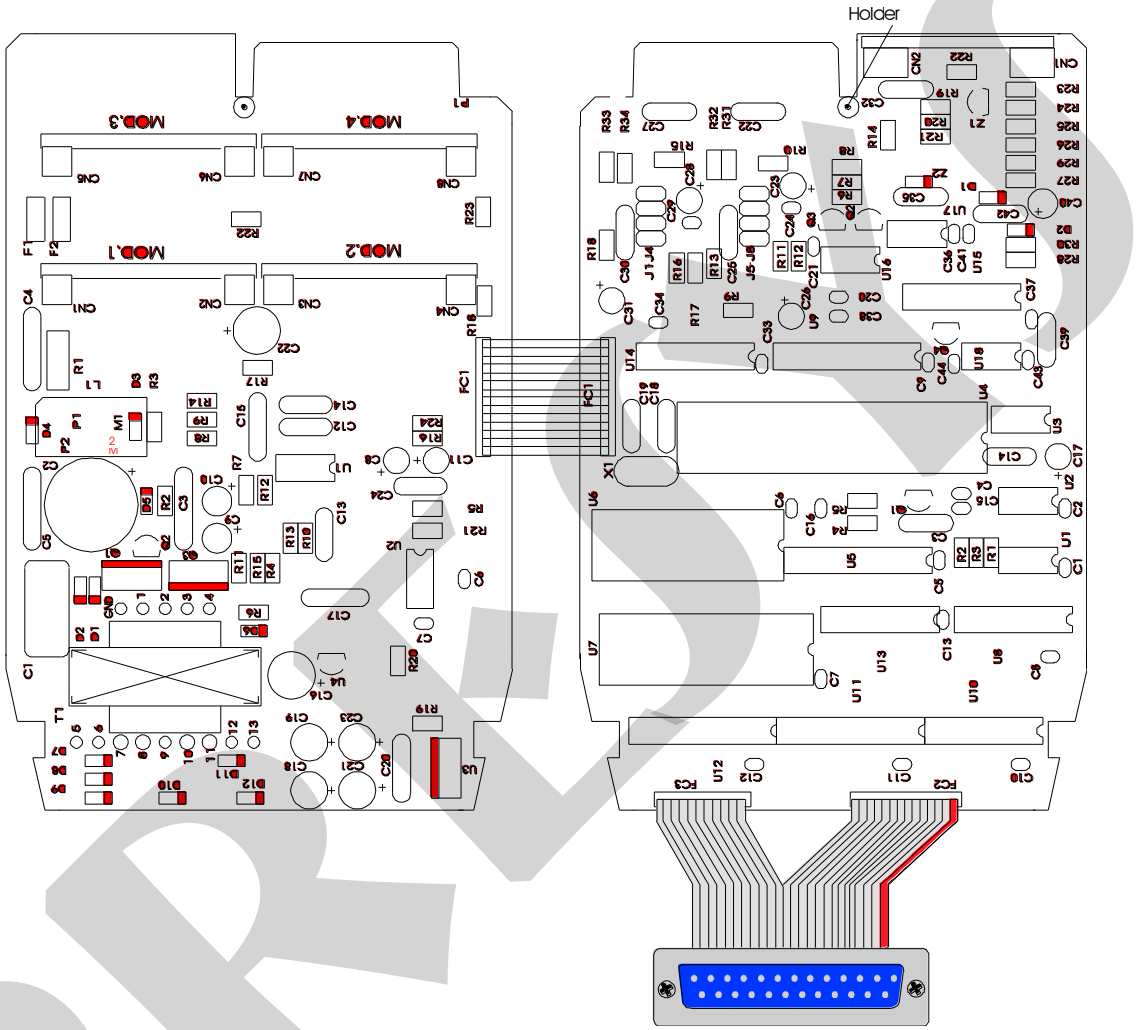


Fig. 21 - Transmitter Hardware

4.2 - Hardware Configuration

The input level configuration by software (level 2 - Inputs) should be implemented by a process input configuration, by means of internal jumpers.

There are four places for jumper installation for channel 1: J5, J6, J7 and J8 and also four places for jumper installation for channel 2: J1, J2, J3 and J4. They are located on the CPU Circuit Board as illustrated in figure 22.

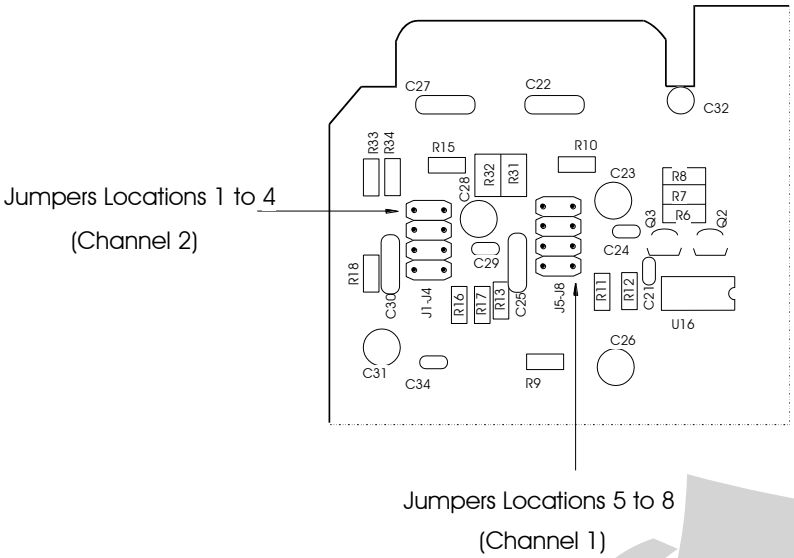


Fig. 22 - Jumper Locations on CPU Circuit Board

Table 2 shows the jumpers which should be installed for different types of inputs. Check the required type of input and place the jumpers as specified. Be sure that only the jumpers corresponding to the desired input are installed.

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

Table 2 - Configuration Jumpers versus Input Type

(*) In case of input under a voltage of 0 to 10 V, the second jumper supplied by factory should be stored by the user out of the instrument, or simply engaged to a connector pin, in a dummy position as illustrated in figure 23.

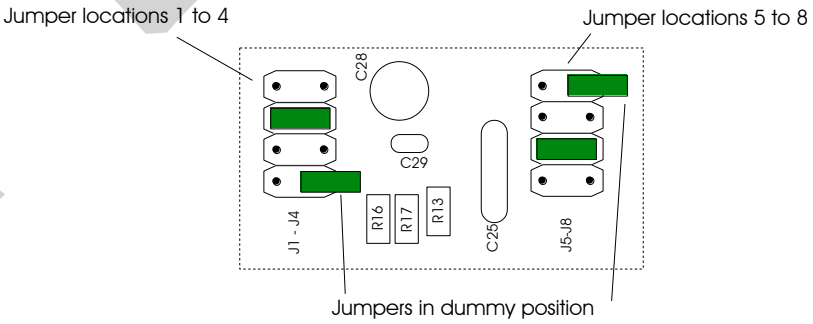


Fig. 23 - Jumpers in dummy position for inputs from 0 to 10 V

4.3 - Optional Module Connections

The TY-2090 Transmitter can be provided with up to four output signals plus communication. For that purpose, the corresponding optional modules should be installed inside the instrument. By opening the Transmitter as explained in section 4.1, access is gained to 4 fittings on the Power Source Board, plus one fitting on CPU Board (see figure 24).

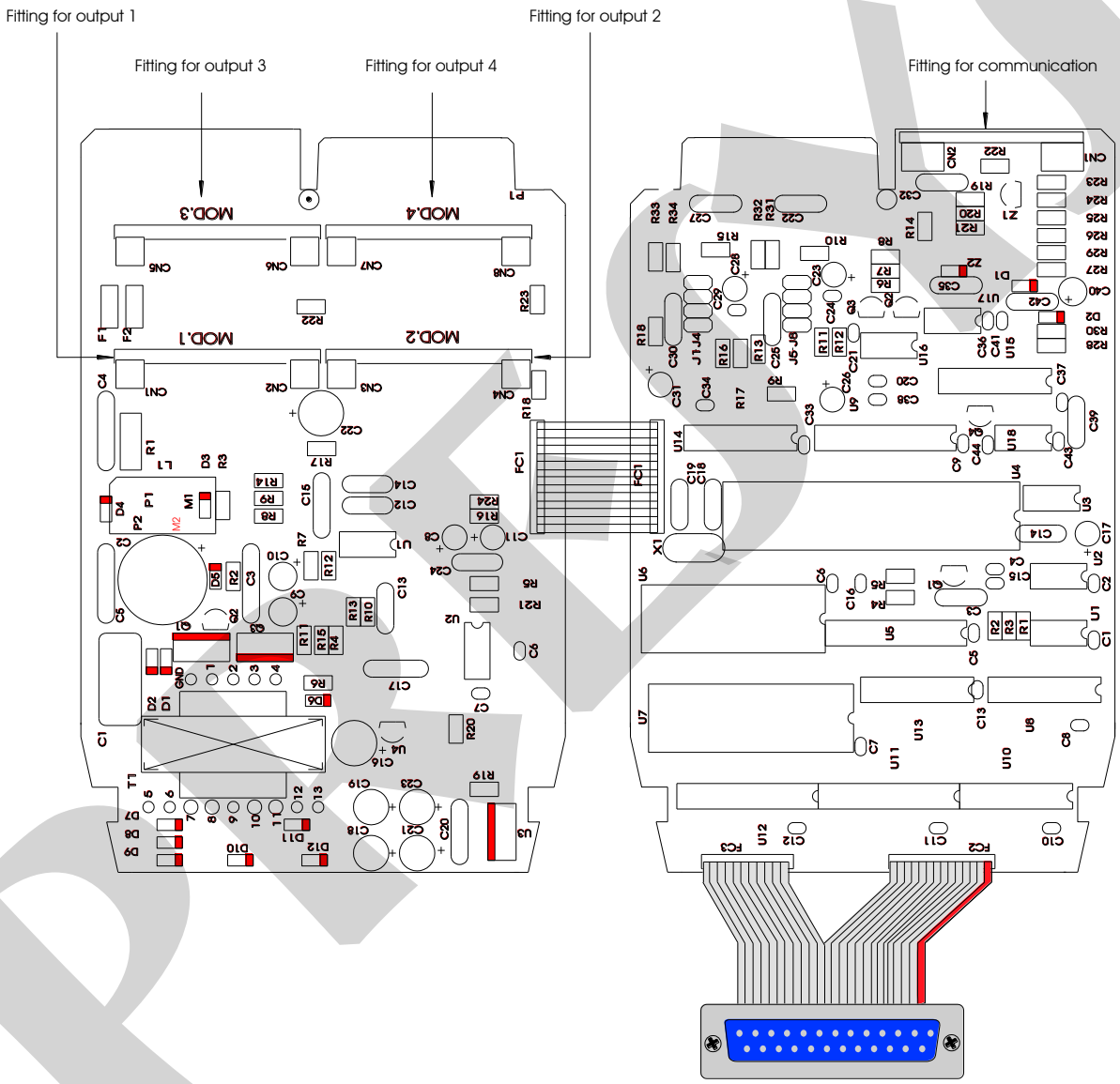


Fig. 24 - Optional Module Connections

The fittings on Power Supply Board are called MOD 1, MOD 2, MOD 3 and MOD 4, and are, respectively, the signal counterparts for output 1, output 2, output 3 and output 4 on the Transmitter I/O terminals shown in figure 3. The fitting for the communication module is located on CPU Circuit Board and have no denomination. Any optional module should always be installed with the component side facing the instrument connector, as illustrated in figure 25.

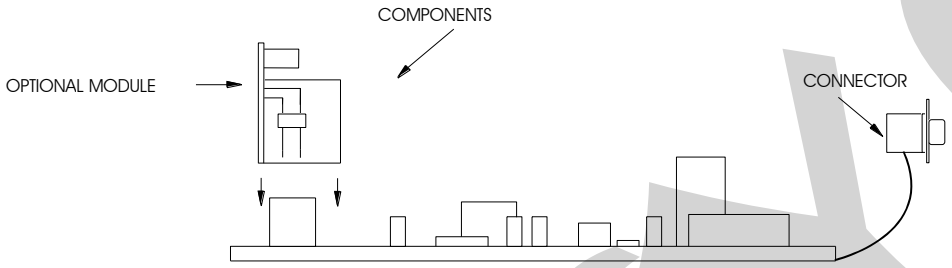


Fig. 25 - Optional Module Installation

Outputs 1 and 2 as retransmission outputs (optional module code: MSAN-20)

Whenever output 1 is required to be a retransmission output (4 to 20 mA, 1 to 5 V or 0 to 10 V), the optional analog output module is fit into the fitting called MOD 1. In case an additional retransmission output is required, a second module is fit into the fitting called MOD 2.

The optional analog output module is provided with two locations for jumper installation: J1 and J2, as illustrated in figure 26.

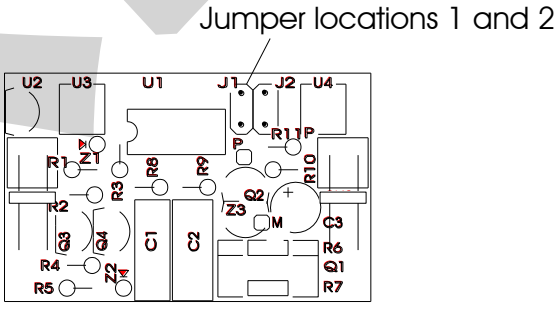


Fig. 26 - Jumper locations on analog output board

In order to configure the optional analog output module for retransmission output of 4 to 20 mA, 1 to 5 V or 0 to 10 V, just install the jumper as specified in Table 3.

Retransmission Output Types	Jumpers	
4 to 20 mA*		
1 to 5 V	J1	
0 to 10 V		J2

Table 3 - Configuration Jumper for Retransmission Output Types

(*) In case of retransmission output under current from 4 to 20 mA, the supplied jumper should be stored out of the instrument or simply engaged to a connector pin, in a dummy position, as illustrated in figure 23.

Outputs 1 and 2 as alarm outputs

Whenever outputs 1 or 2 are required to function as alarms, the corresponding optional module is fit into the fittings called MOD 1 and MOD 2, respectively. Depending on the optional module installed in MOD 1 or MOD 2, there are three possible alarm outputs: the SPST relay, the solid-state relay and the open collector voltage. The relationship between the alarm output type and the corresponding optional module is established on Table 4.

Alarm Output Type	Optional Module Code
SPST Relay	MALRE-20
Solid-state Relay	MALRS-20
Open Collector Voltage	MSD-20

Table 4 - Alarm Output Types for Outputs 1 and 2

Outputs 3 and 4 as Alarm Outputs

Outputs 3 and 4 function as alarms when the corresponding optional module is fit into the fittings called MOD 3 and MOD 4, respectively. There are three possible types of alarm outputs: the SPDT relay, the solid-state relay and the open collector voltage. The relationship between alarm output type and the corresponding optional module is established on 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

4.4 - Calibration

The TY-2090 Transmitter is accurately calibrated in factory and does not require regular calibration under normal conditions. If, for any reason, a recalibration is required, follow the procedure described below.

Disconnect process signals from the Transmitter I/O terminals.

Connect the MCY-20 Configuration Module to Transmitter.

Prior to carrying out the calibration, allow the instrument to warm up for at least 30 minutes to ensure it reaches stable operating conditions.

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

Input Calibration

The input calibration describes the procedure to be followed when calibrating input 1 and input 2.

The accuracy and precision of the equipment used for generating the references for calibration should be at least twice better than the Transmitter specifications.

References are related to the type of input to be calibrated, and are shown on the following tables. The column on the right shows the mnemonics displayed on Module display in the calibration process.

Always check that internal jumper configuration correctly matches the input type to be calibrated.

Before carrying out the calibration, it is necessary to access Calibration Level 5. The calibration level has a password system to prevent the inadvertent access to this level, which could damage the calibration parameters of the transmitter.

The password for accessing this calibration level is number 5.

Once the calibration password is acknowledged, select the input type to be calibrated within INPUT option. Select the channel to be calibrated by pressing ENTER. The MCY-20 Module display will show the mnemonics corresponding to the references required for the calibration process. The references should be entered before the corresponding mnemonic appears on display, and the calibration is started by pressing the ENTER key. At this time the Transmitter starts the calibration procedure with the CAL mnemonic blinking on the Module display.

While the Module display is blinking, the reference should remain connected to the input channel to be calibrated.

When the display stops blinking and the corresponding mnemonic is back on screen, the calibration process for the first point will have finished.
Change to next reference and press the DOWN key to select the next point. Always wait 1 minute between two calibration points. After this time is elapsed, press ENTER to start calibration of the second point.

After running through all references of the table related to the input type to be calibrated, the calibration process will have been completed.

It is possible to recalibrate only one point, without affecting the other points already calibrated, when the calibration of such point has not been properly carried out.

To resume normal operation, revert in the hierarchical levels to level zero.

Figure 27 indicates the input and output calibration options for Calibration Level 5.

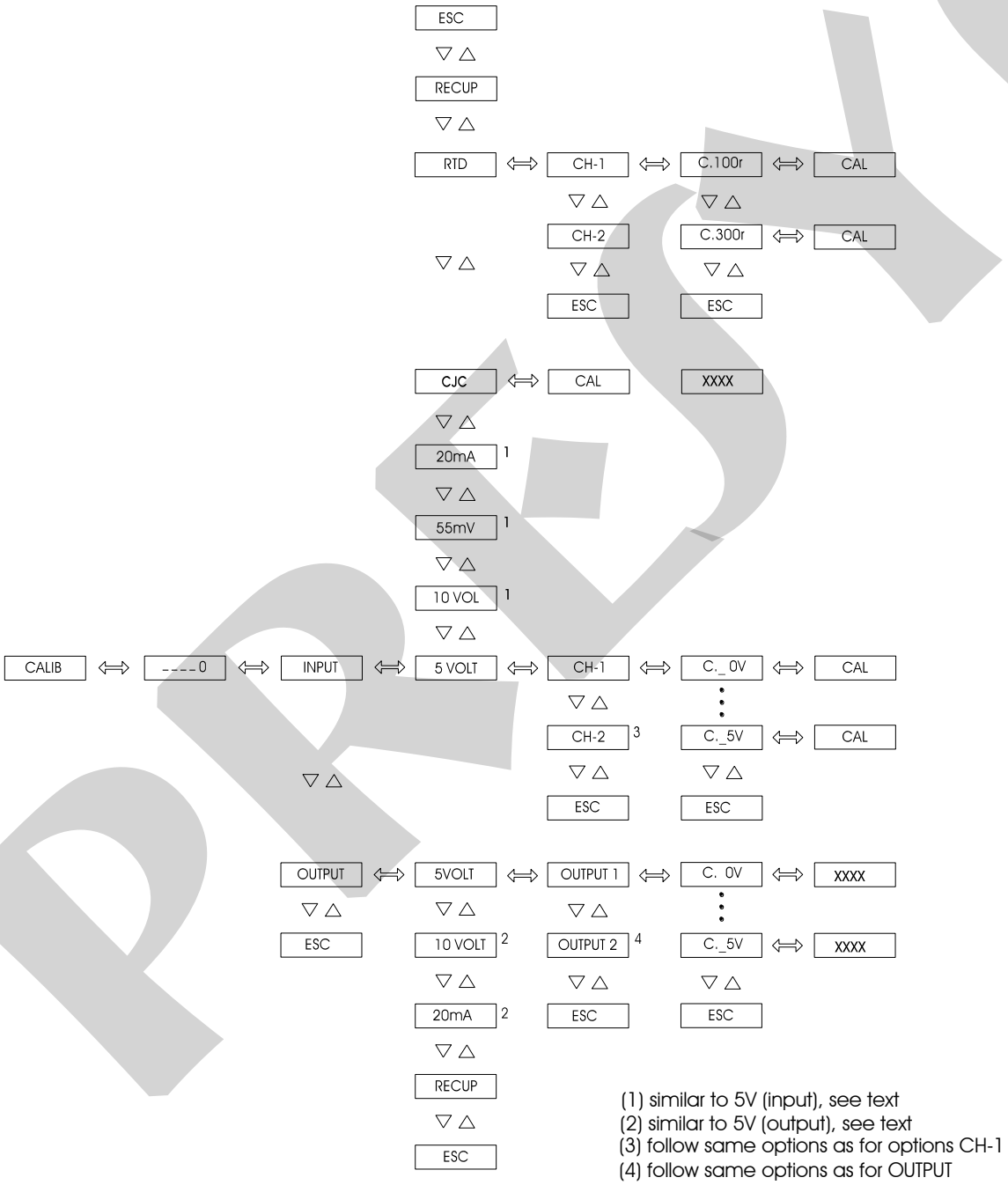


Fig. 27 - CALIBRATION Level Options

Calibration of Voltage Input (0 to 55 mV)

In order to calibrate a voltage input from 0 to 55 mV, connect an accurate DC power source to the channel to be calibrated (terminals 2 (+) and 3 (-) for channel 1, or 5 (+) and 6 (-) for channel 2). The 6 voltage references listed on Table 6 will be required.

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 - Required voltages for the calibration of voltage inputs from 0 to 55 mV

Calibration of Voltage Input (0 to 5 V)

In order to calibrate a voltage input from 0 to 5 V, connect an accurate DC power source to the channel to be calibrated (terminals 2 (+) and 3 (-) for channel 1, or 5 (+) and 6 (-) for channel 2). The 6 voltage references listed on Table 7 will be required.

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

Table 7 - Required voltages for the calibration of voltage inputs from 0 to 5 V

Calibration of Voltage Input (0 to 10 V)

In order to calibrate a voltage input from 0 to 10 V, connect an accurate DC power source to the channel to be calibrated (terminals 1 (+) and 3 (-) for channel 1, or 4 (+) and 6 (-) for channel 2). The 6 voltage references listed on Table 8 will be required.

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

Table 8 - Required voltages for the calibration of voltage inputs from 0 to 10 V

Calibration of Current Input (0 to 20 mA)

In order to calibrate a current input from 0 to 20 mA, connect an accurate DC power source to the channel to be calibrated (terminals 1 (+) and 3 (-) for channel 1, or 4 (+) and 6 (-) for channel 2). The 6 current references listed on Table 9 will be required.

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 - Required current for the calibration of current inputs from 0 to 20 mA

Calibration of thermocouple input

The calibration of a thermocouple input is carried out in two steps. Firstly, calibrate the 0 to 55 mV input and the 0 to 5 V input of the channel (terminals 2 (+) and 3 (-) for channel 1, or 5 (+) and 6 (-) for channel 2) as detailed in Tables 6 and 7. After that, access the CJC mnemonic within the INPUT option of calibration level 5 (see figure 27).

CJC - Is the mnemonic corresponding to the temperature of the Transmitter cold junction.

By pressing the ENTER key after the CJC mnemonic, the program begins automatically to calculate the cold junction temperature. During such period, the mnemonic CAL blinks on Module display.

After 16 seconds, the program completes the calculation of the cold junction temperature and shows the result in ºC on the display.

This value is the first approximation for the cold junction temperature.

The user should then measure accurately the I/O terminal temperature and correct the value presented by the program in the manner usually employed to introduce parameter values, as explained in section 3.2, Configuration.

After completing those two steps, the input calibration for any type of thermocouple is concluded.

Then, it is possible to resume normal operation conditions by reverting to level zero.

Calibration of 2- or 3-wire RTD input

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

In case a precision decade is available, make sure that the three connection wires have exactly the same length, gauge and material.

There is no calibration procedure for 2-wire RTD input. This is automatically carried out when the 3-wire RTD is calibrated.

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

Table 10 - Required resistance for the calibration of 3-wire RTD input

Output Calibration

This topic describes the procedure which should be followed in order to calibrate the retransmission outputs 1 and 2.

The retransmission outputs will be calibrated with the help of the Transmitter itself. Output 1 will be calibrated by input 1, and output 2 will be calibrated by input 2.
The configuration of input hardware should be the same as for the output hardware (0 to 5 V, 0 to 10 V or 0 to 20 mA), since the Transmitter itself will measure the output signal. Therefore, check that the configuration of internal jumpers in the Optional Output Board and CPU Board matches the corresponding types of output and input.

Make sure that the input type to be used for output calibration has already been properly calibrated.

Make the connections listed in Table 11 according to which output and output type will be calibrated.

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

Table 11 - I/O terminal connections for output calibration

Now enter Calibration level 5 and select which of the two outputs will be calibrated.

Then, select the output type (0 to 20 mA, 0 to 5 V or 0 to 10 V) and press ENTER.

The Module display will show the mnemonic corresponding to the first calibration point. There are six output calibration points.

In case of current output, the mnemonics correspond to the electric signals 0, 4, 8, 12, 16 and 20 mA. In case of voltage, the mnemonics correspond to the signals 0, 1, 2, 3, 4 and 5 V or 0, 2, 4, 6, 8 and 10 V.

By pressing ENTER after the mnemonic corresponding to the calibration point is displayed, the Module display will show the output value. Then, it will be possible to adjust the output value for the electric level presented by the mnemonics through the UP and DOWN keys. After adjusting, press ENTER. When calibrating the first point (0 mA, 0 V), be careful to avoid output signal saturation.

Return to normal operating level by reverting to level zero.

Reverting to factory calibration

The Transmitter stores the factory calibration parameters in its non-volatile memory. Such parameters can be retrieved at any time.

In case of suspicion that some instrument malfunction is due to an improper calibration, use the RECUP option (see figure 27).

RECUP - This option allows the retrieval of factory calibration values. It is valid for both the inputs and outputs.

Enter Calibration Level 5 and select whether to retrieve input or output values.

Select the RECUP option and press ENTER to reload factory values.

4.5 - Hardware Maintenance Guidelines

Before returning the instrument to factory, check the following possible causes of instrument malfunction:

Instrument indicating error on display of the MCY-20 Configuration Module

After turning on the equipment start the test routine to check the RAM and E2PROM integrity.

If one of these components presents problems, the Module display will show the following error codes:

Err. 01 - RAM error

Err. 02 - E2PROM error

In case of RAM error, turn the equipment off and then on again to check whether the error message persists. If affirmative, return the instrument to factory.

In case of E2PROM error, press the ENTER key and reconfigure the equipment. Turn the equipment off and then on again to check whether the error message persists. If affirmative, return the instrument to factory.

In configuration time mode, the display might show the following error message: Err. 03.

The message Err. 03 will occur in case of configuration incompatibility between analog output and alarm. To prevent this from happening, before enabling the analog output 1 and 2, make sure to disable the relays 1 and 2 and vice versa.

Instrument with the MCY-20 Module display off

Check that power supply reaches the power terminals 23 and 24 of the Transmitter I/O terminals.

Check the integrity of the 1.0 A fuse F1 on the Power Supply Board as shown in figure 21. Due to its ceramic case, it is necessary to measure its continuity to see if it is blown.

Instrument malfunction

Check that the Transmitter is correctly configured both in terms of software and hardware (internal jumpers).

Check that the optional modules are fit into their correct locations.

Measure the voltages at the flat-cable 1, shown in figure 28, and check that they are close to the voltages in Table 12 and arriving at CPU end.

Points of Flat-cable 1	Voltages
Between point 13 (-) and point 1 (+)	5 V
Between point 13 (-) and point 7 (+)	8 V
Between point 13 (-) and point 8 (+)	0 V
Between point 13 (-) and point 9 (+)	-8 V
Between point 13 (-) and point 12 (+)	24 V
Between point 11 (-) and point 10 (+)	5 V

Table 12 - Voltage Test Points on Flat-Cable 1

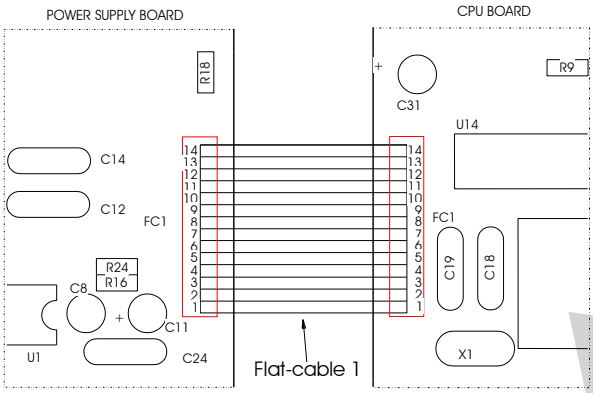


Figure 28 - Transmitter Voltage Test Points

In case the problem is not isolated, the Transmitter should be returned to factory for repairs.

4.6 - Parts Listing

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	LM 1458	U2
01.01.0030-21	UC 3842	U1
01.02.0122-21	Fuse 2A x 250 V	F1
01.09.0022-21	IRF 530	Q3
01.01.0028-21	78L24	U4
01.04.0007-21	Diode 1N4007	D1
01.04.0008-21	Diode 1N4936	D5, 6, 7, 8, 9, 10, 11, 12
01.03.0009-21	Disk Ceramic Capacitor 100 pF x 100 V - Thomson	C12, 13, 14
01.03.0035-21	Multilayer Ceramic Capacitor 0.1 µF x 63 V (VP 42 UMA)	C6, 7
01.03.0036-21	Multilayer Ceramic Capacitor 0.01 µF x 63 V (VP 42 UMA)	C24
01.03.0039-21	Polyester Capacitor 0.1 µF x 250 V (5141)	C1, 3
01.03.0040-21	Polyester Capacitor 0.01 µF x 100 V (5140)	C15, 17
01.03.0041-21	Polyester Capacitor 0.01 µF x 250 V (5141)	C4, 5

Code	Components	Reference
01.03.0038-21	Radial Electrolytic Capacitor 10 μF x 16 V (85700)	C8, 11
01.03.0042-21	Radial Electrolytic Capacitor 22 μF x 25 V (85049)	C9
01.03.0027-21	Radial Electrolytic Capacitor 100 μF x 25 V (85049)	C18, 21
01.03.0043-21	Radial Electrolytic Capacitor 100 μF x 35 V (85049)	C2, C16, C22
01.03.0044-21	Radial Electrolytic Capacitor 220 μF x 10 V (85049)	C19, 20, 23
01.02.0103-21	Resistor 68R1 1%	R10
01.02.0083-21	Resistor 20K 5%	R11
01.02.0080-21	Resistor 4K7 5%	R8, 12
01.02.0109-21	Resistor 3K 5%	R13
01.02.0110-21	Resistor 27K 5%	R14
01.02.0123-21	Resistor 0R22 5%	R15
01.02.0075-21	Resistor 1K 5%	R16, 24
01.02.0074-21	Resistor 470R 5%	R17, 18, 22, 23
01.02.0108-21	Resistor 15K4 1%	R19
01.02.0082-21	Resistor 10K 5%	R5, 20, 21
01.02.0124-21	Resistor 4K99 5%	R3
01.02.0070-21	Resistor 4R7 5%	R6
01.02.0116-21	Resistor 18K 5%	R7
01.02.0106-21	Resistor 150K 5%	R9
01.02.0075-21	Resistor 1K 5%	between Collector (Q1) and Base (Q2)
01.06.0006-21	Transformer for source - 24 Vdc	T1 / 24 V
01.06.0004-21	Coil	L1
01.13.0004-21	Connector MCI 21J02	CN1, 2, 3, 4, 5, 6, 7, 8
	Jumper	R1, R4, D4

CPU Circuit Board

Code	Components	Reference
01.05.0048-20	CPU Circuit Board	-
01.01.0007-21	LM 311	U18
01.01.0009-21	LM 555	U3
01.01.0016-21	EPROM 27C512	U7
01.01.0017-21	RAM 6516	U6
01.01.0018-21	E2PROM X24C04P	U1
01.01.0019-21	4051	U14
01.01.0020-21	Presys SY-02	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
01.01.0025-21	Presys SY-01	U4
01.01.0026-21	AD706	U16
01.01.0027-21	Presys SY-03	U17
01.16.0001-11	Crystal 11.0592 MHz	X1
01.09.0015-21	Transistor BC 337	Q1
01.09.0013-21	Transistor BC 327	Q2, 3, 4
01.04.0003-21	Diode 1N4148	D1, 2
01.04.0005-21	Reference Diode LM336/5 V	Z1

Code	Components	Reference
01.04.0006-21	Zener BZX 79/C6V2	Z2
01.03.0034-21	Disk Ceramic Capacitor 30 pF x 60 V (4 mm)	C18, C19
01.03.0035-21	Multilayer Ceramic Capacitor 0.1 μF x 63 V (VP 42 UMA)	C1, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15, 16, 20, 21, 22, 24, 25, 27, 29, 30, 32, 33, 34, 35, 36, 37, 38, 41, 42, 43, 44
01.03.0036-21	Multilayer Ceramic Capacitor 0.01 μF x 63 V (VP 42 UMA)	C14
01.03.0037-21	Polyester Capacitor 0.1 μF x 100 V - J(5%) (5140)	C3, 39
01.03.0038-21	Radial Electrolytic Capacitor 10 μF x 16 V (85700)	C17, 28, 23, 26, 31
01.03.0027-21	Radial Electrolytic Capacitor 100 μF x 25 V (85049)	C40
01.02.0084-21	Resistor 22K 5%	R1
01.02.0082-21	Resistor 10K 5%	R10, 13, 14, 15, 18, U10(3x)
01.02.0038-21	Resistor 10K 1%	R2, 3, 20
01.02.0089-21	Resistor 1M 5%	R11, 12, 16, 17
01.02.0019-21	Resistor 1K 1%	R6
01.02.0075-21	Resistor 1K 5%	R19, 22, 30
01.02.0010-21	Resistor 100R 1%	R21, 29
01.02.0102-21	Resistor 442R 1%	R23
01.02.0103-21	Resistor 68R1 1%	R24
01.02.0104-21	Resistor 3K32 1%	R25
01.02.0046-21	Resistor 40K2 1%	R26
01.02.0036-21	Resistor 8K66 1%	R28
01.02.0098-21	Resistor 10M 5%	R31, 33
01.02.0013-21	Resistor 249R 1%	R32, 34
01.02.0086-21	Resistor 100K 5%	R4
01.02.0092-21	Resistor 2M2 5%	R5
01.02.0078-21	Resistor 2K 5%	R27
01.02.0031-21	Resistor 4K99 1%	R7, 8, 9
01.17.0002-21	Jumper MKB 0020D (w/o stem)	Selected
01.17.0003-21	Bar MSO 22J04	J1-J4, J5-J8
01.18.0001-21	Socket SPT 0BC14	U7
01.13.0005-21	Connector MCI 21J03	CN1, CN2
01.14.0006-21	Flat-Cable 12 ways	FC3
01.14.0007-21	Flat-Cable 14 ways	FC2
01.14.0007-21	Flat-Cable 14 ways	FC1

I/O Terminal Board

Code	Components	Reference
01.05.0049-20	I/O Terminal Board	-
01.01.0032-21	AD 592	U1
01.13.0002-21	Terminal TS 504-3	C1, 2
01.13.0003-21	Female Connector 26 - ES31B213	P1, 2

Analog Output Board

Code	Components	Reference
01.05.0055-20	Analog Output Board	-

Code	Components	Reference
01.01.0026-21	AD 706	U2
01.01.0031-21	Optical Coupler 2501	U1, 3
01.09.0006-21	TIP 117	Q1
01.09.0015-21	Transistor BC 337	Q2
01.09.0021-21	Transistor BF 245A	Q3
01.04.0009-21	Zener BZX79/C2V4	Z1
01.04.0011-21	Zener BZX79/C3V9	Z3
01.04.0005-21	Reference Diode LM 336/5.0 V	Z2, Z4
01.03.0042-21	Radial Electrolytic Capacitor 22 μF x 25 V (85049)	C1
01.03.0050-21	Tantalum Capacitor 1 μF x 35 V	C2, 3
01.02.0080-21	Resistor 4K7 5%	R1
01.02.0024-21	Resistor 2K 1%	R9
01.02.0038-21	Resistor 10K 1%	R3
01.02.0013-21	Resistor 249R 1%	R10, 11
01.02.0008-21	Resistor 49R9 1%	R4
01.02.0010-21	Resistor 100R 1%	R5
01.02.0069-21	Resistor 1M 1%	R6
01.02.0047-21	Resistor 49K9 1%	R7, 8
01.02.0059-21	Resistor 301K 1%	R12
01.02.0115-21	Resistor 402R 1%	R13
01.02.0121-21	Resistor 3K3 1%	R14
01.02.0029-21	Resistor 4K02 1%	R2
01.17.0001-21	Bar MS0 22J02	J1 and J2
01.17.0004-21	Bar MSP 22J02	CN1, CN2
01.17.0002-21	Jumper MKB (w/o stem) 0020D	Selected
01.06.0004-21	Coil	-

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
01.03.0041-21	Polyester Capacitor 0.01 μF x 250 V (5141)	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 (NEC)	K1
01.17.0004-21	Bar MSP 22J02	CN3, 4

4.7 - Recommended Spare Parts Listing

Power Supply Board

IRF 822	Q3	CPU Board	
UC 3842	U1	4051	U14
Fuse 1 A	F1	Presys SY-02	U15
LM 1458N	U2	Reference Diode LM-336/5 V	Z1

I/O Terminal Board

AD 592	U1

Technical Manual

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