TT302 - smar FIRST IN FIELDBUS

OPERATION & MAINTENANCE
INSTRUCTION MANUAL

FIELDBUS TEMPERATURE TRANSMITTER

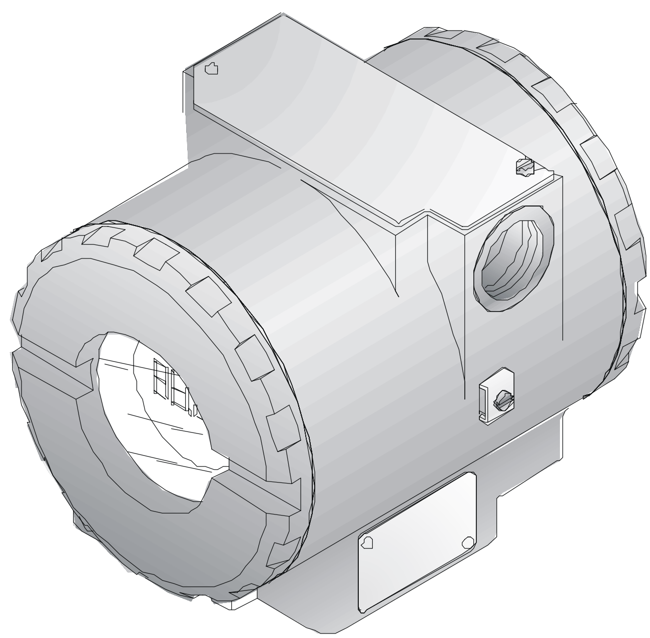

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Table of Contents

Introduction

The **TT302** is from the first generation of FIELDBUS devices. It is a transmitter mainly intended for measurement of temperature using RTDs or thermocouples, but can also accept other sensors with resistance or mV output such as: pyrometers, load cells, resistance position indicators, etc. The digital technology used in the **TT302** enables a single model to accept several types of sensors, an easy interface between the field and the control room and several others features that considerably reduces the installation, operation and maintenance costs.

FIELDBUS is not only a replacement for 4-20 mA or intelligent/smart transmitter protocols. It contains much more. FIELDBUS is a complete system enabling distribution of the control function to equipment in the field.

Some advantages of bi-directional digital communications are known from existing smart transmitter protocols: higher accuracy, multivariable access, remote configuration and diagnostics and multi-dropping of several devices on a single pair of wires. These protocols were not intended to transfer control data, but maintain information. Therefore they were slow and not efficient enough to be used.

The main requirements for Fieldbus were to overcome these problems. Closed loop control with performance like a 4-20 mA system requires higher speed. Since higher speed means higher power consumption, this clashes with the need for intrinsic safety. Therefore a moderately high communication speed was selected, and the system was designed to have minimum communication overhead. Using scheduling, the system controls the variable sampling, the algorithm execution and the communication to optimize the usage of the network, thus achieving high closed loop performance.

Using Fieldbus technology, with its capability to interconnect several devices, very large control schemes can be constructed. In order to be user friendly, the function block concept was introduced (users of SMAR CD600 should be familiar with this, since it was implemented several years ago). The user may now easily build and overview complex control strategies. Another advantage is adding flexibility, the control strategy may be edited without having to rewire or change any hardware.

Now, thanks to Fieldbus, the transmitter accepts two channels, i.e., two measurements. This reduces the cost per channel. Other function blocks are also available. They allow flexibility in control strategy implementation.

The need for Fieldbus implementation in small as well as large systems was considered when developing the entire 302 line of Fieldbus devices. They have the common features of being able to act as a master on the network.

Get the best result of the TT302 by carefully reading these instructions.

WARNING

This Manual is compatible with version 3.XX, where 3 denote software version and XX software release. The indication 3.XX means that this manual is compatible with any release of software version 3.

Section 1

Installation

General

The overall accuracy of temperature and other measurements depends on several variables. Although the transmitter has an outstanding performance, proper installation is essential in order to maximize its performance.

Among all factors which may affect transmitter accuracy, environmental conditions are the most difficult to control. There are, however, ways of reducing the effects of temperature, humidity and vibration.

Locating the transmitter in areas protected from extreme environmental changes can minimize temperature fluctuation effects.

In warm environments, the transmitter should be installed in such a way as to avoid, as much as possible, direct exposure to the sun. Installation close to lines and vessels subjected to high temperatures should also be avoided. For temperature measurements, sensors with cooling-neck can be used or the sensor can be mounted separately from the transmitter housing.

Use of sunshades or heat shields to protect the transmitter from external heat sources should be considered.

Humidity is fatal for electronic circuits. In areas subjected to high relative humidity, the O-rings for the electronic housing covers must be correctly placed and the covers must be completely closed by tightening them by hand until you feel the O-rings being compressed. Do not use tools to close the covers. Removal of the electronics cover in the field should be reduced to the minimum necessary, since each time it is removed, the circuits are exposed to humidity. The electronic circuit is protected by a humidity proof coating, but frequent exposure to humidity may affect the protection provided. It is also important to keep the covers tightened in place. Every time they are removed, the threads are exposed to corrosion, as painting cannot protect these parts. Code-approved sealing methods should be employed on conduit entering the transmitter.

Connecting the sensor as close to the transmitter as possible and using proper wires (See Section 2 Operation), can decrease measurement error.

Mounting

The transmitter may be mounted in two basic ways:

- Separated from the sensor, using optional mounting brackets.
- Mounted on the sensor assembly.

It can be mounted in several different positions using the bracket, as shown in Figure 1.3 - Dimensional Drawing and Mounting Positions. You can also see in the Figure 1.3 how the conduit inlets for electrical connection are used to mount the sensor integral to the temperature transmitter.

For better visibility, the digital display may be rotated in steps of 90º. (See Figure 4.1 – Four Possible Positions of the Display).

Network Wiring

Access the terminal block by removing the Electrical Connection Cover. This cover can be locked closed by the cover locking screw (See Figure 1.1 - Cover Locking).To release the cover, rotate the locking screw clockwise.

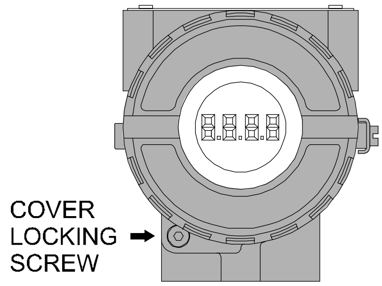

Figure 1.1 - Cover Locking

Cable access to wiring connections are obtained by one of the two conduit outlets. Conduit threads should be sealed by means of code-approved sealing methods. **The unused outlet connection should be plugged accordingly.**

The wiring block has screws on which fork or ring type terminals can be fastened. (See Figure 1.2 - Ground Terminals).

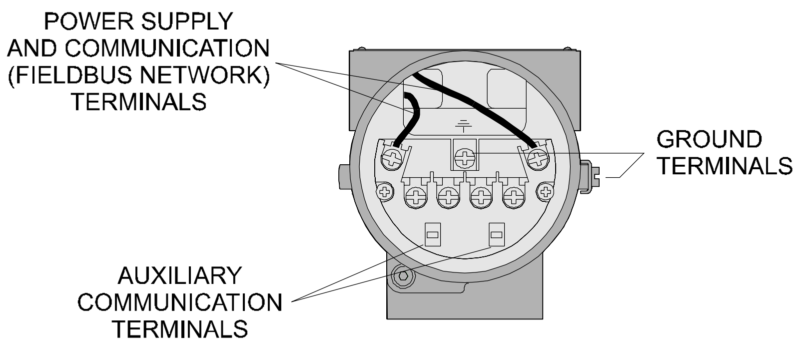

Figure 1.2 - Ground Terminals

For convenience, there are three ground terminals: one inside the cover and two externally, located close to the conduit entries.

WARNING
Do not connect the Fieldbus network wires to the sensor terminals. (Terminals 1, 2, 3 and 4).

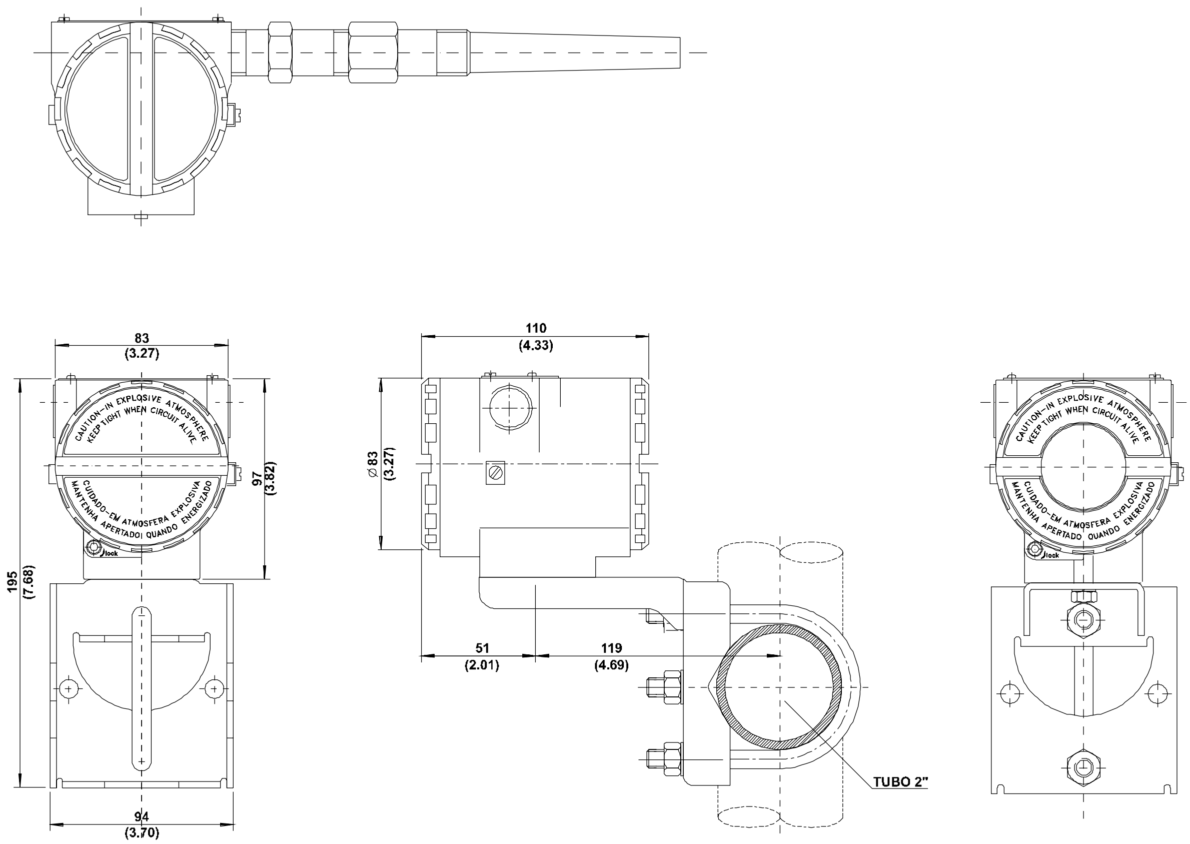

Figure 1.3 - Dimensional Drawing and Mounting Positions

The **TT302** uses the 31.25-kbit/s voltage mode option for the physical signaling. All other devices on the same bus must use the same signaling. All devices are connected in parallel along the same pair of wires.

Various types of Fieldbus devices may be connected on the same bus. The **TT302** is powered via the bus. The limit for such devices is 16 for one bus for non-intrinsically safe requirement.

In hazardous areas, the number of devices may be limited to 6 devices by intrinsically safe restrictions.

The **TT302** is protected against reverse polarity, and can withstand ±35 VDC without damage.

Use of twisted pair cables is recommended. It is also recommended to ground shield of shielded cables at one end only. The non-grounded end must be carefully isolated.

NOTE

Please refer to the General Installation, Operation and Maintenance Manual for more details.

Bus Topology and Network Configuration

Special requirements are applied to the terminator when used in a safety bus.
When intrinsic safety is required, a barrier should be inserted on the trunk between the power supply and the terminator.
The barrier's impedance should be greater than 460 Ω at 7.8 to 39 kHz.
The capacitance measured on both ends should not have a difference greater than 250pF from each other.
The DF47 is recommended.

WARNING

HAZARDOUS AREAS
In hazardous areas with explosion proof requirements, the covers must be tightened with at least 8 turns. In order to avoid the penetration moisture or corrosive gases, tighten the O'ring until feeling it touching the housing. Then, tighten more 1/3 turn (120°) to guarantee the sealing. Lock the covers using the locking screw.

In hazardous zones with intrinsically safe or non-incendive requirements, the circuit entity parameters and applicable installation procedures must be observed.

Cable access to wiring connections is obtained by the two conduit outlets. Conduit threads should be sealed by means of code-approved sealing methods. The unused outlet connection should be plugged and sealed accordingly.

Should other certifications be necessary, refer to the certification or specific standard for installation limitations.

The connection of couplers should be kept at less than 15 per 250 m.

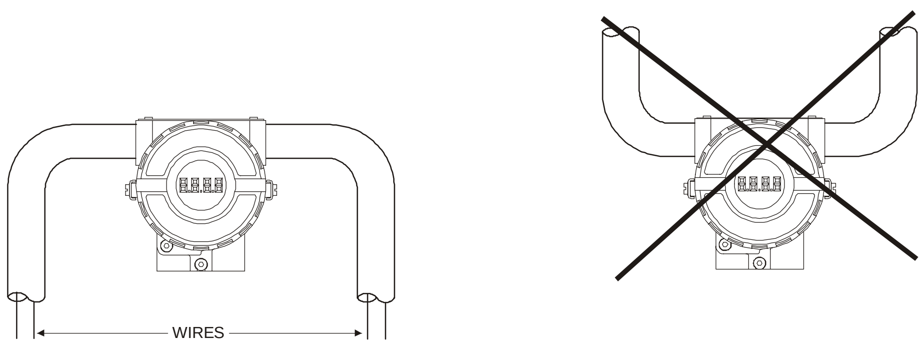

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Figure 1.4 - Bus Topology

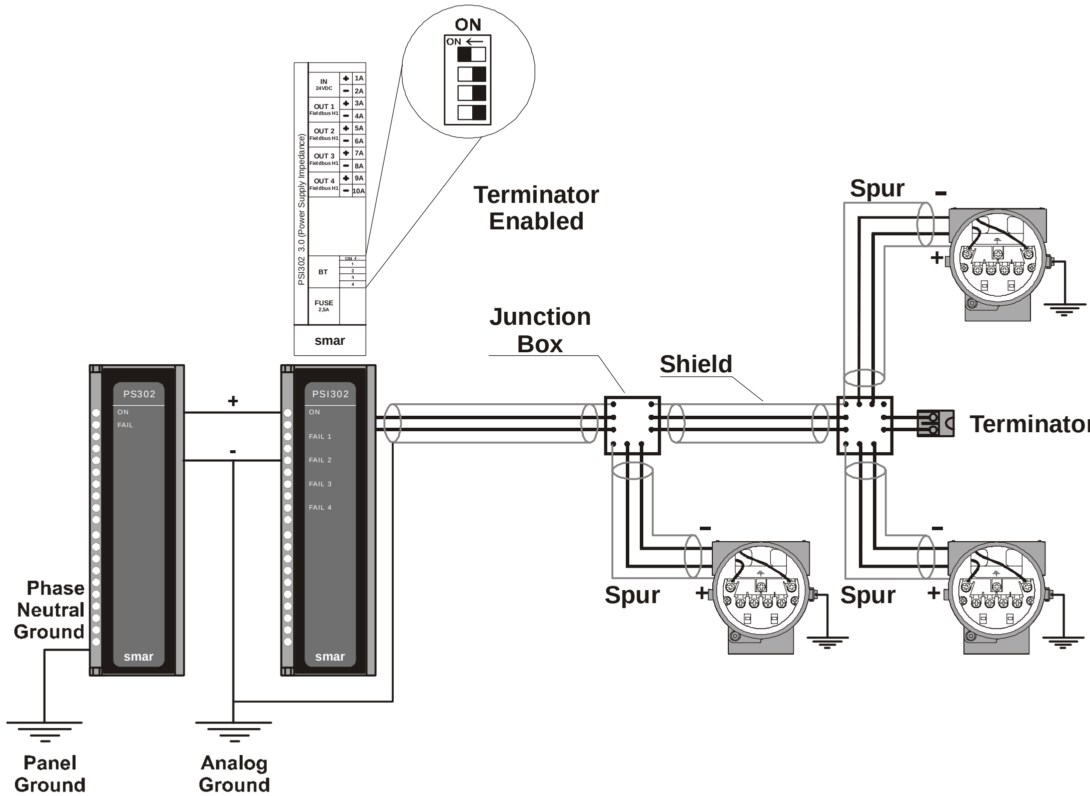


Figure 1.5 - Bus Topology

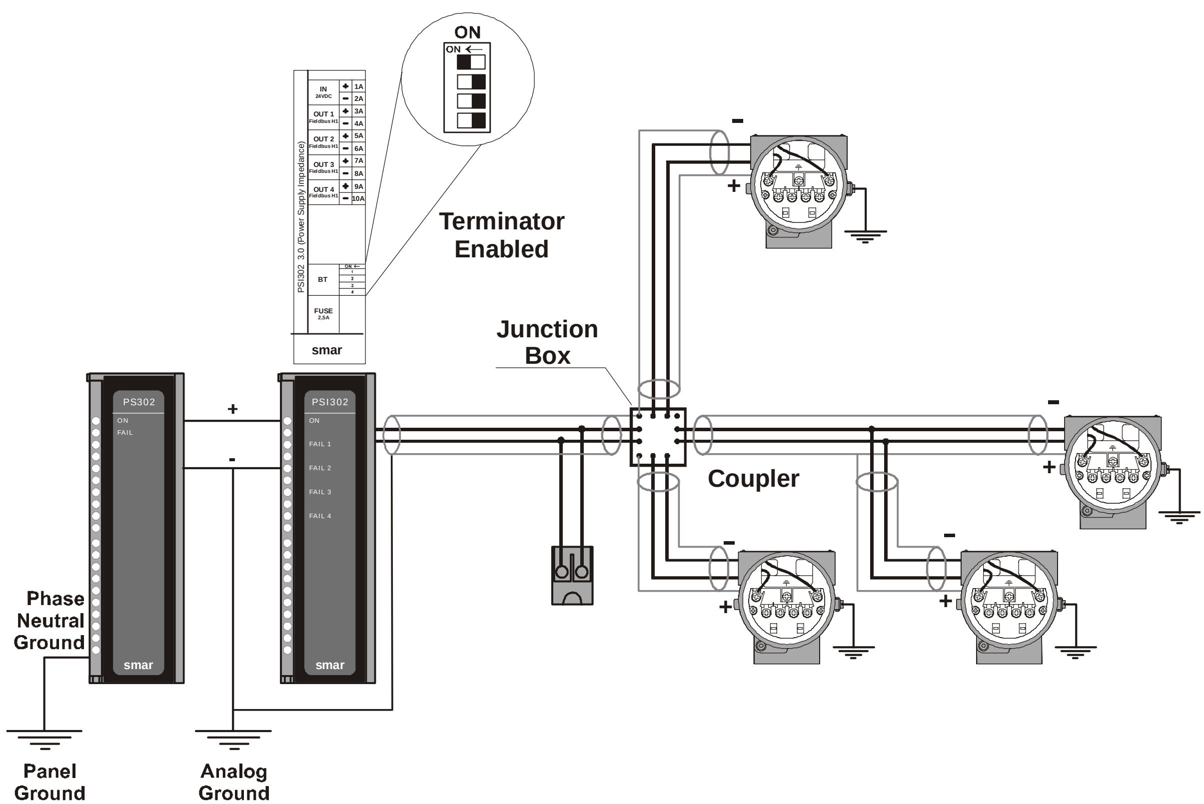


Figure 1.6 - Bus Topology

Section 2

Operation

The **TT302** accepts signals from mV generators such as thermocouples or resistive sensors such as RTDs. The criterion is that the signal is within the range of the input. For mV, the range is -50 to 500 mV and for resistance, 0-2000 Ohm.

Functional Description – Hardware

The function of each block is described below.

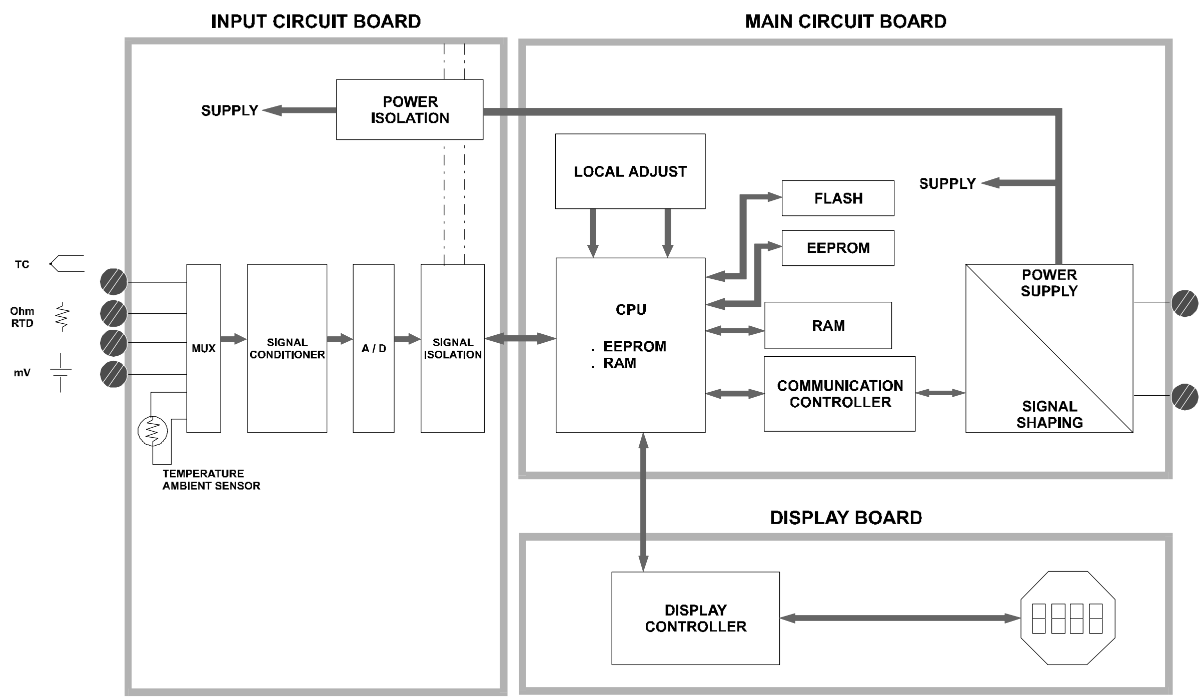


Figure 2.1 - TT302 Block Diagram

MUX Multiplexer
The MUX multiplexes the sensor terminals to the signal conditioning section ensuring that the voltages are measured between the correct terminals.

Signal Conditioner
Its function is to apply the correct gain to the input signals to make them suit the A/D - converter.

A/D Converter
The A/D converts the input signal to a digital format for the CPU.

Signal Isolation
Its function is to isolate the control and data signal between the input and the CPU.

(CPU) Central Processing Unit, RAM, PROM and EEPROM
The CPU is the intelligent portion of the transmitter, being responsible for the management and operation of measurement, block execution, self-diagnostics and communication. The program is stored in a PROM. For temporary storage of data there is a RAM. The data in the RAM is lost if the power is switched off. However there is a nonvolatile EEPROM where data that must be retained is stored. Examples, of such data are trim, calibration, block configuration and identification data.

Communication Controller
It monitors line activity, modulates and demodulates communication signals and inserts and deletes start and end delimiters.

Power Supply
Takes power of the loop-line to power the transmitter circuitry.

Power Isolation
Just like the signals to and from the input section, the power to the input section must be isolated. Isolation is achieved by converting the DC supply into a high frequency AC supply and galvanically separating it using a transformer.

Display Controller
Receives data from the CPU informing which segments of the Liquid Crystal Display, should be turned on.

Local Adjustment
There are two switches that are magnetically activated. They can be activated by the magnetic tool without mechanical or electrical contact.

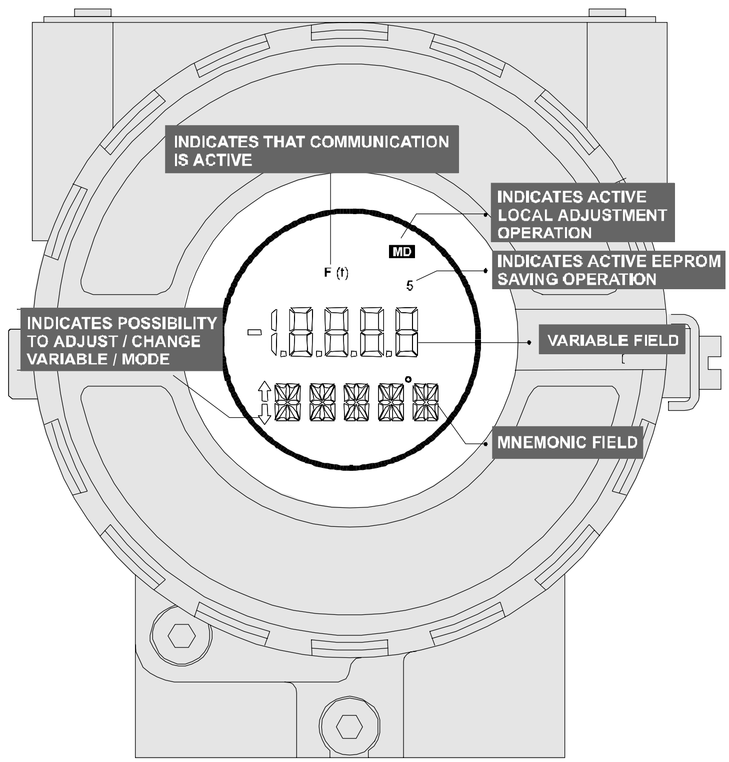


Figure 2.2 - LCD Indicator

Temperature Sensors

The **TT302**, as previously explained, accepts several types of sensors. The **TT302** is specially designed for temperature measurement using thermocouples or Resistive Temperature Detectors (RTDs).

Some basic concepts about these sensors are presented below.

Thermocouples
Thermocouples are constructed with two wires made from different metals or alloys joined at one end, called measuring junction or "hot junction". The measuring junction should be placed at the point of measurement. The other end of the thermocouple is open and connected to the temperature transmitter. This point is called reference junction or cold junction.

For most applications, the **Seebeck** effect is sufficient to explain thermocouple behavior as following:

How the Thermocouple Works (Seebeck Effect)
When there is a temperature difference along a metal wire, a small electric potential, unique to every alloy, will occur. This phenomenon is called *Seebeck* effect. When two wires of dissimilar metals are joined at one end, and left open at the other, a temperature difference between the two ends will result in a voltage since the potentials generated by the dissimilar materials are different and do not cancel each other out. Now, two important things must be noted. First: the voltage generated by the thermocouple is proportional to the difference between the measuring-junction and the cold junction temperatures. Therefore the temperature at the reference junction must be added to the temperature derived from the thermocouple output, in order to find the temperature measured. This is called cold junction compensation, and is done automatically by the **TT302**, which has a temperature sensor at the sensor terminals for this purpose. Secondly, if the thermocouple wires are not used, all the way to the terminals of the transmitter (e.g., copper wire is used from sensor-head or marshaling box) will form new junctions with additional Seebeck effects. It will be created and ruin the measurement in most cases, since the cold-junction compensation will be done at the wrong point.

NOTE

Use thermocouple wires or appropriate extension wires all the way from sensor to transmitter.

The relation between the measuring junction temperature and the generated mili-voltage is tabulated in thermocouple calibration tables for standardized thermocouple types, the reference temperature being 0 ºC.

Standardized thermocouples that are commercially used, whose tables are stored in the memory of the **TT302**, are the following:

- NBS (B, E, J, K, N, R, S & T)
- DIN (L & U)

Resistive Temperature Detectors (RTDs)
Resistance Temperature Detectors, most commonly known as RTD's, are based on the principle that the resistance of metal increases as its temperature increases.
Standardized RTDs, whose tables are stored in the memory of the **TT302**, are the following:

- JIS [1604-81] (Pt50 & Pt100)
- IEC, DIN, JIS [1604-89] (Pt50, Pt100 & Pt500)
- GE (Cu10)
- DIN (Ni120)

For correct measurement of RTD temperature, it is necessary to eliminate the effect of the resistance of the wires connecting the sensor to the measuring circuit. In some industrial applications, these wires may be hundreds of meters long. This is particularly important at locations where the ambient temperature changes constantly.

The **TT302** permits a 2-wire connection that may cause measuring errors, depending on the length of connection wires and on the temperature to which they are exposed. (See Figure 2.3 - Two-Wire Connection).

In a 2-wire connection, the voltage V2 is proportional to the RTD resistance plus the resistance of the wires.

V2 = [RTD + 2 x R] x I

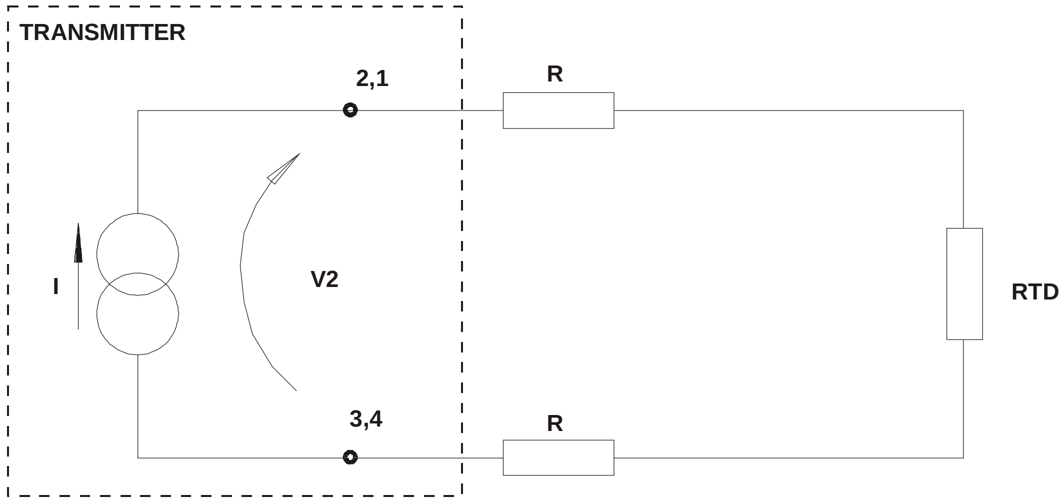


Figure 2.3 - Two-Wire Connection

In order to avoid the resistance effect of the connection wires, it is recommended to use a 3-wire connection (See Figure 2.4 – Three-Wire Connection) or a 4-wire connection (See Figure 2.5 - Four - Wire Connection).

In a 3-wire connection, terminal 3 is a high impedance input. Thus, no current flows through that wire and no voltage drop is caused. The voltage V2-V1 is independent of the wire resistances since they will be cancelled, and is directly proportional to the RTD resistance alone.

V2-V1 = [RTD + R] x I - R x I = RTD x I

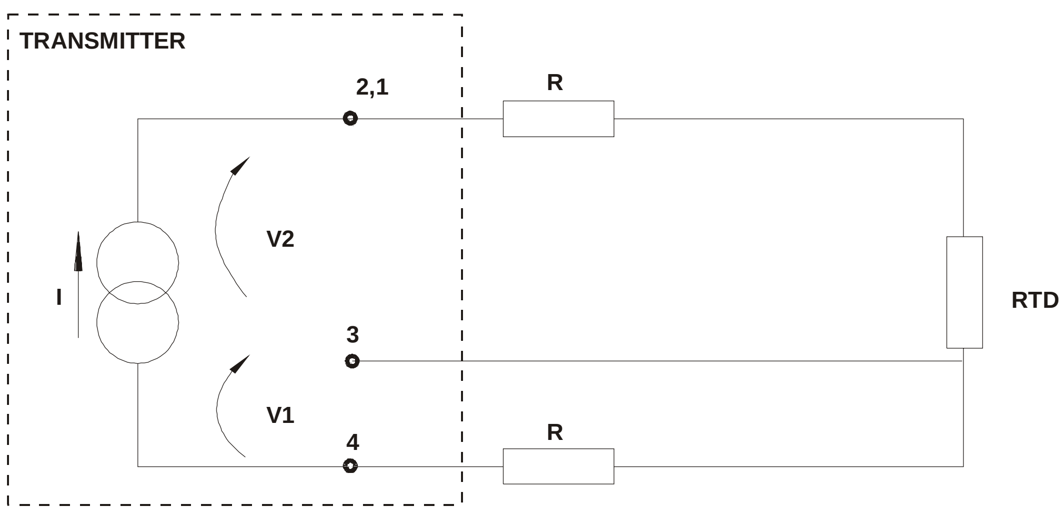


Figure 2.4 - Three – Wire Connection

In a 4-wire connection, terminals 2 and 3 are high impedance inputs. Thus, no current flows through those wires and no voltage drop is caused. The resistance of the other two wires is not of interest, since there is no measurement registered on them. Hence the voltage V2 is directly proportional to the RTD resistance.
(V2 = RTD x I)

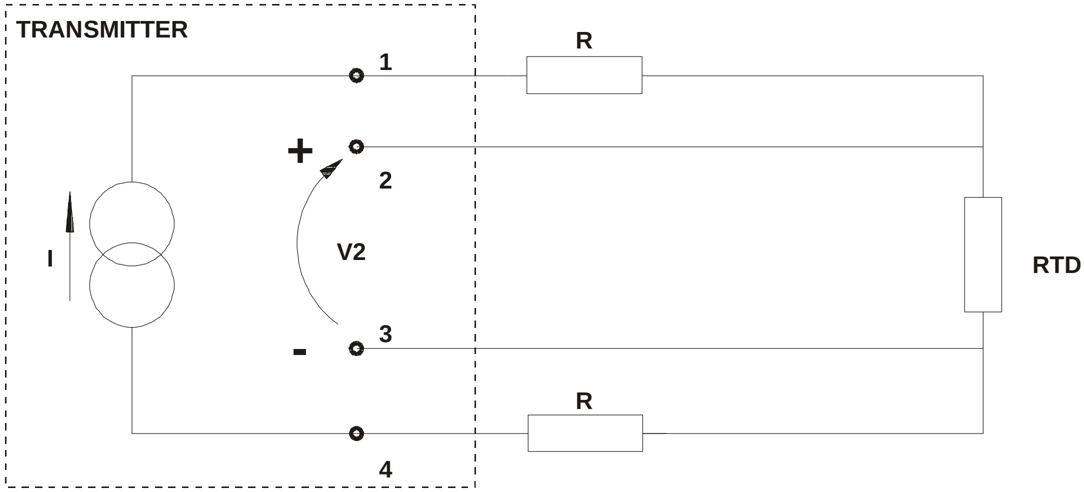


Figure 2.5 - Four - Wire Connection

A differential or dual channel connection is similar to the two-wire connection and gives the same problem (See Figure 2.6 - Differential or Dual Connection). The resistance of the wires will be measured and do not cancel each other out in a temperature measurement, since linearization will affect them differently.

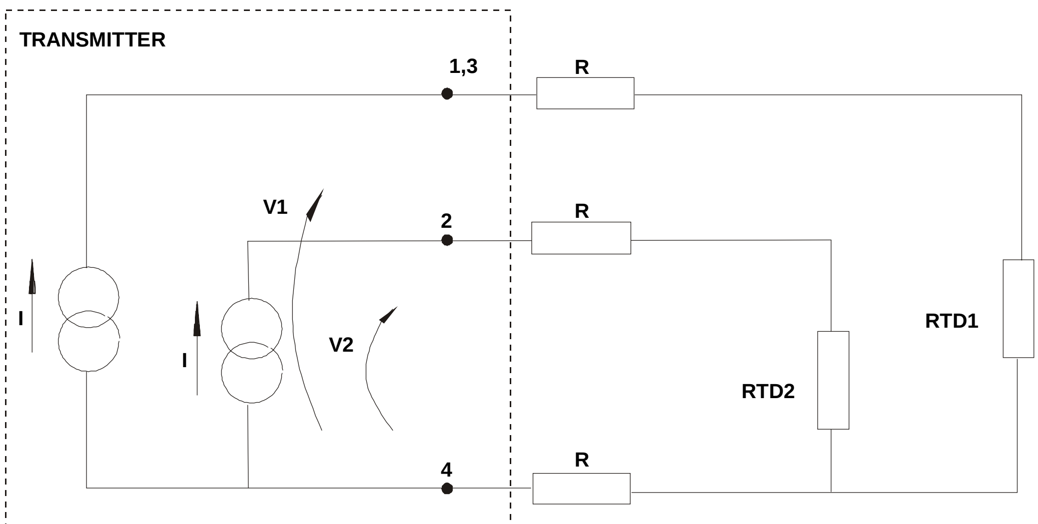


Figure 2.6 - Differential or Dual Connection

Section 3

Configuration

One of the many advantages of Fieldbus is that device configuration is independent of the configurator. The **TT302** may be configured by a third party terminal or console operator. Any particular configurator is therefore not addressed here.

The **TT302** contains two input transducer blocks, one resource block, one display transducer block and other function blocks.

For explanation and details of function blocks, see the “Function Blocks Manual”.

Transducer Block

Transducer block insulates function blocks from the specific I/O hardware (sensors and actuators). The transducer block controls the access to I/O through manufacturer specific implementation. This allows the transducer block to be executed as frequently as necessary to obtain good data from sensors without burdening the function blocks that uses the data. It also insulates the function blocks from the manufacturer specific characteristics of certain hardware.

By accessing the hardware, the transducer block can get data from the I/O or pass control data to it. The connection between Transducer block and Function block is called channel. These blocks can exchange data through the interface.

Normally, transducer blocks perform functions, such as linearization, characterization, temperature compensation and control of data exchange with the hardware.

How to Configure a Transducer Block

The transducer block has an algorithm, a set of contained parameters (it means you are not able to link these parameters to other blocks or publish the link via communication), and a channel connecting it to a function block.

The algorithm describes the behavior of the transducer as a data transfer function between the I/O hardware and other function block. The set of contained parameters defines the user interface to the transducer block. They can be divided into Standard and Manufacturer Specific.

The standard parameters are defined specifically to each device class such as, pressure, temperature, etc., no matter is the manufacturer. Oppositely, the manufacturers specific are only defined by the manufacturer. As common manufacturer specific parameters, we have calibration settings, material information, linearization curve, etc.

When you perform a standard routine such as calibration, you are conducted step by step by a method. The method is generally defined as guideline to help the user make common tasks. **SYSCON** identifies each method associated to the parameters and enables the interface to it.

Sensor Transducer Number

The Sensor Transducer Number associates the sensor to the transducer. It can be set from one up to two, in case of dual sensor.

Sensor Wiring

The **TT302** accepts up to two sensors and may operate in one of four modes:

- Single channel single sensor measurement
- Dual channel dual sensor measurement
- Single channel dual sensor differential measurement.
- Single channel dual sensor backup measurement.

When the sensor is dual, the sensor connected between terminals 3 and 4 is associated with the first transducer, and the sensor connected between terminals 2 and 4 is associated with the second transducer.

NOTE
Avoid routing sensor wiring close to power cables or switching equipment.

In accordance with connection and sensor types, the terminal blocks shall be wired as shown in figure below (See Figure 3.1 - Sensor Wiring).

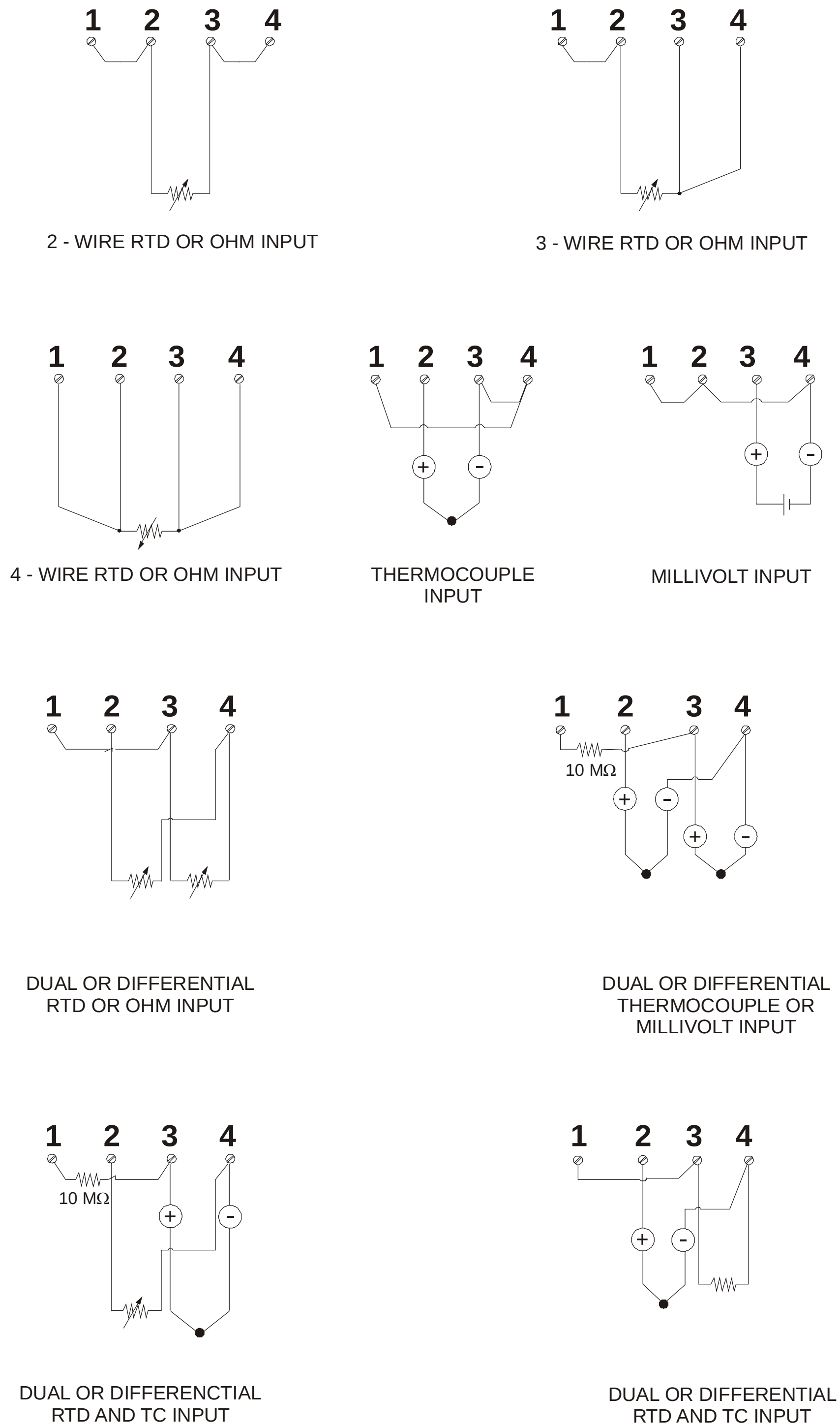


Figure 3.1 - Sensor Wiring

Jumper Configuration

In order to work properly, the jumpers J1 and J3 located in the **TT302** main board must be correctly configured.

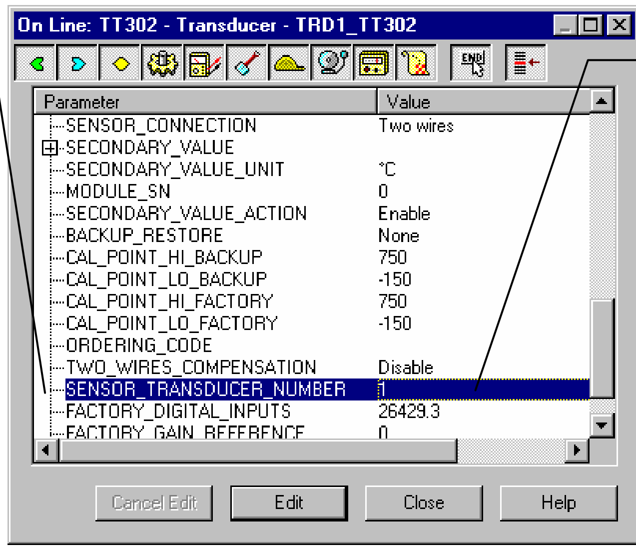
J1 is responsible to enable the AI block simulate mode.

W1 is responsible to enable the local adjustment.

Sensor Configuration

It is necessary to configure the transducer number allocated to its task. The parameter SENSOR_TRANSDUCER_NUMBER should be set to 1.

This parameter sets the transducer number, according to the type of temperature measurement.

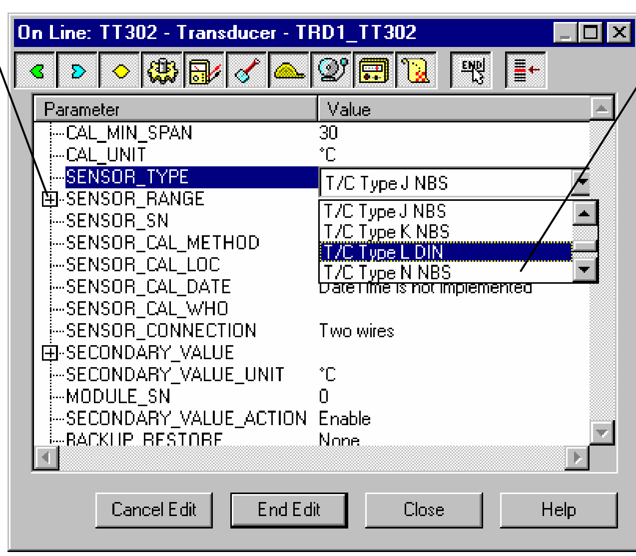


This parameter could be 1 or 2, for indicating respectively first or second transducers.

Figure 3.2 – Transducer Number Configuration

It is possible to configure the type of connection and sensor by means of SENSOR_TYPE and SENSOR_CONNECTION parameters. The connection and sensor types available are listed in Table 3.1 - Sensor Type Table and Table 3.2 - Type of Connection Table, as well as the corresponding value.

This parameter selects the type of sensor connection. The options here will depend on Sensor Type chosen as described above.



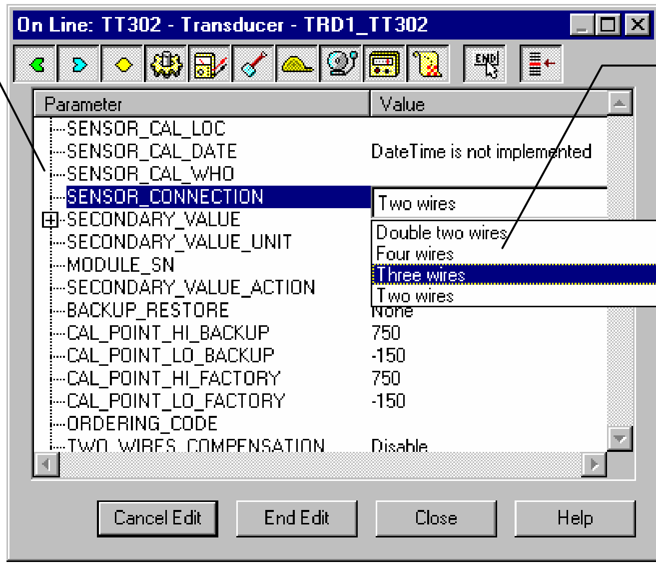
This list contains:

Thermocouples, RTDs, Ohm and millivoltage.

Figure 3.3 – Sensor Type Configuration

NOTE
There are no 3 or 4 wire connections for millivoltage sensors.

This parameter selects the type of sensor attached to the **TT302** in order to measure temperature.



This list contains the number of wires available for each type of sensor.

Figure 3.4 – Sensor Type Connection Configuration

SENSOR_TYPE	ADJUST LOCAL VALUE
Pt 100 IEC	**128**
Pt 100 JIS	**129**
Pt 500 IEC	**131**
Ni 120 DIN	**132**
Cu 10 CE	**133**
Pt 50 IEC	**170**
Pt 50 JIS	**171**
Ohm 100	**181**
Ohm 400	**180**
Ohm 2,000	**104**
TC B NBS	**134**
TC E NBS	**136**
TC J NBS	**137**
TC K NBS	**138**
TC N NBS	**139**
TC R NBS	**140**
TC S NBS	**141**
TC T NBS	**142**
TC L DIN	**143**
TC U DIN	**144**
mV 22	**191**
mV 100	**190**
mV 500	**103**

Table 3.1 - Sensor Type Table

CONNECTION	ADJUST LOCAL VALUE
DOUBLE TWO WIRE	**1**
TWO WIRE	**2**
THREE WIRE	**3**
FOUR WIRE	**4**

Table 3.2 - Type of Connection Table

How to Connect Two Sensors to TT302

Transmitters series **TT302** are capable of operating simultaneously with two sensors, using two transducer blocks, if necessary. Configuration types in two sensors operation are as follows:

Differential – In this case there is only one transducer. Transducer output is the difference between the readout of sensor 1 (between terminals 3 and 4) and the readout of sensor 2 (between terminals 2 and 4). The PRIMARY_VALUE_TYPE parameter should be configured as differential temperature.

Backup – In this case there is only one transducer.
When the first sensor (between terminals 3 and 4) breaks down, the second sensor (between terminals 2 and 4) will supply the signal to the transducer.

Double - In this case there are two transducers. Each sensor provides a signal to its respective transducer.

In order to be able to operate with sensors in the backup or differential modes, the parameter PRIMARY_VALUE_TYPE must be set. In order to operate with double sensors, the parameter SENSOR_CONNECTION must be set.

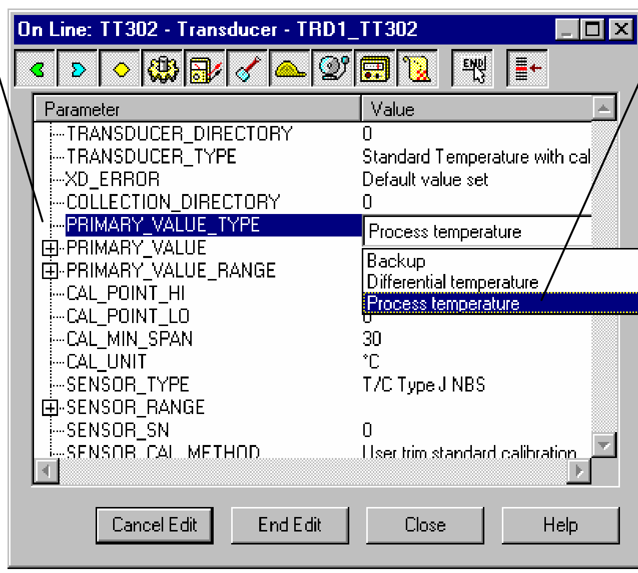


Figure 3.5 – Primary Variable Type Configuration

Compensation of Lead Resistance for Double Sensor (RTD or Ohm)

When 2-wire resistive sensors are used, the readout is not a very accurate because of the resistance of leads connecting sensor to transmitter. In order to reduce this error, it is possible to configure the transmitter to compensate for a constant lead resistance by means of parameter LEAD_RESISTANCE_VALUE.

Compensation of lead resistance for RTD or Ohm Double Sensors

As explained above, 2 – wire resistive sensors are not accurate due to lead resistance. For this reason, 3 or 4 wire sensors are usually preferred.

With **TT302** is possible to connect two sensors to the terminal block. Due to space limitations in the terminal block, it is only possible to connect two 2-wire sensors. In order to optimize lead resistance compensation for these sensors and to minimize error, there is the parameter TWO_WIRES_COMPENSATION that automatically calculates the lead resistance. All the user is required to do is to short-circuit the sensor in the field and to actuate this parameter (Enable). After undo the short-circuit the measurement will be more accuracy.

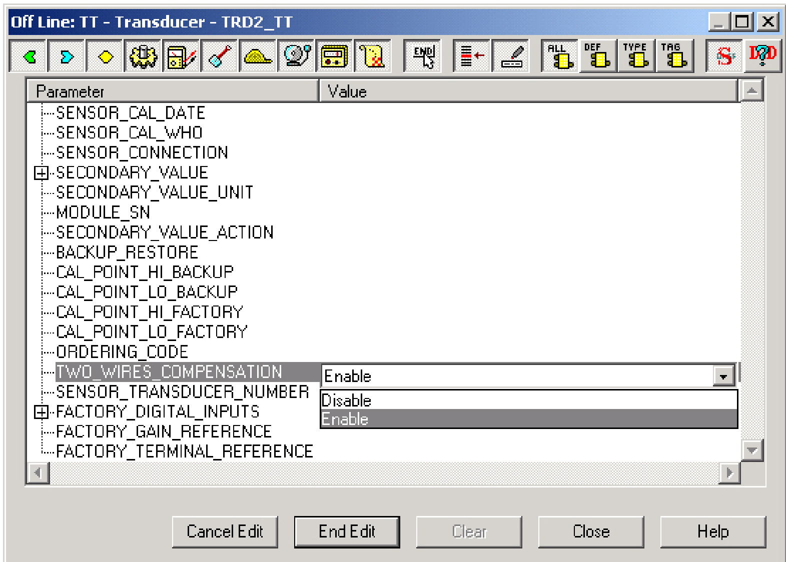


Figure 3.6 – Lead Resistance Compensation

Cold Junction Compensation

The cold junction compensation for thermocouple sensors is done automatically, but it can be disabled by writing DISABLE on the parameter SECONDARY_VALUE_ACTION.

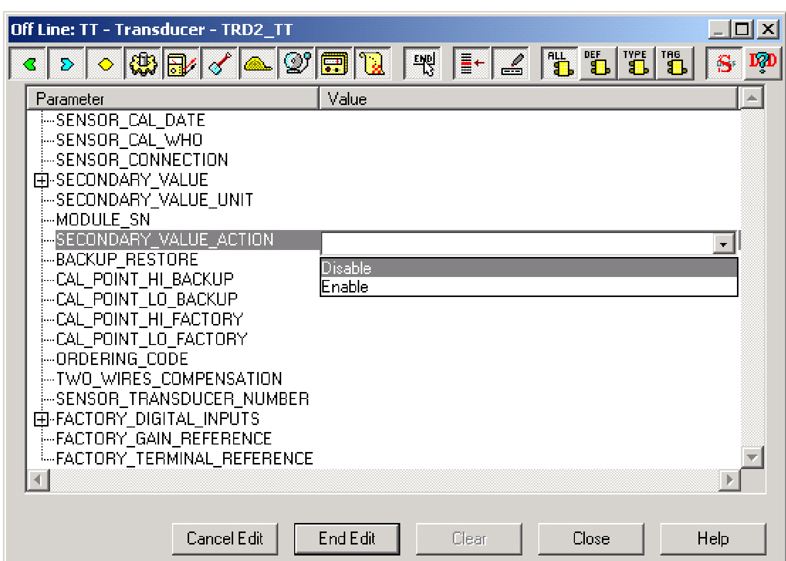


Figure 3.7 – Cold Junction Compensation

Calibration in TT302 by the User

The electronics of TT302 is very stable in time, not requiring further calibrations after manufacturer's calibration. However, if the client decides to use his reference to calibrate the TT302, this may be done through the parameters CAL_POINT_LO and CAL_POINT_HI. Always use two points as reference when trim is performed; never consider only one point as a reference.

NOTE
Every time the sensor is changed, the TRIM values are reset. If a TC is used, it is not necessary to disable the cold Junction Compensation before starting calibration procedures. Trim is not available for TT using two sensors and it is not necessary to set the Transducer Block to Out of Service.

The PRIMARY_VALUE parameter is always used to inform the current reading of the input sensor.

In order to do the Lower Trim, first put the sensor into a place with known temperature. If the PRIMARY_VALUE parameter shows a temperature different from the expected, the Lower trim should be done by writing the desired temperature in the CAL_POINT_LO parameter. The adjust trim results can be seen in the PRIMARY_VALUE parameter.

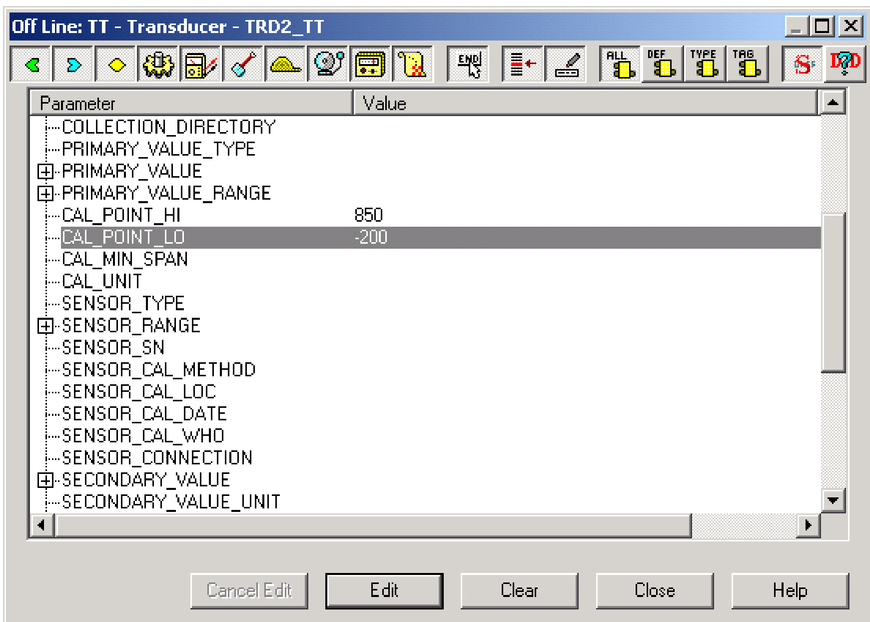


Figure 3.8 – Calibration of the Lower Trim - TT302

In order to do the Upper Trim, first put the sensor into a place with a higher temperature than the lower calibration point. If the PRIMARY_VALUE parameter shows a temperature different from the expected, the Upper trim should be done by writing the desired temperature in the CAL_POINT_HI parameter. The adjust trim results can be seen in the PRIMARY_VALUE parameter.

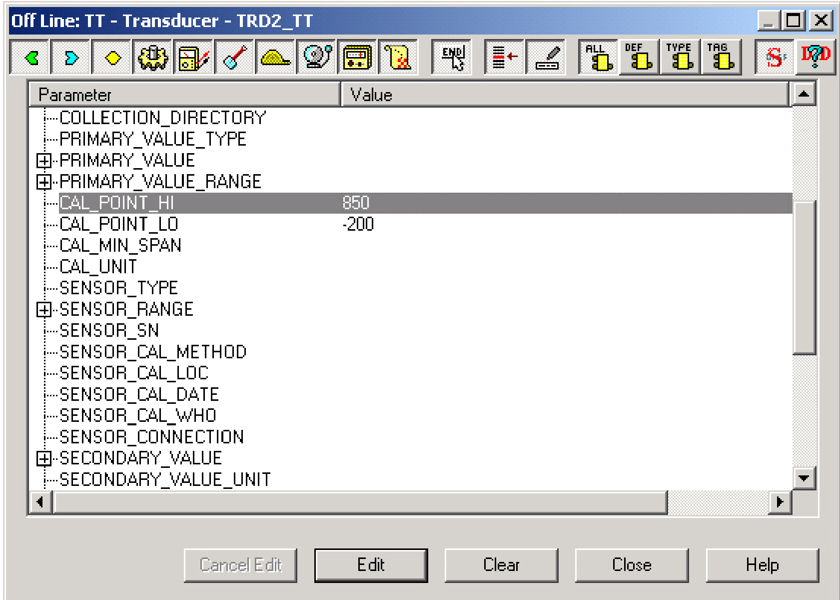


Figure 3.9 – Calibration of the Upper Trim - TT302

Trim is not available for TT302 using two sensors in the backup or differential mode.

Changing Units in Temperature Sensors

The following units are available for temperature sensors: Celsius, Rankine, Kelvin and Fahrenheit. The units values are shown in Table 3.3 - Unit Table.

The unit can be changed in the AI block by the parameter XD_SCALE.

UNIT	VALUE
KELVIN	1000
CELSIUS	1001
FAHRENHEIT	1002
RANKINE	1003

Table 3.3 - Unit Table

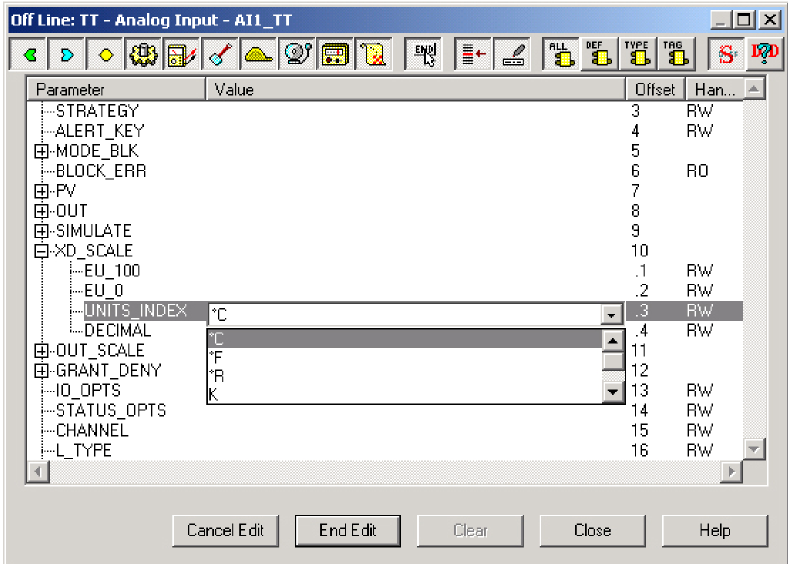


Figure 3.10 –Temperature Sensor Unit

Transducer Display – Configuration

Using the SYSCON is possible to configure the Display Transducer block. As the name described it is a transducer due the interfacing of its block with the LCD hardware.
The Transducer Display is treated as a normal block by **SYSCON**. It means, this block has some parameters can be configured according to customer's needs. (See the Figure 3.11 – Creating Transducers and Function Blocks).

The user can choose the parameters to be shown at LCD display, they can be parameters just for monitoring purpose or for acting locally in the field devices by using a magnetic tool.

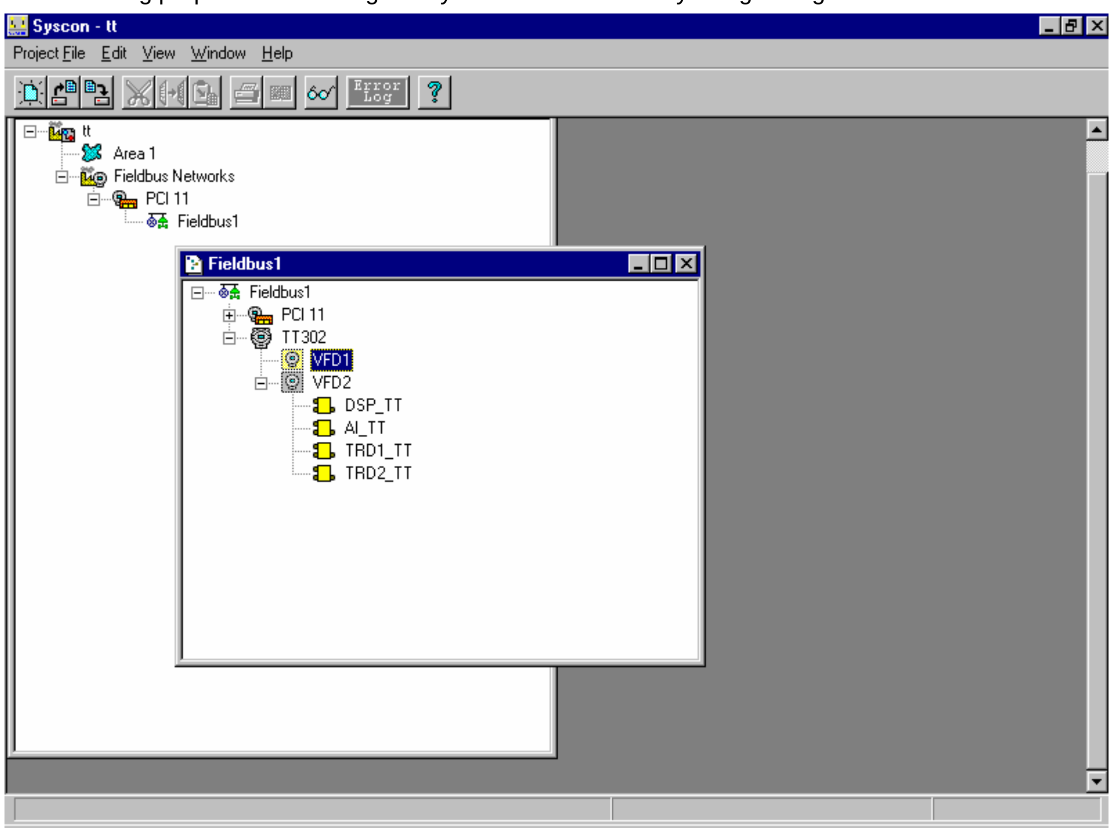


Figure 3.11 – Creating Transducers and Function Blocks

Display Transducer Block

There are seven groups of parameters which may be pre-configured by the user in order to enable a possible configuration by means of the local adjustment. As an example, let's suppose that you don't want to show some parameters; in this case, simply write an invalid Tag in the parameter. By doing this, the device will not take the parameters related (indexed) to its Tag as valid parameters.

Definition of Parameters and Values

Block_Tag_Param
This is tag of the block to which the parameter belongs. Use up to a maximum of 32 characters.

Index_Relative
This is the index related to the parameter to be actuated or viewed (0, 1, 2…). Refer to the "Function Blocks Manual" to know the desired indexes, or visualize them on the **SYSCON** by opening the desired block.

Sub_Index
In case you wish to visualize a certain tag, opt for the index relative equal to zero, and for the sub-index equal to one (refer to paragraph Structure Block in the Function Blocks Manual).

Mnemonic
This is the mnemonic for the parameter identification (it accepts a maximum of 16 characters in the alphanumeric field of the display). Choose the mnemonic, preferably with no more than 5 characters because, this way, it will not be necessary to rotate it on the display.

Inc_Dec
It is the increment and decrement in decimal units when the parameter is Float or Float Status time, or integer, when the parameter is in whole units.

Decimal_Point_Numb.
This is the number of digits after the decimal point (0 to 3 decimal digits).

Access
The access allows the user to read, in the case of the "Monitoring" option, and to write when "action" option is selected, then the display will show the increment and decrement arrows.

Alpha_Num
These parameters include two options: value and mnemonic. In option value, it is possible to display data both in the alphanumeric and in the numeric fields; this way, in the case of a data higher than 10000, it will be shown in the alphanumeric field.
In option mnemonic, the display may show the data in the numeric field and the mnemonic in the alphanumeric field.

In case you wish to visualize a certain tag, opt for the index relative equal to zero, and for the sub-index equal to one (refer to paragraph Structure Block in the Function Blocks Manual).

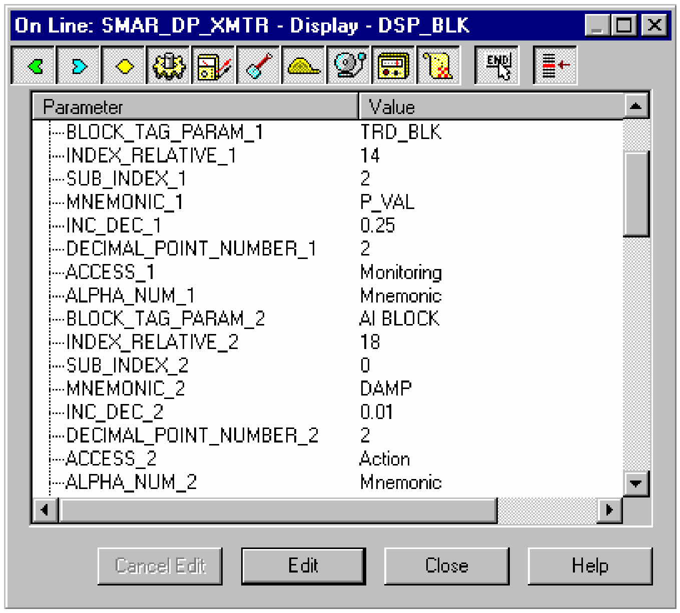


Figure 3.12 - Parameters for Local Adjustment Configuration

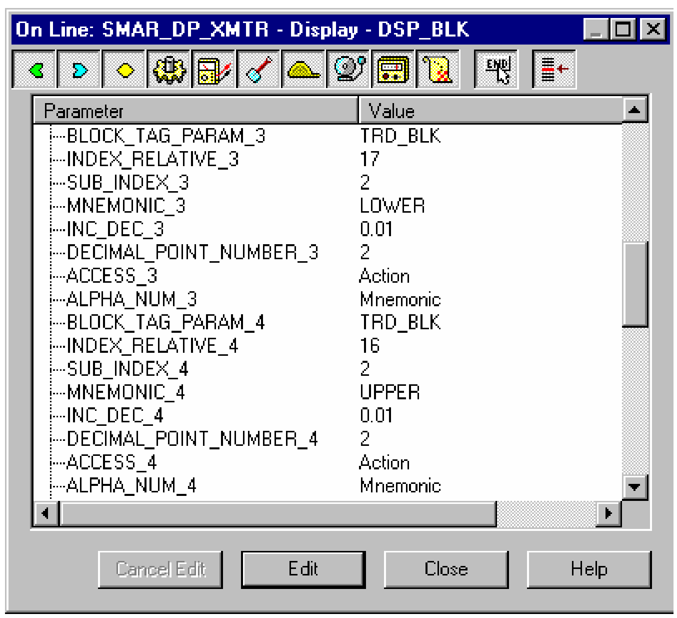


Figure 3.13 - Parameters for Local Adjustment Configuration

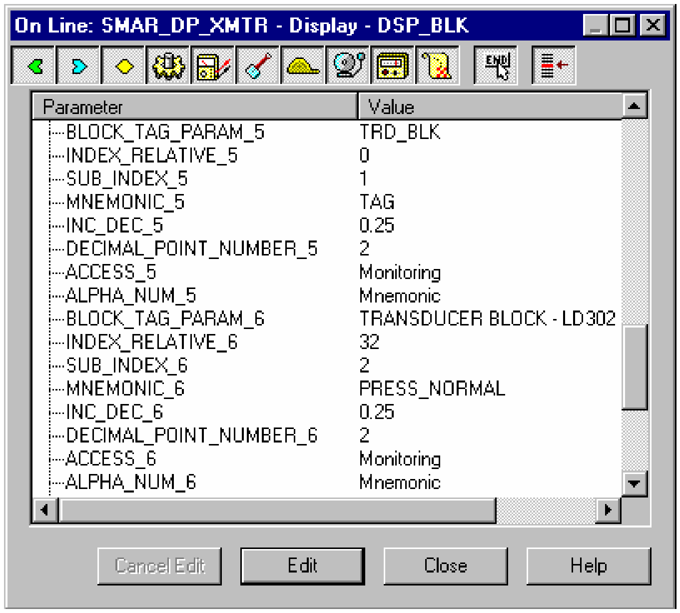


Figure 3.14 - Parameters for Local Adjustment Configuration

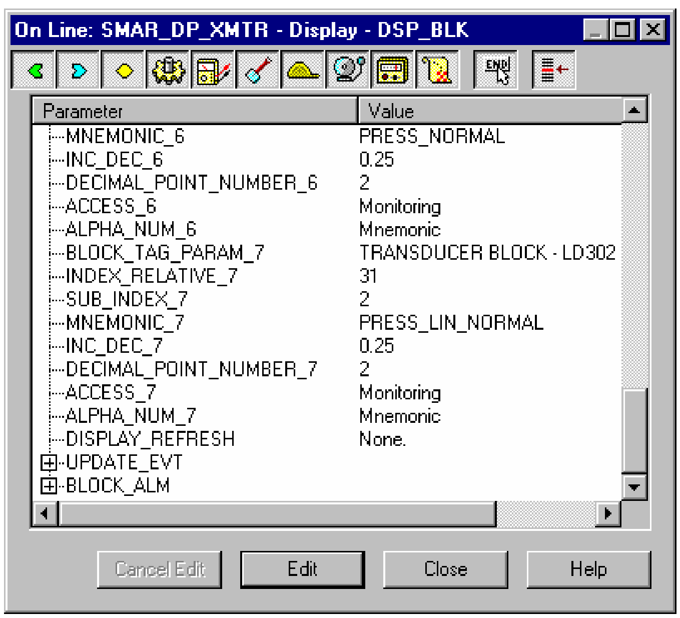
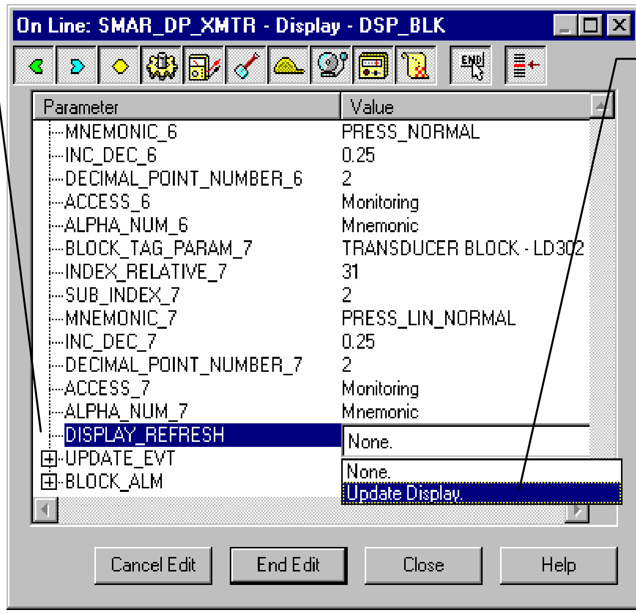


Figure 3.15 - Parameters for Local Adjustment Configuration

This parameter updates the local adjustment programming tree configured on each device.



The option "update" should be selected in order to execute the upgrade of local adjustment programming tree.

After its step all the parameters selected will be show on the LCD display.

Figure 3.16 - Parameters for Local Adjustment Configuration

Programming Using Local Adjustment

The local adjustment can not configure all the parameters as SYSCON can. It means the user can select the best options for this application. From the factory, it is configured with the options to set the Upper and Lower trim, for monitoring the transducer output and check the Tag. Usually, the transmitter is much better configured by SYSCON, but the local functionality of the LCD allows an easy and fast action on certain parameters, since it does not rely on communication and network wiring connections. Among the possibilities of the Local Adjustment, the following options can be emphasized: Mode block, Outputs monitoring, Tag visualization and Tuning Parameters setting.

The interaction between the user and the transmitter is also described in detail on the "General Installation, Operation and Maintenance Procedures Manual". Take a look at this manual in the chapter related to "Programming Using Local Adjustment".

The TT302 has, underneath its identification plate, two holes marked with the letters S and Z beside them. These holes give access to two magnetic switches (Reed Switch), which can be activated by the magnetic tool (See Figure 3.17).

This magnetic tool enables adjustment of the most important parameters of the blocks.

The jumper W1 on top of the main circuit board must be in place and the positioner must be fitted with digital display for access to the local adjustment. Without the display, it is not possible to do the local adjustment.

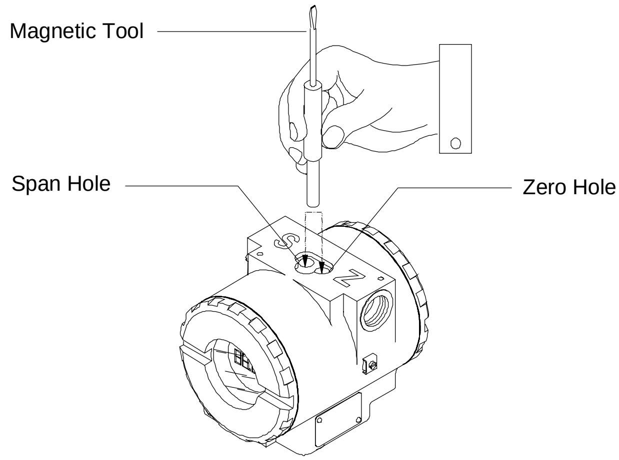


Figure 3.17 - Local Adjustment Holes

Table 3.4 shows the actions on the Z and S holes on the TT302 when Local Adjustment is enabled.

HOLE	ACTION
Z	Initializes and rotates through the available functions.
S	Selects the function shown in the display.

Table 3.4 - Purpose of the holes on the Housing

J1 Jumper Connections

If J1 (see figure 3.18) is connected to ON, it is possible to simulate values and status through the SIMULATE parameter, from the Analog Input block.

If W1 (see figure 3.18) is connected to ON, the local adjustment programming tree is enabled, and so the block parameters can be adjusted via local adjustment.

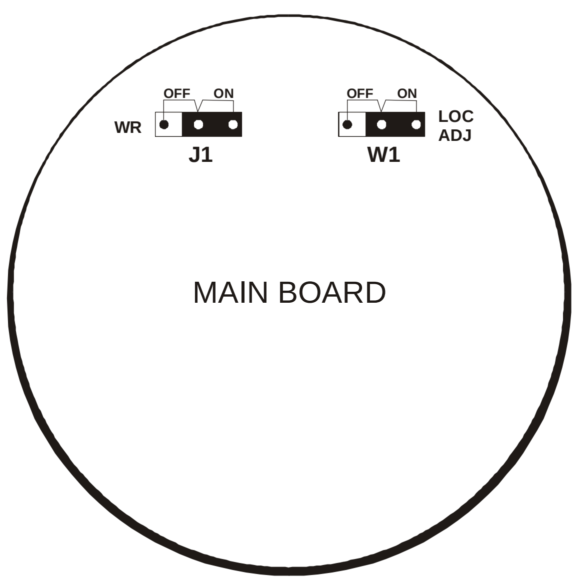


Figure 3.18 - J1 and W1 Jumpers

Local Programming Tree

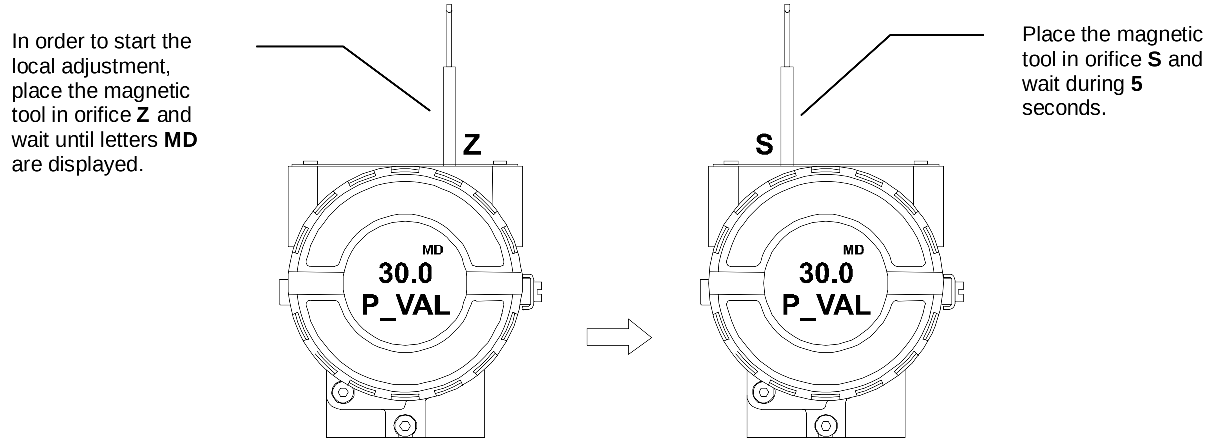


Figure 3.19 - Step 1 - TT302

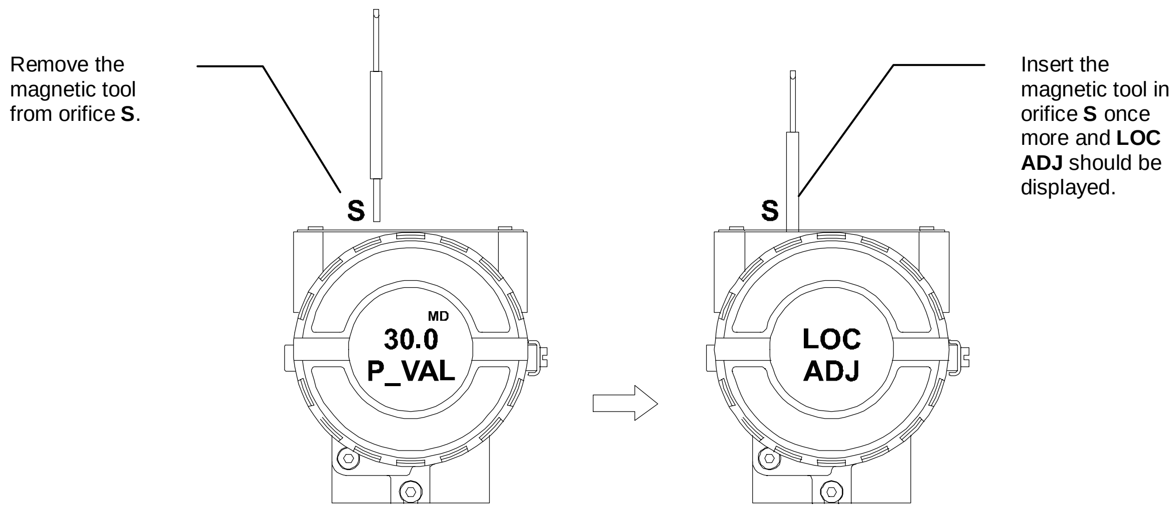


Figure 3.20 - Step 2 - TT302

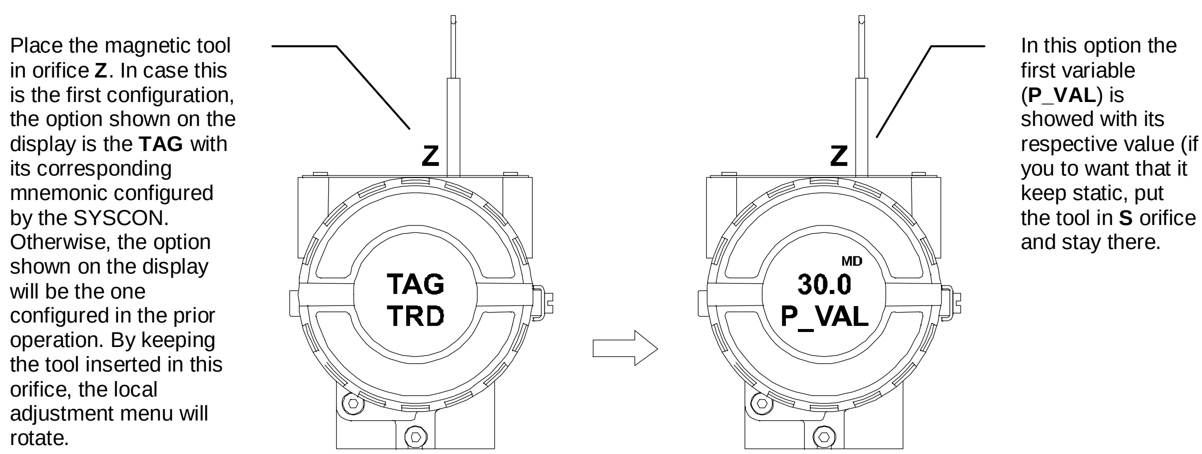
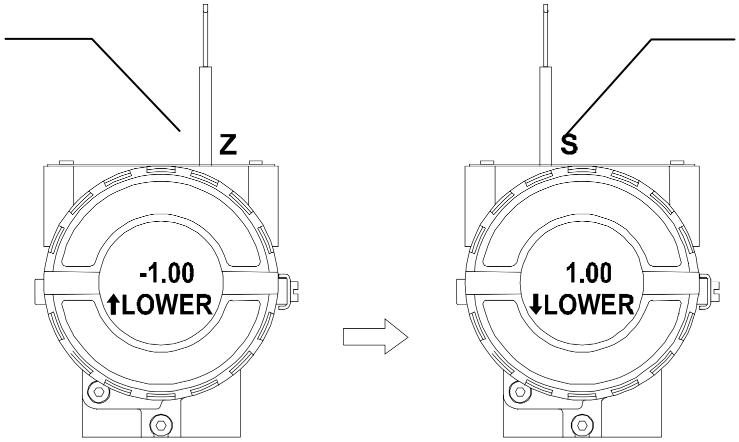


Figure 3.21 - Step 3 - TT302

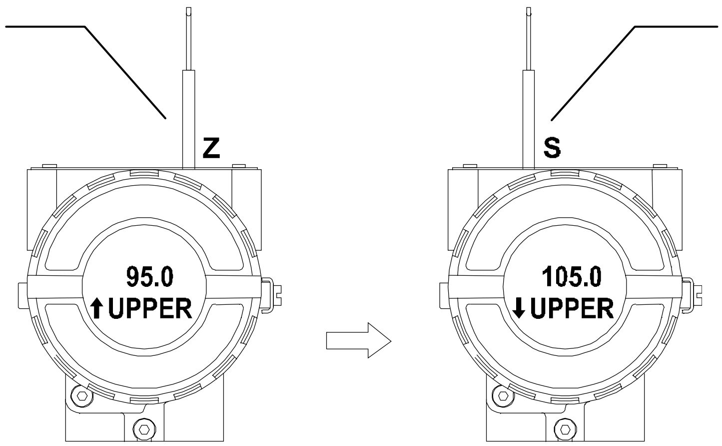
In order to configure the lower value (lower), simply insert the magnetic tool in orifice **S** as soon as LOWER is shown on the display. An arrow pointing upward (↑) increments the valve and an arrow pointing downward (↓) decrements the value. In order to increment the value, keep the tool insert in **S** up to set the value desired.



In order to decrement the lower value, insert the magnetic tool in orifice **Z** to shift the arrow to the downward position. After this, lift it from orifice **Z** and insert it in the orifice **S**, and wait to achieve the desired value.

Figure 3.22 - Step 4 - TT302

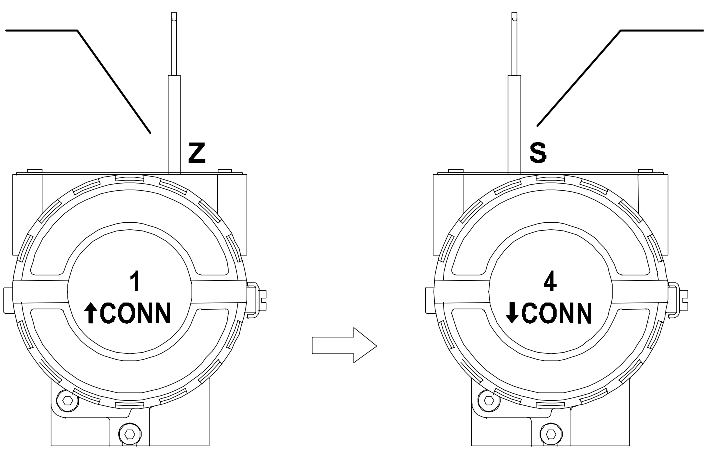
In order to range the upper value (upper), simply insert the magnetic tool in orifice **S** as soon as upper is shown on the display. An arrow pointing upward (↑) increment the value and an arrow pointing downward (↓) decrements the value. In order to increment the value, keep the tool insert in **S** up to set the value desired.



In order to decrement the upper value, insert the magnetic tool in orifice **Z** to shift the arrow to the downward position. After this, insert it in the orifice **S**, and wait to achieve the desired value.

Figure 3.23 - Step 5 - TT302

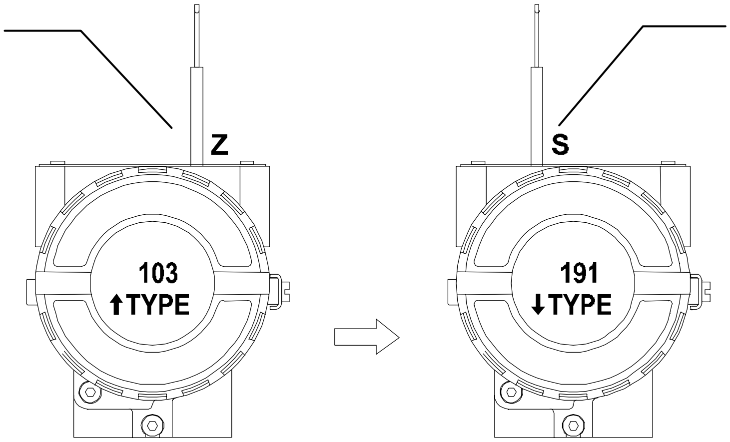
In order to configure the connection (**CONN**), simply insert the magnet tool in orifice **S** as soon as **CONN** is shown on the display. An arrow pointing upward (↑) increment the value and an arrow pointing downward (↓) decrement the value. The number over **CONN** mnemonic is the value corresponding of the table 3.2. See it to do the correct choice of the connection value.



In order to decrement the connection value, insert the magnetic tool in orifice **Z** to shift the arrow to the downward position. After this, insert it in the orifice **S**, and wait to achieve the desired value.

Figure 3.24 - Step 6 - TT302

In order to configure the connection (**TYPE**), simply insert the magnet tool in orifice **S** as soon as **TYPE** is shown on the display. An arrow pointing upward (↑) increment the value and an arrow pointing downward (↓) decrement the value. The number over **TYPE** is the value corresponding of the table 3.1. See it to do the correct choice of the connection value.



In order to decrement the connection type value, place the magnetic tool in orifice **Z** to shift the arrow to the downward position. After this, insert it in the orifice **S**, and wait to achieve the desired value.

Figure 3.25 - Step 7 - TT302

Transducer Block Parameters Description

The parameters described below are used to configure the transducer block, having direct influence in the hardware.

PARAMETER	***DESCRIPTION***
ST_REV	Number of changes in the static parameter.
TAG_DESC	Transducer block tag.
STRATEGY	Parameter not processed by the Transducer block.
ALERT_KEY	Identification number in the plant.
MODE_BLK	Operation mode of the Transducer block.
BLOCK_ERR	Hardware and software status associated with the Transducer.
UPDATE_EVT	Static parameters alarm.
BLOCK_ALM	Alarm used by the configuration or by the hardware.
TRANSDUCER_DIRECTORY	Number and initial index of the Transducer inside the Transducer block.
TRANSDUCER_TYPE	Type of Transducer according to its class. 101 - Standard Temperature with calibration
XD_ERROR	Used to show the calibration status.
COLLECTION_DIRECTORY	Number, initial index and description device item of the Transducer, inside the Transducer block.
PRIMARY_VALUE_TYPE	Measurement type represented by the primary variable. 104 – Process Temperature 106 – Differential Temperature 120 – Backup Temperature
PRIMARY_VALUE	Measured variable and available status for the function block.
PRIMARY_VALUE_RANGE	Upper and lower limits, engineering unit, and number of decimal places used to designate the primary variable.
CAL_POINT_HI	Upper calibration value.
CAL_POINT_LO	Lower calibration value.
CAL_MIN_SPAN	Minimum span value allowed in the calibration. This minimum span is necessary to make sure that the two calibrated points (lower and upper) are not too close, when the calibration is done.
CAL_UNIT	Engineering unit used in the lower and upper calibration.
SENSOR_TYPE	Sensor type 128 – Pt100 IEC 129 – Pt100 JIS 131 – Pt500 IEC 132 – Ni 120 DIN 133 – Cu 10 GE 170 – Pt 50 IEC 171 – Pt 50 JIS

PARAMETER	DESCRIPTION
	181 – Ohm 100 180 – Ohm 400 104 – Ohm 2000 134 – TC B NBS 136 – TC E NBS 137 – TC J NBS 138 – TC K NBS 139 – TC N NBS 140 – TC R NBS 141 – TC S NBS 142 – TC T NBS 143 – TC L DIN 144 – TC U DIN 191 – mV 22 190 – mV 100 103 – mV 500
SENSOR_RANGE	Lower and upper limits, engineering unit and number of decimal point of the sensor.
SENSOR_SN	Sensor serial number.
SENSOR_CAL_METHOD	Last method of calibration of the sensor.
SENSOR_CAL_LOC	Localization of the last calibration of the sensor. That is the place where the calibration was done.
SENSOR_CAL_DATE	Date of the latest calibration of the sensor.
SENSOR_CAL_WHO	Name of the person responsible for the last calibration of the sensor.
SENSOR_CONNECTION	Number of sensor wires connected to the equipment terminal blocks. 1 – Dual two wires 2 – Two wires 3 – Three wires 4 – Four wires
SECONDARY_VALUE	Secondary variable related to the sensor.
SECONDARY_VALUE_UNIT	Engineering unit used by the secondary variable.
MODULE_SN	Module serial number.
SECONDARY_VALUE_ACTION	Type of action of the cold junction compensation. 0 – disabled 1 – enabled
BACKUP_RESTORE	Parameter used to restore or save the configuration data. 1 – Factory Cal Restore 2 – Last Cal Restore 3 – Default Data Restore 4 – Shut-Down Data Restore 5 – Sensor Data Restore 11 – Factory Cal Backup 12 – Last Cal Backup 14 – Shut-Down Data Backup 15 – Sensor Data Backup 0 – None
CAL_POINT_HI_LAST	Upper calibration saved by the backup_restore.
CAL_POINT_LO_LAST	Lower calibration saved by the backup_restore.
CAL_POINT_HI_FACTORY	Factory upper calibration saved by the backup_restore
CAL_POINT_LO_FACTORY	Factory lower calibration saved by the backup_restore
ORDERING_CODE	Product information to manufacture.
TWO_WIRES_COMPENSATION	Automatic compensation of the lead resistance for two wire RTD sensors or dual two wire RTD sensors. 0 – Disabled 1 – Enabled
SENSOR_TRANSDUCER_NUMBER	Number of Transducer being used: 1 – First Transducer (this one should always exist) 2 – Second Transducer (It exists if the type of connection of the first transducer is dual or two wires)

Transducer Block Parameters Types

Parameter	Data Type	Storage	Size	Initial Value	Class
ST_REV	Unsigned16	S	2	0	R
TAG_DESC	Octet String	S	32	Nulls	R/W
STRATEGY	Unsigned16	S	2	0	R/W
ALERT_KEY	Unsigned8	S	1	0	R/W
MODE_BLK	DS-69	Mix	4	AUTO	R/W
BLOCK_ERR	Bit String	D	2	*	R
UPDATE_EVT	DS-73	D	5	*	R
BLOCK_ALM	DS-72	D	13	*	R
TRANSDUCER_DIRECTORY	Array of Unsigned16	N	Variable	*	R
TRANSDUCER_TYPE	Unsigned16	N	2	101	R
XD_ERROR	Unsigned8	D	1	*	R
COLLECTION_DIRECTORY	Array of Unsigned16	N	Variable	*	R
PRIMARY_VALUE_TYPE	Unsigned16	S	2	104	R/W
PRIMARY_VALUE	DS-65	D	5	0	R
PRIMARY_VALUE_RANGE	DS-68	NS	11	-200/850/1001/1	R
CAL_POINT_HI	Float	S	4	850.0	R/W
CAL_POINT_LO	Float	S	4	-250.0	R/W
CAL_MIN_SPAN	Float	N	4	10.0	R
CAL_UNIT	Unsigned16	S	2	1001	R/W
SENSOR_TYPE	Unsigned16	S	2	128	R/W
SENSOR_RANGE	DS-68	N	11	-200/850/1001/1	R
SENSOR_SN	Unsigned Long	N	4	0	R
SENSOR_CAL_METHOD	Unsigned8	S	1	103	R
SENSOR_CAL_LOC	Visible String	S	32	NULL	R/W
SENSOR_CAL_DATE	Time of Day	S	7	0	R/W
SENSOR_CAL_WHO	Visible String	S	32	NULL	R/W
SENSOR_CONNECTION	Unsigned8	S	1	3	R/W
SECONDARY_VALUE	DS-65	D	5	0	R
SECONDARY_VALUE_UNIT	Unsigned16	S	2	1001	R/W
MODULE_SN	Unsigned Long	N	4	0	R
SECONDARY_VALUE_ACTION	Unsigned8	S	1	1	R/W
BACKUP_RESTORE	Unsigned8	S	1	0	R/W
CAL_POINT_HI_LAST	Float	S	4	850.0	R
CAL_POINT_LO_LAST	Float	S	4	-200.0	R
CAL_POINT_HI_FACTORY	Float	S	4	850.0	R
CAL_POINT_LO_FACTORY	Float	S	4	-200.0	R
ORDERING_CODE	Visible String	S	50	Null	R/W
TWO_WIRE_COMPENSATION	Unsigned8	D	1	1	R/W
SENSOR_TRANSD_NUMBER	Unsigned8	S	1	0	R/W

D: Dynamic
N: Non-volatile
S: Static

Transducer Block Parameters View

Parameter	View_1	View_2	View_3	View_4
ST_REV	2	2	2	2
TAG_DESC				
STRATEGY				2
ALERT_KEY				1
MODE_BLK	4		4	
BLOCK_ERR	2		2	
UPDATE_EVT				
BLOCK_ALM				
TRANSDUCER_DIRECTORY				
TRANSDUCER_TYPE	2	2	2	2
XD_ERROR	1		1	
COLLECTION_DIRECTORY				
PRIMARY_VALUE_TYPE		2		
PRIMARY_VALUE	5		5	
PRIMARY_VALUE_RANGE				11
CAL_POINT_HI		4		
CAL_POINT_LO		4		
CAL_MIN_SPAN				4
CAL_UNIT				2
SENSOR_TYPE				2
SENSOR_RANGE				11
SENSOR_SN				4
SENSOR_CAL_METHOD				1
SENSOR_CAL_LOC				32
SENSOR_CAL_DATE				7
SENSOR_CAL_WHO				32
SENSOR_CONNECTION				1
SECONDARY_VALUE			5	
SECONDARY_VALUE_UNIT				2
MODULE_SN				4
SECONDARY_VALUE_ACTION				
BACKUP_RESTORE				1
CAL_POINT_HI_LAST		4		
CAL_POINT_LO_LAST		4		
CAL_POINT_HI_FACTORY		4		
CAL_POINT_LO_FACTORY		4		
ORDERING_CODE				
TWO_WIRE_COMPENSATION				
SENSOR_TRANSD_NUMBER				1

Maintenance Procedures

Troubleshouting

SMAR TT302 transmitters are extensively tested and inspected before delivery to the end user. Nevertheless, during their design and development, consideration was given to the possibility of repairs being made by the end user, if necessary.

In general, it is recommended that end users do not try to repair printed circuit boards. Spare circuit boards may be ordered from **SMAR** whenever necessary.

SYMPTOM	PROBABLE SOURCE OF PROBLEM
NO COMMUNICATION	▪ ***Transmitter Connections*** Check wiring polarity and continuity. Check for shorts or ground loops. Check if the power supply connector is connected to main board. Check if the shield is not used as a conductor. It should be grounded at one end only.
	▪ ***Power Supply*** Check power supply output. The voltage must be between 9 - 32 VDC at the **TT302** terminals. Noise and ripple should be within the following limits: a) 16 mV peak to peak from 7.8 to 39 KHz. b) 2 V peak to peak from 47 to 63 Hz for non-intrinsic safety applications and 0.2 V for intrinsic safety applications. c) 1.6 V peak to peak from 3.9 MHz to 125 MHz.
	▪ ***Network Connection*** Check that the topology is correct and all devices are connected in parallel. Check that two Terminators are OK and correctly positioned. Check that the Terminators are according to the specifications. Check length of trunk and spurs. Check spacing between couplers.
	▪ ***Network Configuration*** Make sure the device tag is configured if system configuration is desired.. Make sure that device address, connection and index for all variables are configured correctly if pre-configuration is used.
	▪ ***Electronic Circuit Failure*** Check the main board for defect by replacing it with a spare one.
NCORRECT READING	▪ ***Transmitter Connections*** Check for intermittent short circuits, open circuits and grounding problems. Check if the sensor is correctly connected to the **TT302** terminal block. Check if the sensor signal is reaching the **TT302** terminal block by measuring it with a multimeter at the transmitter end.
	▪ ***Noise, Oscillation*** Adjust damping Check grounding of the transmitters housing, extra important for mV and thermocouple input. Check the terminal block for moisture. Check that the shielding of the wires between sensor/ transmitter and transmitter/ panel is grounded only in one end.
	▪ ***Sensor*** Check the sensor operation; it shall be within its characteristics. Check sensor type; it shall be the type and standard that the **TT302** has been configured to. Check if process is within the range of the sensor and the **TT302**.
INCORRECT READING	▪ ***Electronic Circuit Failure*** Check the integrity of circuit replacing it with a spare one.
	▪ ***Transmitter Configuration*** Check if the sensor and wires configuration are correct.

Table 4.1 - Messages of Errors and Potential Cause

If the problem is not presented in the table above follow the Note below:

NOTE

The Factory Init should be tried as a last option to recover the equipment control when the equipment presents some problem related to the function blocks or the communication. **This operation must only be carried out by authorized technical personnel and with the process offline, since the equipment will be configured with standard and factory data.**

This procedure resets all the configurations run on the equipment, after which a partial download should be performed.

Two magnetic tools should be used to this effect. On the equipment, withdraw the nut that fixes the identification tag on the top of the housing, so that access is gained to the "S" and "Z" holes.

The operations to follow are:

1) Switch off the equipment, insert the magnetic tools and keep them in the holes (the magnetic end in the holes);

2) Feed the equipment;

3) As soon as Factory Init is shown on the display, take off the tools and wait for the "5" symbol on the right upper corner of the display to unlit, thus indicating the end of the operation.

This procedure makes effective all the factory configuration and will eliminate eventual problems with the function blocks or with the equipment communication.

Disassembly Procedure

Refer to Figure 4.2 - Exploded View. Make sure to disconnect the power supply before disassembling the transmitter.

Sensor
If the sensor is mounted on the transmitter, first disconnect the wires in order to prevent the wires from breaking. To access the terminal block, first loosen the cover locking screw on the side marked “Field Terminals”, then unscrew the cover.

Electronic Circuits
The main board (5) and input board (7) are matched pairs and must be changed together and not mixed with others. To remove the circuit boards (5 and 7) and the display (4), first loosen the cover locking (8) on the side not marked “Field Terminals” then unscrew the cover (1).

Loosen the two screws (3) that anchors the display and the main circuit board. Gently pull out the display, and then the main board (5). To remove the input board (7), first unscrew the two screws (6) that anchors it to the housing (9), gently pull out the board.

WARNING

The boards have CMOS components, which may be damaged by electrostatic discharges. Observe correct procedures for handling CMOS components. It is also recommended to store the circuit boards in electrostatic-proof cases.

Reassembly Procedure

- Put input board (7) into housing (9).
- Anchor input board with its screws (6).
- Put main board (5) into the housing, ensuring all inter connecting pins are connected.
- Put display (4) into the housing, observing the four mounting positions (See Figure 4.1 - Four Possible Positions of the Display) “_” should point in the direction desired as UP.
- Anchors main board and display with their screws (3).
- Fit the cover (1) and lock it using the locking screw (8).

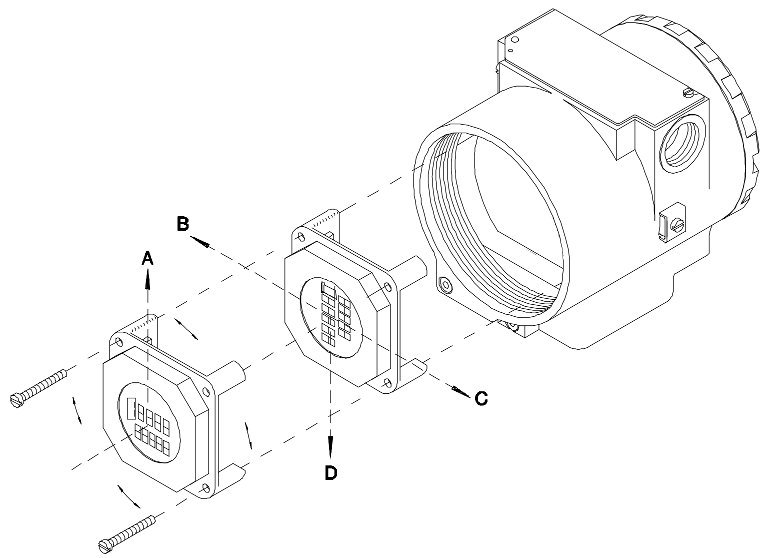


Figure 4.1 - Four Possible Positions of the Display

Interchangeability

The Main and Input boards must be kept together because of the calibration data that is stored in the main board EEPROM. In the case of one board being faulty, both must be replaced.

Returning Materials

Should it become necessary to return the transmitter to **SMAR**, simply contact your local agent or **SMAR** office, informing the defective instrument's serial number, and return it to our factory.

In order to expedite analysis and solution of the problem, the defective item should be returned with a description of the failure observed, with as many details as possible. Other information concerning the instruments operation, such as service and process conditions are also helpful.

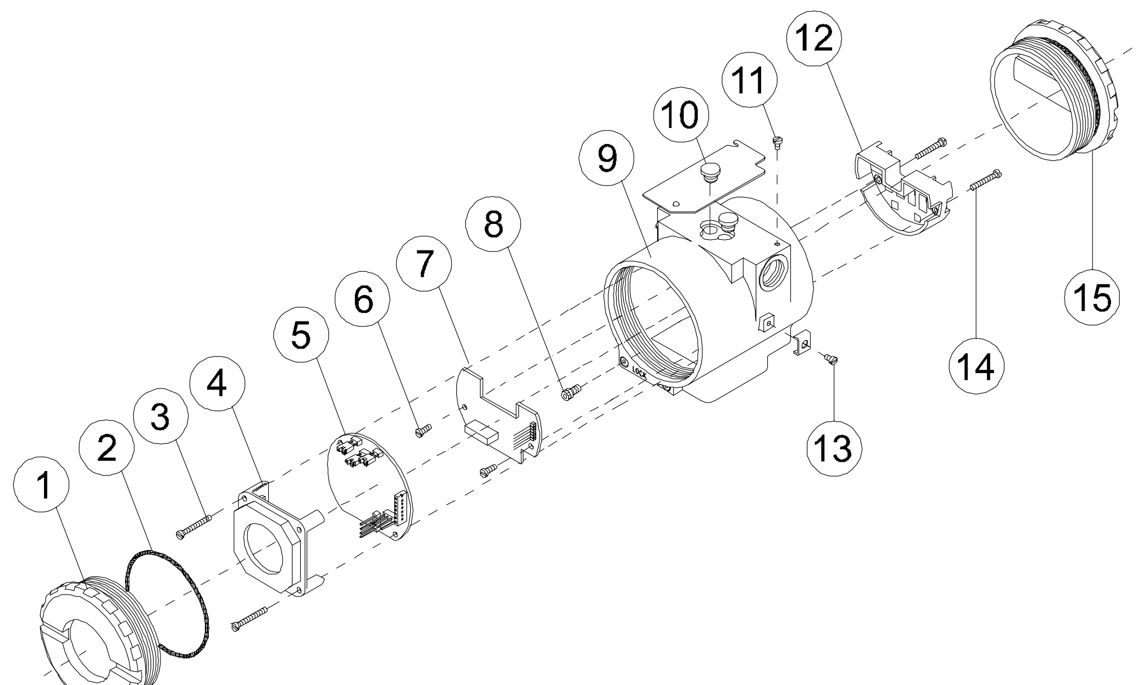


Figure 4.2 - Exploded View

ACCESSORIES	
ORDERING CODE	DESCRIPTION
SD1	Magnetic Tool for Local Adjustment
SYSCON	System Configurator
PS302	Power Supply
BT302	Terminator
DFI302	Fieldbus Universal Bridge

Table 4.2 - Accessories of SYSTEM 302

SPARE PARTS LIST			
DESCRIPTION OF PARTS	POSITION	CODE	CATEGORY (NOTA 1)
HOUSING, Aluminum (NOTE 2)			
. ½ - 14 NPT	9	314-0130	
. M20 x 1.5	9	314-0131	
. PG 13.5 DIN	9	314-0132	
HOUSING, 316 SS (NOTE 2)			
. ½ - 14 NPT	9	314-0133	
. M20 x 1.5	9	314-0134	
. PG 13.5 DIN	9	314-0135	
COVER (INCLUDES O'RING)			
. Aluminum	1 and 15	204-0102	
. 316 SS	1 and 15	204-0105	
COVER WITH WINDOW FOR INDICATION (INCLUDES O'RING)			
. Aluminum	1	204-0103	
. 316 SS	1	204-0106	
COVER LOCKING SCREW	8	204-0120	
EXTERNAL GROUND SCREW	13	204-0124	
IDENTIFICATION PLATE FIXING SCREW	11	204-0116	
DIGITAL INDICATOR	4	214-0108	
TERMINAL INSULATOR	12	314-0123	
MAIN INPUT CIRCUIT BOARD ASSEMBLY	5 and 7	400-0234	**A**
O'RINGS (NOTE 3)			
. Cover, Buna-N	2	204-0122	**B**
TERMINAL HOLDING SCREW.			
. Housing in Aluminum	14	304-0119	
. Housing in 316 Stainless Steel	14	204-0119	
MAIN BOARD SCREW HOUSING IN ALUMINUM			
. Units with indicator	3	304-0118	
. Units without indicator	3	304-0117	
MAIN BOARD SCREW HOUSING IN 316 STAINLESS STEEL			
. Units with indicator	3	204-0118	
. Units without indicator	3	204-0117	
INPUT BOARD SCREW			

SPARE PARTS LIST			
DESCRIPTION OF PARTS	POSITION	CODE	CATEGORY (NOTA 1)
. Housing in Aluminum	6	314-0125	
. Housing in 316 Stainless Steel	6	214-0125	
MOUNTING BRACKET FOR 2" PIPE MOUNTING (NOTE 4)			
. Carbon Steel	-	214-0801	
. Stainless Steel 316	-	214-0802	
. Carbon Steel bolts, nuts, washers and U-clamp in Stainless Steel	-	214-0803	
LOCAL ADJUSTMENT PROTECTION CAP	10	204-0114	

Table 4.3 - Spare Part List

NOTE

1. For category A, it is recommended to keep, in stock, 25 parts installed for each set, and for category B, 50.
2. It includes Terminal holder insulator, bolts (cover lock, grounding and terminal holder insulator) and identification plate without certification.
3. 0-Rings are packaged in packs of 12 units.
4. Including U-clamp, nuts, bolts and washers.

Section 5

Technical Characteristics

Functional Specifications

Inputs Signal
See the following table for options.

Output Signal
Digital only. Foundation Fieldbus 31.25 kbit/s voltage mode with bus power.

Power Supply
Bus power: 9 to 32 V DC.
Current consumption: quiescent 12 mA.
Output impedance: non-intrinsic safety from 7.8 kHz to 39 kHz should be greater or equal to 3 kOhm.
Intrinsic safety output impedance (assuming an IS barrier in the power supply) from 7.8 kHz to 39 kHz should be greater or equal to 400 Ohm.

Display
Optional 4½ digit numeric and 5-character alphanumeric LCD indicator.

Hazardous Location Certification
Explosion proof, weather proof and intrinsically safe (CENELEC and FM standards).

Temperature Limits

Operation:	-40	to	85 °C	(-40	to	185 °F)	
Storage:	-40	to	120 °C	(-40	to	250 °F)	
Display:	-10	to	60 °C	(14	to	140 °F)	operation
	-40	to	85 °C	(-40	to	185 °F)	without damage

Humidity Limits
0 to 100% RH

Turn-on Time
Approximately 10 seconds.

Update Time
Approximately 0.2 second.

Configuration
Basic configuration may be done using local adjustment magnetic tool if device is fitted with display. Complete configuration is possible using remote configurator (Ex.: **SYSCON**).

Performance Specifications

Accuracy
See the following tables.

Ambient Temperature Effect
For a 10°C variation:

mV (-6...22 mV), TC (NBS: B, R, S, T): ±0.03% of reading or 0.002 mV whichever is greater.

mV (-10...100 mV), TC (NBS: E, J, K, N; DIN: L, U): ±0.03% of reading or 0.01 mV whichever is greater.

mV (-50...500 mV): ±0.03% of reading or 0.05 mV whichever is greater.

Ohms (0...100), RTD (GE: Cu10) : ±0.03% of reading or 0.01 whichever is greater.

Ohms (0...400), RTD (DIN: Ni120; IEC: Pt50, Pt100; JIS: Pt50, Pt100): ±0.03% of reading or 0.04 whichever is greater.

Ohms (0...2000), RTD (IEC: Pt500): ±0.03% of reading or 0.2 whichever is greater.

TC: Cold-junction compensation rejection 60:1 Reference: 25,0 ± 0,3°C.

Vibration Effect
Meets SAMA PMC 31.1.

Electro-Magnetic Interference Effect
Designed to comply with IEC 801.

Physical Specifications

Electrical Connection
1/2-14 NPT, Pg 13.5 or M20 x 1.5 metric.

Material of Construction
Injected low copper aluminum with polyester painting or 316 Stainless Steel housing, with Buna N 0-rings on covers (NEMA 4X, IP67).

Mounting
Can be attached directly to the sensor. With an optional bracket can be installed on a 2" pipe or fixed on a wall or panel.

Weight
Without display and mounting bracket: 0.80 kg.
Add for digital display: 0.13 kg.
Add for mounting bracket: 0.60 kg.

	2, 3 OR 4 WIRES					DIFFERENTIAL			
SENSOR	TYPE	RANGE °C	*RANGE °F*	MINIMUN SPAN °C	ACCURACY °C	RANGE °C	RANGE °F	MINIMUN SPAN °C	ACCURACY °C
RTD	Cu10 GE	-20 to 250	-4 to 482	50	±1.0	-270 to 270	-486 to 486	50	±2.0
	Ni 120 DIN	-50 to 270	-58 to 518	5	±0.1	-320 to 320	-576 to 576	5	±0.5
	Pt50 IEC	-200 to 850	-328 to 1562	10	±0.2	-1050 to 1050	-1890 to 1890	10	±1.0
	Pt100 IEC	-200 to 850	-328 to 1562	10	±0.2	-1050 to 1050	-1890 to 1890	10	±1.0
	Pt500 IEC	-200 to 450	-328 to 842	10	±0.2	NA	NA	NA	NA
	Pt50 JIS	-200 to 600	-328 to 1112	10	±0.25	-800 to 800	-1440 to 1440	10	±1.0
	Pt100 JIS	-200 to 600	-328 to 1112	10	±0.25	-800 to 800	-1440 to 1440	10	±1.5
THERMO-COUPLE	B NBS	+100 to 1800	212 to 3272	50	±0.5*	-1700 to 1700	-3060 to 3060	60	±1.0*
	E NBS	-100 to 1000	-148 to 1832	20	±0.2	-1100 to 1100	-1980 to 1980	20	±1.0
	J NBS	-150 to 750	-238 to 1382	30	±0.3	-900 to 900	-1620 to 1620	30	±0.6
	K NBS	-200 to 1350	-328 to 2462	60	±0.6	-1550 to 1550	-2790 to 2790	60	±1.2
	N NBS	-100 to 1300	-148 to 2372	50	±0.5	-1400 to 1400	-2520 to 2520	50	±1.0
	R NBS	0 to 1750	32 to 3182	40	±0.4	-1750 to 1750	-3150 to 3150	40	±2.0
	S NBS	0 to 1750	32 to 3182	40	±0.4	-1750 to 1750	-3150 to 3150	40	±2.0
	T NBS	-200 to 400	-328 to 752	15	±0.15	-600 to 600	-1080 to 1080	15	±0.8
	L DIN	-200 to 900	-328 to 1652	35	±0.35	-1100 to 1100	-1980 to 1980	35	±0.7
	U DIN	-200 to 600	-328 to 1112	50	±0.5	-800 to 800	-1440 to 1440	50	±2.5

***** Not applicable for the first 20% of the range (up to 440 °C).
NA Not applicable.

SENSOR	RANGE mV	MINIMUN SPAN mV	DIGITAL * ACCURACY %
mV	-6 to 22	0.40	±0.02% or ±2 μV
	-10 to 100	2.00	±0.02% or ±10 μV
	-50 to 500	10.00	±0.02% or ±50 μV
mV DIF.	-28 to 28	0.40	±0.1% or ±10 μV
	-110 to 110	2.0	±0.1% or ±50 μV

Table 5.2 *- Sensor Milivoltagem Characteristics*

SENSOR	RANGE OHM	MINIMUN SPAN mV	*DIGITAL * ACCURACY %*
OHM	0 to 100	1	±0.02% or ±0.01 Ohm
	0 to 400	4	±0.02% or ±0.04 Ohm
	0 to 2000	20	±0.02% or ±0.20 Ohm
OHM DIF.	-100 to 100	1	±0.08% or ±0.04 Ohm
	-400 to 400	4	±0.1% or ±0.2 Ohm

Table 5.3 - *Sensor Ohm Characteristics*

ORDERING CODE

MODEL	
TT301	TEMPERATURE TRANSMITTER

CODE	Local Indicator
0	Without Indicator
1	With Digital Indicator

CODE	Mounting Bracket
0	Without Bracket
1	Carbon Steel Bracket
2	316 SS Bracket
7	Carbon Steel Bracket With 316 SST Fasteners

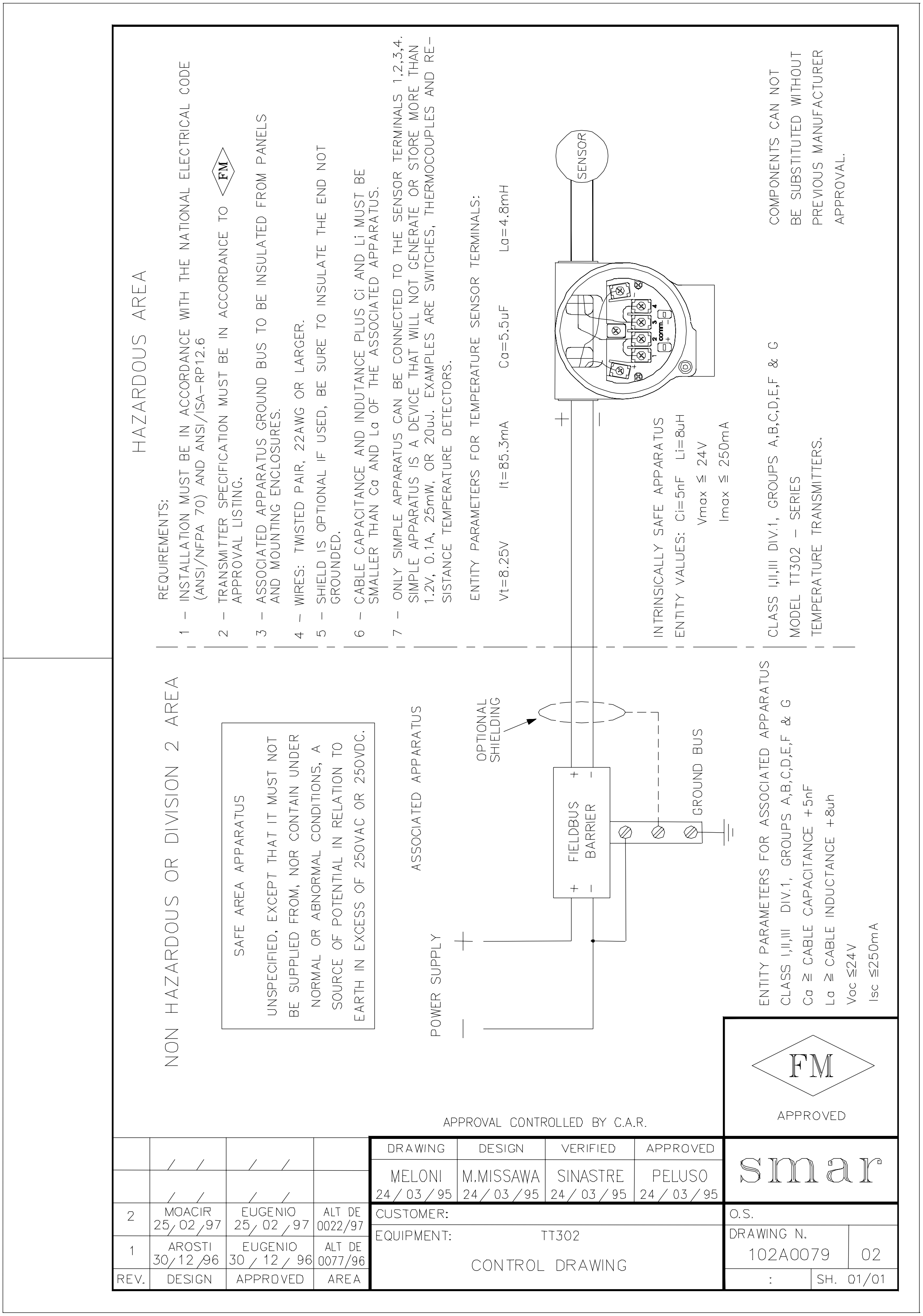
CODE	Electrical Connections
0	½ - 14 NPT
A	M20 x 1.5
B	Pg 13.5 DIN
Z	Others – Specify

CODE	Optional Items*
H1	316 SST Housing
Z	With Special Features – Specify

TT301 | 0 | 2 | B / *

* Leave it blank for no optional items.

Appendix


HAZARDOUS AREA
REQUIREMENTS:
1 – INSTALLATION MUST BE IN ACCORDANCE WITH THE NATIONAL ELECTRICAL CODE (ANSI/NFPA 70) AND ANSI/ISA–RP12.6
2 – TRANSMITTER SPECIFICATION MUST BE IN ACCORDANCE TO FM APPROVAL LISTING.
3 – ASSOCIATED APPARATUS GROUND BUS TO BE INSULATED FROM PANELS AND MOUNTING ENCLOSURES.
4 – WIRES: TWISTED PAIR, 22AWG OR LARGER.
5 – SHIELD IS OPTIONAL IF USED, BE SURE TO INSULATE THE END NOT GROUNDED.
6 – CABLE CAPACITANCE AND INDUTANCE PLUS Ci AND Li MUST BE SMALLER THAN Ca AND La OF THE ASSOCIATED APPARATUS.
7 – ONLY SIMPLE APPARATUS CAN BE CONNECTED TO THE SENSOR TERMINALS 1,2,3,4. SIMPLE APPARATUS IS A DEVICE THAT WILL NOT GENERATE OR STORE MORE THAN 1.2V, 0.1A, 25mW, OR 20uJ. EXAMPLES ARE SWITCHES, THERMOCOUPLES AND RESISTANCE TEMPERATURE DETECTORS.
ENTITY PARAMETERS FOR TEMPERATURE SENSOR TERMINALS:
Vt=8.25V It=85.3mA Ca=5.5uF La=4.8mH
SENSOR
INTRINSICALLY SAFE APPARATUS
ENTITY VALUES: Ci=5nF Li=8uH
Vmax ≦ 24V
Imax ≦ 250mA
CLASS I,II,III DIV.1, GROUPS A,B,C,D,E,F & G
MODEL TT302 – SERIES
TEMPERATURE TRANSMITTERS.
COMPONENTS CAN NOT
BE SUBSTITUTED WITHOUT
PREVIOUS MANUFACTURER
APPROVAL.
NON HAZARDOUS OR DIVISION 2 AREA
SAFE AREA APPARATUS
UNSPECIFIED, EXCEPT THAT IT MUST NOT BE SUPPLIED FROM, NOR CONTAIN UNDER NORMAL OR ABNORMAL CONDITIONS, A SOURCE OF POTENTIAL IN RELATION TO EARTH IN EXCESS OF 250VAC OR 250VDC.
ASSOCIATED APPARATUS
POWER SUPPLY
OPTIONAL SHIELDING
FIELDBUS BARRIER
GROUND BUS
ENTITY PARAMETERS FOR ASSOCIATED APPARATUS
CLASS I,II,III DIV.1, GROUPS A,B,C,D,E,F & G
Ca ≧ CABLE CAPACITANCE +5nF
La ≧ CABLE INDUCTANCE +8uh
Voc ≦24V
Isc ≦250mA
FM
APPROVED
APPROVAL CONTROLLED BY C.A.R.
DRAWING DESIGN VERIFIED APPROVED
MELONI M.MISSAWA SINASTRE PELUSO
24 / 03 / 95 24 / 03 / 95 24 / 03 / 95 24 / 03 / 95
smar
2 MOACIR 25/02/97 EUGENIO 25/02/97 ALT DE 0022/97
1 AROSTI 30/12/96 EUGENIO 30/12/96 ALT DE 0077/96
REV. DESIGN APPROVED AREA
CUSTOMER:
EQUIPMENT: TT302
CONTROL DRAWING
O.S.
DRAWING N. 102A0079 02
SH. 01/01