MANUAL

INSTRUCTIONS | OPERATION | MAINTENANCE

INTELLIGENT TEMPERATURE TRANSMITTER WITH CONTROL CAPABILITY

TT301

HART® COMMUNICATION PROTOCOL

DEC/24 - VERSION 6

smar
Technology Company

TT301

Temperature Transmitter

HART® COMMUNICATION PROTOCOL

Consult our subsidiary

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INTRODUCTION

The **TT301** 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 **TT301** enables the choice of several output functions, an easy interface between the field and the control room and several interesting features that reduce considerably the installation, operation, and maintenance costs.

The **TT301**, besides the normal functions offered by other smart transmitters, offers the following functions:

PID OUTPUT CHARACTERIZATION: the PID output signal (MV) follows a curve determined by 16 points.

BACKUP SENSOR: the process measurement is performed by two sensors, but only one supplies the temperature. If one failure the other take its place.

INPUT SELECTOR: the selection between two sensors to obtain the measure is configured by user based in the conditions of maximum, minimum or average temperature of the sensor.

CONTROLLER: the process variable is compared to a setpoint. The deviation acts on the output signal according to a PID algorithm (Optional).

BATCH: setpoint generator allowing pre-programmed recipes of up to 2-week duration in 16 points.

LOCAL ADJUSTMENT: allow to set lower and upper value, sensor type, operation mode, indication, setpoint, PID parameters without a configurator.

PASSWORD: three configurable levels for different functions.

CHANGE COUNTER: indicates the number of changes in each function.

Get the best results of the TT301 by carefully reading these instructions.

NOTE:
This Manual is compatible with version 6.XX, where 6 de notes software Version and XX software "RELEASE". So, this manual is compatible with any release of software version 6.

Waiver of responsibility

The contents of this manual abides by the hardware and software used on the current equipment version. Eventually there may occur divergencies between this manual and the equipment. The information from this document are periodically reviewed and the necessary or identified corrections will be included in the following editions. Suggestions for their improvement are welcome.

Warning

For more objectivity and clarity, this manual does not contain all the detailed information on the product and, in addition, it does not cover every possible mounting, operation or maintenance cases.

Before installing and utilizing the equipment, check if the model of the acquired equipment complies with the technical requirements for the application. This checking is the user's responsibility.

If the user needs more information, or on the event of specific problems not specified or treated in this manual, the information should be sought from Smar. Furthermore, the user recognizes that the contents of this manual by no means modify past or present agreements, confirmation or judicial relationship, in whole or in part.

All of Smar's obligation result from the purchasing agreement signed between the parties, which includes the complete and sole valid warranty term. Contractual clauses related to the warranty are not limited nor extended by virtue of the technical information contained in this manual.

Only qualified personnel are allowed to participate in the activities of mounting, electrical connection, startup and maintenance of the equipment. Qualified personnel are understood to be the persons familiar with the mounting, electrical connection, startup and operation of the equipment or other similar apparatus that are technically fit for their work. Smar provides specific training to instruct and qualify such professionals. However, each country must comply with the local safety procedures, legal provisions and regulations for the mounting and operation of electrical installations, as well as with the laws and regulations on classified areas, such as intrinsic safety, explosion proof, increased safety and instrumented safety systems, among others.

The user is responsible for the incorrect or inadequate handling of equipments run with pneumatic or hydraulic pressure or, still, subject to corrosive, aggressive or combustible products, since their utilization may cause severe bodily harm and/or material damages.

The field equipment referred to in this manual, when acquired for classified or hazardous areas, has its certification void when having its parts replaced or interchanged without functional and approval tests by Smar or any of Smar authorized dealers, which are the competent companies for certifying that the equipment in its entirety meets the applicable standards and regulations. The same is true when converting the equipment of a communication protocol to another. In this case, it is necessary sending the equipment to Smar or any of its authorized dealer. Moreover, the certificates are different and the user is responsible for their correct use.

Always respect the instructions provided in the Manual. Smar is not responsible for any losses and/or damages resulting from the inadequate use of its equipments. It is the user's responsibility to know and apply the safety practices in his country.

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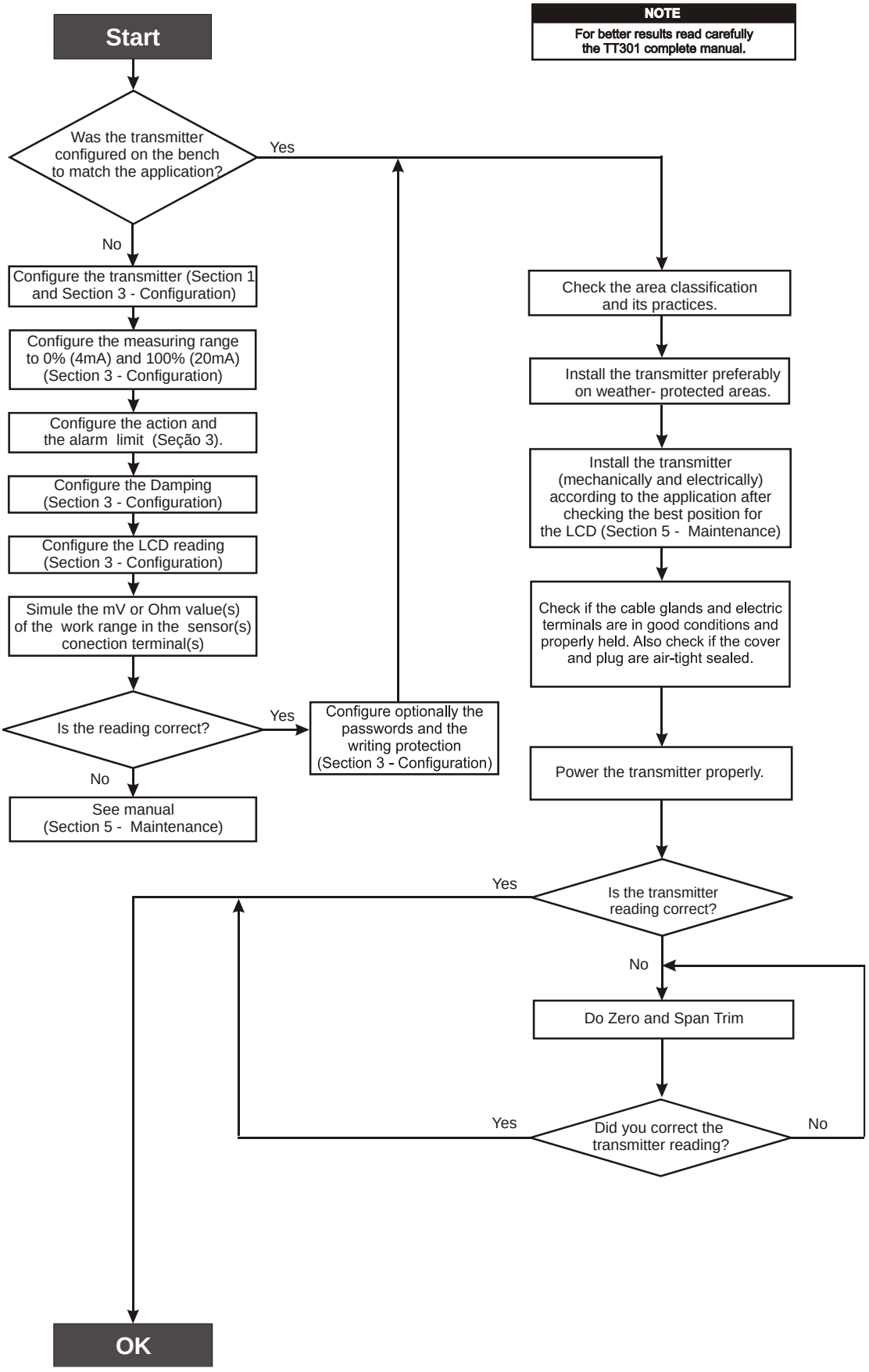
Installation Flowchart



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 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.

Temperature fluctuation effects can be minimized by locating the transmitter in areas protected from extreme environmental changes.

In warm environments, the transmitter should be installed 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 heat sink can be used or the sensor can be mounted separated from the transmitter housing.

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

Mounting

The transmitter may be mounted in two basic ways, as follows:

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

Using the brackets, the mounting may be done in several positions, as shown on Figure 1.1.

One of the conduit inlets for electrical connection is used to mount the sensor integral to the temperature transmitter (see Fig. 1.1).

For better visibility, the digital indicator may be rotated in steps of 90º (see Section 5, Maintenance).

To reach the display and main electronic board remove the cover with window. This cover should be locked closed by the cover locking screw. To release the cover, rotate the locking screw clockwise. See figure 1.2.

Measurement error can be decreased by using proper wires (see Section II, Operation).

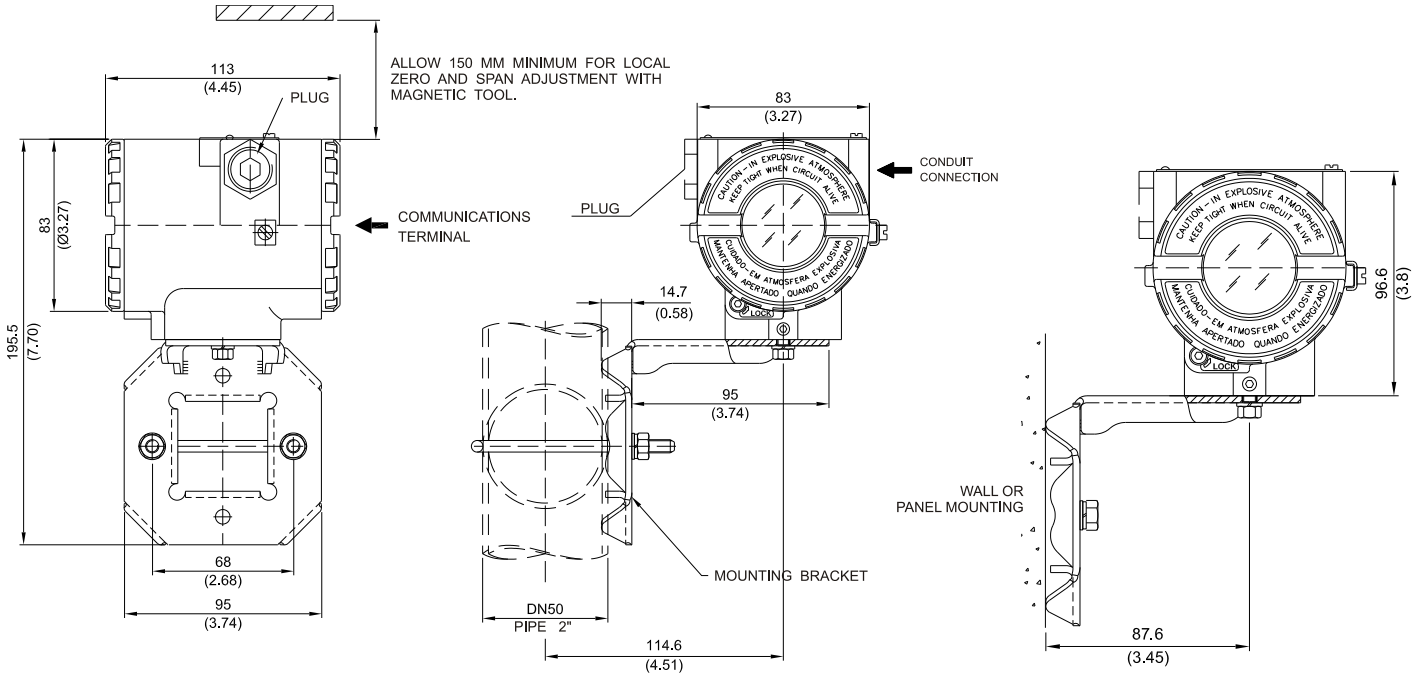


Figure 1.1 - Dimensional Drawing and Mounting Positions

WARNING
Do not remove the graphite grease from the covers, or they may jam.

Electronic Housing

Humidity is fatal to electronic circuits. In areas subjected to high relative humidity, the O-rings for the electronics cover must be correctly placed. 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 the humidity.

The electronic circuit is protected by a humidity proof coating, but frequent exposures 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, since painting cannot protect these parts. Sealing methods should be employed on conduit entering the transmitter.

WARNING
The unused cable entries should be plugged and sealed accordingly to avoid humidity entering, which can cause the loss of the product's warranty.

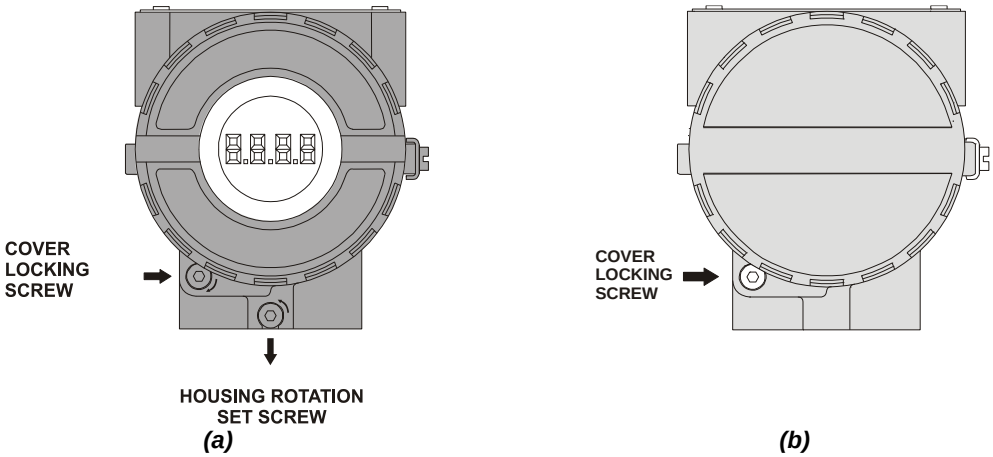


Figure 1.2- Cover Locking and Housing Rotating Set Screw (a) Electronic Board Side (b) Terminal Connection Side

Wiring

Access the wiring block by removing the Electrical Connection Cover. This cover can be locked closed by the cover locking screw (Figure 1.2- b). To release the cover, rotate the locking screw clockwise.

The terminals in the superior part marked with (**+**) and (−) are to receive the powering from 12 to 45 Vdc. The inferior terminals marked with the numbers from 1 to 4 they are for the connections of the different types of sensors.

Test and Communication terminals allow, respectively, to measure the current in the 4 - 20 mA loop, without opening it, and to communicate with the transmitter. To measure it, connect a multimeter in the mA scale in the "**–** " and "**+**" **TEST** terminals. To communicate with it, use a HART configurator between "**+**" and "**–** " **COMM** terminals. The wiring block has screws on which terminals type fork or ring can be fastened, see Figure. 1.3.

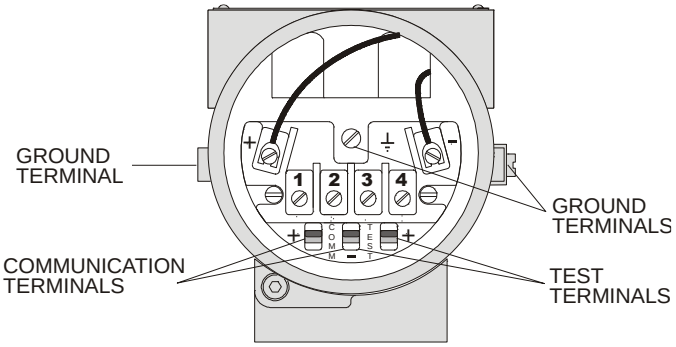


Figure 1.3 - Ground Terminal

The access of the signal cables to the connection terminals can be done through one of the conduit entries in the housing, which can preferably be connected through cable glands. Conduits should be avoided if they do not have protection to prevent the entry of moisture.

The **TT301** is protected against reversed polarity.

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

Use of twisted pair (22 AWG) cables is recommended.

Avoid routing signal wiring close to power cables or switching equipment.

Loop Connections

WARNING
Do **not** connect the Power Supply to the sensor terminals (Terminals 1, 2, 3, and 4).

Connection of the **TT301** working as transmitter should be performed as in Figure 1.5.

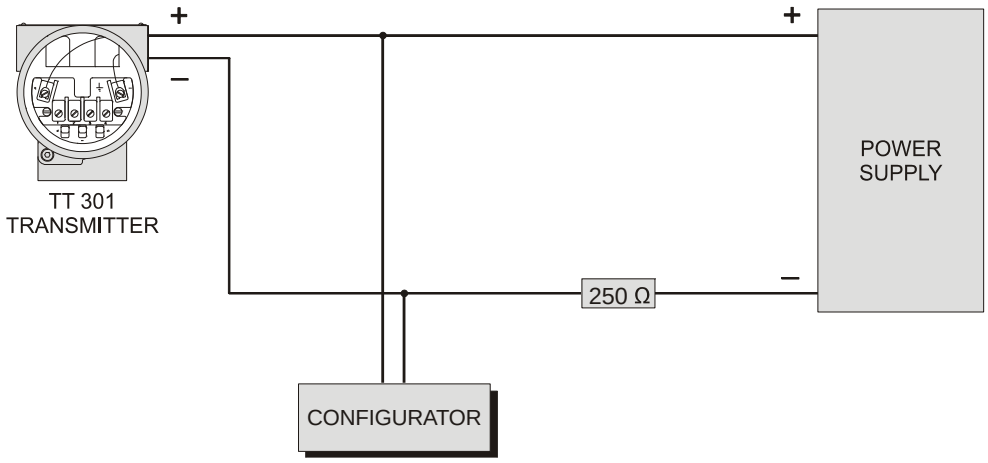


Figure 1.4 – Wiring Diagram for the TT301 Working as Transmitter

Connection of the **TT301** working as a controller (Optional) should be as indicated in Figure 1.6.

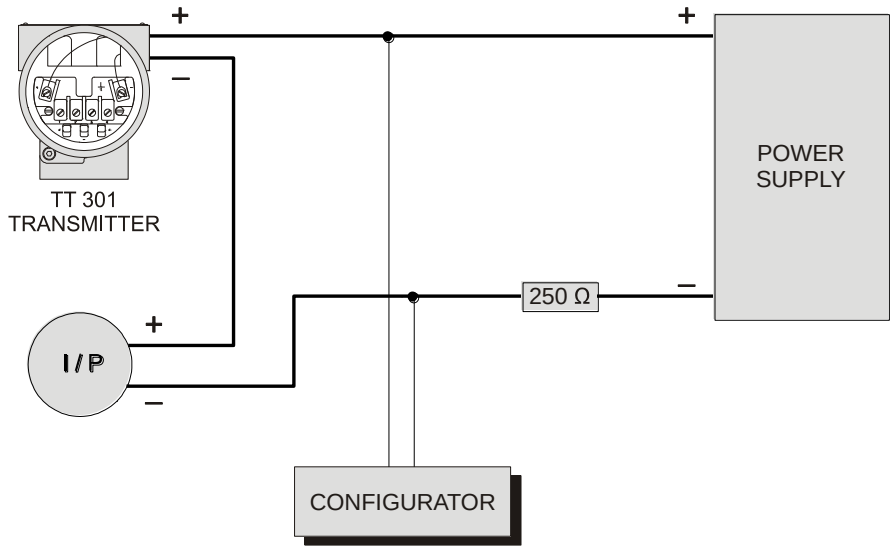


Figure 1.5 – Wiring Diagram for the TT301 Working as Controller

Connection of the **TT301** in multidrop configuration should be done as in Figure 1.7. Note that a maximum of 15 transmitters can be connected in parallel on the same line if the HART protocol is 5. If the HART protocol is version 7, up to 63 transmitters can be connected.

When many transmitters are connected to the same line, calculate the voltage drop through the 250 Ohm resistor and verify that the voltage of the power supply is enough (Figure 1.8).

WARNING
For proper operation, the configurator requires a minimum load of 250 Ohm between it and the power supply.

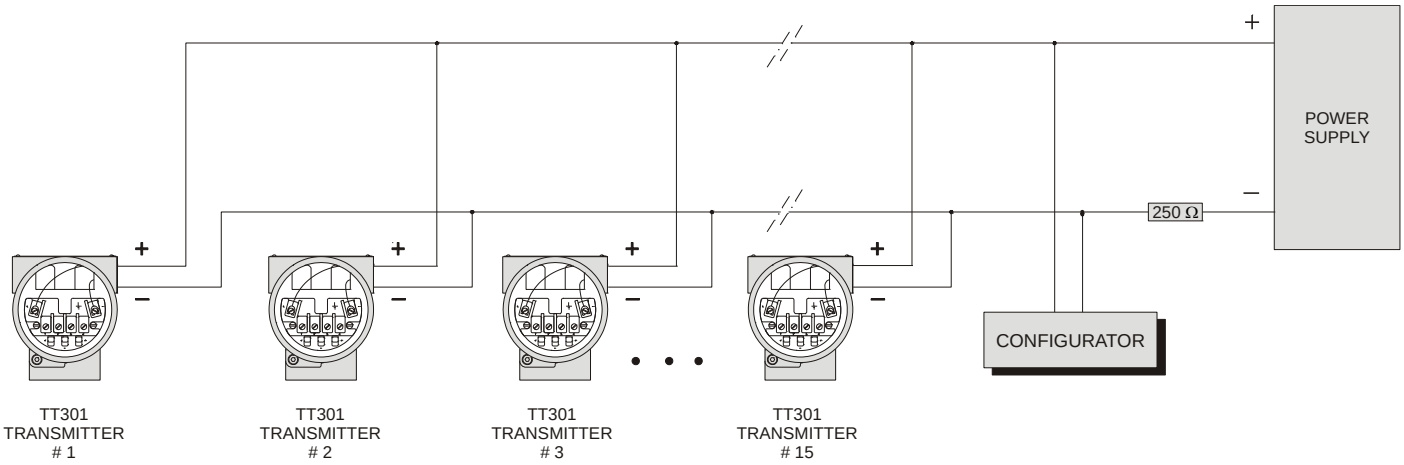


Figure 1.6 - Wiring Diagram for the TT301 in Multidrop Configuration with HART protocol version 5

The Configurator can be connected to the communication terminals of the transmitter or at any point of the signal line by using the interface with alligator clips.

It is also recommended to ground the shield of shielded cables at only one end. The not grounded end must be carefully isolated.

NOTE
Make sure that the transmitter is operating within the operating area as shown on the load diagram (Figure 1.8). Communication requires a minimum load of 250 Ohm.

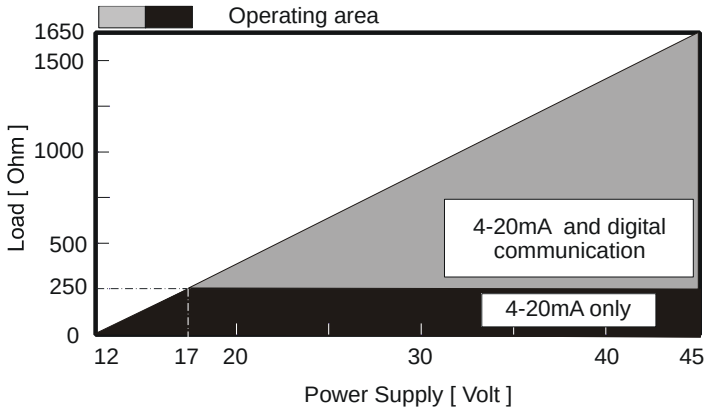


Figure 1.7 – Load Curve

The sensor should be connected as per Figure 1.8.

WARNING
When operating with two sensors, the sensors can not be both grounded. At least one has to be not grounded for proper operation of **TT301**.

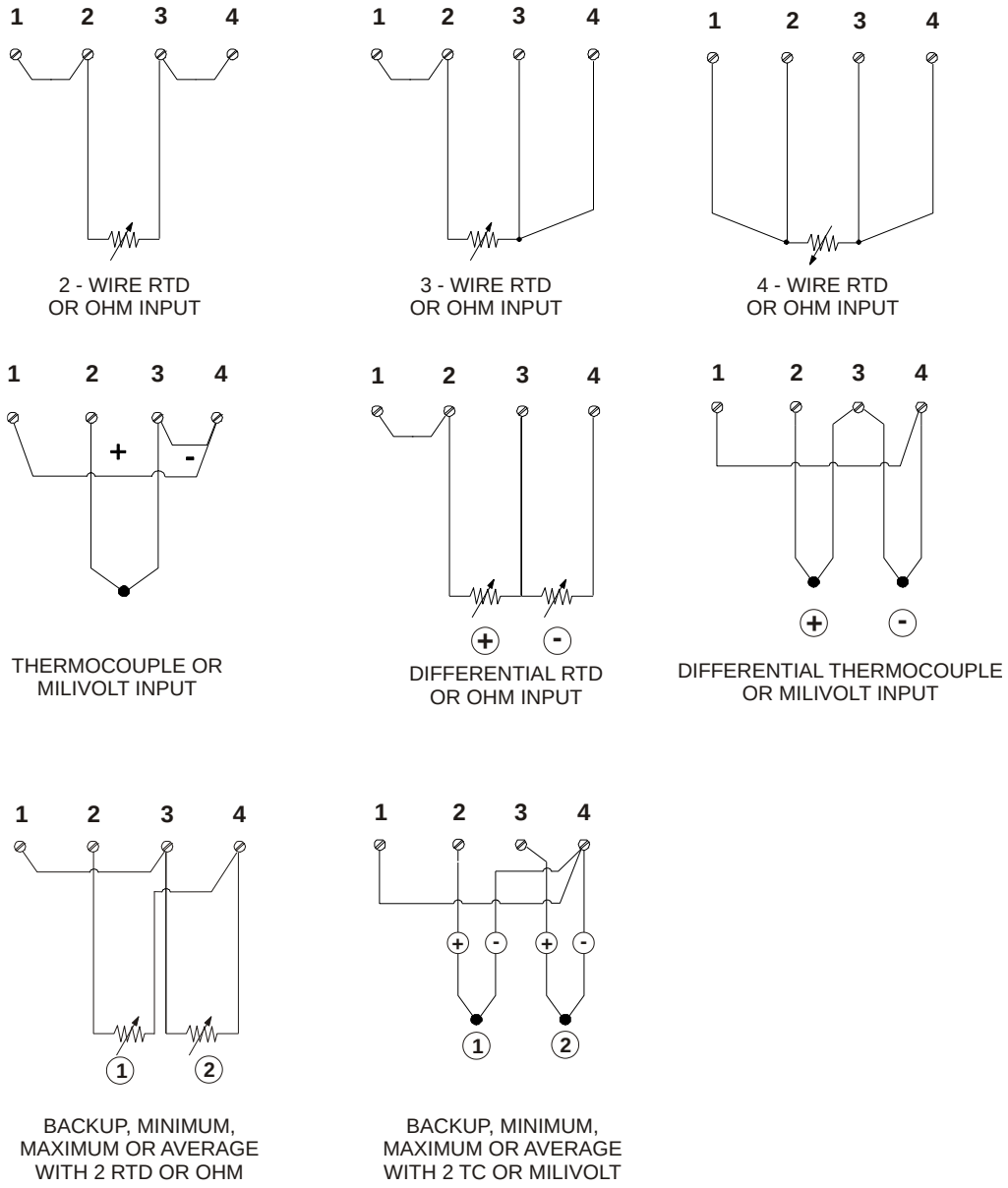


Figure 1.8 – Sensor Wiring

Installation in Hazardous Areas

Consult the Appendix A for Hazardous Location Approvals.

Section 2

OPERATION

The **TT301** 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 to 2000 Ohm.

Functional Description-Hardware

Refer to the block diagram (Figure 2.1). The function of each block is described below.

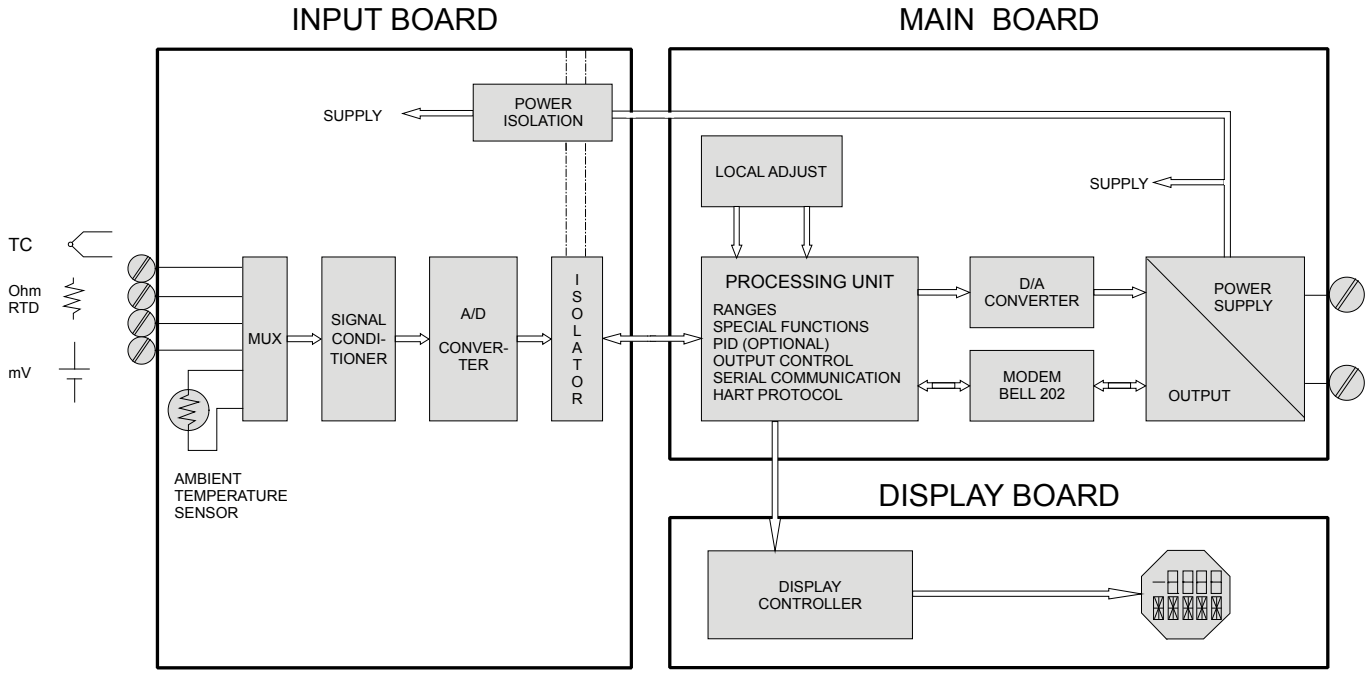


Figure 2.1 – TT301 Block Diagram

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.

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

CPU - Central Processing Unit & PROM
The CPU is the intelligent portion of the transmitter, being responsible for the management and operation of all other blocks: linearization, cold junction compensation and communication. The program is stored in the PROM as well as the linearization data for the temperature sensors.
For temporary storage of data, the CPU has an internal RAM, the data in the RAM is lost if the power is switched off, however the CPU also has an internal nonvolatile EEPROM where data that must be retained is stored. Examples: calibration, configuration, and identification data.

D/A Converter
Converts the digital data from the CPU to an analog signal.

Output
Controls the current in the line feeding the transmitter. It acts as a variable resistive load whose value depends on the voltage from the D/A converter.

Modem
Modulates a communication signal on the current line. A "1" is represented by 1200 Hz and a "0", by 2200 Hz. These signals are symmetric and do not affect the DC level of the 4-20 mA signal.

Power Supply
Power shall be supplied to the transmitter circuit using the signal line (2-wire system). This transmitter needs a minimum of 3.9 mA to function properly.

Power Isolation
Its function is to isolate power supply between the input and the CPU.

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

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

Functional Description - Software

Refer to the block diagram (Figure 2.2).

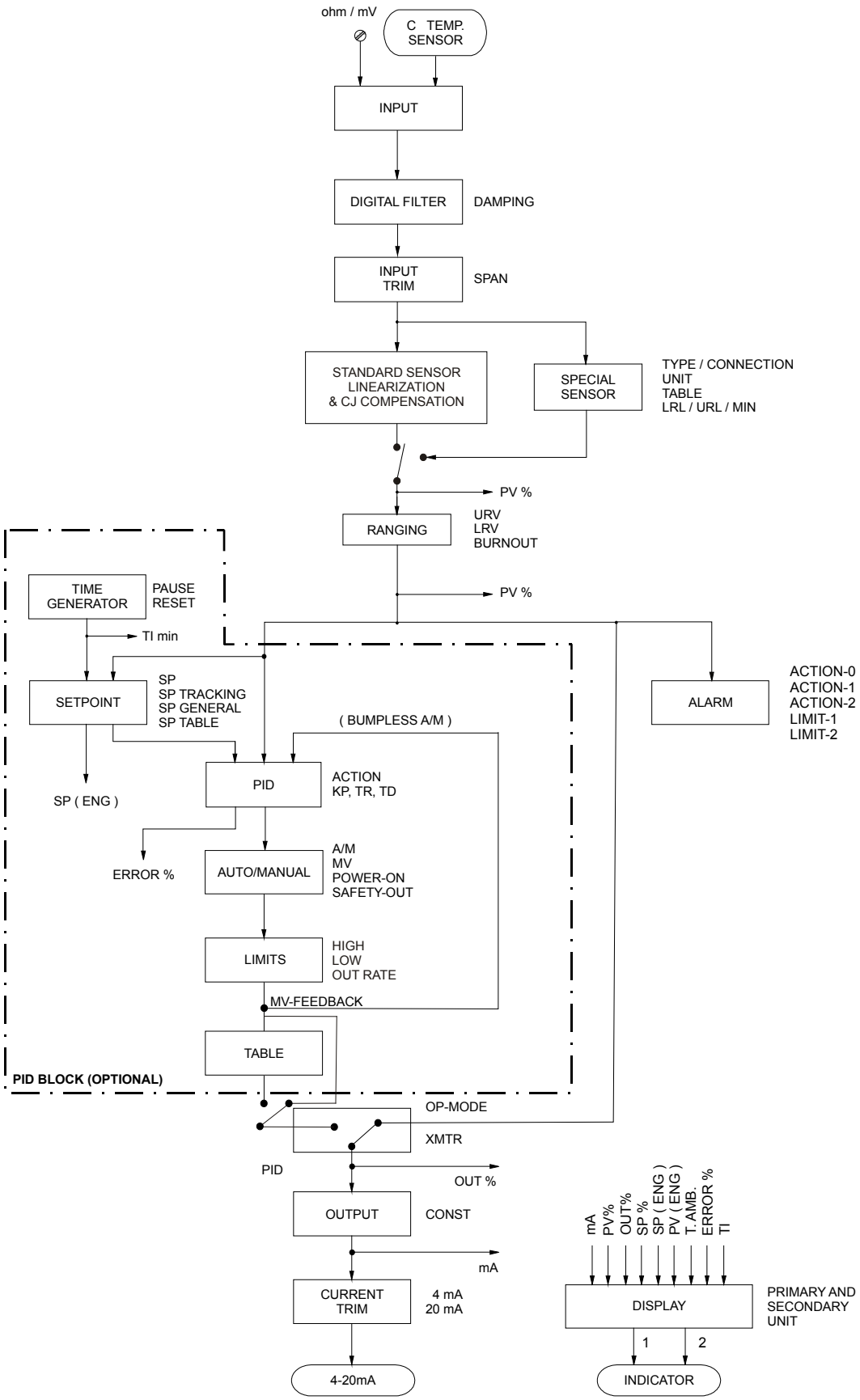


Figure 2.2 – Software Flow Chart

The function of each block is described below.

Input
Calculates the actual mV or Ohm from the value sensed by the input circuitry.

Digital Filter
The digital filter is a low-pass filter with an adjustable time constant. It is used to smooth noisy signals. The Damping value is the time required for the output to reach 63.2% for a step input of 100%.

Input Trim
Here, the value obtained by READING-TRIM is used to correct the transmitter for long term drift.

Standard Sensor Linearization & Compensation
Here, the mV and Ohm measurements are linearized, and cold junction compensated according to the sensor characteristics stored in the CPU. The CPU contains data about most standard sensors available.

Calibration
It is used to set the process values corresponding to the output 4 and 20 mA in transmitter mode or process variable 0 and 100% in PID mode. In transmitter mode the LOWER-VALUE is the point corresponding to 4 mA, and UPPER-VALUE is the point corresponding to 20 mA. In PID mode, the LOWER-VALUE corresponds PV = 0% and UPPER-VALUE corresponds to PV = 100%.

Time Generator (Optional)
Counts the time to be used by the Setpoint generator function. It may be paused by using PAUSE or set to any value inside the table.

Setpoint (Optional)
The setpoint can be adjusted or generated automatically via the SP generator. When running, the setpoint generator causes the SP to follow values according to a pre-configured table.

PID (Optional)
First the error is calculated as SP-PV or PV-SP depending on which action (direct or reverse) is configured in ACTION.

$$MV = Kp(e + \frac{1}{Tr}\int edt + Td.\frac{dPV}{dt})$$

TABLE POINTS
This block relates the output (%) with the input (%) according to a 16 table points. The output is calculated through the interpolation of these points.

Auto/Manual (Optional)
The Auto/Manual mode is toggled in PID. In Manual, MV may be adjusted by the user. The SP-POWER-ON option is used here to determine in which mode the controller should be upon powering it on.

Limits (Optional)
This block makes sure that the MV does not go beyond its minimum and maximum limits as established by the HIGH-LIMIT and LOW-LIMIT. It also makes sure that the Rate-of-Change does not exceed the value set in RATE-CHNG.

Output
Calculates the current proportional to the process variable or manipulated variable to be transmitted on the 4-20 mA output depending on the configuration in OP-MODE. This block also contains the constant current function configured in OUTPUT. The output is physically limited to 3.6 to 21 mA.

Current Trim
The 4 mA TRIM and 20 mA TRIM are used to make the transmitter current comply with a standard current, if necessary.

Display
Alternates two indications as configured in DISPLAY. The engineering unit for the process variable can be selected in UNIT.

Temperature Sensors

The **TT301**, as previously explained, accepts several types of sensors. The **TT301** is specially designed for temperature measurement using thermocouples or thermoresistances (RTDs).

Some basic concepts about these sensors are presented below.

Thermocouples

Thermocouples are the mot widely used sensors in industrial temperature measurements.

Thermocouples consist of two wires made from different metals or alloys joined at one end, called measuring 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:

How the Thermocouple Works

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 in one end, and left open in 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 does 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 **TT301**, 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 marshalling box) new junctions with additional Seebeck effects will be created and ruin the measurement in most cases, since the cold-junction compensation will be done in the wrong point.

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

Standardized thermocouples which are commercially used, whose tables are stored in the memory of the **TT301**, are the following:

- ✓ **NBS (B, E, J, K, N, R, S, T)**
- ✓ **DIN (L, U)**
- ✓ **GOST (L)**
- ✓ **ASTM-E (W5Re/W26Re)**

Thermoresistances (RTDs)

Resistance Temperature Detectors, most known as RTDs, are based on the principle that the resistance of a metal increases as its temperature increases.

Standardized RTDs, whose tables are stored in the memory of the **TT301**, are the following:

- ✓ **JIS [1604-81] (Pt50 & Pt100)**
- ✓ **IEC, DIN, JIS [1604-89] (Pt50, Pt100, Pt500, Pt1000)**
- ✓ **GE (Cu 10)**
- ✓ **Edison Curve (Ni 120)**
- ✓ **GOST (Pt50, Pt100, Cu50, Cu100)**
- ✓ **IEC 751-95 (Pt100)**
- ✓ **MILT (Ni120, Pt100)**

For a 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 a lot.

The **TT301** permits a 2-wire connection which may cause measuring errors, depending on the length of connection wires and on the temperature to which they are exposed (see Figure 2.3).

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

wires.

V2 = [RTD + 2x R] x I

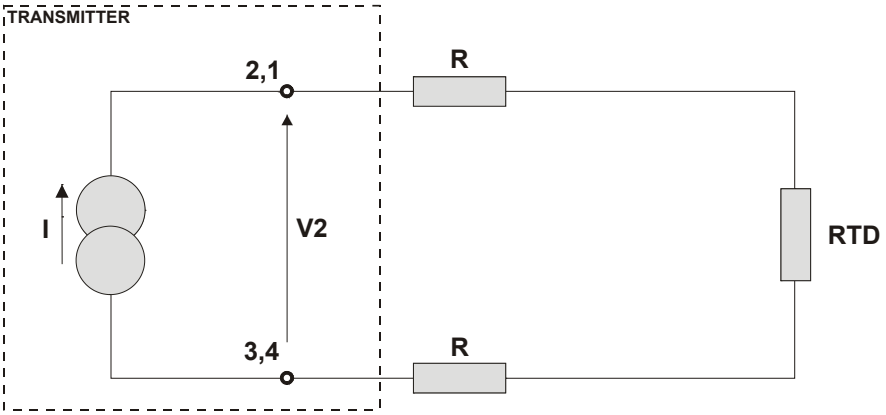


Figure 2.3 – Two-Wire Connection

To avoid the resistance effect of the connection wires, it is recommended to use a 3-wire connection (see Figure 2.4) or a 4-wire connection (see Figure 2.5).

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 canceled out and is directly proportional to the RTD resistance alone.

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

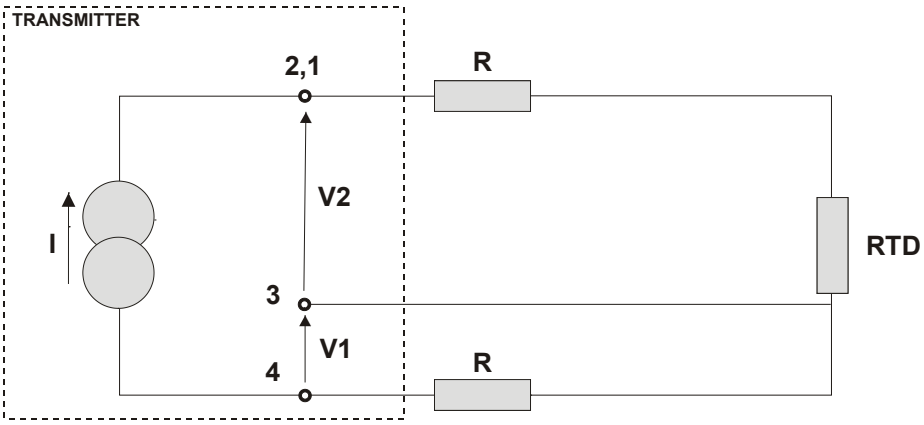


Figure 2.4 – Tree-Wire Connection

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 resistances of the other two wires are not interesting since no measurement is done on them. Hence the voltage V2 is directly proportional to the RTD resistance. (V2 = RTD x I).

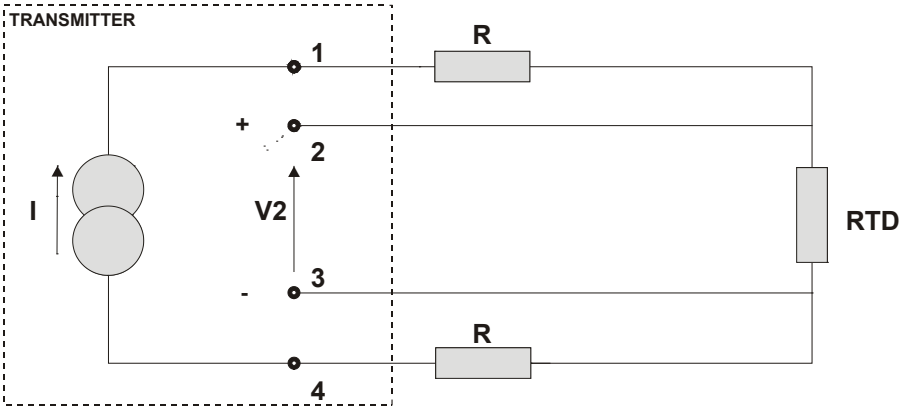


Figure 2.5 – Four-Wire Connection

A differential connection is like the two-wire connection and gives the same problem (see Figure 2.6). Terminal 3 is a high impedance input. Thus, no current flow through and no voltage drop is caused, but the resistance of the other two wires will be measured and does not cancel each other out in a temperature measurement, since linearization will affect them differently.

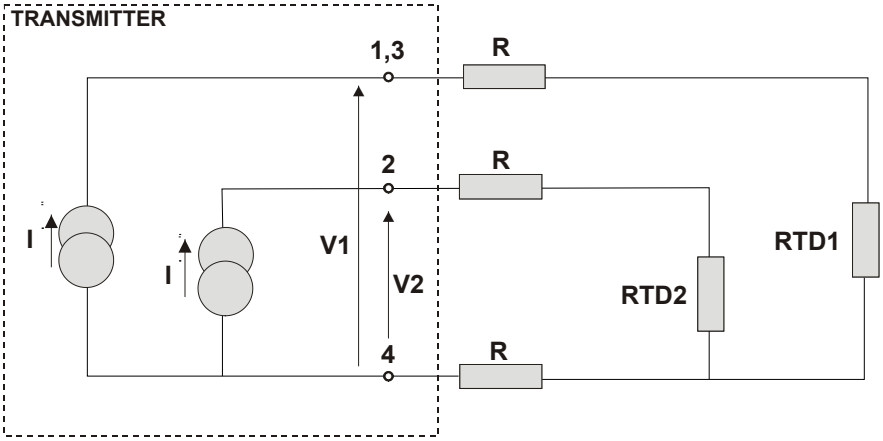


Figure 2.6 – Differential Connection

NOTE
The material, the gauge, and the length should be the same connections of 3 or 4 wires.

Display

The digital indicator can display one or two variables which are user selectable. When two variables are chosen, the display will alternate between the two with an interval of 3 seconds.

The different fields and status indicators are explained in Figure 2.8.

Monitoring

During normal operation, the **TT301** is in the monitoring mode. In this mode, indication alternates between the primary and secondary variable as configured in **DISPLAY**. See Figure 2.7.

The display indicates engineering units, values and parameters simultaneously with most status indicators. The monitoring mode is interrupted in two situations:

- ✓ User performs complete local adjustment.
- ✓ An alarm is activated.

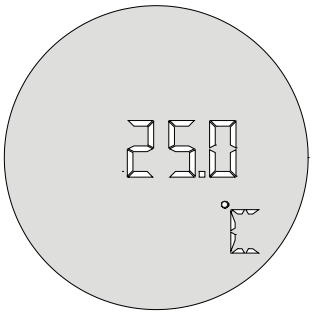


Figure 2.7 – Display

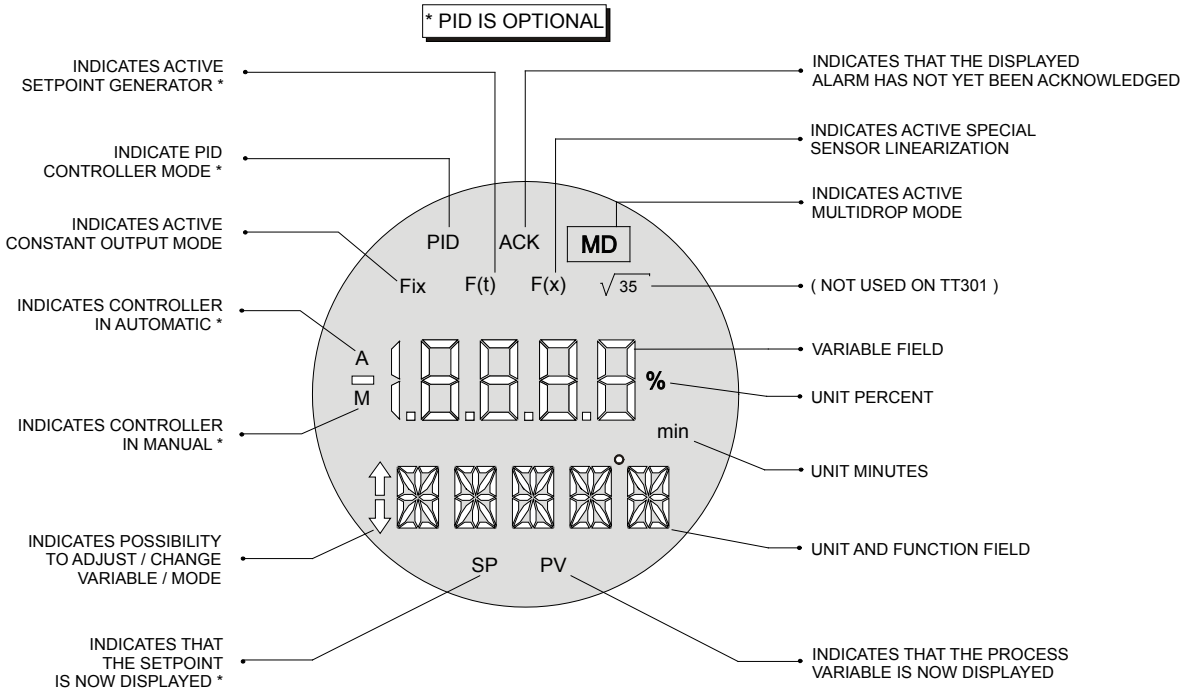


Figure 2.8 – Typical Monitoring Mode Display

Alarm

The three alarms are software alarms and have no contacts available on the transmitter. The alarms are acknowledged by using the Local Adjustment or the Configurator, which can view and configure alarms as well - see further Section III. During an alarm, the display will indicate which alarm has been activated and if it has been acknowledged or not.

The transmitter display also indicates the alarms status as shown in Figure 2.9.

AL H means High Alarm, AL L means Low Alarm and ALO indicates Burnout failure. The ACK indicates that the alarm has not yet been acknowledged.

When the alarm condition disappears, the "ACK" is switched off and the display returns to monitoring mode.

For further information on alarm configuration, see Section III - Programming Using Terminal.

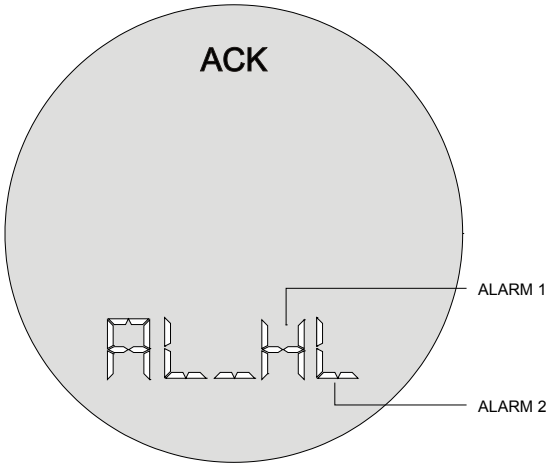


Figure 2.9 – Typical Alarm Condition Display

CONFIGURATION

The Temperature Intelligent Transmitter **TT301** is a digital device bearing the most advanced features a measurement apparatus can offer. A HART® digital communication protocol permits the device to be connected to an external computer for a simple and complete configuration. These computers, connected to the transmitters, are called HOST computers and may be a Primary or Secondary Master type. Although HART may be a master/slave protocol, it may coexist with up to two masters in a field bus. Generally, the Primary HOST stands for a Supervisory and the Secondary HOST is used as a Configurator.

Transmitters may be connected to a point-to-point or a multidrop network. In a point-to-point network, the equipment should have its address set at “0”, so that the output current is modulated from 4 to 20 mA, according to the measurement performed. In a multidrop network, the transmitters should be configured on a network address between “1” and “15” (HART version 5) and “1” and “63” (HART version 7) if the identification devices work via address. In this case, the transmitter’s output current must be constant, each transmitter consuming 4 mA. If the identification mechanism is done via Tag, the transmitters may be addressed at “0” and control their current output, even on a multidrop configuration.

The **TT301** may be configured both for Transmitter and Controller and the HART addressing may be used as follows:

- ✓ **TRANSMITTER MODE:** With address "0" the TT301 controls its current output. With addresses from "1" to "15", for HART protocol, version 5, it works in multidrop mode without output current control, keeping it fixed at 4 mA. If it is HART version 7 protocol, the addresses vary from “1” to “63”.

- ✓ **CONTROLLER MODE:** The **TT301** always controls the output current according to the value calculated for the Manipulated Variable, regardless of its address value on the net.

NOTE
When configured in multidrop for the classified areas the entity parameters allowed for the area must be strictly observed. So, verify that: **$Ca \geq \Sigma Cij + Cc$ $La \geq \Sigma Lij + Lc$** **$Voc \leq \min [Vmaxj]$ $Isc \leq \min [Imaxj]$** **Where:** **Ca, La** = capacitance and inductance permitted in bus; **Ci_j, Li_j** = transmitter capacitance and inductance r j (j=1, 155), without internal protection; **Cc, Lc** = cable capacitance and inductance; **Voc** = open circuit tension of the intrinsic safety barrier; **Isc** = short circuit tension of the intrinsic safety barrier; **Vmax** = maximum permissible tension to be applied on the r j transmitter; **Imax** = maximum permissible tension to be applied on the r j transmitter.

The **TT301** Intelligent Temperature Transmitter presents a comprehensive set of HART Commands that permit accessing any implemented functionality. These commands comply with the HART protocol specifications and are grouped in Universal Commands, Common Practice Commands and Specific Commands.

Smar has developed the **DEVCOMDROID** (Android DDL Interpreter) software, used with HART interfaces, such as the **HI331** (Bluetooth Interface), in addition to **AssetView** (based on DTM) to configure the HART equipment. However, the old PALM with HPC301 or CONF401, which are obsolete, remains operable even with the latest updates in HART transmitters.

They provide easy configuration and monitoring of field devices, capability to analyze data and to modify the performance of these devices. The operation characteristics and use of each one of the configuration tools are stated on their respective manuals.

Figures 3.1 and 3.2 show examples of the **DEVCOMDROID** windows used to configure the TT301.

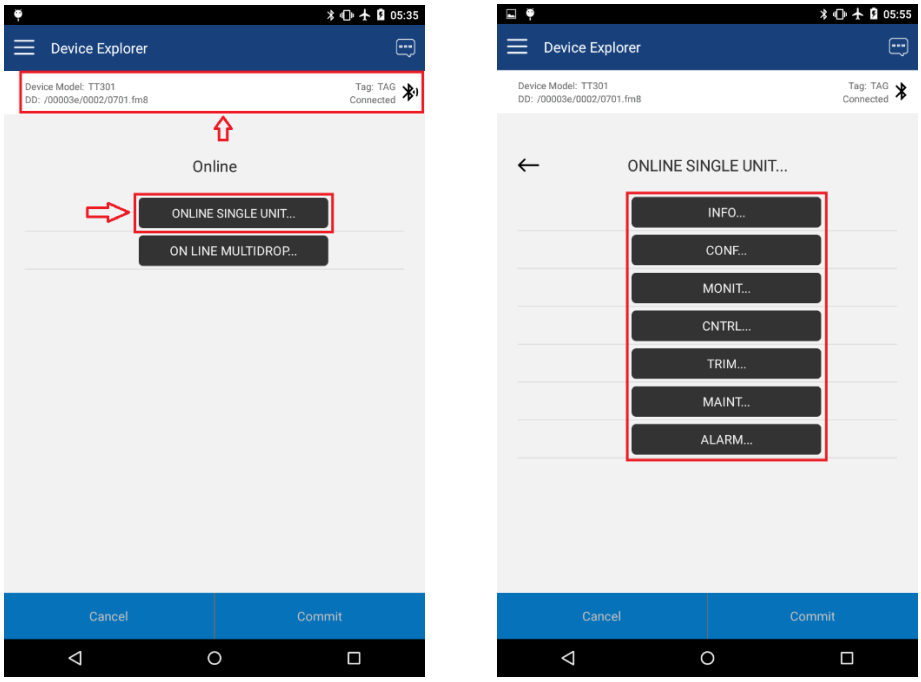


Figure 3.1 - DevComDroid Configurator

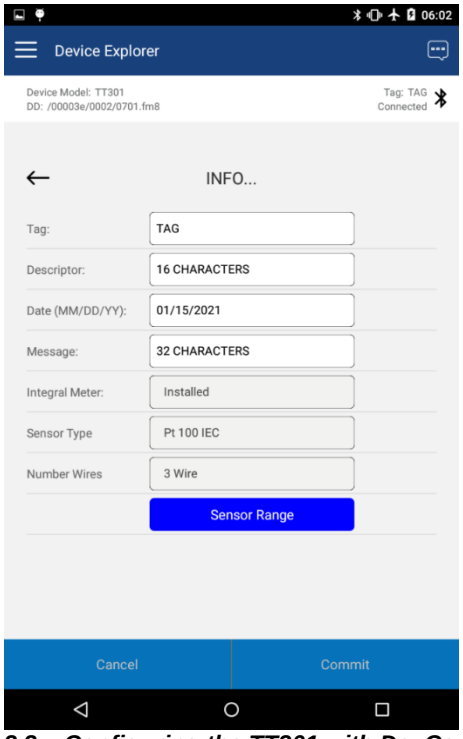


Figure 3.2 – Configuring the TT301 with DevComDroid

Configuration Resources

Through the HART configurators, the **TT301** firmware allows the following configuration resources to be accessed:

- ✓ Transmitter Identification and Manufacturer Data;
- ✓ Primary Variable Trim – Temperature;
- ✓ Secondary Variable Trim – Terminal Block Temperature;

- ✓ Equipment Current Trim;
- ✓ Transmitter Adjustment to Work range;
- ✓ Engineering Unit Selection;
- ✓ Set Point Generator Configuration;
- ✓ PID Controller Configuration;
- ✓ Equipment Configuration;
- ✓ Equipment Maintenance.

The operations occurring between the configurator and the transmitter do not interrupt the temperature measuring and do not disturb the output signal. The configurator may be connected on the same 4-20 mA signal cable to a maximum 2000 m distance from the transmitter.

Programming Tree

The programming tree is a structure resembling a tree, with all the resources available in the software, as shown on Figure 3.3.

DEVICE ADDRESS 0: Used when the Configurator is connected in parallel with a single transmitter and this transmitter has 0 (zero) for address.

ON_LINE_MULTIDROP: Used when the Configurator is connected in parallel with several transmitters and these transmitters are configured with different addresses (See Multidrop).

WARNING
All transmitters are factory-configured without passwords. To avoid faulty operation on a few critical levels on the programming tree, the configuration is recommended of all passwords before operating. See option “PASSWORD”, on the maintenance section.

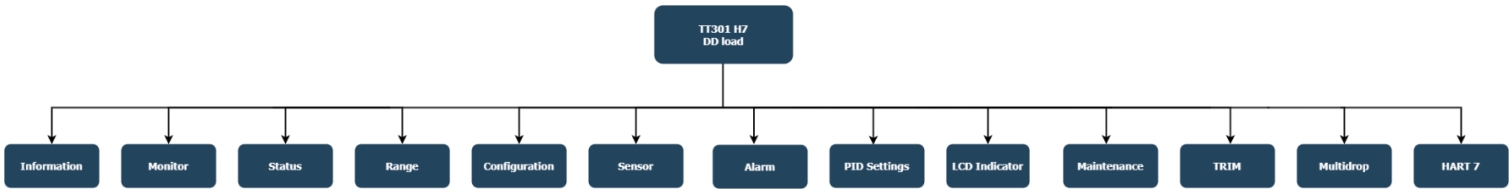


Figure 3.3 – Configuration Tree

INFORMATION – The main information on the transmitter may be accessed here. They include: Tag, Description, Message and Single ID.

MONITOR – The user may monitor 4 of the transmitter dynamic variables and the current output.

STATUS – Allows the user to check transmitter status information, for example, if the primary variable is outside the operating limits of the equipment, if maintenance is required, if there is an electronic failure, etc.

RANGE – The following outputs related to the parameters may be configured: Lower Value, Upper Value, Unit and damping.

CONFIGURATION – This option allows the user to configure burnout, write protection, transfer function and output.

SENSOR – This option allows configuring the sensor type, operating range and the connection to be used.

ALARM – Any of the three available types of alarm may be configured. They may be used as an alert tool to be activated when the PV is out the configured range.

PID SETTINGS – This option connects and disconnects the controller function and adjusts and monitors all the control parameters.

LCD INDICATOR - The TT301 accepts up to two display configurations that are shown alternately, every 3 seconds. The parameters that can be selected for visualization are: OUT, OUT%, PRES, PV%, PV and TEMP.

MAINTENANCE – This option allows testing the current loop, restarting the equipment, viewing the operations counter, configuring write protection, enabling or disabling local adjustment, etc.

TRIM – Adjusts the transmitter displaying to a current or an Ohm/mV standard.

MULTIDROP – This option allows the user to view the equipment's current address and designate a new one, if necessary.

HART 7 – On this tab, under Dynamic Variable, the variables selected for PV, SV, TV, and QV are shown, with their current values and units. PV will always be the temperature. The Change Dynamic Variable option allows the user to change which will be SV, TV, and QV, if desired. In Device Variables there are eight selectable boxes for the user to choose the variables to monitor. Just choose and click Monitor Device Variables. The Lock/Unlock Device option is used to lock a device temporarily or permanently, preventing any changes from being made from a local panel or another master.

Information - Identification and Manufacturing Data

The main information on the transmitter may be obtained here. They are Tag, Description, Message, Date and Unique Identification. There is also a screen with important additional information on the equipment. They are Manufacturer, Type of equipment, Serial Number and Transmitter Firmware Version, HART protocol Version and Hardware Revision.

The following information are available for the **TT301** transmitter identification and manufacturer data:

- ✓ **TAG** – Field with 8 alphanumerical characters for transmitter identification;
- ✓ **DESCRIPTOR** – Field with 16 alphanumerical characters for additional transmitter identification;
- ✓ **MESSAGE** – Field with 32 alphanumerical characters for any other information, such as the name of the last person to calibrate, some special caution to be observed or if a ladder is needed to access the transmitter, for example.
- ✓ **DATE (MM/DD/YYYY)** – The date may be used to identify a relevant date, as the last calibration, the next calibration or installation. The date is stored in the form of bytes, where DD = [1..31], MM = [1..12], YYYY = [1900..2155].
- ✓ **UNIQUE ID** - Shows the Unique Identifier of the equipment. Read-only information, therefore cannot be modified.
- ✓ **LONG TAG -** Field with 32 alphanumeric characters for transmitter identification (HART7).
- ✓ **HART –** Shows the minimum number of preambles needed in requests and responses for the equipment to recognize or send a valid message, the revision number of the universal HART commands and the configuration change counter.
- ✓ **SENSOR INFORMATION –** Sensor information: number of wires, type and whether there is a display installed.
- ✓ **DEVICE INFORMATION –** Distributor, manufacturer, type, profile, and ID.
- ✓ **SOFTWARE VERSION –** Equipment firmware version.
- ✓ **SECOND CPU VERSION –** Secondary CPU information.

Monitor - Monitoring

In this section, the variables selected for PV, SV, TV, and QV are shown, with their current values and units. PV will always be the temperature.

Specific Monitor is the function that allows monitoring the transmitter 4 variables on display simultaneously. See the next table.

VARIABLE	DESCRIPTION
OUT (mA)	mA output.
OUT%	Output percent.
PV	Process variable on the selected engineering unit.
TEMP	°C Ambient temperature.
PV%	Process variable percent.
***SP%**	Setpoint percent.
***SP**	Setpoint on the selected engineering unit.
***SPTime(min)**	Setpoint generator time in minutes.
***Error(%)**	Deviation between SP and PV percents.

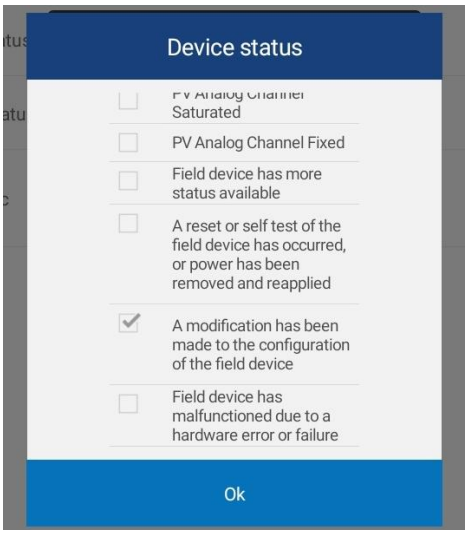
Table 3.3 - Monitored Variables

*NOTE
These items may only be selected on PID mode.

Status

Allows the user to check transmitter status information, for example, if the primary variable is outside the operating limits of the equipment, if maintenance is required, if there is an electronic failure, etc.

In **Device Status**, **Extended Device Status** (**Ext dev status**) and **Device Diagnostic Status 0** the available statuses are shown. The options that appear checked are those that are currently active. See an example in the following figure:



Range - Calibration

This option configures the lower and upper values of the operating range, selects the unit that will represent the process variable, transmitter damping and calibration with reference.

The **PV DAMP** option enables electronic damping adjustment. Damping can be adjusted between 0 and 32 seconds.

The Engineering Unit shown on the transmitter and configurator display can be changed. Units are linked to the selected process variable type.

The following units are available:

- For **mV** input: always **mV**.
- For **Ohm** input: Always **Ohm**.
- For **Thermocouple** and **RTD** input: degrees **Celsius**, **Fahrenheit**, **Rankine** and **Kelvin**.

Configuration

This function affects the transmitter 4-20 mA output and display indication. It may alter the lower and upper burnout, select the variables to be displayed and verify the status of writing protection.

Burnout – The burnout may occur when the sensor reading is out of range or the sensor is open. In this case, the transmitter may be adjusted for maximum output limit at 21 mA, by configuring it on the upper value, or the minimum limit at 3.6 mA configured on the lower value.

Sensor

Sensor Types

It configures the **TT301** input for the type of sensor in use and its connecting mode. The types covered in this manual are:

RTD: Resistance Temperature Detector
Cu10 (GE)
Ni120 (DIN)
Pt50, 100, 500, 1000 (IEC)
Pt50, 100 (JIS)
Pt50, PT100, Cu50, Cu100 (GOST)
Pt100 (IEC 751-95)
Ni120, Pt100 (MILT)
Configurable for 2, 3 or 4 wires, differential, backup, maximum, minimum, or average

TC: Thermocouples
B, E, J, K, N, R, S, and T (NBS)
L and U (DIN)
L (GOST)
W5Re/W26Re (ASTM)
Configurable for 2, 3 or 4 wires, differential, backup, maximum, minimum, or average

Ohm: Resistance Measuring
0 to 100 Ohm
0 to 400 Ohm
0 to 2000 Ohm
Configurable for 2, 3 or 4 wires, differential, backup, maximum, minimum, or average

mV: Voltage Measuring
-6 to 22 mV
-10 to 100 mV
-50 to 500 mV
Configurable for 2 wires, differential, backup, maximum, minimum, or average

Cold Junction:
This option enables or not the cold junction for TC sensors. Do not use the "send" button. The alteration is made automatically in the transmitter.

Sensor - Connection and Work Mode

After selecting the sensor type is necessary to choose the way how sensors work. The available options are differential, 2 wires, 3 wires, 4 wires, backup, average, maximum, and minimum. In the options 2, 3 or 4 wires, only one sensor is connected in the device terminal. In the options differential, backup, average, maximum and minimum two sensors are connected.

2, 3, and 4 wires: Only one sensor will generate the process variable. If it ruptures, the burnout indication will be showed.

Differential: In this mode, the TT301 works with the difference in the measurement of the two sensors. If one of them breaks, there will be an indication of burnout.

Backup: The TT301 works with the reading of the first sensor (between terminals 2 and 4). When there is a break in this sensor, the second sensor (between terminals 3 and 4) provides the reading of the process variable. If the second sensor takes over, the reading from the first sensor will be ignored, even if this sensor returns to normal operation. Only in the case of a reset of the equipment via software or a reenergization of it will the first sensor again provide the reading of the process variable. When the second sensor is active, the following alarm is generated: 'process variable other than the primary one is out of limits'.

Average: The final reading will be the average of the signals from two sensors. If the difference between them is higher than a programmed value, an alarm will be generated. If one of them breaks, the other continues performing the process variable reading, and an alarm will be generated: 'process variable other than the primary one is out of limits'.

Maximum and minimum: The process variable will be provided by the sensor that has the maximum or minimum reading respectively. In case one of the sensors breaks, the good sensor will continue to give the process variable reading, but the alarm 'process variable other than the primary one is out of limits' will be generated.

Callendar Van Dusen

The Callendar van Dusen equations describe the relationship between temperature and resistance of industrial platinum RTDs. They are used to approximate RTD curves in cases where there are large temperature ranges or in measurements with low uncertainty.

The coefficients will be in the TT301's memory, they will be shown one by one to the user who will be able to modify them, if necessary, or just confirm them.

Alarm

This function configures the three **TT301** alarms, with independent configuration for alarms 1 and 2 action and limit. All the alarms may be monitored and identified through this function. Alarm zero indicates burnout and may be activated or deactived in this function.

Acknowledge - Recognizes the alarm. The **ACK** indication on the transmitter display disappears as the pending alarms are identified.

Action - Configures the alarm operation mode: low, high, or off.

Status – Indicates if there is active alarm or not.

Level - Configures the level that the alarm is occurring.

Alarm Configuration

Low - Is activated when the PV goes below the signal configured (decreasing).

High - Is activated when the PV goes above the signal configured (increasing).

Off - The alarm is disabled.

PID

This option adjusts the PID parameters including the Setpoint, change on auto/manual mode and the tuning parameters.

The **TT301** with an activated PID works as a controller/transmitter, while, deactivated, it works only as a transmitter. The transmitter 4/20mA output may become a PID controller output, following the equation below:

$$MV = Kp\left(e + \frac{1}{Tr}\int edt + Td.\frac{dPV}{dt} \right)$$

Where:

e = PV – SP (Direct) or SP – PV (Reverse)
SP = Setpoint
PV = Process Variable
Kp = Proportional Gain
Td = Derivative Time
MV = Output
Tr = Integration Time

See below a list of configurations feasible on the PID function.

PID Controller – ON/OFF

Tuning Parameters – This feature configures the Kp, Tr and Td tuning parameters, as well as output limits and rate.

PV, SP, MV, and Error Readings – Provides real-time variable value.

SP Tracking – When in MANUAL, the setpoint follows the PV. When the controller is switched to AUTO, the last PV value before the switch will be regarded as SP.

Control Action – This option configures the transmitter Operation Mode. The options are:

Direct – The output increases when the PV rises.

Reverse – The output decreases when the PV does.

Power on is (Control Mode) – Selects Automatic and Manual.

MV Configuration – Adjusts the manipulated variable.

SP Configuration – The Setpoint is adjusted.

Control Limits – This option switches the **SP Power On** to automatic, manual, and last value.

Safety Out (Safety value) – The output after a power shortage or during a failure.

Out Change (Rate / Alteration) – The maximum allowed output change.

Lower Limit – The minimum allowed percent output.

Upper Limit – The maximum allowed percent output.

Setpoint Table – When the setpoint generator is activated, the setpoint varies according to a curve table. The time is always read in minutes and the setpoint in percentage.

SP Generator – When activated, the setpoint varies with time according to the schedule on **TABELA_SP** table.

LCD Indicator

The options to be set on both displays are **First Var=** and **Second Var=.** Available variables are OUT(mA), OUT(%), PV, TEMP, PV(%), *SP(%), *SP, *SPTime (min), *Error(%), KP, TR (min) , TD (sec), MV(%) and None.

The None option is only available for the second variable.

The indication will always alternate between the first and second variable. If the user does not want to alternate the indications on the display, select the same indication in both variables, or select

"None" in the second variable.

*NOTE
These items may only be selected on PID mode.

Maintenance

The maintenance option offers the user 5 choices to user check the loop functionality, such as: restart the equipment, test the current loop, verify the number of configurations performed, configure passwords and verify the equipment order code. Below is a brief description of the characteristics performed by the equipment Maintenance function:

Device Reset – The equipment is switched off and then on. The restarting option should be carried out as the last one, as it may destabilize the process control.

Loop Test – The current output may be adjusted to any desired value between 3.6 and 21.0 mA regardless of the input value. There are a few stable current values for the loop test. The options available are: 4 and 20 mA.

Reset Configuration Changed Flag: Reset the configuration change counter.

Operations Counter: The operation number counting is useful to indicate if somebody changed any configuration on the equipment. Every time one of the parameters below is altered, the respective operation counter is activated. The monitored parameters are:

- Range configuration (Lower/Upper)
- Change to Constant Current
- 4 mA Trim
- 20 mA Trim
- Sensor Trim
- Burnout configuration
- Sensor configuration
- Auto/Manual shift (PID enabled)
- Multidrop

CONF_LEVEL and Passwords: The options for password configuration and access level are Info, Conf, Monit, Cntrl, Trim, Manut, and Alarm

There are three password levels. They are used to restrict the access to certain operations in the programming tree. In the default condition no password is configured.

Each operation item may have a specified password level. The default password level is 0 (“Zero”), but the adjustment of **Info** at level “1” and **Manut** at level “3” are feasible. These levels may be altered by someone who knows the level “3” password. To cancel, just delete the current password and send another blank one.

The level 3 password is hierarquically superior to the level 2 passwords, which, on its turn is superior to level 1.

Format – It contains the equipment ordering code and sensor information.

NOTE
Contact Smar in case you forgot or lost your password.

Write Protect - Controls write protection and local adjustment.
Write Comm.: Enables and disables write protection through software communication.
Local adj: Enables and disables write protection with magnetic key via local adjustment**.**

Trim

The TRIM function is used to adjust resistance, voltage, and current reading to user standard. To continue the TRIM adjustment, the control loop must be on MANUAL to avoid disturbances in the process.

There are two options: Current signal and input reading.

Current TRIM (4-20 mA output)
When the microprocessor generates a 0 percent signal, the Digital-to-Analogic converter and related electronic circuits must send a 4 mA output. If the signal is 100 percent, the output must be 20 mA. Differences may occur between the SMAR standard current and the plant standard. In this case, the current TRIM adjustment should be used.

The Configurator will adjust the output signal and then it will ask again if the current is correct or not.

Repeat this procedure for the 20 mA current.

Input Reading TRIM
There may be differences between the SMAR resistance standard and mV and the plant standards. In this event, the user TRIM adjustment may be used. The TRIM available are: Zero trim, the Gain trim and Factory trim.

- Zero Trim – Calibrates the resistance or millivoltage lower value. The zero trim does not interfere with the gain trim.

- Gain Trim – Calibrates the resistance or milivoltage upper value.

- Factory Trim – Recovers the Zero, Gain, and temperature sensor trim done in factory.

For zero or gain adjustment, connect a resistance or mV standard with a better than 0.02% accuracy.

If the transmitter is configured as either differential sensor, backup, average, maximum or minimum, that is working with two sensors simultaneously, only the zero trim is available.
To perform zero trim, it should to short circuit the two sensors in the field and to enter with the value 0 (zero).

After performing the trim, remove the short circuit for the transmitter to read the sensors resistance without the influence of the lines. The line maximum resistance should be less than 32 Ω for that zero trim would be possible.

Temperature Sensor Trim
Althouth it is not necessary to perform the temperature trim of the terminal, it is possible a little adjustment in the temperature measure through this menu.

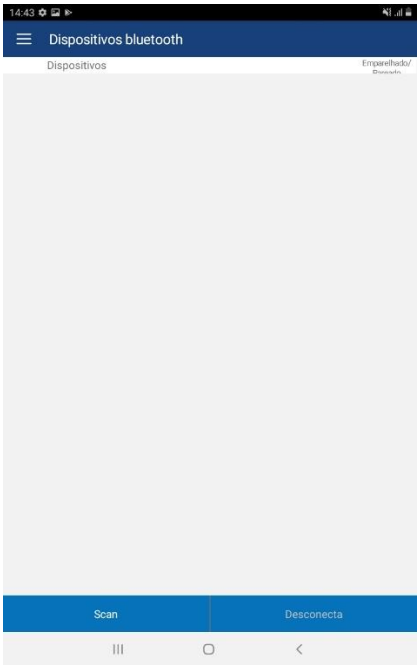
Multidrop

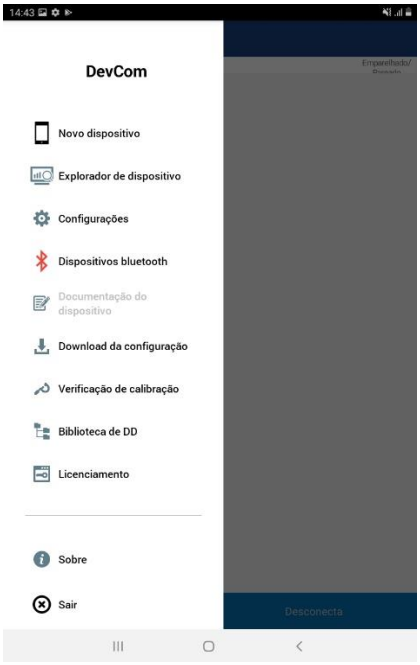
The multidrop connection is made up of several transmitters connected in parallel in a single communication line. The communication between the master system and the transmitters is digitally done, with the transmitter analog output deactivated (TRM mode) or activated (PID mode).

All equipment leave factory with a 0 (zero) address, unable to work in multidrop. To operate in multidrop they must be singly connected to any number between 1 and 15 (HART 5) or 1 and 63 (HART 7).

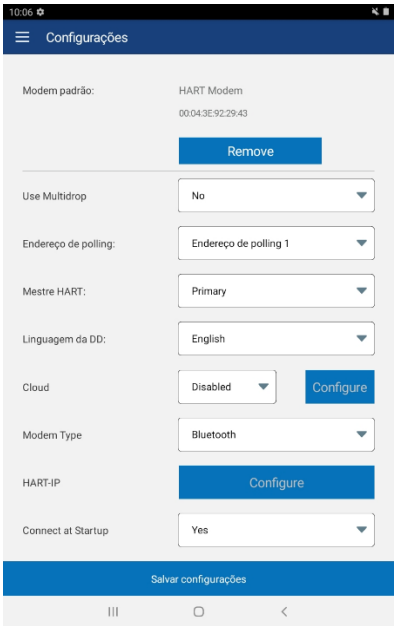
In the **Multidrop** tab, the user can change the address of the equipment with which is already communicating. Select **ONLINE MULTIDROP** to access the multidrop network. After the configurator identifies the transmitter, in **Select Address** the user must choose the desired address for it. Note that no other transmitters on the same line (regardless of brand, model, and type) must have the same address. Repeat this procedure for all devices that will participate in the multidrop connection.
Before communicating with the equipment, it is necessary to configure the tablet to the equipment current address. This address is shown on the equipment's LCD at initialization.

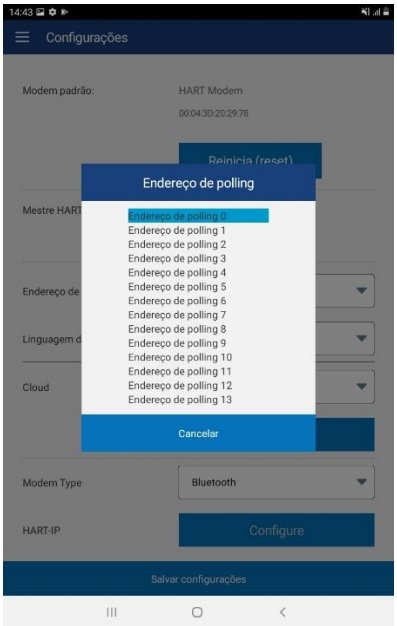
Using **DevComDroid**, click the three bars in the top left corner and select **Settings (Configurações)**. See following figures.



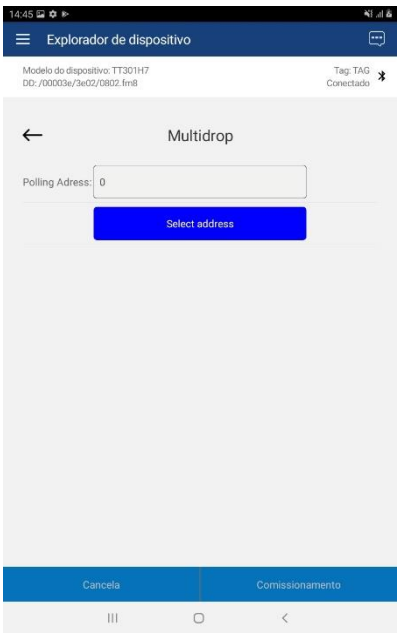


Modify the pooling address value to the equipment address. In this example the transmitter is at address 0, select it. After selecting the correct address, the DD for the device will be loaded. See following figures.



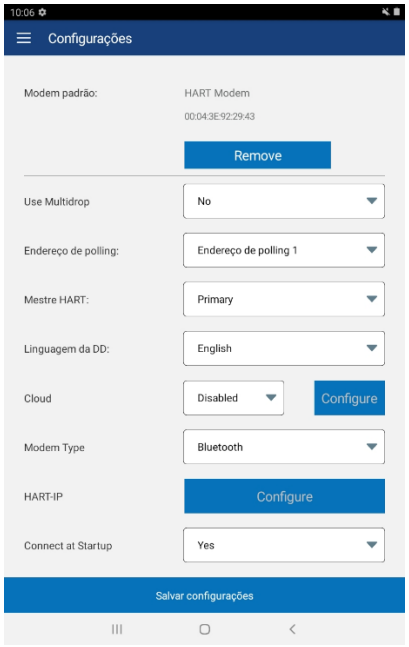


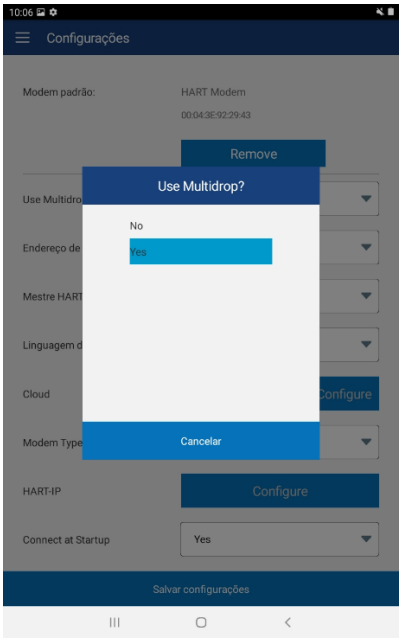
In the **Multidrop** tab, it is possible to see the current address (0) and it is also possible to change the equipment address. To change just select **Select Address**.



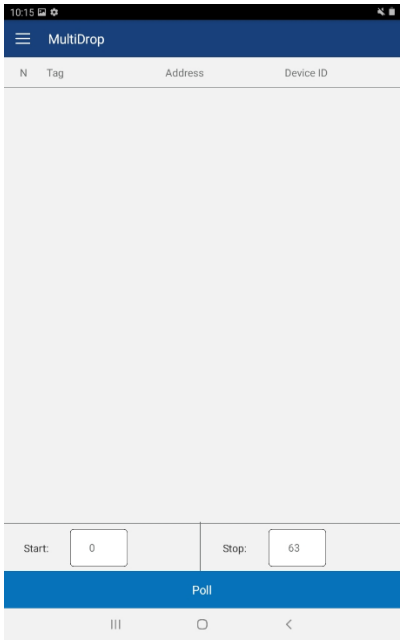
If the user wants to change the address to 5, for example, just choose 5 and then click **Ok**. The **Pooling Address** value will change to the device's current address.

As of version 2.2.5 of **DevComDroid** there is a scanning option in which the user can discover the address of each device on the network. For this, in the **DevComDroid** settings tab, in the **Use Multidrop** option, select **Yes** and click **Save Settings (Salvar Configurações)**. Open the app again.

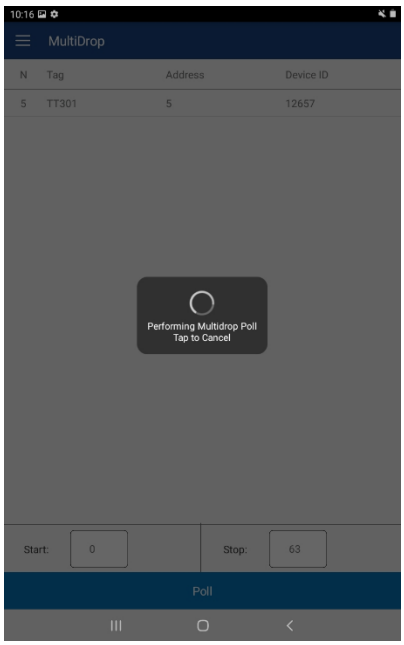




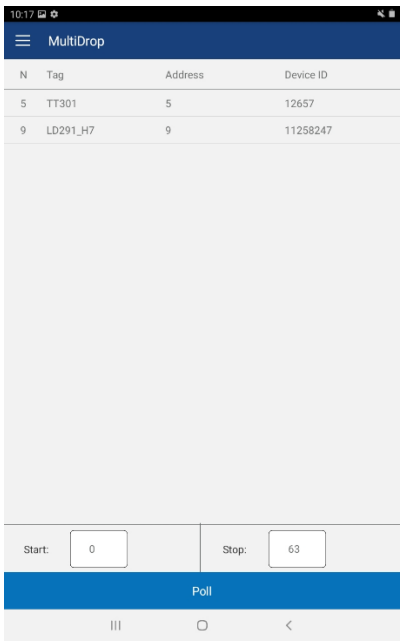
When opening the application, the scan screen will appear, select the start address of the scan in **Start** and the end address in **Stop**. After selecting the range for the scan, click **Poll**. See next figure.



A pop-up will open indicating that the scan is running. During this scan, as the equipment is found, it is possible to view the address, tag and ID of each one, as in the example below: Address = 5 Tag = TT301 ID = 12657 and Address = 9 Tag = LD291_H7 ID = 11258247



When the scan is finished, it is possible to see all the equipment found. On this screen, it is possible to select which device the user wants to start communication with.



HART 7

On this tab, under Dynamic Variable, the variables selected for PV, SV, TV, and QV are shown, with their current values and units. PV will always be the temperature. The Change Dynamic Variable option allows the user to change which will be SV, TV, and QV, if desired. In Device Variables there are eight selectable boxes for the user to choose the variables to monitor. Just choose and click Monitor Device Variables. The Lock/Unlock Device option is used to lock a device temporarily or permanently, preventing any changes from being made from a local panel or another master.

Calibrating the TT301

A transmitter calibration consists of configuring the input values related to 4 mA and 20 mA. The **TT301** may do this in 5 different methods:
1 – By using the Configurator (no-reference method) whose calibration input is not required.
2 – By using the Configurator and an input signal as reference (referenced method).
3 – Local adjustment and an input signal as reference (simple local adjustment, with reference).
4 – Local adjustment and an input signal as reference (complete local adjustment, with reference).
5 – Local adjustment (complete local adjustment, without reference).

In transmitter mode, the lower value always corresponds to 4 mA and the upper value to 20 mA. In PID mode, the lower value corresponds to PV=0 % and upper value to PV=100 %.

Calibration Without Reference

The **TT301** may be configured to supply 4 to 20 mA, the equivalent to the temperature limits on the user's application, without needing to connect a reference calibrating generator on its terminals. This is possible because the **TT301** has linearization curves for several standard temperature sensors in its memory. Let us suppose the transmitter range is calibrated from –100 to 300º C and one must calibrate it on 0 to 100º C.

The transmitter generates a signal varying from 4 to 20 mA when the temperature oscillates between 0 and 100º C.

Watch that both the LOWER and UPPER values are entirely independent. Adjusting one does not affect the other. However, the following rule must be observed:

a) Both values should not be less than the lower limit or more than the upper calibration limit.
b) The Upper value less Lower value span must be greater than the LOWER SPAN.

If a signal needs to be reverted, i.e., have an UPPER VALUE smaller than the LOWER VALUE, proceed as follows:

Make the lower value as close as possible to the upper value or vice-versa, observing the allowed minimum span. Adjust the upper value with the desired value and then, adjust the lower value.

Example: If the transmitter is calibration such as:
LOWER VALUE = 4 mA = 0 ºC
UPPER VALUE = 20 mA = 100 ºC and the values should change to:

LOWER VALUE = 4 mA = 100º C
UPPER VALUE = 20 mA = 0º C;

Considering that the Pt100 IEC Minimum Span is 10º C, the adjustments must be altered as follows:

a) LOWER VALUE = 90, or 100-10.
b) UPPER VALUE = 0 ºC
c) LOWER VALUE = 100 ºC

The table 3.4 shows graphycaly how to do this ranging.

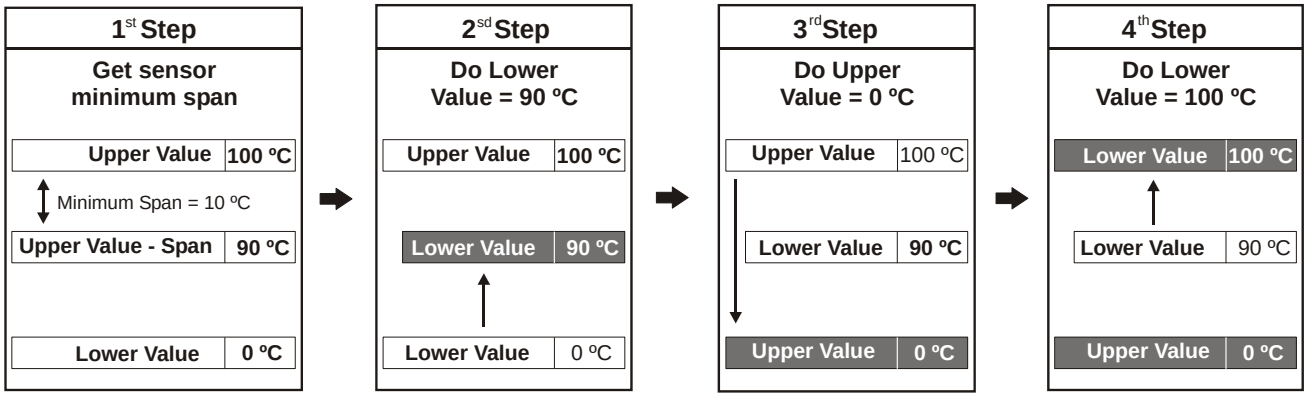


Table – 3.4 – Procedure to Range without Reference

Calibration With Reference

This is the most convenient way to calibrate a transmitter. Apply the signal for adjusting the 4 mA point (PV=0 %). The Lower Value is altered but the span remains the same.

The same procedure is applied for the Upper Value.

LOWER VALUE = 0 Ohm
UPPER VALUE = 100 Ohm

Example: When measuring resistance, the **TT301** is calibrated as follows:

After the installation is done, the potentiometer (input sensor) was found to have a 5 Ohm residual resistance when its indicator was on a zero position.

The Lower Value reference trim quickly corrects this problem, causing the Lower Value to equal 5 Ohm.

The Upper Value may be altered in the same way.

As mentioned before, the Ohm or mV sensor input may differ a little from its plant standard. The Zero and Gain Trim may be used to adjust the transmitter reading to Engineering Units with its plant standard, thus eliminating possible differences.

Online Multidrop Operation

The multidrop connection is made up of several transmitters connected in parallel in a single communication line. The communication between the master system and the transmitters is digitally done, with the transmitter analog output deactivated (TRM mode) or activated (PID mode).

The communication between the transmitters and the master system (PROG, DCS, data acquiring system or PC) is performed through a Bell 202 modem using a HART protocol. Each transmitter is identified by a single address, 1 to 15 (HART 5) or 1 to 63 (HART 7).

The **TT301** is produced with the address equal to zero, in a point-to-point operational mode. The transmitter communicates with the configurator by overlaying the communication on the 4-20 mA signals. To operate in multidrop mode, the transmitter address must switch to a 1 to 63. This change deactivates the 4-20 mA analog output by assuming the fixed value equal to 4 mA (TRM mode) or maintains the 4-20 mA variable when the equipment is configured for PID mode.

When intrinsic safety is required, special attention must be laid on Ca and La parameters allowed for that area.

To operate in multidrop mode, search for the transmitters connected on the same line.

WARNING
The output current is fixed on 4 mA as soon as the transmitter address is changed, except when the transmitter is configured for PID operation mode.

PROGRAMMING USING LOCAL ADJUSTMENT

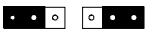
The Magnetic Tool

Smar's magnetic tool is the second man-machine interface; it compromises the advantage of the powerful Smar Configurator and the convenience of the "good-old" tool.

If the transmitter is fitted with a display and is configured for complete local adjustment (using internal jumper) the magnetic tool is almost as powerful as the **Configurator**, eliminating the need for a **Configurator** in most basic applications.

If the transmitter is not fitted with a display or is configured for simple local adjustment (using internal jumper) the adjustment capability is reduced to calibration.

To select the function mode of the magnetic switches, configure the jumpers located at the top of the main circuit board as indicated below:

SI/COM OFF/ON	NOTE	WRITE PROTECT	SIMPLE LOCAL ADJUSTMENT	COMPLETE LOCAL ADJUSTMENT
		Disables	Disables	Disables
	**1**	**Enables**	Disables	Disables
	**2**	Disables	**Enables**	Disables
		Disables	Disables	**Enables**

NOTES
If the hardware protection is selected, the EEPROM will be protected. The local adjustment default condition is simple enabled and write protect disabled.

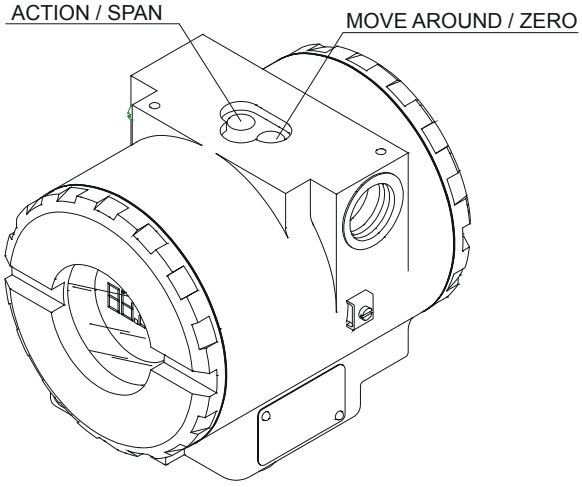


Figure 4.1 – Local Adjustment Switches

The transmitter has, under the identification plate, holes for two magnetic switches activated by the magnetic tool.

The holes are marked with **Z** (Zero) and **S** (Span). If **"Simple Local Adjustment"** is selected by the jumpers position, the switches have the following functions:

Transmitter mode:

Z - It is used to select the Lower Range Value.
S - It is used to select the Upper Range Value.
They work exactly as the adjustment with reference of the **Configurator** controller mode for transmitters with digital display.

If **"Complete Local Adjustment"** is selected by the jumpers position, the switches have the following functions:

Z - Moves the options.
S - Activates the selected function.

Calibration Using the Local Zero and Span Adjustments in Simple Mode

It is possible to rerange the transmitter with the local adjustment switches located on the top of the electronic housing. The switches work like the adjustment "with reference" for the **Configurator**.

To make these adjustments, the instrument must be configured as "transmitter" (TRM).

To adjust the zero of the transmitter, proceed as follows:

- ✓ Apply the temperature corresponding to the lower value.
- ✓ Wait for the process to stabilize.
- ✓ Insert the magnetic tool in the ZERO adjustment hole (see Figure 4.2)
- ✓ Wait two seconds. The transmitter should be reading 4 mA.
- ✓ Remove the tool.

As the calibration with reference, the span is maintained. In case you want to change the span, proceed as follows:

- ✓ Apply the temperature corresponding to the upper value.
- ✓ Wait for the process to stabilize.
- ✓ Insert the magnetic tool in the SPAN adjustment hole.
- ✓ Wait two seconds. The transmitter should be reading 20 mA
- ✓ Remove the tool.

Note that when zero adjustment is done, the URV cannot be pushed above the URL. In this case, span is not maintained.

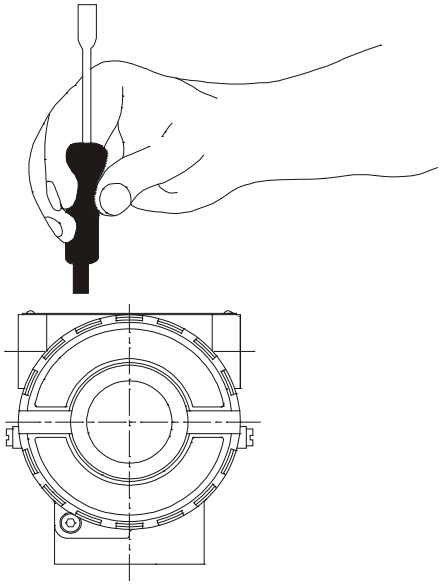


Figure 4.2 – Local Zero and Span Adjustment

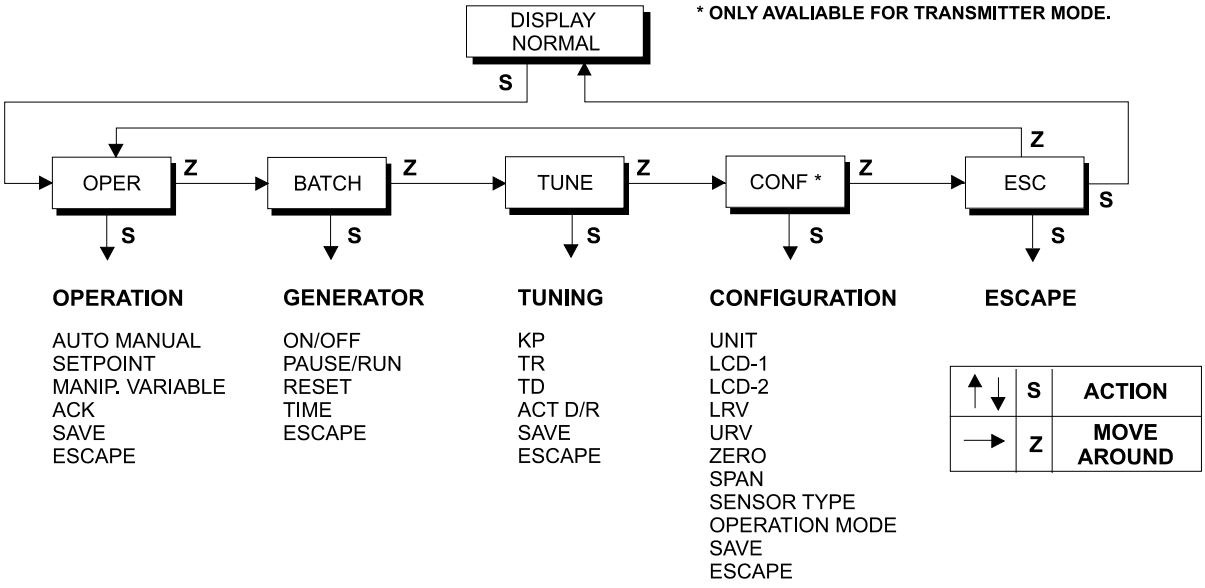


Figure 4.3 - Local Adjustment Programming Tree – Main Menu

Complete Local Adjustment

LOCAL PROGRAMMING TREE
The programming tree is a tree-shaped structure with a menu of all available software resources, as shown in Figure 4.3.

The Local Programming mode is entered by activating switch (**Z**). In transmitter mode, only the configuration branch of the tree is applicable, thus the first menu function will be UNIT.

WARNING
When programming using local adjustment, the transmitter will not prompt "Control loop should be in manual!" as it does when programming using the **Configurator**. Therefore, it is a good idea, prior to configuration, to switch the loop to manual. And do not forget to return to auto after configuration is completed.

OPER (OPERATION): Is the option where the operation related parameters of the controller are configured: Auto/ Manual, Setpoint, Manual output.

BATCH: Is the option where the Setpoint generator related functions are operated: on/off, Pause, Reset and time adjustment.

TUNE (TUNING): Is the option where the PID-Algorithm related parameters are configured: Action, K_p, T_r, and T_d.

CONF (CONFIGURATION): Is the option where the output and display related parameters are configured: unit, primary and secondary display, Lower and Upper Value, damping, sensor type and operation mode.

ESC (ESCAPE): Is the option used to go back to normal monitoring mode.

Operation [OPER]

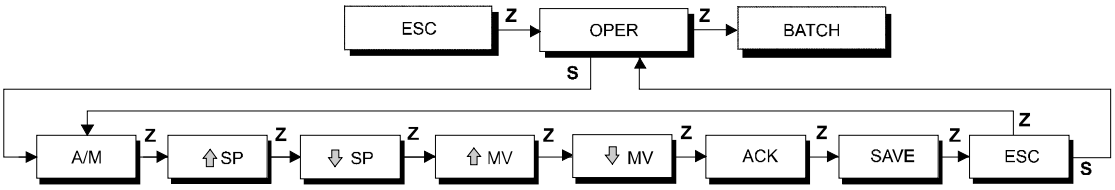
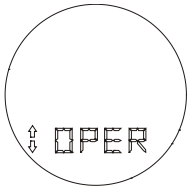


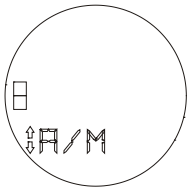
Figure 4.4 – Local Adjustment Operation Tree



Z: Moves to the next branch (BATCH).

S: Enters the OPERATION branch, starting with function AUTO/MANUAL.

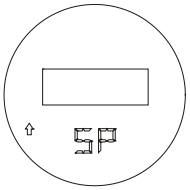
Auto/Manual (A/M)



Z: Moves to the SETPOINT INCREASE function.

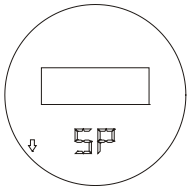
S: Toggles controller status, Automatic to Manual or Manual to Automatic. “A” and “M” indicates status.

Setpoint Adjustment (SP)



Z: Moves to the SETPOINT DECREASE function.

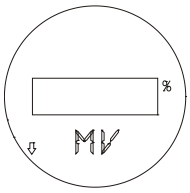
S: Increases the setpoint until the magnetic tool is removed or 100% is reached.



Z: Moves to the MANIPULATED VARIABLE ADJUSTMENT function.

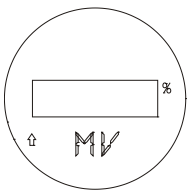
S: Decreases the setpoint until the magnetic tool is removed or 0% is reached.

Manipulated Variable Adjustment (MV)



Z: Moves to the MANIPULATED VARIABLE DECREASE function.

S: Increases the control output until the magnetic tool is removed or the upper output limit is reached.



Z: Moves to the ACK function.

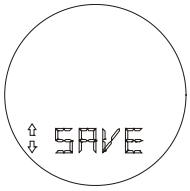
S: Decreases the control output until the magnetic tool is removed or the lower output limit is reached.

Acknowledge (ACK)

Z: Moves the SAVE function.

S: Acknowledges all alarms.

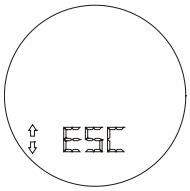
Save (SAVE)



Z: Moves to ESCAPE of the operation menu.

S: Saves the setpoint and manual output values in the transmitter EEPROM, for use after power-on.

Escape (ESC)



Z: Moves to the AUTO/ MANUAL function.

S: Escapes to the MAIN menu.

Batch [BATCH]

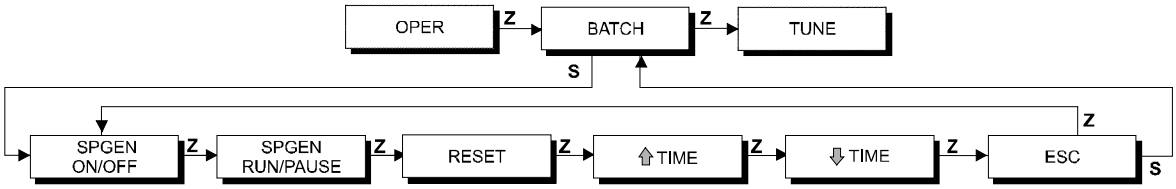
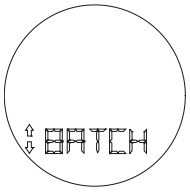


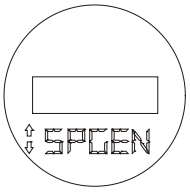
Figure 4.5 – Local Adjustment Batch Tree



Z: Moves to the TUNING branch.

S: Enters the BATCH branch, starting with function SPGEN on/off.

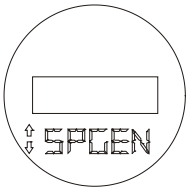
Setpoint Generator On/Off (SPGEN)



Z: Moves to the SPGEN Pause/ Run function.

S: Toggles setpoint generator. On to Off or Off to On.

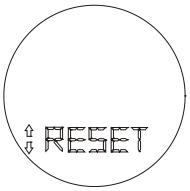
Setpoint Generator Pause/Run (SPGEN)



Z: Moves to the RESET function.

S: Toggles setpoint generator mode, pause to run or run to pause.

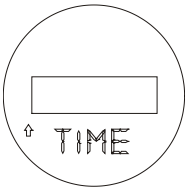
Reset (RESET)



Z: Moves to the TIME INCREASE function.

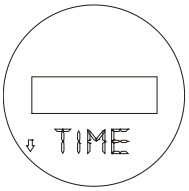
S: Resets the time register of the setpoint generator to 0.

Time (TIME)



Z: Moves to the time decrease function.

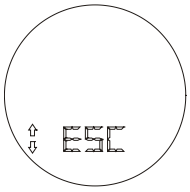
S: Increases the time register for the setpoint generator until the magnetic tool is removed or 19999 min. is reached.



Z: Selects ESCAPE of the BATCH menu.

S: Decreases the time register for the setpoint generator until the magnetic tool is removed or the time-base register is zero.

Escape (ESC)



Z: Moves to the SPGEN on/off function.

S: Escapes to the MAIN menu.

Tuning [TUNE]

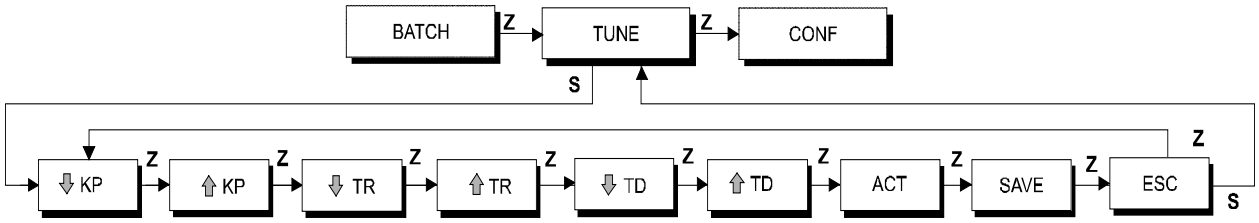
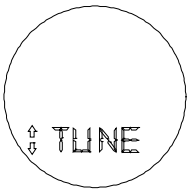


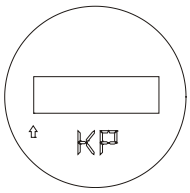
Figure 4.6 – Local Adjustment Tuning Tree



Z: Moves to the CONFIGURATION branch.

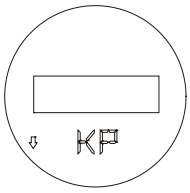
S: Enters the TUNING branch, starting with function KP-ADJUSTMENT.

Kp - Adjust (KP)



Z: Moves to the proportional gain decrease function.

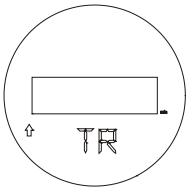
S: Increases the proportional gain until the magnetic tool is removed or 100 is reached.



Z: Moves to the TR_ADJUSTMENT function.

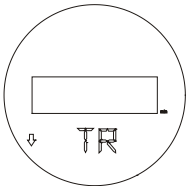
S: Decreases the proportional gain until the magnetic tool is removed or 0.0 is reached.

Tr - Adjust (TR)



Z: Moves to the integral time decrease function.

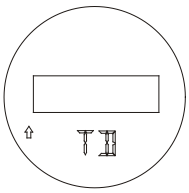
S: Increases the integral time until the magnetic tool is removed or 999 minutes are reached.



Z: Moves to the TD_ADJUST function.

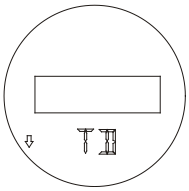
S: Decreases the integral time until the magnetic tool is removed or 0 minute is reached.

Td - Adjust (TD)



Z: Moves to the derivative time decrease function.

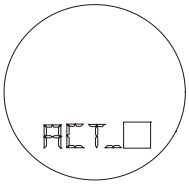
S: Increases the derivative time until the magnetic tool is removed or 999 seconds are reached.



Z: Moves to the ACTION function.

S: Decreases the derivative time until the magnetic tool is removed or 0 second is reached.

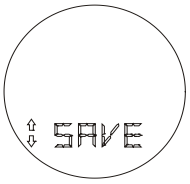
Action (ACT)



Z: Moves to the SAVE function.

S: Toggles the action direct to reverse or reverse to direct.
The far-right character of the unit/function-field indicates the present mode:
D = direct action
R = reverse action

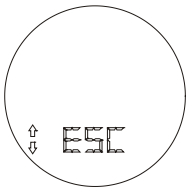
Save (SAVE)



Z: Moves to the ESCAPE to TUNING menu.

S: Saves the KP, TR and TD constants in the transmitter EEPROM.

Escape (ESC)



Z: Moves to the KP-ADJUSTMENT function.

S: Escapes to the MAIN menu.

Configuration [CONF]

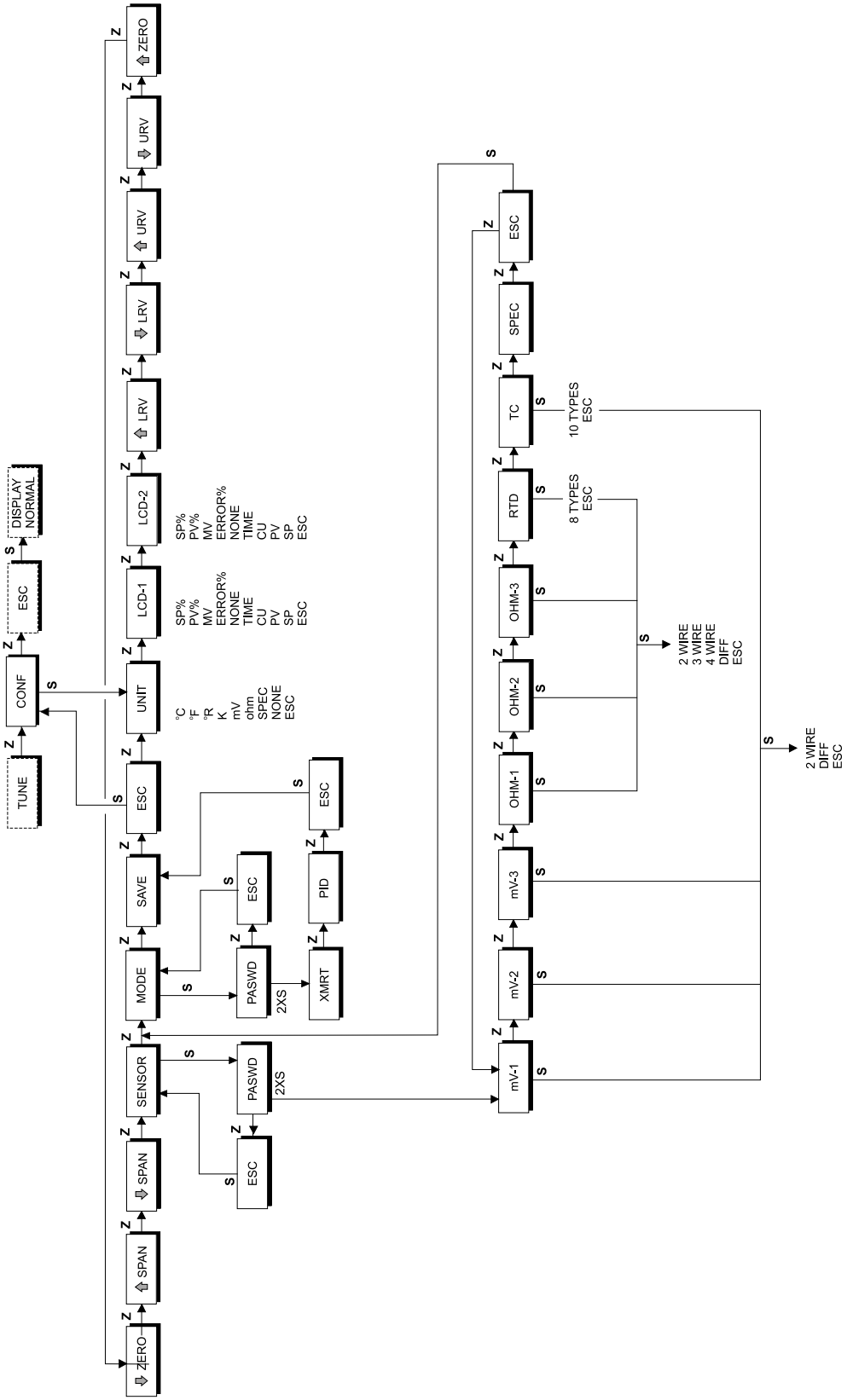
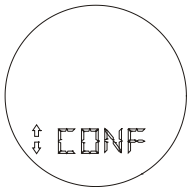


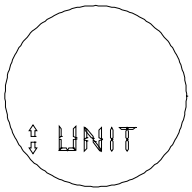
Figure 4.7 – Local Adjustment Configuration Tree



Z: Selects ESCAPE of the monitoring mode.

S: Enters the CONFIGURATION branch, starting with function UNIT.

Unit (UNIT)



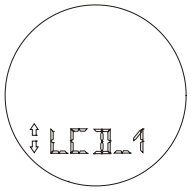
Z: Moves to the DISPLAY-1 function.

S: Starts selection of engineering unit for process variable and setpoint indication. After activating (S), you can move around the options available in the table below by activating (Z).

DISPLAY	DESCRIPTION
C	Celsius Degree
F	Fahrenheit Degree
R	Rankine Degree
K	Kelvin
mV	millivolt
Ohm	Ohm
SPEC	Special Unit
NO	No Unit
ESC	-escape-

The desired unit is activated by using (S). Escape leaves unit unchanged.

Display 1 (LCD_1)



Z: Moves to the DISPLAY-2 function.

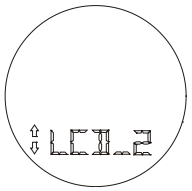
S: Starts selection of variable to be indicated as primary display.
After activating (S), you can move around the options available in the following table by activating (Z).

DISPLAY	DESCRIPTION
SP%	Setpoint (%)
PV%	Process Variable (%)
MV%	Output (%)
ER%	Error (%)
□	Nothing
TI	SP generator time
CU	Output (mA)
PV	Process Variable (eng. unit)
SP	Setpoint (eng. unit)
ESC	-escape-

The desired variable is activated using (S). Escape leaves primary display unchanged.

NOTE
In TRANSMITTER mode, only PV%, CU, PV and "none" are selectable.

Display 2 (LCD_2)

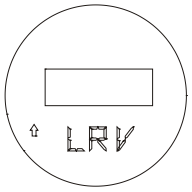


Z: Moves to the ZERO ADJUSTMENT function.

S: Starts selection of variable to be indicated as secondary display.

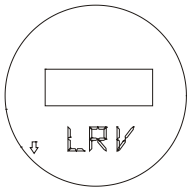
The procedure for selection is the same as for DISPLAY_1, above.

Lower Range Value Adjustment without Reference (LRV)



Z: Moves to the LRV decrease function.

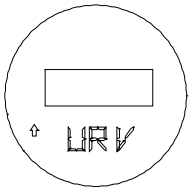
S: Increases the Lower Value until the magnetic tool is removed or the maximum for the Lower Value is reached.



Z: Moves to the URV ADJUSTMENT function.

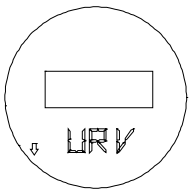
S: Decreases the Lower Value until the magnetic tool is removed or the minimum for the Lower Value is reached.

Upper Range Value Adjust without Reference (URV)



Z: Moves to the URV decrease function.

S: Increases the Upper Value until the magnetic tool is removed or the maximum for the Upper Value is reached.

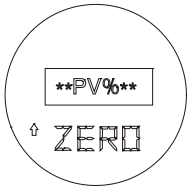


Z: Moves to the ZERO ADJUSTMENT function.

S: Decreases the Upper Value until the magnetic tool is removed or the minimum for the Upper Value is reached.

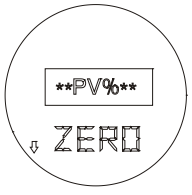
Calibration using the LRV and URV items in the menu is the same as on the CONFIGURATOR. No input must be applied; the range is set independent of applied input. Adjust the value indicated on the display to the desired range value. Changing one does not affect the other.

Zero Adjust with Reference (ZERO)



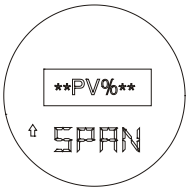
Z: Moves to the ZERO decrease function.

S: Decreases the Lower Value (Increases output) until the magnetic tool is removed or the minimum for the Lower Value is reached.



Z: Moves to the SPAN ADJUSTMENT function.

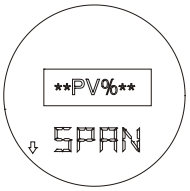
S: Increases the Lower Value (Decreases Output) until the magnetic tool is removed or the maximum for the Lower Value is reached.



Span Adjust with Reference (SPAN)

Z: Moves to the SPAN decrease function.

S: Decreases the Upper Value (Increases Output) until the magnetic tool is removed or the minimum for the Upper Value is reached.



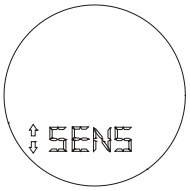
.

Z: Moves to the SENSOR function.

S: Increases the Upper Value (Decreases output) until the magnetic tool is removed or the maximum for the Upper Value is reached.

Calibration using the ZERO and SPAN items in the menu is equivalent to the calibration applied on the Configurator. The range values are adjusted relative to the applied input. The value in the display is the applied temperature in percentage of the range. Changing the lower value shifts the upper value too, maintaining the span. Changing the upper value does not affect the lower value. For example, if you want 4 mA (0%) for the applied input, adjust until the display reads 0%. Likewise, if you want 20% (7.2 mA), adjust until the display shows 20%.

Sensor (SENS)



Z: Moves to the OPERATION MODE function.

S: This function is protected by a "password", when prompted PSWD activate (S) 2 times to proceed with sensor selection.

After activating (S), you can move around the options available in the following table by activating (Z).

SENSOR SELECTION TABLE	
DISPLAY	**DESCRIPTION**
mV-1	-6 to 22 mV
mV-2	-10 to 100 mV
mV-3	-20 to 500 mV
Ohm-1	0 to 100 Ohm
Ohm-2	0 to 400 Ohm
Ohm-3	0 to 2000 Ohm
RTD	RTD
TC	Thermocouple
SPEC	Special Sensor
ESC	- escape -

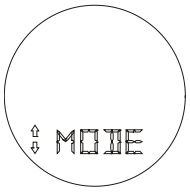
For all sensors, further selections must be done to determine the specific type and connection. Move around the available options - listed in the tables below - using (Z).

RTD SELECTION TABLE			
DISPLAY	**DESCRIPTION**	**DISPLAY**	**DESCRIPTION**
Cu-10	Cu10	**Mi100**	MILT Pt100
Ni 120	Ni 120	**Mi120**	MILT Ni120
I50	IEC Pt50	**IE100**	IEC751-95 Pt100
I100	IEC Pt100	**Go50**	GOST Pt50
JI 50	JIS Pt50	**Go100**	GOST Pt100
JI 100	JIS Pt100	**Cu50**	GOST Cu50
I500	IEC Pt500	**Cu100**	GOST Cu100
I1000	IEC Pt1000	**Esc**	Escape

OHMS & RTD CONNECTION	
DISPLAY	**DESCRIPTION**
2 WIRE	2 - wire
3 WIRE	3 – wire
4 WIRE	4 – wire
DIFF	Differential
ESC	- escape -

THERMOCOUPLE - TYPE			
DISPLAY	**DESCRIPTION**	**DISPLAY**	**DESCRIPTION**
B_NBS	NBS type B	**WR26**	ASTM W5Re/W25Re
E_NBS	NBS type E	**L GOS**	GOST Type L
J_NBS	NBS type J	**ESC**	Escape
K_NBS	NBS type K		
N_NBS	NBS type N		
R_NBS	NBS type R		
S_NBS	NBS type S		
T_NBS	NBS type T		
L_DIN	DIN type L		
U_DIN	DIN type U		

Operation Mode (MODE)



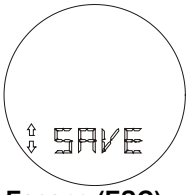
Z: Moves to the SAVE function.

S: This function is protected by a "password", when prompted PSWD activate (S) 2 times to proceed.

After entering the "password", you can move around the options listed in the table below using (Z). To select the desired option, activate (S).

OPERATION MODE	
DISPLAY	**DESCRIPTION**
XMTR	Transmitter
CNTRL	Controller (Optional)

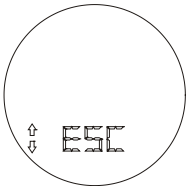
Save (SAVE)



Z: Selects ESCAPE to CONFIGURATION mode.

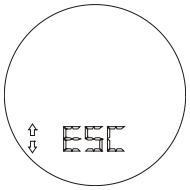
S: Saves lower value and upper value.

Escape (ESC)



Z: Moves to the UNIT function.

S: Escapes to the MAIN menu.



ESCAPE [ESC]

Z: Selects OPERATION branch.

S: Escapes to MONITOR mode.

Section 5

MAINTENANCE PROCEDURES

General

SMAR **TT301** intelligent temperature 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 by the end user, if necessary.

In general, it is recommended that the end user do not try to repair printed circuit boards. Instead, the user should have spare circuit boards, which may be ordered from **SMAR** whenever necessary.

Diagnosis with Smar Configurator

Should any problem be noticed related to the transmitter's output, investigation may be carried out by the Configurator, as long as power is supplied, and communication and the processing unit are operating normally.

The configurator should be connected to the transmitter in accordance with the wiring diagram shown on Section 1, Figures 1.4, 1.5 and 1.8.

Error Messages

When communicating using the Configurator the user will be informed about any problem found by the transmitter's self-diagnostics.

As an example, the Configurator of the display may show:

> OUTPUT SATURATED <

The messages are always alternated with the information on the top line. The table below lists the error messages. Refer to troubleshooting for more details on corrective action.

Diagnostics with the Configurator

DIAGNOSTIC MESSAGES	POTENTIAL SOURCE OF PROBLEM
PARITY ERROR	• Excessive noise or ripple ≤ 0,4 Vpp.
OVERRUN ERROR	
CHECK SUM ERROR	
FRAMING ERROR	
NO RESPONSE	• The line resistance is not in accordance with load curve. • Transmitter not powered. • Interface not connected. • Transmitter configured in Multidrop mode being accessed by ON LINE SINGLE UNIT. • Transmitter reversely powered (polarity is reversed). • Interface damaged. • Power supply or battery voltage of the Configurator lower than 9 V.
LINE BUSY	• Other device using the line.
CMD NOT IMPLEMENTED	• Software version not compatible between Configurator and transmitter. • Configurator is trying to carry out a **TT301** specific command in a transmitter from another manufacturer.
TRANSMITTER BUSY	• Transmitter carrying out on important task. e.g., Local Adjustment.
COLD START	• Power supply failure.
OUTPUT FIXED	• Output in Constant Mode. • Transmitter in Multidrop mode.

DIAGNOSTIC MESSAGES	POTENTIAL SOURCE OF PROBLEM
OUTPUT SATURATED	• Primary variable out of calibrated Span (Output current in 3.8 or 20.5 mA, XMTR mode only).
SV or PV OUT OF LIMITS	• Input signal out of operating range; • Sensor damaged; • Transmitter with wrong configuration.

Table 1 - Diagnostics with the Configurator

Diagnostics without the Configurator

- **Symptom: NO LINE CURRENT**

Probable Source of Trouble:

- **Transmitter Connections**

- Check wiring polarity and continuity.
- Check for short circuits or ground loops.

- **Power Supply**

- Check power supply output. The voltage at the **TT301** terminals must be between 12 and 45 Vdc, and the ripple less than 0.4V.

- **Electronic Circuit Failure**

- Check the main board for defect by replacing it with a spare one.

Symptom: NO COMMUNICATION

Probable Source of Trouble:

- **Terminal Connections**

- Check terminal interface connections.
- Check if the interface is connected to the points [COMM] and [-] or in the line between the transmitter and the load resistor.
- Check that the interface is the model compatible with the configurator.

- **Transmitter Connections**

- Check if connections are as per wiring diagram.
- Check line resistance; it must be equal to or greater than 250 Ohm, between the transmitter and the power supply.

- **Power Supply**

- Check output of power supply. The voltage at the **TT301** terminals must be between 12 and 45V, and ripple less than 0.4V.

- **Electronic Circuit Failure**

- Locate the failure by alternately replacing the transmitter circuit and the interface with spare parts.

- **Transmitter Address**

- In On Line Multidrop item check if the address is "0".

Symptom: CURRENT OF 21.0 mA OR 3.6 mA

Probable Source of Trouble:

- **Transmitter Connection**

- Check if the sensor is correctly connected to the **TT301** terminal block.
- Check if the sensor signal is reaching the **TT301** terminal block by measuring it with a multimeter at the transmitter-end. For mV and thermocouples test can be done with connected and disconnected to the transmitter.

- **Sensor**

- Check the sensor operation; it shall be within its characteristics.
- Check sensor type; it shall be the type and standard that the **TT301** has been configured to.
- Check if process is within the range of the sensor and the **TT301**.

NOTE
A 21.0 or 3.6mA current in XMTR mode indicates burnout.

Symptom: INCORRECT OUTPUT

Probable Source of Trouble:

- **Transmitter Connections**

- Check power supply voltage. The voltage at the **TT301** terminals must be between 12 and 45V, and ripple less than 0.4V.
- Check for intermittent short circuits, open circuits, and grounding problems.

- **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 **TT301** has been configured to.

- **Electronic Circuit Failure**

- Check the integrity of circuit replacing it with a spare one.

- **Calibration**

- Check calibration of transmitter.

Disassembly Procedure

Refer to Figure 5.1. Make sure to disconnect power supply before disassembling the transmitter.

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

Electronic Circuits
To remove the circuit boards and display (**3**), first loose the cover locking (**4**) on the side not marked "Field Terminals" then unscrew the cover (**1**).

WARNING:
The board has 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.

Loosen the two screws that anchor the main circuit board. Gently pull out the main board. To remove the input board, first unscrew the two screws that anchors it to the housing (**5**), gently pull out the board.

Reassembly Procedure

- Put input board into housing (**5**).
- Anchor input board with its screws.
- Put main board into the housing, ensuring all interconnecting pins are connected.
- Anchor main board with their screws.
- Connect the display to the main board, observing the four mounting positions (see Figure 5.2) "▲" symbol should point in the direction desired as UP.
- Anchor display with their screws.
- Fit the cover (**1**) and lock it using the locking screw (**4**).

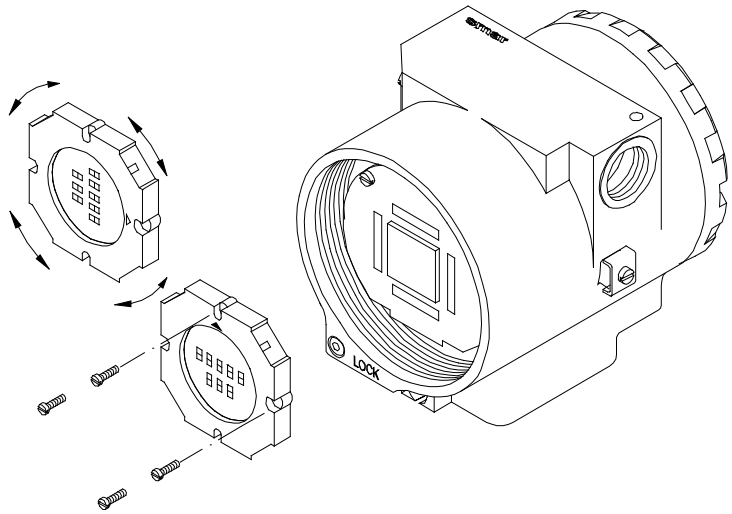


Figure 5.2 – Four Possible Positions of the Display

Interchangeability

Calibration data is stored in the EEPROM of the main board, hence READING TRIM must be done if main-board or input board has been changed.

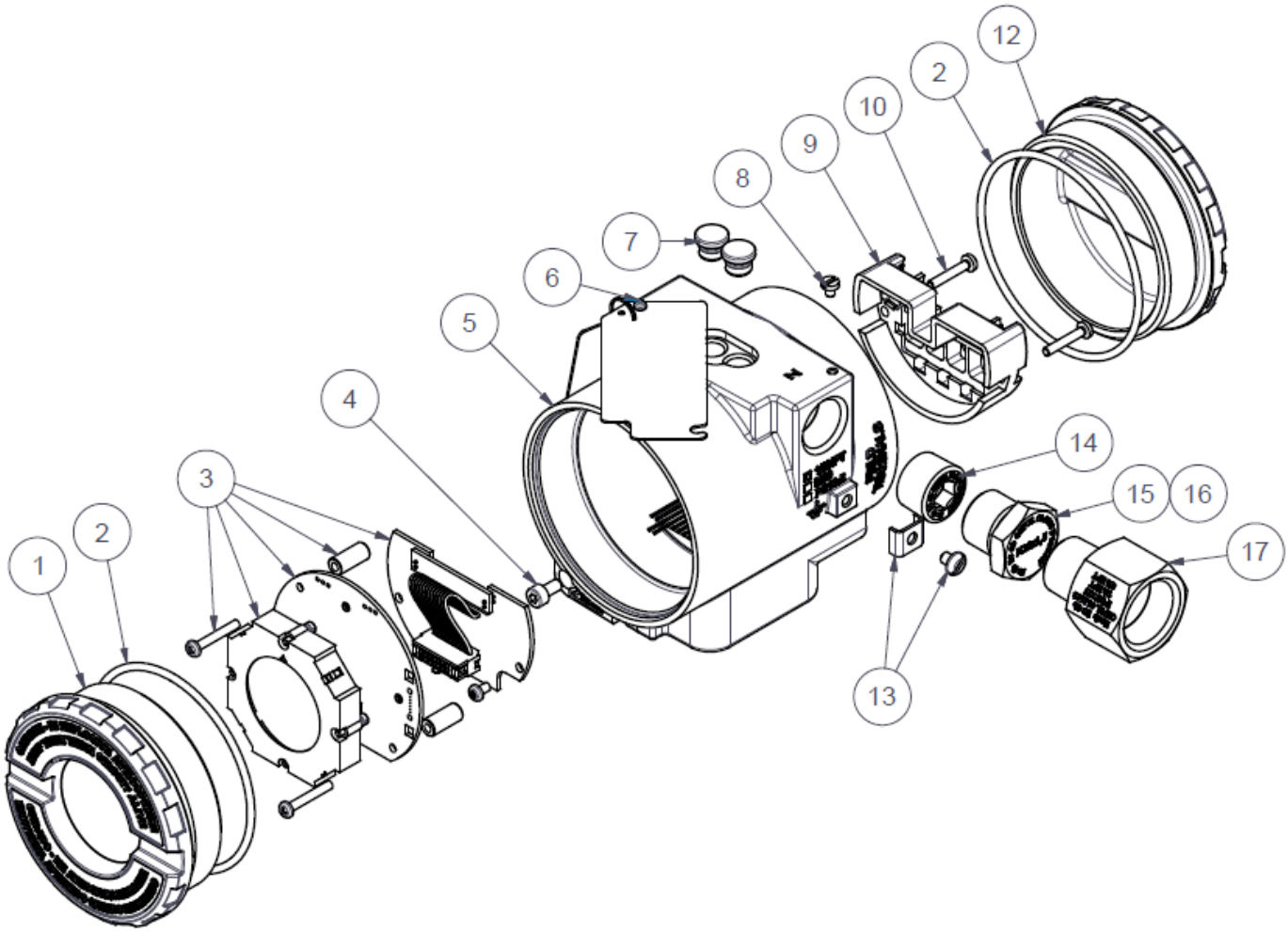
NOTE
The main and input boards are factory matched to ensure accuracy. If replacement is necessary, replace the set.

Returning Materials

Should it become necessary to return the transmitter and/or configurator to SMAR, simply contact our office, informing the defective instrument serial number, and return it to our factory.

To speed up analysis and solution of the problem, the defective item should be returned with the Service Request Form (SRF – Appendix B) properly filled with a description of the failure observed and with as much details as possible. Other information concerning to the instrument operation, such as service and process conditions, is also helpful.

Instruments returned or to be revised outside the warranty term should be accompanied by a purchase order or a quote request.



ITEM	QTY	DESCRIPTION	PART NUMBER
17	1	Buching reducer 3/4NPTx1/2NPT	400-0812
16	1	Plug PG13.5	400-0811
15	1	Plug M20 EXD	400-0810
14	1	Plug 1/2 NPT EXD	400-1484
13	1	Ground (plate + screw)	204-0124
12	1	Blind cover 300 line	400-1307-0x
10	2	Insulator screw	204-0119
9	1	Insulator	214-0220
8	1	Iidentification plate screw	204-0116
7	2	Z / S hole cap	204-0114
6	1	Rivet U 3/16"	400-0834
5	1	Housing	400-1315-1xxxx
4	2	Cover Lock screw	204-0120
3	1	Electronic board TT301 (GLL1403+1436+1437)	400-1300
2	2	Cover o-ring	204-0122
1	1	Cover with window 300 line	400-1307-1xx

Figure 5.1 – Exploded View

SPARE PARTS LIST FOR TRANSMITTER		
DESCRIPTION OF PARTS	**POSITION**	**CODE**
MOUNTING BRACKET FOR 2" PIPE MOUNTING (NOTE 6)		
Carbon Steel (Accessories in Carbon Steel)	-	214-0801
Stainless Steel 316 (Accessories in Stainless Steel 316)	-	214-0802
Carbon Steel (Accessories in Stainless Steel 316)	-	214-0803
OTHERS		
Terminal Block Screw		214-0124
Input Board Screw		214-0125
Mounting Bracket Accessories – Carbon Steel		214-0807
Mounting Bracket Accessories – 316 SST		214-0808
Display		400-0559

NOTES

1 - Item 3 - It is recommended to keep one set in stock for every 25 parts installed.
2 - Item 3 - Access https://www.smar.com/en/support. In general support, look for compatibility note and consult the document.
3 - Item 3 – If it has FM certification, the spare set must have code 400-1425.
4 - Item 5 - Includes terminal block, screws (cover lock, grounding, and terminal block) and identification plate without certification.
5 - Item 2 – O'Rings are packaged as 12 units. It is recommended to keep one set in stock for every 50 parts installed.
6 - Includes "U" clamp, nuts, washers, and fixing screws.
7 - Item 14 - The spare part 400-1484, Internal Hex Plug 1/2" NPT Stainless Steel 316 BR-Ex-d, was standardized in 316 SST material and will be used in the entire line of housings (aluminum, Copper free aluminum or 316 SST). With or without CEPEL certificate.

Detailed Code for Ordering Spare Parts

400-1315-1	TEMPERATURE INTELLIGENT TRANSMITTER HOUSING TT301

COD.	Communication Protocol
0	4 - 20 mA
H	HART & 4 - 20 mA
T	HART & 0 - 20 mA

COD.	Electrical Connection
0	½ NPT
A	M20x1,5
B	PG13,5 DIN

COD.	Material
H0	Aluminum
H1	316 SST
H2	Aluminum for Saline Atmosphere
H4	Cooper Free Aluminum

COD.	Painting
P0	Gray Munsell N6.5
P1	Safety Blue Epoxy – Immersion Condition – Petrobras N1021
P2	Safety Blue Epoxy – Atmospheric Zone - Petrobras N1021
P3	Black Polyester
P8	Without Painting
P9	Blue Safety Epoxy

COD.	Manufacturing Standard
S0	Smar

COD.	Applicable Certification
I0	All except CSA
I3	CSA

400-1315-1	H	0	H0	P0	S0	I0

400-1307	COVER FOR ALL LINE 300

COD.	Type
0	Without Window
1	With Window

COD.	Material
H0	Aluminum (IP/TYPE)
H1	316 SST (IP/TYPE)

COD.	Painting
P0	Gray Munsell N6.5
P2	Safety Blue Epoxy – Atmospheric Zone - Petrobras N1021
P8	Without Painting
P9	Blue Safety Epoxy

400-1307	1	H0	P0

Accessories

ACCESSORIES	
ORDERING CODE	**DESCRIPTION**
SD-1	Magnetic Tool for local adjustment.
DEVCODROID	The DevComDroid. APP uses DDs to access the data stored in memory and configure the HART equipment.
HI331	HART Bluetooth Interface

Isolation Test on Equipment Housings

1. Power off the equipment in the field, remove its back cover and disconnect all field cables from the transmitter terminal block, isolating them safely.

2. It is not necessary to remove the main board and display.

3. Jumper (connect) the power terminals (positive and negative) with the cable coming from the Megohmmeter (megger). In the case of a temperature transmitter, also jumper all the connectors with the same cable. In these instruments, in addition to the power terminals, there are sensor terminals. All these terminals must be connected to apply voltage in relation to the housing.

4. Configure the megohmmeter for 500 Vdc scale and check the isolation between the housing and the cable that short-circuits all the terminals.

ATTENTION
 Never test with a voltage greater than 500 Vdc.

5. The value obtained must be greater than or equal to 2GΩ and the voltage application time must be at least 1 second and at most 5 seconds.

6. If the value obtained by the megohmmeter is below 2GΩ, the possibility of moisture entering the electrical connection compartment must be analyzed.

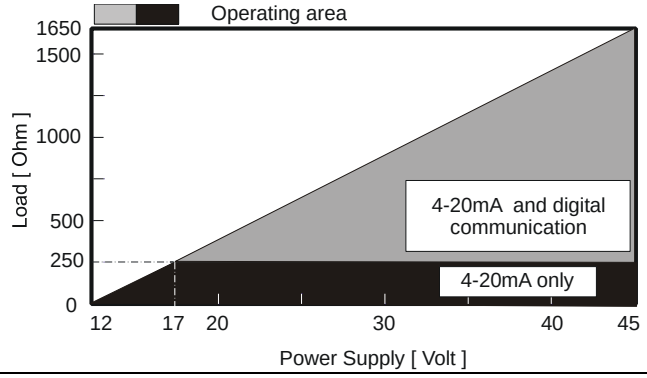
7. It is possible to loosen the two screws that secure the terminal block to the housing and carry out a superficial cleaning and dry the surface well. Afterwards, the isolation can be tested again.

8. If the isolation test still shows that the isolation has been compromised, the housing must be replaced and sent to Nova Smar S.A. for analysis and retrieval.

IMPORTANT
a) For equipment certified Exd and Exi (Explosion Proof and Intrinsically Safe) the standards advise not to carry out repairs in the field of the housing electronic components, only at Nova Smar S.A.
b) In normal use, the housing components must not cause failures that affect its isolation. For this reason, it is important to verify whether there are traces of water entering the housing and, if so, an assessment of the electrical installations and the sealing rings of the covers must be carried out. Nova Smar S.A. has a team ready to support the assessment of facilities, if necessary.

Section 6

TECHNICAL CHARACTERISTICS

Functional Specifications	
Inputs	See table 6.1, 6.2 and 6.3
Output Signal	Two-wire, 4-20 mA with superimposed digital communication
Power Supply	**Bus powered:** 12 - 45 Vdc.
Load Limitation	
Display	Optional 4 1/2 digit LCD indicator.
Hazardous Area Certifications	See Appendix A.
Zero and Span Adjustments	No interactive, via digital communication or local adjustment.
Temperature Limits	**Ambient:** -40 ºC to 85 ºC (-40 ºF to 185 ºF) **Storage:** -40 ºC to 120 ºC (-40 ºF to 248 ºF) **Display:** -20 ºC to 80 ºC (-4 ºF to 176 ºF) -40 ºC to 85 ºC (-40 ºF to 185 ºF) (without damage)
Loss of Input (Burnout)/Failure Alarm	In case of sensor burnout or circuit failure, the self-diagnostics drives the output to 3.6 or to 21.0 mA, according to the user's choice.
Humidity Limits	0 to 100% RH
Turn-on Time	Approximately 10 seconds.
Update Time	Approximately 0.5 second.
Damping Adjustment	User configurable from 0 to 32 seconds (via digital communication).
Configuration	This is done by an external Configurator that communicates with the transmitter remote or locally using HART Protocol. Locally the magnetic tool can be used as well. The magnetic tool can configure the majority of the items provided the transmitter is fitted with a display.

Performance Specifications	
Accuracy	See tables 6.1, 6.2, 6.3 and 6.4.
Ambient Temperature Effect	**For a 10 ºC variation:** **mV (- 6 to 22 mV), TC (NBS: B, R, S,T):** ± 0.03% of the milivoltage input or 0.002 mV whichever is greater; **mV (- 10 to 100 mV), TC (NBS: E, J, K, N; DIN: L, U):** ± 0.03% of the milivoltage input or 0.01 mV whichever is greater; **mV (-50 to 500 mV):** ± 0.03% of the milivoltage input or 0.05 mV whichever is greater; **Ohms (0 to 100Ω), RTD (GE: Cu10):** ± 0.03% of the resistance input or 0.01Ω whichever is greater; **Ohms (0 to 400Ω), RTD (DIN: Ni120; IEC: Pt50, Pt100; JIS: Pt50, Pt100):** ± 0.03% of the resistance input or 0.04 Ω whichever is greater; **Ohms (0 to 2000Ω), RTD (IEC: Pt500), RTD (IEC: Pt1000):** ± 0.03% of the resistance input or 0.2 Ω whichever is greater; **TC:** cold-junction compensation rejection 60:1 (Reference: 25.0 ± 0.3 °C).

Performance Specifications	
Power Supply Effect	± 0.005% of calibrated span per volt.
Vibration Effect	Meets SAMA PMC 31.1.
Electromagnetic Interference Effect	Designed according to IEC61326-1:2006, IEC61326-2-3:2006, IEC61000-6-4:2006, IEC61000-6-2:2005.

Physical Specifications	
Electrical Connection	1/2 - 14 NPT, PG 13.5 DIN, and M20 X 1.5.
Material of Construction	Injected low copper aluminum with polyester painting or 316 Stainless Steel housing, with Buna N O'rings on cover (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.
Approximate Weights	**Without display and bracket mounting:** 0.80 kg **Add to the display**: 0.13 kg **Add to the bracket mounting**: 0.60 kg

Control Characteristics	
PID	Proportional Gain: 0 to 100. Integral Time: 0.01 to 999 min/rep. Derivative Time: 0 to 999 s. Direct/Reverse Action. Lower and Upper output limits: -0.6 to +106.25%. Output rate-of-change limit: 0.02 to 600 %/s. Power-on safety output: -0.6 to +106.25%. Antireset windup. Bumpless Auto/Manual transfer. Setpoint Generator up to 16 points, up to 19999 minutes.
Alarm	Dual, trip levels adjustable over entire range. High or Low action. Acknowledge message.

	2, 3 or 4 wires					
SENSOR	**TYPE**		**RANGE °C**	**RANGE °F**	**MINIMUM SPAN °C**	**°C DIGITAL ACCURACY***
RTD	Cu10	GE	-20 to 250	-4 to 482	50	± 1.0
	Ni120	Edison Curve #7	-50 to 270	-58 to 518	5	± 0.1
	Pt50	IEC 751-83 (0.00385)	-200 to 850	-328 to 1562	10	± 0.25
	Pt100	IEC 751-83 (0.00385)	-200 to 850	-328 to 1562	10	± 0.2
	Pt500	IEC 751-83 (0.00385)	-200 to 450	-328 to 842	10	± 0.2
	Pt1000	IEC 751-83 (0.00385)	-200 to 300	-328 to 572	10	± 0.2
	Pt50	JIS 1604-81 (0.003916)	-200 to 600	-328 to 1112	10	± 0.25
	Pt100	JIS 1604-81 (0.003916)	-200 to 600	-328 to 1112	10	± 0.25
	Pt100	MIL-T-24388C (0.00392)	-40 to 540	-40 to 1000	10	± 0.2
	Ni120	MIL-T-24388C (0.00672)	-40 to 205	-40 to 400	5	± 0.13
	Pt100	IEC 751-95 (0.00385)	-200 to 850	-328 to 1562	10	± 0.2
	Pt100	GOST 6651-09 (0.003911)	-200 to 850	-328 to 1562	10	± 0.2
	Pt50	GOST 6651-09 (0.003911)	-200 to 850	-328 to 1562	10	± 0.2
	Cu100	GOST 6651-09 (0.00426)	-50 to 200	-58 to 392	10	± 0.15
	Cu50	GOST 6651-09 (0.00426)	-50 to 200	-58 to 392	10	± 0.15
THERMOCOUPLE	B	NBS Monograph 125	100 to 1800	212 to 3272	50	± 0.5**
	E	NBS Monograph 125	-100 to 1000	-148 to 1832	20	± 0.2
	J	NBS Monograph 125	-150 to 750	-238 to 1382	30	± 0.3
	K	NBS Monograph 125	-200 to 1350	-328 to 2462	60	± 0.6
	N	NBS Monograph 125	-100 to 1300	-148 to 2372	50	± 0.5
	R	NBS Monograph 125	0 to 1750	32 to 3182	40	± 0.4
	S	NBS Monograph 125	0 to 1750	32 to 3182	40	± 0.4
	T	NBS Monograph 125	-200 to 400	-328 to 752	15	± 0.15
	L	DIN 43710	-200 to 900	-328 to 1652	35	± 0,35
	U	DIN 43710	-200 to 600	-328 to 1112	50	± 0.5
	L	GOST 8.585-01	-200 to 800	-328 to 1472	60	± 0.4
	W5Re/ W26Re	ASTM E 988-06	0 to 2200	32 to 3992	60	± 0.5

Table 6.1 - 2, 3 or 4 wires Sensor Characteristics

* Accuracy of value read on display and accessed by communication.
** Not applicable for the first 20% of the range (up to 440 °C).

SENSOR	RANGE mV	MINIMUM 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

Table 6.2 - mV Sensor Characteristics

SENSOR	RANGE Ohm	MINIMUM SPAN Ohm	*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

Table 6.3 - Ohm Sensor Characteristics

***** Accuracy of value read on display and accessed by communication.
****** Not applicable for the first 20% of the range (up to 440 °C).
NA Not applicable.

Ordering Code

MODEL — **TEMPERATURE TRANSMITTER**

Local Indicator (1)

COD.			
0	Without Indicator	1	With Digital Indicator

Mounting Bracket

COD.			
0	Without Bracket	2	316 SST Bracket
1	Carbon Steel Bracket	7	Carbon Steel Bracket with 316 SST accessories

Zero and Span Adjustment

COD.	
1	With local adjustment

Electrical Connections

COD					
0	1/2" - 14 NPT **(3)**	3	1/2" - 14 NPT X 1/2 BSP (AI 316) – With adapter **(2)**	Z	According to user´s notes
1	1/2" - 14 NPT X 3/4 NPT (316 SST) – With adapter **(4)**	A	M20 x 1.5 **(5)**		
2	1/2" - 14 NPT X 3/4 BSP (316 SST) – With adapter **(2)**	B	PG 13.5 DIN **(6)**		

Burn Out

COD.			
BD	Down scale	BU	Up scale

Housing Material (8) (9)

COD.			
H0	Aluminum (IP/TYPE)	H3	316 SST for saline atmosphere (IPW/TYPEX) **(8)**
H1	316 SST (IP/TYPE)	H4	Copper Free Aluminum (IPW/TYPEX) **(8)**
H2	Aluminum for saline atmosphere (IPW/TYPEX) **(8)**		

Identification Plate

COD.					
I1	FM (XP, IS, NI, DIP)	I6	Without Certification	IL	IECEX (EX-D) Gas
I4	ATEX (EX-I, EX-D) Gas	I7	ATEX (EX-I) Mining	IO	INMETRO (Dust)
I5	INMETRO (EX-I, EX-D) Gas				

Sensor Connection

COD.			
L2	2-wire	LF	Differential
L3	3-wire	LB	Backup
L4	4-wire		

PID Configuration

COD.			
M0	With PID (default)	M1	Without PID

Painting

COD.	
P0	Gray Munsell N6.5
P2	Safety Blue Epoxy – Atmospheric Zone - Petrobras N1021
P3	Black Polyester
P8	Without Painting
P9	Safety Blue Epoxy
PG	Safety Orange Epoxy
PH	Special Painting

Manufacturing Standard

COD.	
S0	Smar

Sensor Type

COD.		COD.	
T1	RTD Cu10 - GE	TK	Thermocouple type L – DIN
T2	RTD Ni120 - DIN	TP	Thermocouple type U - DIN
T3	RTD PT50 - IEC	TN	100 OHM
T4	RTD PT100 - IEC	TO	Special OHM
T5	RTD PT500 - IEC	TQ	22 mV
T6	RTD PT50 - JIS	TR	100 mV
T7	RTD PT100 - JIS	TS	500 mV
T8	2K OHM	TT	Special mV
T9	400 OHM	TU	RTD PT1000 – IEC
TA	Thermocouple type B - NBS	TV	RTD PT100 - MILT
TB	Thermocouple type E - NBS	TW	RTD NI120 – MILT
TC	Thermocouple type J - NBS	TX	RTD PT100 – IEC
TD	Thermocouple type K - NBS	10	RTD PT100 – GOST
TE	Thermocouple type N – NBS	11	RTD PR50 – GOST
TF	Thermocouple type R - NBS	12	CU100 – GOST
TG	Thermocouple type S – NBS	13	CU50 – GOST
TH	Thermocouple type T – NBS	TZ	Special

LCD1 Indication

COD.	
Y0	Display 1: Percentage (default)
Y1	Display 1: Current (mA)
Y3	Display 1: Temperature (Eng Unit)
YU	User specification

LCD2 Indication

COD.	
Y4	Display 2: Current (mA)
Y6	Display 2: Temperature (Eng Unit)

COD.	Continues Next Page
*	

TT301	1	2	1	0	BD	H1	I1	L2	M0	P8	S0	T1	Y0	Y0	*

MODEL	TEMPERATURE TRANSMITTER (CONTINUATION)			
	COD.	Tag Plate (5)		
	J0	With tag	J1	Blank
	COD.	Special Characteristic		
	ZZ	See notes		
	COD.	Electronic Housing Type		
	COD	Output Signal		
	G0	4 – 20 mA		
	G1	0 – 20 mA		

TT301- **121**0BD**H1I1L2**M0**P8S0T1Y0Y0**	**J0**	**ZZ**		**G0**	TYPICAL MODEL

NOTES

(1) Values limited to 4 1/2 digits; units limited to 5 characters.
(2) Options not certified for use in hazardous locations.
(3) Certification Ex-d for FM / ATEX / IECEx / INMETRO.
(4) Certification Ex-d for INMETRO.
(5) Rectangular plate in 316 SST.
(6) IPX8 tested in 10 meters of water column for 24 hours.
(7) Ingress Protection:

Products	CEPEL	NEMKO / EXAM	FM	CSA	NEPSI
TT300	IP66/68W	IP66/68W	Type 4X/6(6P)	Type 4X	IP67

(8) IPW/Type tested for 200 hours according to NBR 8094 / ASTM B 117 standard.

Appendix A

CERTIFICATIONS INFORMATION

European Directive Information

Consult www.Smar.com for the EC declarations of conformity and certificates.

Authorized representative/importer located within the Community:
Smar Europe BV De Oude Wereld 116 2408 TM Alphen aan den Rijn Netherlands

ATEX Directive 2014/34//EU - "Equipment for explosive atmospheres" (applicable from 20 April 2016)
The EC-Type Examination Certificate is released by DNV Product Assurance AS (NB 2460) and DEKRA Testing and Certification GmbH (NB 0158).
Designated certification body that monitors manufacturing and released QAN (Quality Assurance Notification) is UL International Demko AS (NB 0539).

LVD Directive 2014/35/EU – "Low Voltage" (applicable from 20 April 2016)
According the LVD directive Annex II, electrical equipment for use in an explosive atmosphere is outside the scope of this directive.
According to IEC standard: IEC 61010-1 - Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 1: General requirements.

ROHS Directive 2011/65/EU - "Restriction of the use of certain hazardous substances in electrical and electronic equipment"
For the evaluation of the products the following standards were consulted: EN IEC 63000.

EMC Directive 2014/30/EU - "Electromagnetic Compatibility" (applicable from 20 April 2016)
For products evaluation the standard IEC 61326-1 were consulted and to comply with the EMC directive the installation must follow these special conditions:
Use shielded, twisted-pair cable for powering the instrument and signal wiring.
Keep the shield insulated at the instrument side, connecting the other one to the ground.

Hazardous locations general information

Ex Standards:
IEC 60079-0 General Requirements
IEC 60079-1 Flameproof Enclosures "d"
IEC 60079-7 Increased Safe "e"
IEC 60079-11 Intrinsic Safety "i"
IEC 60079-18 Encapsulation "m"
IEC 60079-26 Equipment with Separation Elements or combined Levels of Protection
IEC 60079-31 Equipment dust ignition protection by enclosure "t"
IEC 60529 Classification of degrees of protection provided by enclosures (IP Code)
IEC 60079-10 Classification of Hazardous Areas
IEC 60079-14 Electrical installation design, selection and erection
IEC 60079-17 Electrical Installations, Inspections and Maintenance
IEC 60079-19 Equipment repair, overhaul and reclamation
ISO/IEC 80079-34 Application of quality systems for equipment manufacture

Warning:
Explosions could result in death or serious injury, besides financial damage.
Installation of this instrument in hazardous areas must be in accordance with the local standards and type of protection. Before proceedings with installation make sure that the certificate parameters are in accordance with the classified hazardous area.

Maintenance and Repair
The instrument modification or replaced parts supplied by any other supplier than authorized representative of Smar is prohibited and will void the Certification.

Marking Label
The instrument is marked with type of protection options. The certification is valid only when the type of protection is indicated by the user. Once a particular type of protection is installed, do not reinstall it using any other type of protection.

Intrinsic Safety / Non Incendive application

Only connect the equipment with the "Intrinsic safety" protection type to a circuit intrinsically safe. If the equipment has already been used in circuits not intrinsically safe or if the electrical specifications have not been respected, the safety of the equipment is no longer guaranteed for "Intrinsic Safety" installations.

In hazardous areas with intrinsic safety or non-incendive requirements, the circuit entity parameters and applicable installation procedures must be observed.

The instrument must be connected to a proper intrinsic safety barrier. Check the intrinsically safe parameters involving the barrier and equipment including the cable and connections. Associated apparatus ground bus shall be insulated from panels and mounting enclosures. Shield is optional, when using shielded cable, be sure to insulate the end not grounded.

Cable capacitance and inductance plus Ci and Li must be smaller than Co and Lo of the Associated Apparatus.

It is recommended do not remove the housing covers when powered on.

Explosionproof / Flameproof application

Only use Explosionproof/Flameproof certified Plugs, Adapters and Cable glands.

The electrical connections entries must be connected using a conduit with sealed unit or closed using metal cable gland or metal blanking plug with at least IP66.

Do not remove the housing covers when powered on.

Enclosure

The electronic housing and sensor threads installed in hazardous areas must have a minimum of 6 fully engaged threads. The covers must be tightening with at least 8 turns, to avoid the penetration of humidity or corrosive gases, and until it touches the housing. Then, tighten more 1/3 turn (120º) to guarantee the sealing.

Lock the housing and covers using the locking screw.

The enclosure contains aluminum and is considered to present a potential risk of ignition by impact or friction.

Care must be taken during installation and use to prevent impact or friction.

Degree of Protection of enclosure (IP)

IPx8: Second numeral meaning continuous immersion in water under special condition defined as 10m for a period of 24 hours (Ref: IEC60529).

IPW/ TypeX: Supplementary letter W or X meaning special condition defined as saline environment tested in saturated solution of NaCl 5% w/w at 35ºC for a period of 200 hours (Ref: NEMA 250/ IEC60529).

For enclosure with IP/IPW/TypeX applications, all NPT threads must apply a proper water-proof sealant (a non-hardening silicone group sealant is recommended).

Hazardous Locations Approvals

FM Approvals
FM18US0182X
XP Class I Division 1, Groups A, B, C, D
DIP Class II, Class III Division 1, Groups E, F, G
IS Class I, II,III Division 1, Groups A, B, C, D, E, F G
NI Class I, Division 2, Groups A, B, C, D; NIFW
T4; Tamb = +60°C Max; Type 4, 4X, 6

Electrical parameters: 30Vdc
Entity Parameters/Nonincendive Field Wiring Parameters:
Supply terminals: Vmax = 30 V dc, Imax = 110 mA, Pi = 825mW, Ci = 0.005 µF, Li = 0.
Sensor terminals: Voc = 6.51V, Isc 42mA, Pi = 68mW, Ca= 21uF, La =19mH

Special conditions for safe use:
The enclosure contains aluminum and is considered to present a potential risk of ignition by impact or friction. Care must be taken during installation and use to prevent impact or friction.

Drawings 102A-0005, 102A-1225, 102A-1352

ATEX DNV
Explosion Proof (PRESAFE 20 75160X)
II 2 G Ex db IIC T6 Gb
Ambient Temperature: -20 ºC to +60 ºC
Options: IP66W/68W or IP66/68

Special conditions for safe use:
Repairs of the flameproof joints must be made in compliance with the structural specifications provided by the manufacturer. Repairs must not be made on the basis of values specified in tables 1 and 2 of EN/IEC 60079-1.

The Essential Health and Safety Requirements are assured by compliance with:
EN IEC 60079-0:2018 General Requirements
EN 60079-1:2014 Flameproof Enclosures “d”

Drawings 102A-1526, 102A-1470, 102A-2158, 102A-2159

IECEx DNV
Explosion Proof (IECEx DNV 21.0090X)
Ex db IIC T6 Gb
Ta -20 ºC to +60 ºC
Options: IP66/68W or IP66/68

Special Conditions for Safe Use
Repairs of the flameproof joints must be made in compliance with the structural specifications provided by the manufacturer. Repairs must not be made on the basis of values specified in tables 1 and 2 of EN/IEC 60079-1.

The Essential Health and Safety Requirements are assured by compliance with:
IEC 60079-0:2017 General Requirements
IEC 60079-1:2014-06 Equipment protection by flameproof enclosures “d”

Drawings 102A-2187, 102A-2188

ATEX DEKRA
Intrinsic Safety (DMT 01 ATEX E 150)
II 2G Ex ia IIC T4/T5/T6 Gb
I M2 Ex ia I Mb

Supply and signal circuit intended for connection to an intrinsically safe 4-20 mA current loop:
Ui = 28 Vdc, Ii = 93 mA, Ci ≤ 5 nF, Li = Neg

Maximum Permissible power:

Max. Ambient temperature Ta	Temperature Class	Power Pi
85°C	T4	700 mW
75ºC	T4	760 mW
44ºC	T5	760 mW
50ºC	T5	700 mW
55ºC	T5	650 mW
60ºC	T5	575 mW
65ºC	T5	500 mW
70ºC	T5	425 mW
40ºC	T6	575 mW

Ambient Temperature: -40ºC ≤ Ta ≤ +85ºC

The Essential Health and Safety Requirements are assured by compliance with:
EN 60079-0:2012 + A11:2013 General Requirements
EN 60079-11:2012 Intrinsic Safety “i”

Drawings 102A-1526, 102A-1470, 102A-2158, 102A-2159, 102A-1472, 102A-1528

INMETRO NCC
Segurança Intrínseca (NCC 24.0162X)
Ex ia IIC T5 Ga
Ex ia IIIC T_{200}100 ºC Da
Tamb: -20 °C a +65 °C
IP66/68 ou IP66/68W

Terminais de Alimentação
Ui = 30V Ii = 100 mA Pi = 0,7 W Ci = 6,4 nF Li = desp

Terminais dos sensores de temperatura
Uo = 5,5 V Io = 22 mA Po = 30 mW Co = 3,6 uF Lo = 20 mH

Prova de Explosão (NCC 24.0165)
Ex db IIC T6 Gb
Ex tb IIIC T85 ºC Db
Tamb: -20 °C a +40 °C
IP66/68 ou IP66/68W

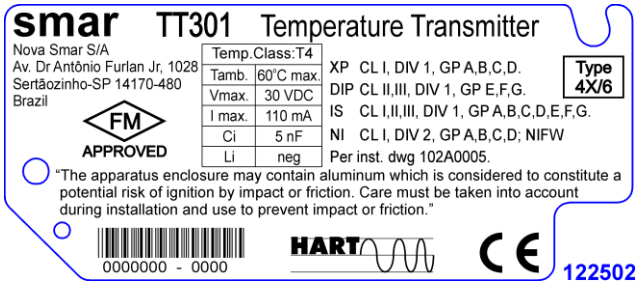
Observações:
O número do certificado é finalizado pela letra "X": Para indicar que para a versão do Transmissor de Temperatura, modelo TT301 equipado com invólucro fabricado em liga de alumínio, somente pode ser instalado em localização que exigem o “EPL Ga”, se durante a instalação for excluído o risco de ocorrer impacto ou fricção entre o invólucro e peças de ferro/aço.
O produto adicionalmente marcado com a letra suplementar "W" indica que o equipamento foi ensaiado em uma solução saturada a 5% de NaCl p/p, à 35 °C, pelo tempo de 200 h e foi aprovado para uso em atmosferas salinas, condicionado à utilização de acessórios de instalação no mesmo material do equipamento e de bujões de aço inoxidável ASTM-A240, para fechamento das entradas roscadas não utilizadas.
Os planos de pintura P1 são permitidos apenas para equipamento fornecido com plaqueta de identificação com marcação para grupo de gás IIB.
O grau de proteção IP68 só é garantido se nas entradas roscadas de ½” NPT for utilizado vedante não endurecível à base de silicone.
O segundo numeral oito indica que o equipamento foi ensaiado para uma condição de submersão de dez metros por vinte e quatro horas. O acessório deve ser instalado em equipamentos com grau de proteção equivalente.
É responsabilidade do fabricante assegurar que todos os transformadores da placa analógica tenham sido submetidos com sucesso aos ensaios de rotina de 1500 V durante um minuto.
Este certificado é válido apenas para os produtos dos modelos avaliados. Qualquer modificação nos projetos, bem como a utilização de componentes ou materiais diferentes daqueles definidos pela documentação descritiva dos produtos, sem a prévia autorização, invalidará este certificado.
As atividades de instalação, inspeção, manutenção, reparo, revisão e recuperação dos equipamentos são de responsabilidade dos usuários e devem ser executadas de acordo com os requisitos das normas técnicas vigentes e com as recomendações do fabricante.

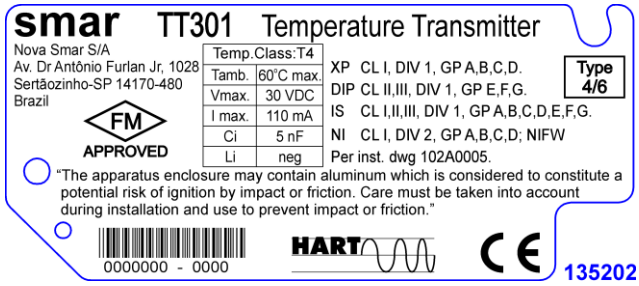
Normas Aplicáveis:
ABNT NBR IEC 60079-0:2020 Atmosferas explosivas - Parte 0: Equipamentos – Requisitos gerais
ABNT NBR IEC 60079-1:2016 Atmosferas explosivas - Parte 1: Proteção de equipamento por invólucro à prova de explosão “d”
ABNT NBR IEC 60079-11:2013 Atmosferas explosivas - Parte 11: Proteção de equipamento por segurança intrínseca "i"
ABNT NBR IEC 60079-26:2022 Atmosferas explosivas - Parte 26: Equipamentos com elementos de separação ou níveis de proteção combinados
ABNT NBR IEC 60079-31:2022 Atmosferas explosivas - Parte 31: Proteção de equipamentos contra ignição de poeira por invólucros “t”
ABNT NBR IEC 60529:2017 Graus de proteção providos por invólucros (Código IP)

Desenhos 102A1381, 102A1257, 102A2050, 102A2049, 102A2100

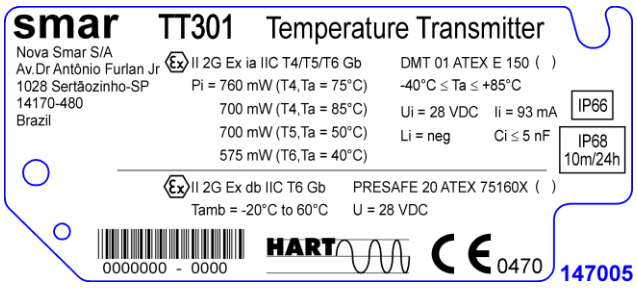
Identification Plate

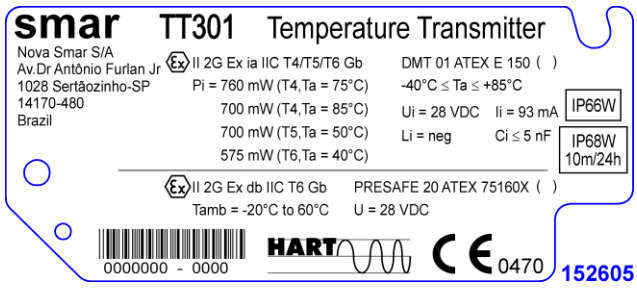
FM Approvals

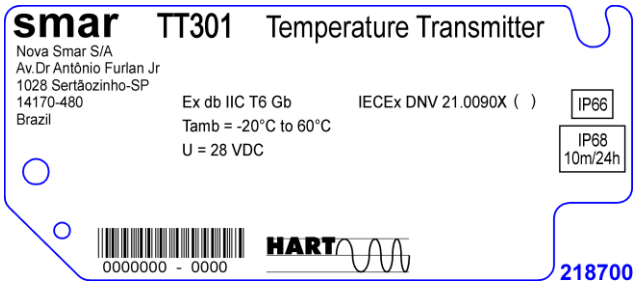


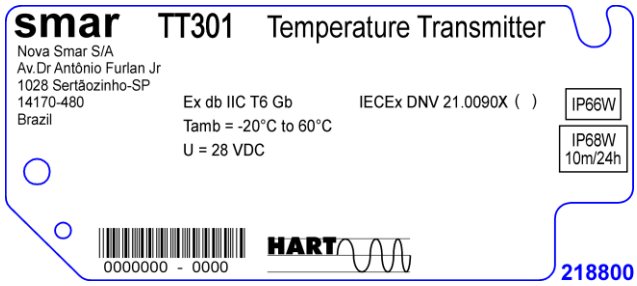


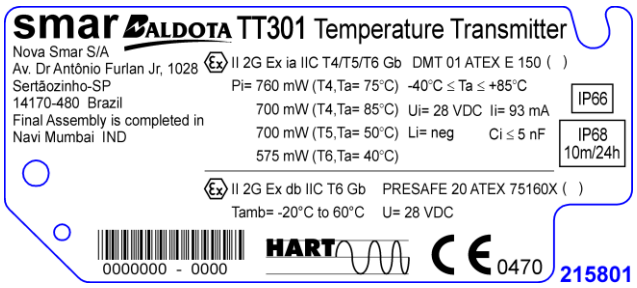
ATEX/ IECEx

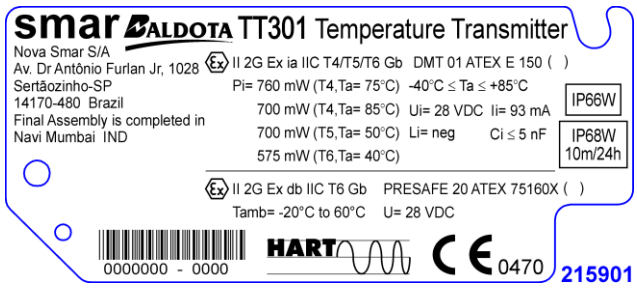


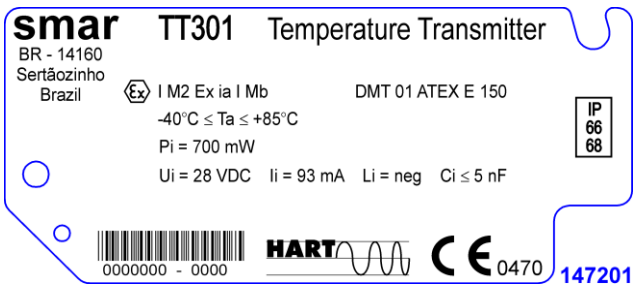


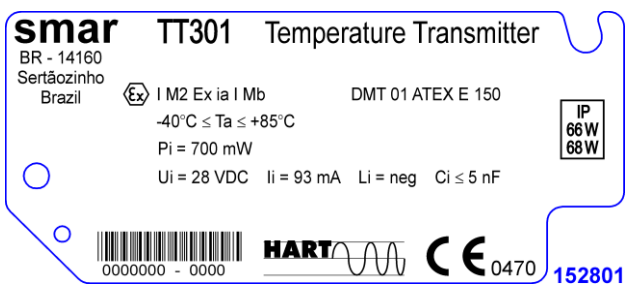




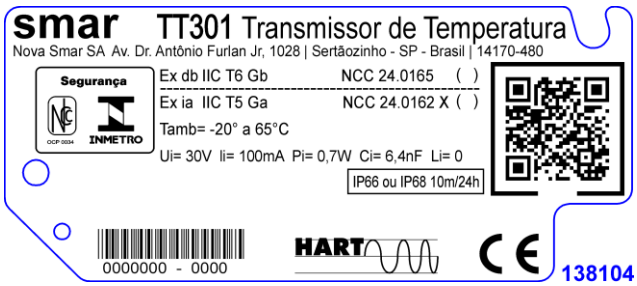


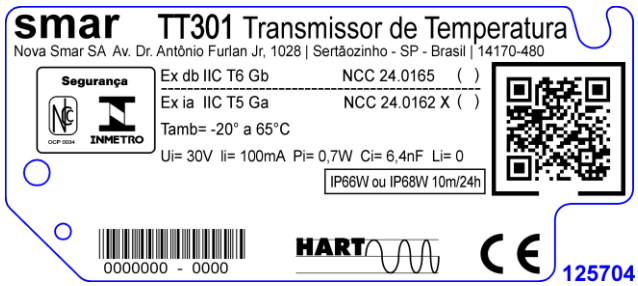






INMETRO NCC


smar TT301 Transmissor de Temperatura
Nova Smar SA Av. Dr. Antônio Furlan Jr, 1028 | Sertãozinho - SP - Brasil | 14170-480
Segurança
Ex db IIC T6 Gb NCC 24.0165 ( )
Ex ia IIC T5 Ga NCC 24.0162 X ( )
Tamb= -20° a 65°C
Ui= 30V Ii= 100mA Pi= 0,7W Ci= 6,4nF Li= 0
IP66 ou IP68 10m/24h
0000000 - 0000
HART
138104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Nova Smar SA Av. Dr. Antônio Furlan Jr, 1028 | Sertãozinho - SP - Brasil | 14170-480
Segurança
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Ex ia IIC T5 Ga NCC 24.0162 X ( )
Tamb= -20° a 65°C
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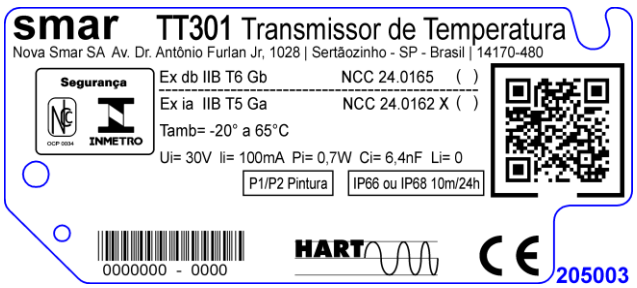
smar TT301 Transmissor de Temperatura
Nova Smar SA Av. Dr. Antônio Furlan Jr, 1028 | Sertãozinho - SP - Brasil | 14170-480
Segurança
Ex db IIB T6 Gb NCC 24.0165 ( )
Ex ia IIB T5 Ga NCC 24.0162 X ( )
Tamb= -20° a 65°C
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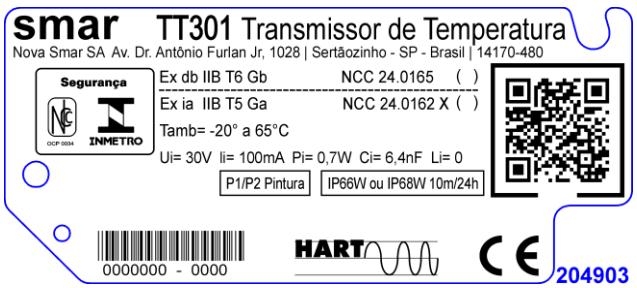
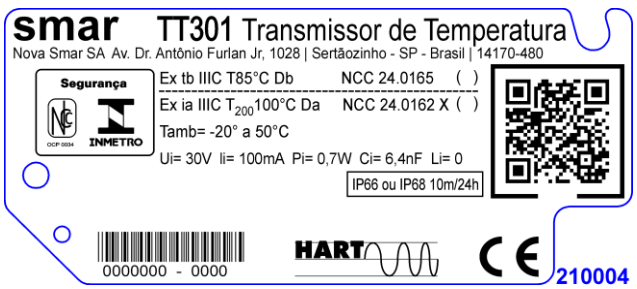
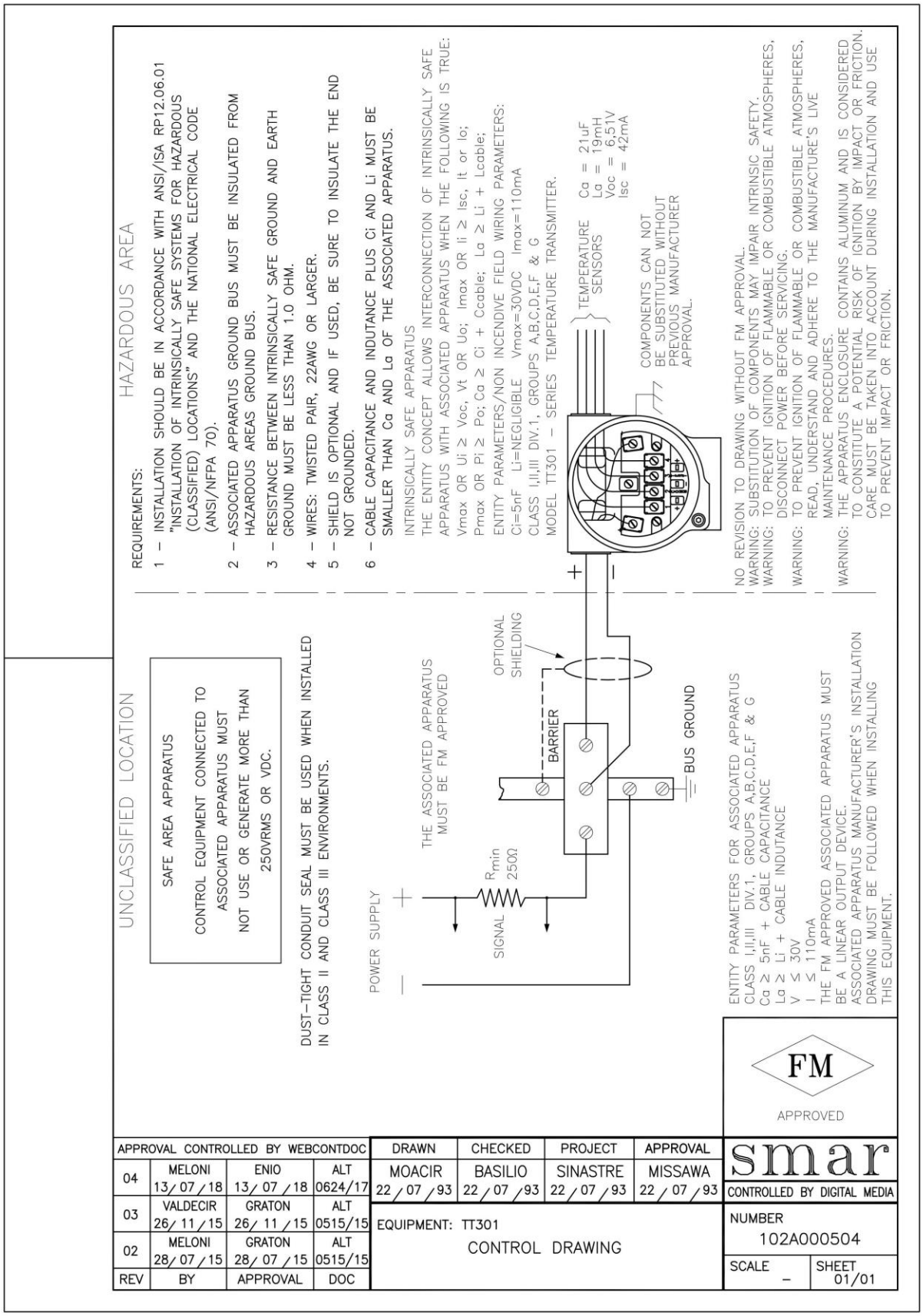
P1/P2 Pintura
IP66 ou IP68 10m/24h
0000000 - 0000
HART
205003


smar TT301 Transmissor de Temperatura
Nova Smar SA Av. Dr. Antônio Furlan Jr, 1028 | Sertãozinho - SP - Brasil | 14170-480
Segurança
Ex db IIB T6 Gb NCC 24.0165 ( )
Ex ia IIB T5 Ga NCC 24.0162 X ( )
Tamb= -20° a 65°C
Ui= 30V Ii= 100mA Pi= 0,7W Ci= 6,4nF Li= 0
P1/P2 Pintura
IP66W ou IP68W 10m/24h
0000000 - 0000
HART
204903


smar TT301 Transmissor de Temperatura
Nova Smar SA Av. Dr. Antônio Furlan Jr, 1028 | Sertãozinho - SP - Brasil | 14170-480
Segurança
Ex tb IIIC T85°C Db NCC 24.0165 ( )
Ex ia IIIC T200100°C Da NCC 24.0162 X ( )
Tamb= -20° a 50°C
Ui= 30V Ii= 100mA Pi= 0,7W Ci= 6,4nF Li= 0
IP66 ou IP68 10m/24h
0000000 - 0000
HART
210004

FM Approvals



Appendix B

smar	SRF–SERVICE REQUEST FORM	Proposal No.:

Company:	Unit:	Receipt of Remittance:	Warranty	
			Yes ( ) Purchase Order:	No ( )

COMMERCIAL CONTACT	TECHNICAL CONTACT
Full name:	Full name:
Position:	Position:
Phone: Extension:	Phone: Extension:
Fax:	Fax:
Email:	Email:

EQUIPMENT DATA / TEMPERATURE SENSOR

Model:	Serial Number:	Sensor Type and Connection:
TT301 ( ) TT302 ( ) TT303 ( ) TT400SIS ( ) TT411 ( ) TT421 ( )		Measurement type: ( ) Double Sensor ( ) Average between Sensors ( ) Differential ( ) Backup ( ) Single

INFORMATION AND DESCRIPTION OF THE FAILURE

Environment Temperature (ºC)		Work Temperature (ºC)		Calibration Range	
Min:	Max:	Min :	Max:	Min:	Max:
Operation Time:		Failure Data:			

IMPORTANT COMMENTS ABOUT EQUIPMENT APPLICATION AND PROCESS

(Please, inform more details about the application, installation, etc.).

FAILURE DESCRIPTION OR BAD OPERATION

(Please, describe the behavior of the fail, if it is repetitive, how it exactly happens, and so on.)

NOTES

For warranty or non-warranty repair, please contact your representative.
Further information about address and contacts can be found on https://www.smar.com/en/support.