

MANUAL

INSTALLATION | OPERATION | MAINTENANCE

WirelessHART™ **TEMPERATURE TRANSMITTER** **TT400WH**

WirelessHART™



APR/24 - VERSION 2

smar
Technology Company

TT400WH

WirelessHART™ Temperature Transmitter

WirelessHART™

Consult our
subsidiary



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Specifications and information are subject to change.
Updated addresses are available on our website.

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NOTE

This manual is compatible with version 2.XX, where 2 denote software version and XX software release. The indication 2.XX means that this manual is compatible with any release of software version 2.

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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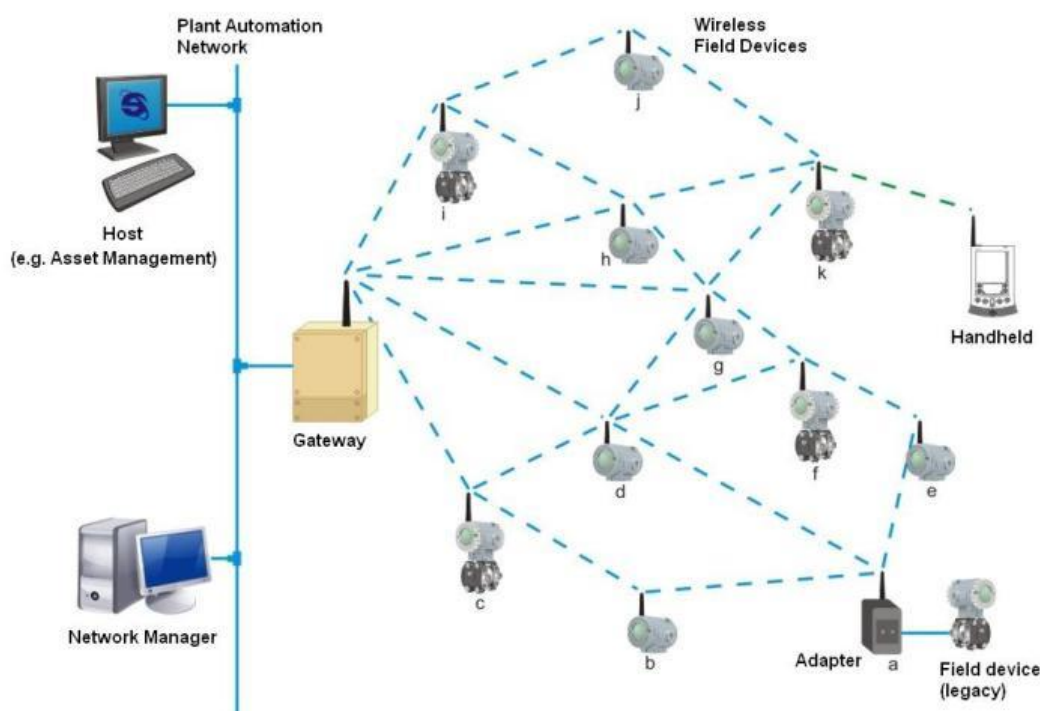
INTRODUCTION

WirelessHART technology overview

The *WirelessHART* technology is based on a wireless mesh network communication protocol used in process automation applications. It adds wireless capabilities to the HART protocol, while maintaining compatibility with existing HART devices, commands and already known and used tools.

WirelessHART network

Basically, a *WirelessHART* network, defined in the HART specifications, consists of a host, a *WirelessHART* Gateway and one or more field devices and/or *WirelessHART* adapters. Together they compose a mesh network where the host and devices can communicate.



Host

The host, usually connected to the control network, is a workstation in which, e.g., can be installed an Human Machine Interface application, which allows an operator to interact with the process. Through the *WirelessHART* Gateway, the host can gather data from devices connected to the *WirelessHART* network. The host communicates with the *WirelessHART* Gateway using a communication protocol, for example, HSE, H1, Profibus or Modbus.

WirelessHART Gateway

It is a "translator" equipment. Thus it converts data from the host to the *WirelessHART* protocol, used by the devices connected to the *WirelessHART* network, and converts data from the devices to the host. In general, the *WirelessHART* Gateway incorporates the features of Network Manager and Access Point. Roughly, the access point can be understood as the *WirelessHART* radio installed at the gateway to communicate with devices connected to the wireless network.

Network Manager

The Network Manager is an application that can be embedded in the *WirelessHART* Gateway. On a *WirelessHART* network is only allowed to have one Network Manager. Among its responsibilities, the Network Manager distributes network identity (advertisement) publishing its existence, manages and authenticates the addition (joining) of devices to the network. It also distributes individual security keys (static or rotating) to the devices to ensure secure communication between it and the devices. The Network Manager assigns communication band to the devices already connected to

the network that requested services to it, as well as manages the routes between the devices on the mesh network.

Specifically, about the joining process of a *WirelessHART* device to the network, the Network Manager validates the Network ID and the Join Key attributes which are configured in the *WirelessHART* Gateway and *WirelessHART* devices.

The Network ID identifies a *WirelessHART* network in unique way. It is an unsigned integer attribute and must be configured on the *WirelessHART* Gateway and all *WirelessHART* devices. Considering a *WirelessHART* network installed in a plant, the permitted values for the Network ID ranges from 0 (hex 0x0000) to 32767 (0x7FFF hexadecimal).

The Join Key is a security key used to encrypt joining requests from *WirelessHART* devices that receive the advertisement with the Network Id identical to theirs. It may be single or each *WirelessHART* device may be configured with an individual Join Key. In the first case, the *WirelessHART* Gateway and all *WirelessHART* devices must be configured with the same Join Key. In the second case, which provides higher communication security level, (a) must be configured in the *WirelessHART* Gateway a list with individual Join Keys, i.e., a key for each *WirelessHART* device, and (b) you must configure each *WirelessHART* device with its individual Join Key. The Join Key is a hexadecimal string of 16 bytes. There is no restriction to the hexadecimal value of each byte. The table below shows examples of some join keys.

JOIN KEYS	16-BYTES HEXADECIMAL STRING
00000000000000000000000000000000	0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00
000000000000000000000000000000302	0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x03, 0x02
00000000FFFFFFFF0000000000000000	0x00, 0x00, 0x00, 0x00, 0xFF, 0xFF, 0xFF, 0xFF, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00
550000000000000000000000000000AA	0x55, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0xAA

WirelessHART device

The *WirelessHART* field device is the device that connects to the process, being able to receive and/or transmit data on the *WirelessHART* network. It is a *WirelessHART* router (repeater) by nature, i.e., it is able to retransmit messages to/from other devices on the *WirelessHART* network.

WirelessHART Adapter

It is a bridge-type device, because it is able to provide data of HART + 4 to 20mA field device, legacy, to the host via *WirelessHART*. The adapter uses HART FSK standard communication, wired, to access data from HART field devices. And the adapter also uses the *WirelessHART* communication to provide data of the field device to the host. The adapter thus enables a HART field device to work on *WirelessHART* network.

We recommend a visit to the HART Communication Foundation website for additional information about the *WirelessHART* protocol such as *WirelessHART* project planning, positioning of devices, commissioning and verification tools, and practices.

Planning a WirelessHART network

The planning of a *WirelessHART* network is a task that is very similar to the activities that currently we perform with conventional wired devices. Furthermore, due to the simplicity of a mesh *WirelessHART* network, is exempt, in general, detailed field surveys, which are usually needed when we plan networks based on other wireless technologies.

Basically, a *WirelessHART* network involves planning, design, installation and commissioning phases.

Planning

This phase requires the execution of the steps below:

Scope definition

Clearly define the scope of the network. Answer the question: why do we need the wireless network? To monitor process variables or to implement a non-critical control? The answer to this question will facilitate the understanding between the team members responsible for the network

and determine one or more process units in the plant. For each process unit, allocate a gateway with unique and specific Network ID. Outline the main field devices.

Identify potential sources of interference

Are there radio communications or other wireless networks in the plant? What protocols and frequencies do they use? Use high power? Although unlikely, given the robustness of the radios used by the *WirelessHART* technology, prior knowledge of the answers to these questions may identify potential sources of interference and to indicate the taking of preventive and/or limiting actions even before installation. For example, you can select a frequency channel as unavailable, adding it to the black list of frequencies that is under the *WirelessHART* Network Manager control.

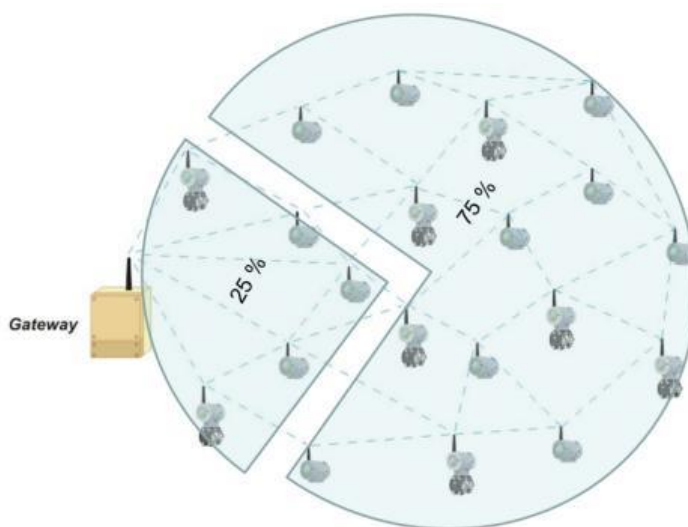
Integration with the host

The gateway connects the *WirelessHART* field devices to the host system. Plan what devices and what data are needed. Also, the stations or applications which will process the data have to be clearly defined. From this set, among the protocols in the system, define which one will be used for integration with the host and with the existing tools for configuring the devices. After defining the protocol for integration, the user has to choose the gateway on the market that best meets your requirements.

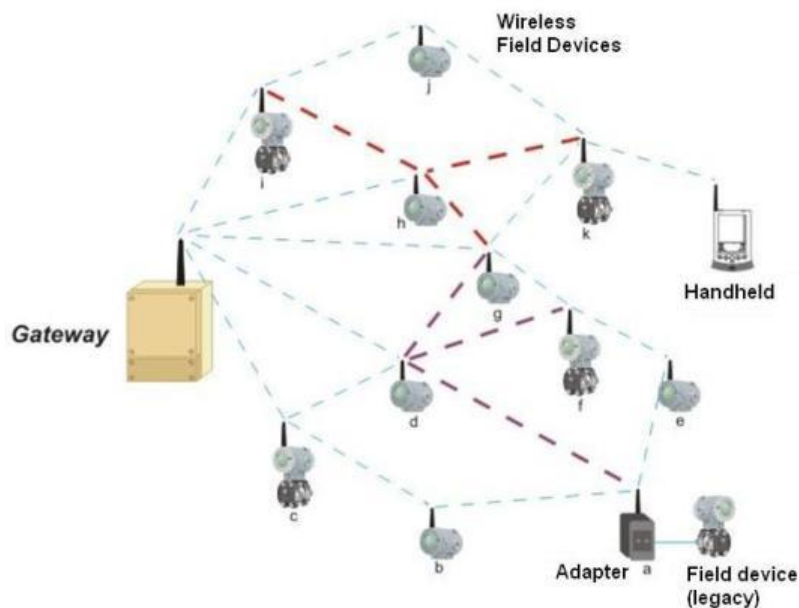
Project

In the project phase, it is recommended the adoption of the practices below. Although conservative, these practices ensure robustness and scalability to the network.

- Define the Network ID that will be used for all devices in the process unit;
- Define if the Join Key will be common to all devices or individual and dedicated ;
- Define the policy to be used for the definition of devices (Long) Tags;
- Use a scale drawing of the process unit;
- Place the gateway in a strategic position in the process unit ;
- Plan networks with at least five devices;
- Install at least five devices within the gateway coverage area;
- Ensure that 25 % of the devices are within the gateway coverage area;



- Reposition the gateway as needed;
- Check the coverage area of each device;
- Ensure that each device has three neighbors within its coverage area;



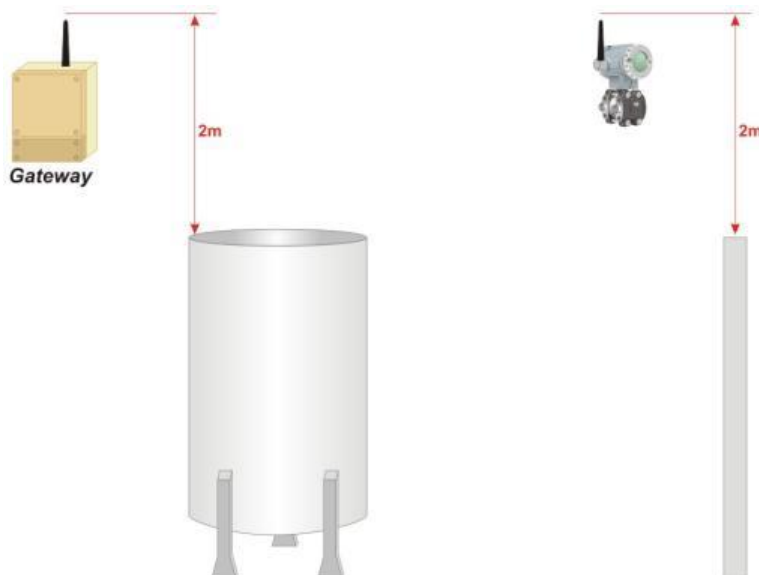
- Place the repeaters as needed.

Installation

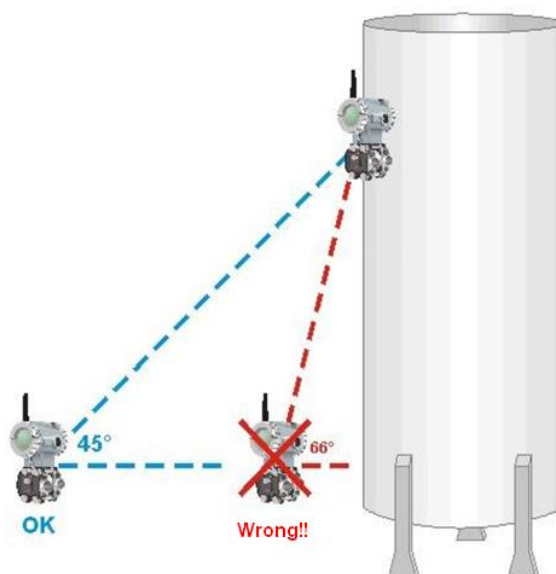
As mentioned before, *WirelessHART* devices should be connected to the process and configured the same way as conventional wired HART devices.

Handheld terminals can be used normally. Just be sure of having it properly uploaded with the latest DD files of the devices. However, it is known that the *WirelessHART* devices have characteristics inherent to the technology. Because of this, it is recommended the adoption of practices mentioned below for positioning the gateway and devices.

- Install the gateway and the devices so that their antennas are vertical;
- Ensure that the antennas are at 0.5 m minimum distance of large obstacles or surfaces;
- Ensure that the antennas of gateway and repeaters are 2 m above most obstacles within their coverage areas;



- If there are high devices, does not exceed 45 ° viewing angles between them;



- Make sure that the gateway is integrated to the host system as planned.

Commissioning

The commissioning of devices and gateway must be considered¹.

WirelessHART devices commissioning

- Ensure that the gateway is installed and powered;
- Install each device individually. Start with those closest to the gateway, i.e., those that will be within the coverage area of the gateway;
- If the device is powered by batteries, check that they have the same characteristics documented in the device's operation manual;
- Power the device up;
- Use a handheld terminal and configure the device according to the application requirements;
- Configure the Long Tag of the device;
- Configure the Network ID;
- Configure the Join Key;
- Define and configure the update rate;
- Command, if necessary, the device connection to the network;
- Follow the device connection to the network, waiting until it reaches the operational state. The monitoring can be done from the device² or gateway;
- Make sure the device is operating to ensure its commissioning. For example, check the value of PV measured and its update rate.

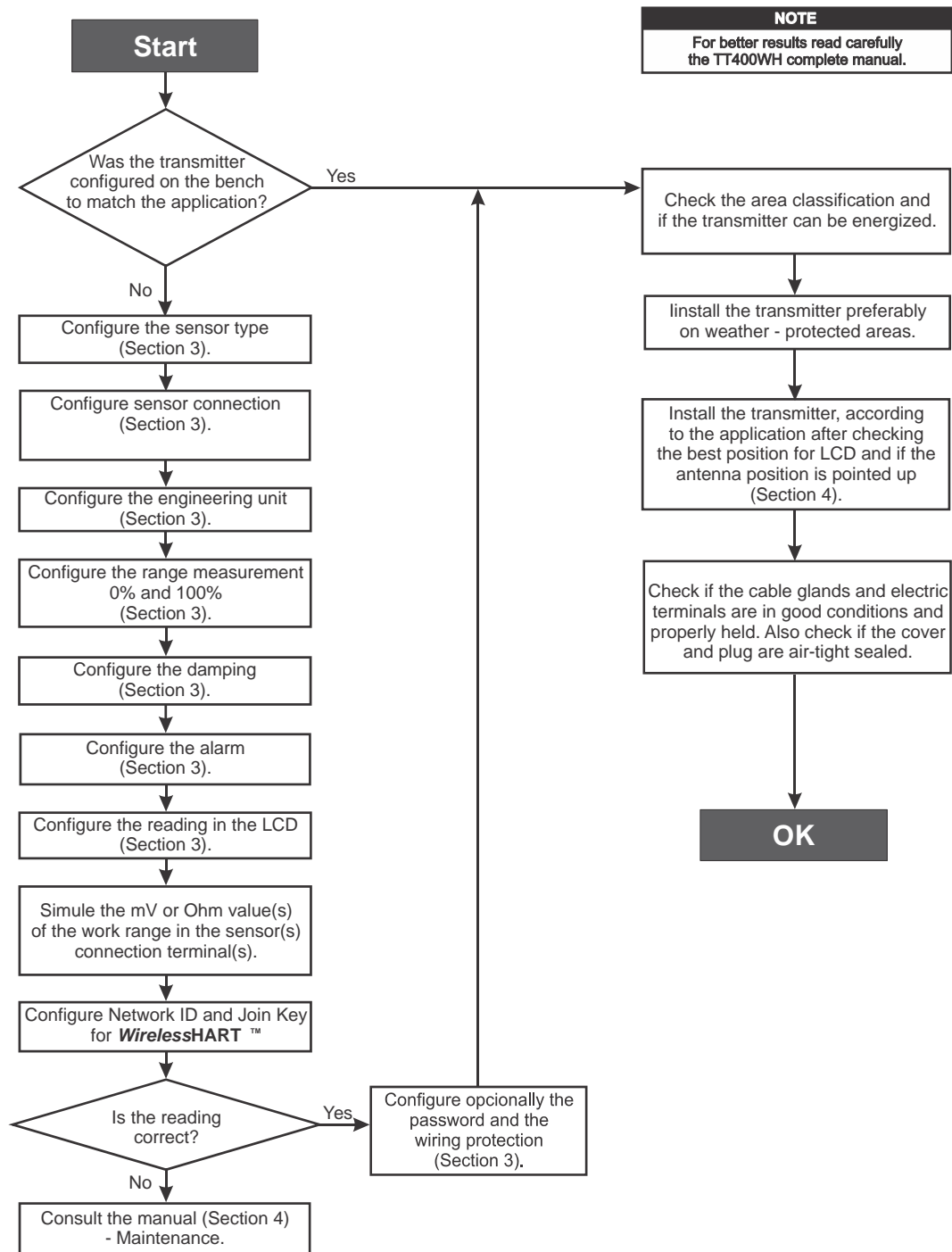
Gateway commissioning

- Make sure that the gateway is available to the host system;
 - Check the gateway and make sure it has at least five devices directly connected to it;
 - Check if 25 % of the devices are connected directly to the gateway. If necessary, add repeaters;
- The gateway connects the devices to the host system. Thus, check if the data of the devices are coming to the applications that subscribe them.

¹ The steps below assume that the Network ID and the Join Key(s) are already configured.

² Refer to the device's manual to learn procedures for such verification.

Installation Flowchart



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 cooling-neck 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.

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 must 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 these parts cannot be protected by painting. Code-approved sealing methods on conduit entering the transmitter should be employed.

Measurement error can be decreased by connecting the sensor as close to the transmitter as possible and using proper wires (see Section 2, Operation).

WARNING

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

WARNING

Random, frequent, or common cause failures must not damage the equipment or result in death or serious injury, must not harm to the environment or equipment, and must not loss of equipment or production.

WARNING

Electrical shock can result in serious injury.

Mounting

The transmitter may be mounted according to figure 1.1.

For better visibility, the housing can be rotated by loosening the locking screw (Figure 1.3).

Reach the display and main electronic board by removing the cover with window. This cover can be locked by the cover locking screw. To release the cover, rotate the locking screw clockwise. See Figure 1.3.

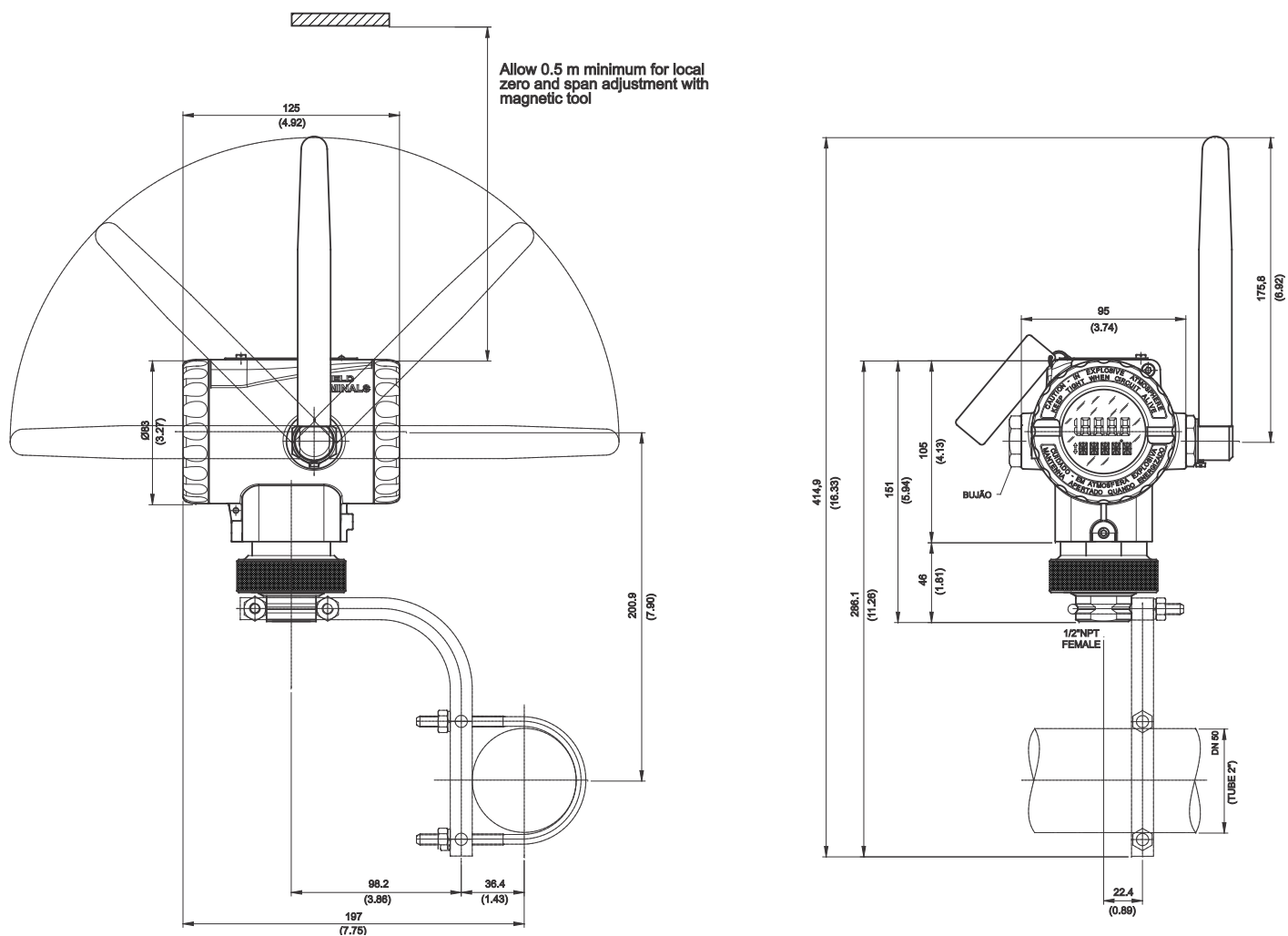


Figure 1.1 - Dimensional Drawing and Mounting Positions

WARNING

The **TT400 WirelessHART™** should be installed with the antenna positioned upward. Do not rotate the antenna, because the cable may break.

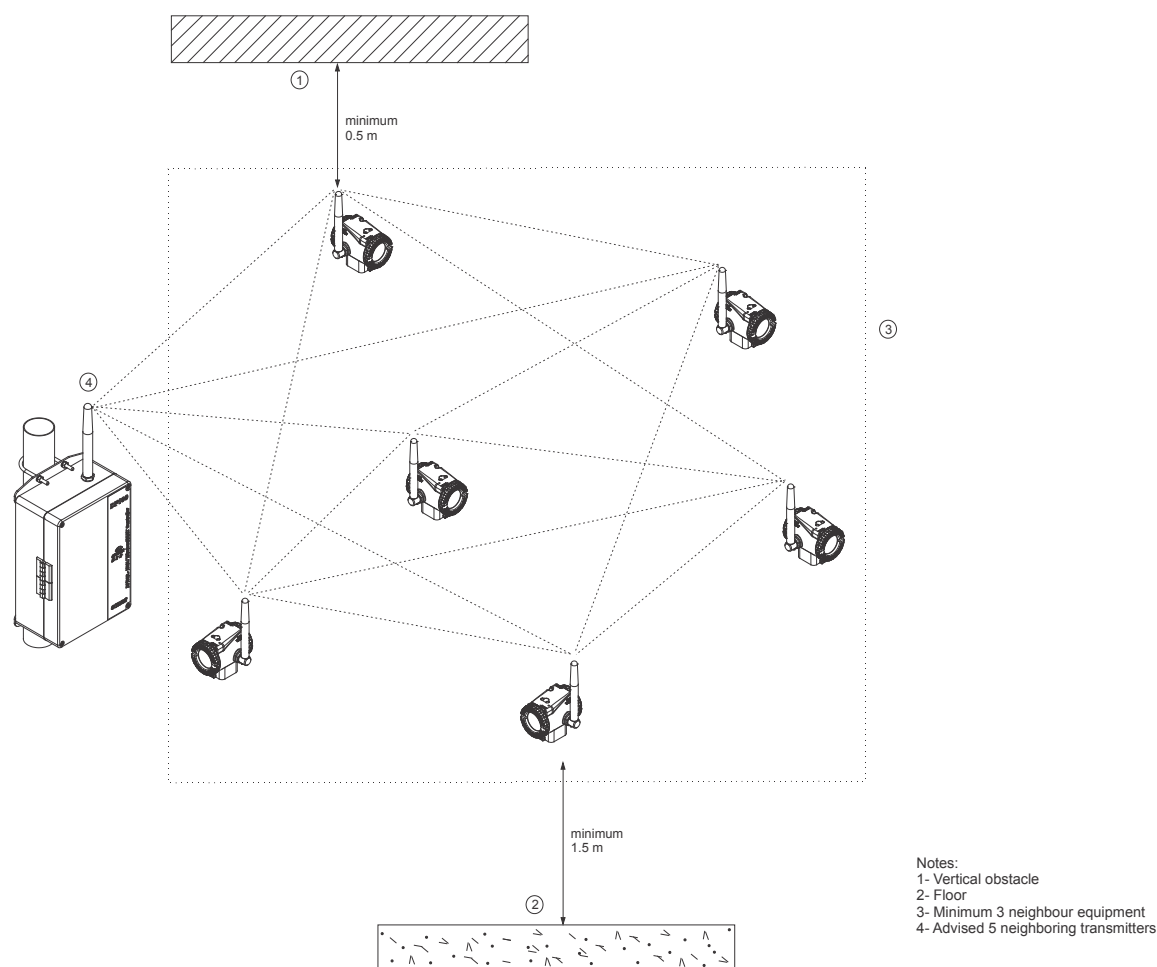


Figure 1.2 – Wiring Diagram for Wireless Transmitter

Battery Module Connection

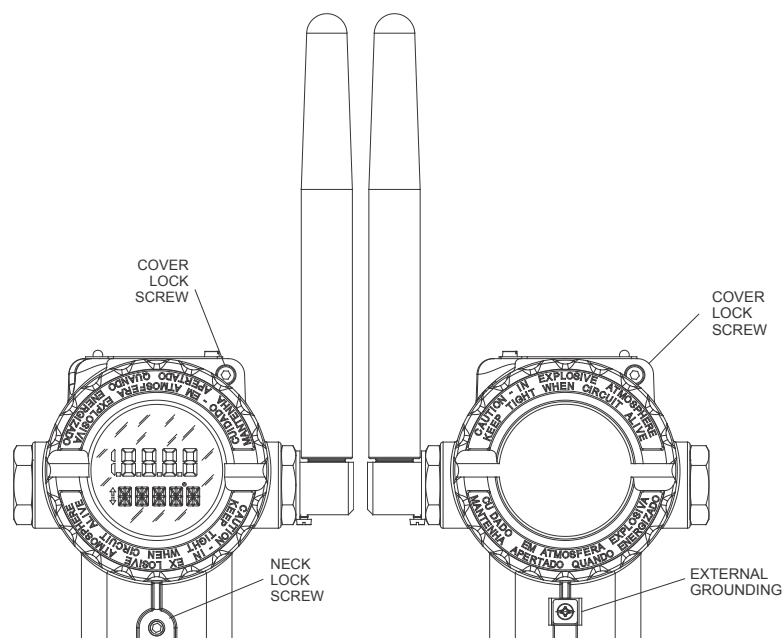


Figure 1.3 – Terminal Locking Screws

Maintenance Port

The equipment comes from the factory with the Battery Module turned off, for safety reasons and shipping regulations. To turn it on using the front switch, it is necessary to previously connect the Battery Module connector to the radio board, located on the back of the equipment.

The communication ports allow communication with the transmitter. To this end, should be connected to a HART configurator in the "CN1" and "CN2" communication terminal, which is shown in Figure 1.5.

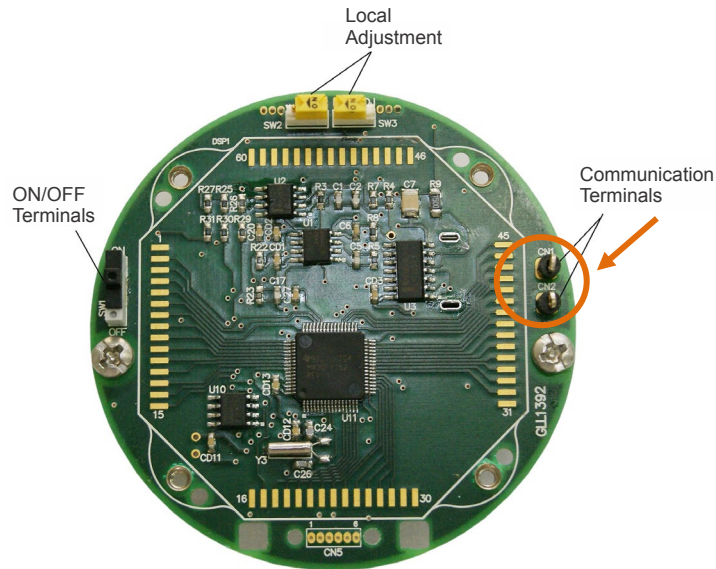


Figure 1.4 – Transmitter Terminals

The maintenance port allows for local configuration of the equipment. To access it, a HART configurator must be connected to the communication terminals "CN1" and "CN2", shown in Figures 1.4 and 1.5.

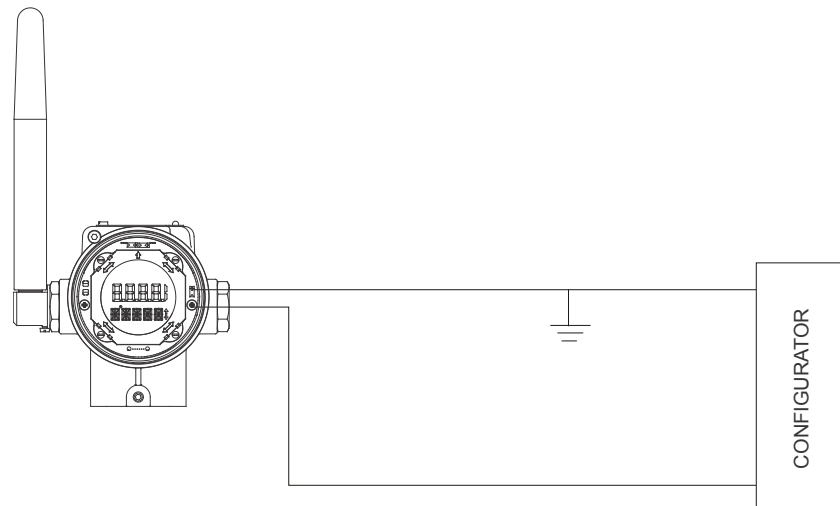


Figure 1.5 - Wiring Diagram

The sensor connection on the equipment's input board must be carried out following the next figure, considering the type and number of sensors to be connected.

WARNING

When operating with two sensors, the sensors cannot be both grounded. At least one must be not grounded for proper operation of TT400 WirelessHART®.

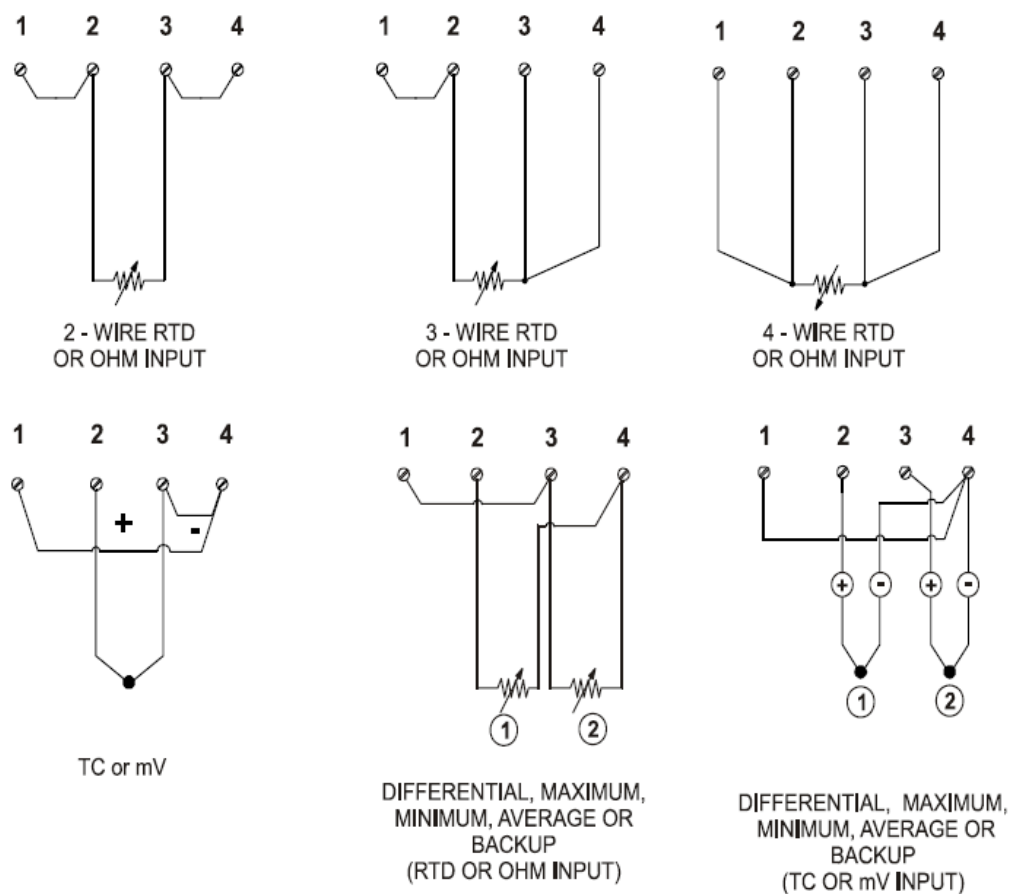


Figure 1.6 – Sensor Wiring

Installation in Hazardous Locations

WARNING

Explosions could result in death or serious injury, besides financial damage. Installation of this transmitter in explosive areas must be carried out in accordance with the local standards and the protection type adopted. Before continuing the installation make sure the certificate parameters are in accordance with the classified area where the equipment will be installed.

The instrument modification or parts replacement supplied by other than authorized representative of Smar is prohibited and will void the certification.

The transmitters are marked with options of the protection type. The certification is valid only when the protection type is indicated by the user. Once a particular type of protection is selected, any other type of protection can not be used.

The electronic housing and the sensor installed in hazardous areas must have a minimum of 6 fully engaged threads. Lock the housing using the locking screw (Figure 1.3).

The cover must be tightened with at least 8 turns to avoid the penetration of humidity or corrosive gases. The cover must be tightened until it touches the housing. Then, tighten more 1/3 turn (120°) to guarantee the sealing. Lock the covers using the locking screw (Figure 1.3).

Intrinsically Safe

WARNING

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

The configurator data to guarantee the intrinsically safe parameters are:

Uo(max.) = 5 V

Io(max.) = 100 µA

For free access to the HART bus in the explosive environment, ensure the instruments in the loop are installed in accordance with intrinsically safe or non-incendive field wiring practices.

It is not recommended to remove the transmitter cover when the power is ON.

OPERATION

The **TT400 WirelessHART™** accepts signals from mV generators such as thermocouples or resistive sensors such as RTDs. The criterium 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.

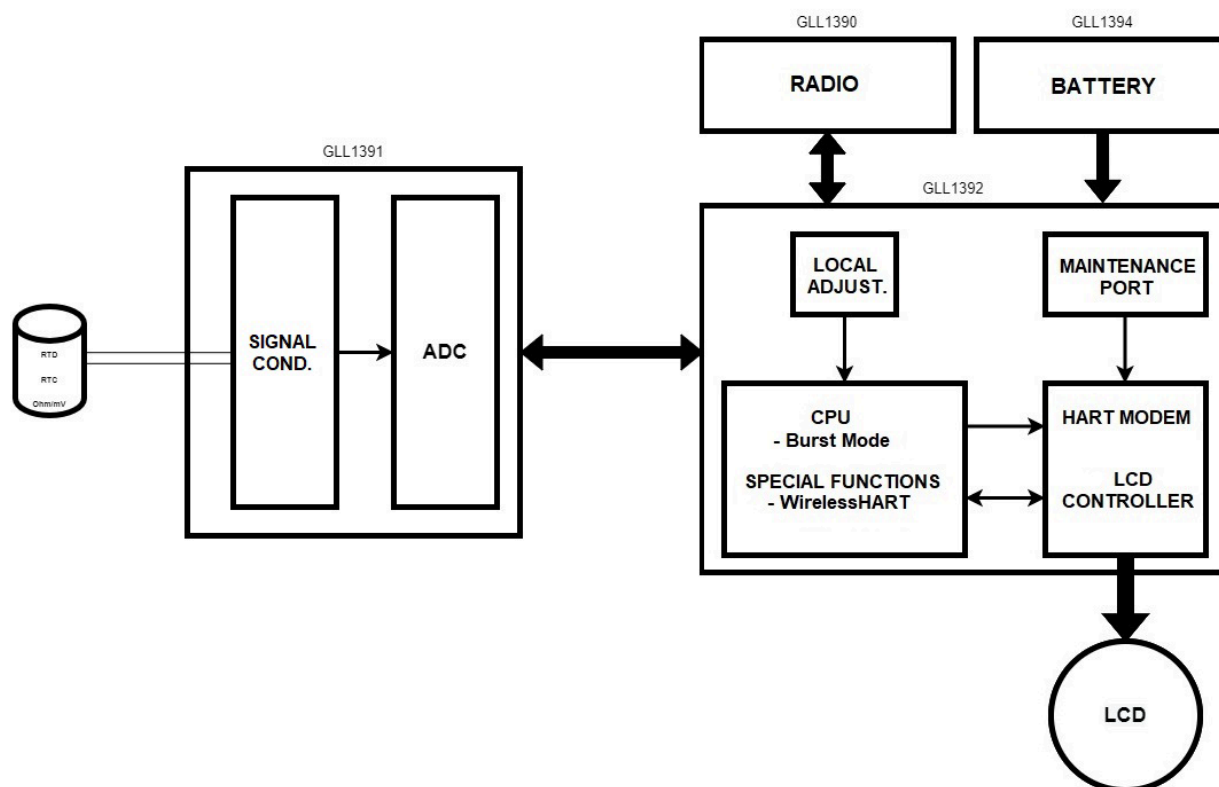


Figure 2.1 – TT400 WirelessHART™ Block Diagram

Input Signal Conditioner

A function 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.

Processing Central Unit (CPU), RAM, FLASH and FRAM

The central processing unit (CPU) is the intelligent part of the transmitter responsible for the management and operation of measurement, execution block, self-test and communication. The program is stored in FLASH memory. For temporary storage of data, the CPU has an internal RAM. If the power is turned off, data stored in RAM is lost.

For data storage that requires persistence, such as configuration data, calibration and identification, a non-volatile memory type FRAM for **TT400 WirelessHART™** is used. It has an access time consistent with the RAMs normal and there is no limitation in terms of write cycles.

Modem

The function of this system is to make possible the exchange of information between the configurator and the transmitter, through digital communications Master-Slave type.

Therefore, the transmitter makes the demodulation of the received signal serially configurator, for the

current line, and after treating it appropriately modulates the response to be sent. The HART® technology uses FSK for modulation of the signal.

Battery

The Battery Module consists of 2 primary lithium batteries (Li-SOCl₂) of 3.6 Volts, totaling 7.2 Volts. Each battery has 2.5 grams of lithium, totaling 5.0 grams Battery Module.

WARNING

By no means should be used other than the power supplied by batteries Module Smar (code 400-1209). When you replace the Battery Module (code Smar 400-1209) to set up the replacement via a configurator that will cause the device to reboot count the estimated lifespan for the new module.

Under normal use, the batteries offer no risk of spontaneous reaction if they are handled properly. You should exercise caution in relation to falls, high temperature and short-circuit the Battery Module, so that it does not offer any risk or malfunction.

Even with low batteries should keep the same care, they still offer dangers. Never attempt to disassemble, modify or recharge the batteries as this may result in leakage or explosion.

STORAGE - the battery module should preferably be stored in an environment below 30 °C, dry, ventilated subject to less variation in temperature.

Do not dispose of batteries in Module trash. Use a battery for proper disposal or chemical waste.

When you replace the Battery Module (code Smar 400-1209) to set up the replacement via a configurator that will cause the device to reboot count the estimated lifespan for the new module.

For Additional Information and First Aid, see Appendix B - "Safety Datasheet Battery" or consult the manufacturer's website.

Display Controller

It receives the data from the CPU and activates the LCD segments. It also activates the back plane and the control signals for each segment.

Temperature Sensors

The **TT400 WirelessHART™**, as previously explained, accepts several types of sensors. The **TT400 WirelessHART™** is specially designed for temperature measurement using thermocouples or thermoresistances (RTDs).

Some basic concepts about these sensors are presented below.

THERMOCOUPLES

Thermocouples are the most 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 different 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 different materials are not the same and does not cancel each other out. 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 **TT400 WirelessHART™**, 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 0 °C.

Standardized thermocouples which are commercially used, whose tables are stored in the memory of the **TT400 WirelessHART™**, are the following:

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

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 **TT400 WirelessHART™**, are the following:

- ✓ **JIS [1604-81] (Pt50 & Pt100)**
- ✓ **IEC, DIN, JIS [1604-89] (Pt50, Pt100, Pt500, Pt1000)**
- ✓ **GE (Cu 10)**
- ✓ **DIN (Ni 120)**

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.

A 2-wire connection may cause measuring errors. It will depend on the length of connections wires and on the temperature to which they are exposed (see Figure 2.2).

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

$$V2 = [RTD + 2 \times R] \times I$$

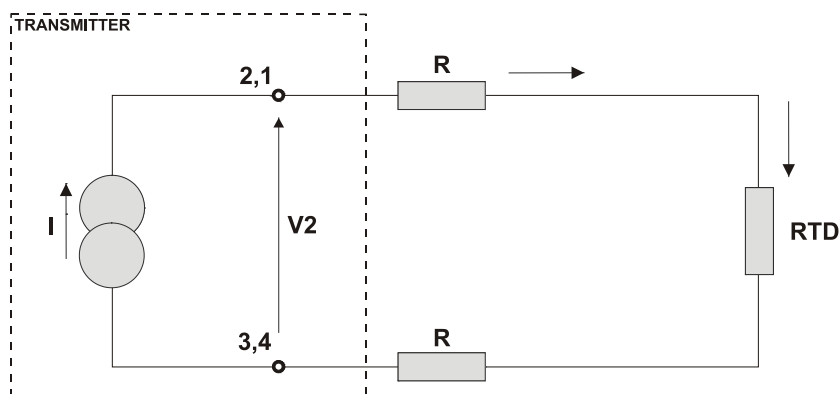


Figure 2.2 – Two-Wire Connection

To avoid the resistance effect of the connection wires, it is recommended to use a 3-wire connection (see Figure 2.3) or a 4-wire connection (see Figure 2.4).

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.

$$V2 - V1 = [RTD + R] \times I - R \times I = RTD \times I$$

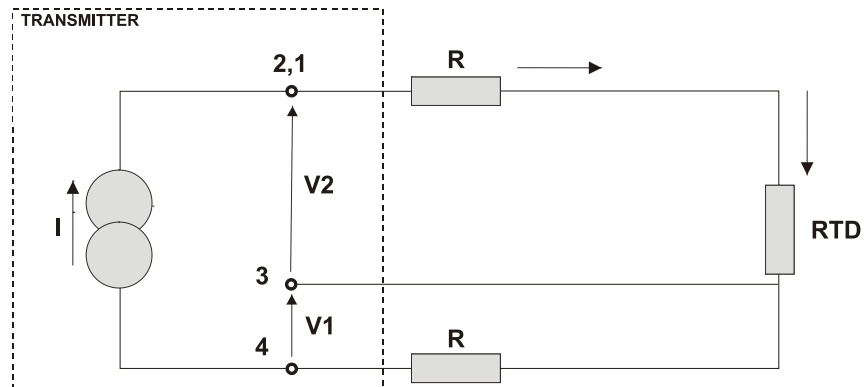


Figure 2.3 – Tree-Wire Connection

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. ($V2 = RTD \times I$).

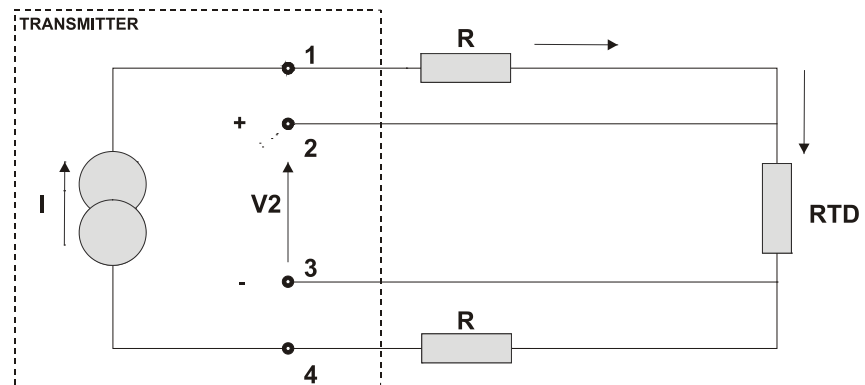


Figure 2.4 – Four-Wire Connection

A differential connection is like the two-wire connection and gives the same problem (see Figure 2.5). 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.

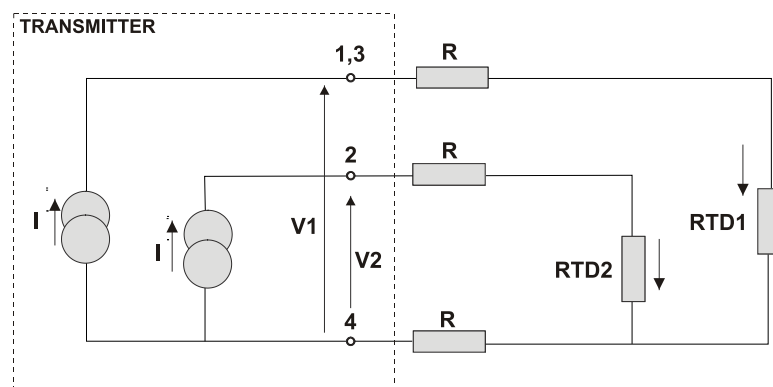


Figure 2.5 – Two Sensor Connection

NOTE

The material the gauge and the length should be the same connections of 3 or 4 threads.

The 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 display indicates engineering units, values and parameters simultaneously with most status indicators. The monitoring mode indication is interrupted in case of an alarm been activated.

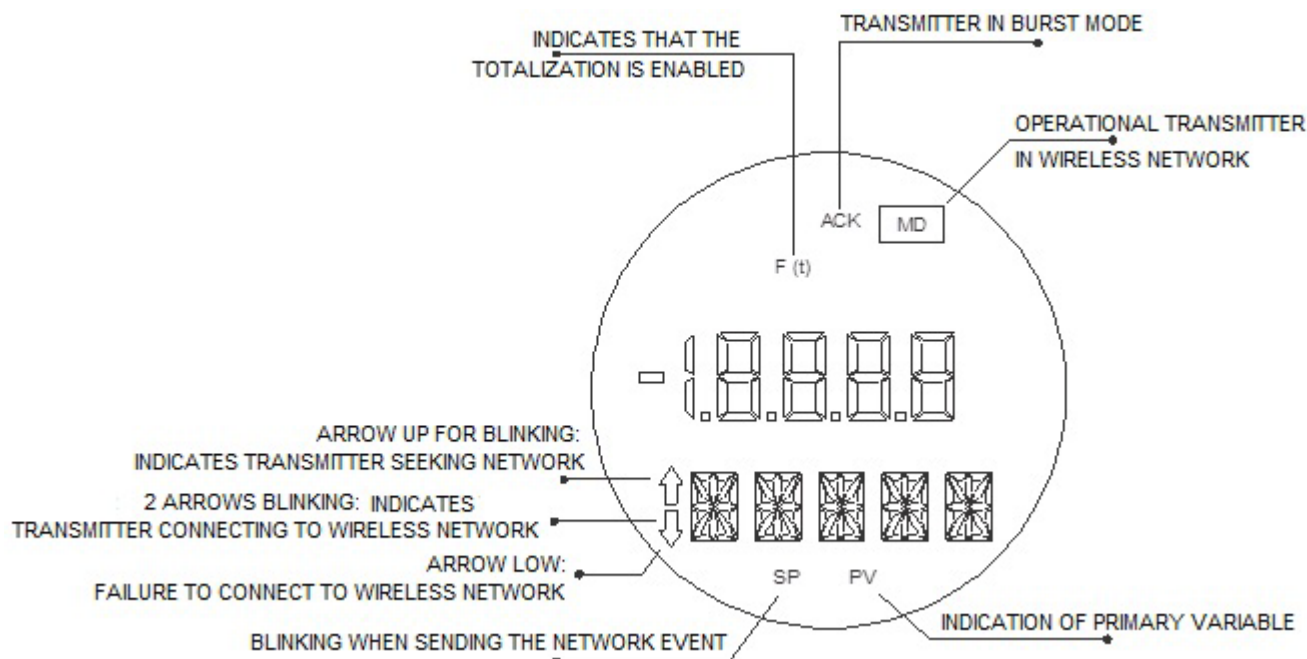


Figure 2.6 – Typical Monitoring Mode Display

Monitoring

During normal operation, **TT400 WirelessHART®** is in monitoring mode. In this mode, toggles the indication between the first and second variable. See Figure 2.7.

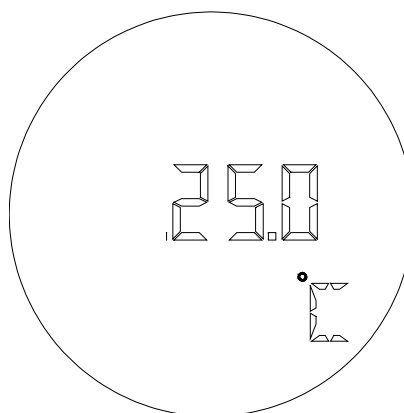


Figure 2.7 – Typical Display in Monitoring Mode

Local Adjustment

For configuration via local adjustment to be possible:

- The write protection jumper must be disabled;
- Local adjustment jumper must be enabled.

See Figure 1.4 for the positions of the Local Adjustment and Write Protection jumpers on the main electronic board.

The transmitter has, under the identification plate, two holes that allow the placement of the magnetic tool for the Local Adjustment. See Figure 2.8.

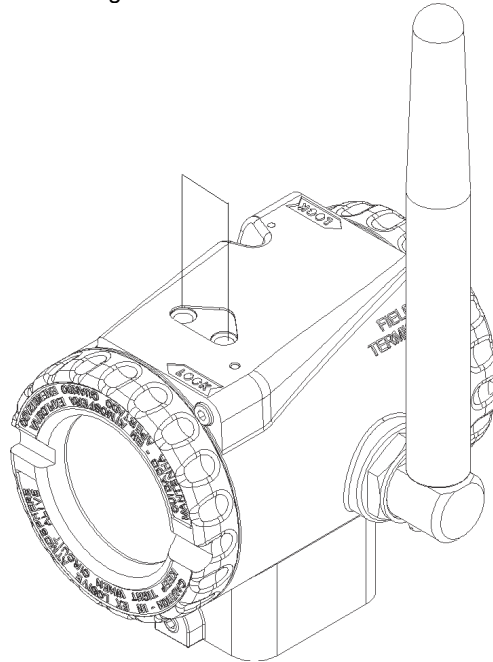


Figure 2.8 – Local Adjustment

The holes are marked with **Z** (Zero) and **S** (Span) and henceforth will be designated by only (**Z**) and (**S**), respectively.

The movement through the functions and their branches works as follows:

- By inserting the handle of the magnetic tool in (**Z**), the transmitter leaves the normal measurement state to the transmitter configuration state. The transmitter software automatically starts indicating the available functions on the display, cyclically;
- Leave the key at (**Z**) to cycle through all available configuration options;
- Once the display shows the desired option, change the key to (**S**) to select the option and navigate within the branch of the selected option. Removing the key will make the equipment save the changes made (in case of change).

The available options for local adjustment of **TT400 WirelessHART™** are:

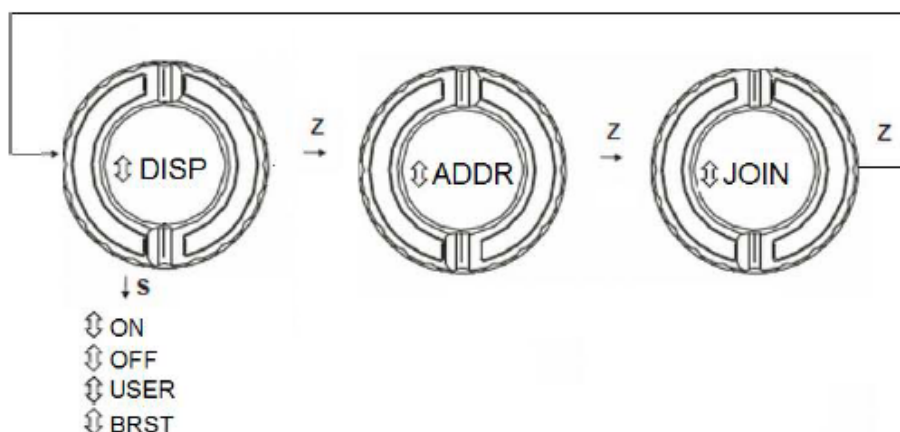


Figure 2.9 – Local Adjustment Configuration Tree

The DISP option changes the configuration of display mode. Four modes are supported:

- OFF: display is always turned off.
- ON: display is always turned on.
- USER: display normally off but activated when user inserts the magnetic tool in (S).
- BRST: display normally off but activated when the equipment sends a Burst command.

The ADDR and JOIN options are read-only and are used to identify the configuration address by the maintenance port and the equipment status on the **WirelessHART™** network, respectively.

Writing Protection

The write protection function can be activated by two means: hardware (key on the main board) and software. The writing of any parameter will only be possible if both protections are disabled.

Another way to protect the writing, but in a partial way, is the option to Lock Device, for **WirelessHART™**.

This option is used in **WirelessHART™** equipment to block writing by only one configuration means, Maintenance Port or Gateway. In this way, the user avoids conflicting configurations when acting through one of the configurators, in dangerous situations.

The types of lock are:

- Unlocked: both configurators have writing permission.
- Temporarily Locked: only the configurator that locked the device has writing permission. However, after the equipment is restarted, the status reverts to Unlocked.
- Permanently Locked: only the configurator that locked the device has writing permission and this state remains even after the device is restarted.
- All locked: no configurator has writing permission until the device is unlocked by the same configurator that locked it.

ATTENTION

The use of this function should only be used on special occasions, where the guarantee of writing the parameter is critical and fast. Afterwards, the configurator must return the equipment to unlocked mode.

MAINTENANCE

General

TT400 WirelessHART™ is extensively tested and inspected before delivery to the end user.

All maintenance services must be carried out by a qualified person and the replacement of components (supplied by Smar) must only be carried out by qualified personnel.

Diagnostics with the Transmitter

Symptom: *WITHOUT COMMUNICATION*

Possible causes:

- ✓ Terminal Connection
 - Check the configurator interface connection.
 - Check if the interface is compatible with the HART protocol.
- ✓ Electronic Circuit Fault
 - Check if the fault is in the transmitter circuit or in the interface, using sets spares.
- ✓ Transmitter Address
 - Check if the address of the transmitter is compatible with the expected configurator. The communication address default is 1.

Equipment does not connect to the *WirelessHART™* network

Possible causes:

- ✓ The equipment is turned off;
- ✓ Network/Gateway manager is turned off;
- ✓ The equipment is far from the Network/Gateway Manager or other equipment connected to it;
- ✓ Safety key (Join Key) and Access key (Network Id) are not configured correctly;
- ✓ The antenna is not connected in the Network/Gateway Manager or in the equipment;
- ✓ There is an Access Control List in the Network/Gateway Manager and the device is not on this list;
- ✓ Maximum number of equipment configured in the Network/Gateway Manager was reached.

Equipment disconnecting and connecting to the network continuously to the *WirelessHART™* network

Possible causes:

- ✓ Low battery or bad contact in the power causing the restart of equipment;
- ✓ The connectivity in relation to neighbors is unstable (mobile obstacles or distance in the limit);

Equipment is within the operating range, but the communication stability is not good

Possible cause:

- ✓ Interference. Move the equipment closer until better stability is achieved.

Symptom: *DISPLAY INDICATING “FAIL RADIO”*

Possible cause:

- ✓ Radio Board
 - Check the integrity of the board and replace it by a spare.

Symptom: *DISPLAY INDICATING “FAIL BATT”*

Possible causes:

- ✓ Battery
 - Check the voltage measured for battery.
- ✓ Electronic Circuit Fault
 - Check the integrity of the main board and replace it with a spare.

Disassembly Procedure

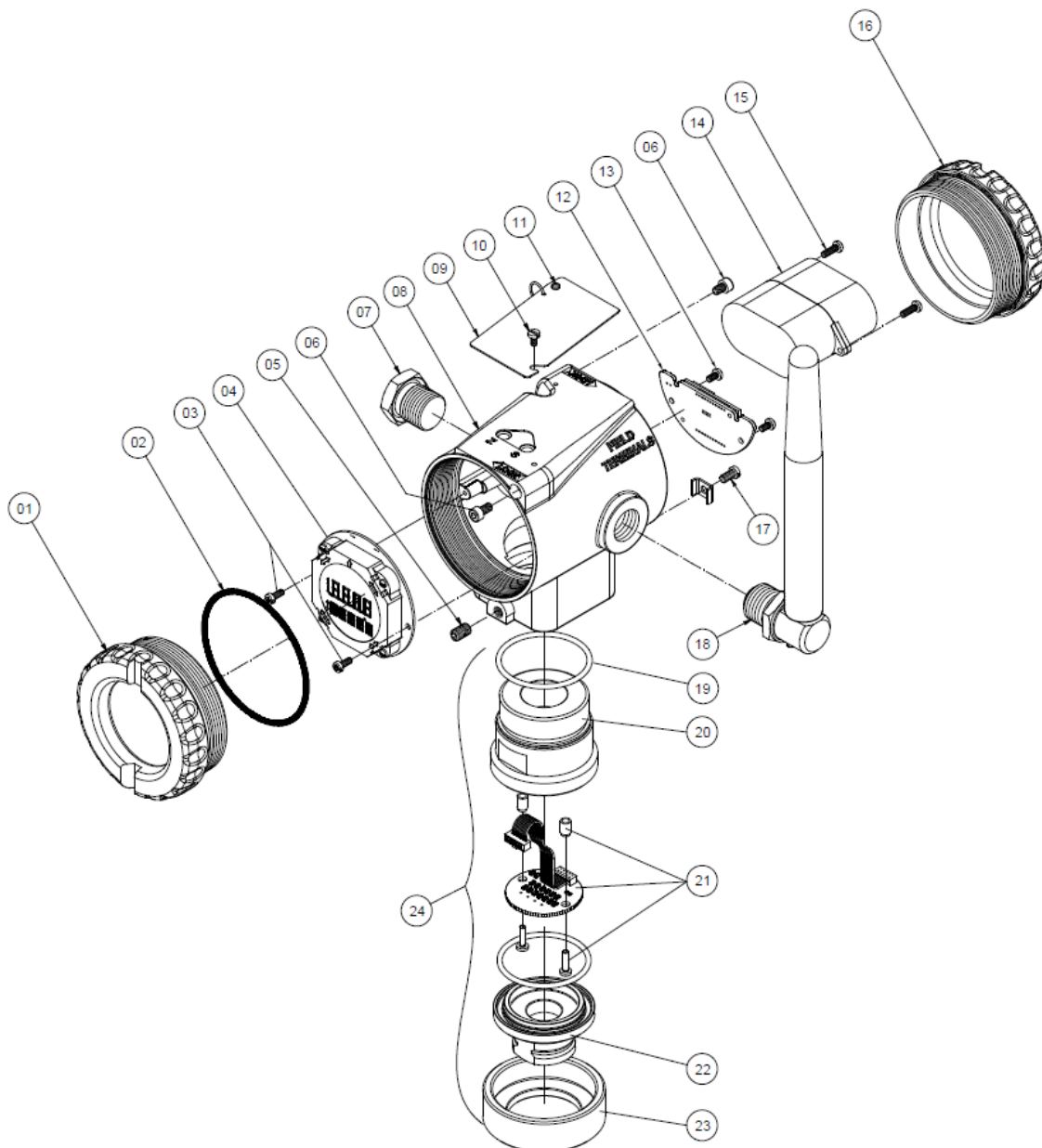


Figure 3.1 – Exploded View

Here is the disassembly procedure of TT400WH. Figure 3.1 indicates the position of the components mentioned in this description.



a) Remove the front and back covers.



b) Remove the main board at the front of the housing, unplug the sensor and radio cables;



c) Disconnect the sensor from the bottom, as in the picture, unscrewing it carefully;

d) Disconnect the Battery Module from the housing and remove it. For further details, refer to Battery Module Replacement Procedure topic.



e) Loosen the antenna with the aid of a wrench. Use the wrench in the way is being shown in the picture, always beneath the antenna.

Table 3.1 – Quick Disassembly Procedure of Transmitter

To avoid equipment damage, do not rotate the housing more than 270 ° from the limit of the thread, without disconnecting the electronic circuit and sensor power supply. Do not forget to release the sensor rotate locking screw. See Figure 3.2.



Figure 3.2 – Housing Safety Rotate

Sensor

If the sensor is mounted on the transmitter, first disconnect the wires to prevent them from breaking. To access the terminal block, first remove the sensor housing screw (23) and housing (22), removing it carefully.

Antenna

If it is necessary to disassemble the antenna set, it is mandatory to remove the back cover of the equipment to disconnect the antenna cable from the radio board.

WARNING

This procedure is required for the antenna cable is not damaged during its rotation in the disassembly process.

After disconnecting the cable, it must release the antenna set by means of the set screw with the aid of a wrench, turning it counterclockwise.

To avoid equipment damage, do not rotate the antenna below the imaginary line of 180 ° in relation to the base of the equipment. To avoid damage to the equipment, do not rotate the antenna below the imaginary line 180° in relation to the base of the equipment. If there is a need to rotate the antenna, loosen the lower fixing screw and travel just above this line. See Figure 3.3



Figure 3.3 –Antenna Safety Rotate



SPECIAL CONDITION FOR SAFE USE (X)

The plastic antenna housing can be considered a potential source of electrostatic ignition and should not be rubbed or cleaned with a dry cloth.

The plastic antenna housing has a surface resistance greater than 1GΩ and care should be taken to touch it only with insulating equipment and take precautions to continuously drain electrostatic charges.

Electrical Circuits

To remove the main board (4), it must remove the front cover (1), by turning it counterclockwise, and its fixation screws (3). Then remove the connections of the other boards, making sure to leave the On/Off terminal (Figure 1.4) in the OFF position before starting.

To remove the radio board (12) and the battery module (14), it must remove the back cover (16), by turning it counterclockwise, and you must also have completed the main board removal process (4), described above. With the removal of the screws (13), the radio board can be removed from the housing. To remove the battery module (14), release their screws (15) and carefully remove it.

To remove the input board (21), the sensor housing must first be disassembled, as explained in the "Sensor" item. The main board (4) must have already been removed in previous steps so that all connections are removed. After disconnecting the boards, loosen the two screws on the input board (21) and carefully remove it.

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.

Reassembly Procedure

This operation type must be done in a safety area and with the transmitter no energized.

Figure 3.1 shows the components position mentioned in this description. The Table 3.2 shows how to mount the transmitter.



- a) First, make mounting the antenna on the side of the housing indicated by "FIELD TERMINALS." Always keep the antenna upright.



- b) Tighten the antenna with a wrench. Use the wrench to how the picture is being displayed, always below the antenna;



- c) Screw radio board on the back of the housing. Pass the antenna cable to the mark indicated in the picture and connect it to the radio board as shown in the picture;

- d) Screw the Battery Module in the housing with the connector facing the main board;



- e) Connect the sensor from the bottom, as shown in the picture, threading it carefully;



- f) Place the main board on the front of the housing and connect the sensor cables and radio to it. After connection, screw the board to the housing;



- g) Finish putting the front and back covers.

Table 3.2 – Quick Assembly Procedure of Transmitter

Considering the complete assembly of the device must be initiated by the antenna set.

To mount the antenna set (18) just screw it on the side of the equipment with the aid of a wrench, as shown in table 3.2 item b. To mount the radio board (12) first connect it to the main board (4) and then attach to the housing through its screws (13). Connect the antenna cable to the radio connector. To assemble the battery module (14) just screw it to the housing, using its screws (15). To assemble the input board (21) first connect it to the main board (4) and then attach to the housing through its screws and spacers. The sensor mounting must be done with the use of the cable gland (to ensure sealing) in the housing (22) and ends with the closing of the thread sensor (23).

To mount the main board (4) make sure that the cables to the radio board (12), input board (21), and

battery are connected. Attach the board to the housing through its screws (3) and be sure to leave the terminal ON/OFF (Figure 1.4) in the off position (OFF). To finish the equipment assembling, screw the front (1) and rear (16) covers clockwise.

Battery Module Replacement Procedure

Follow the steps below to replace the battery module:

- 1 – Remove the front and rear covers of the equipment.
- 2 – Turn off the equipment.



- 3 – Remove the digital board fixing screws.



- 4 – Disconnect the power cable from the digital board.



5 – Remove the battery fixing screws, indicated by the arrows.



6 – Remove the old battery and insert a new Smar battery pack (code 400-1209).

7 – Insert the fixing screws of the new battery.

8 – Connect the battery power cable to the digital board.



9 – Place the digital board fixing screws in the equipment housing.

10 – Turn on the equipment and insert the front and rear covers.

Carefully read the warnings placed on the battery module and on the equipment housing to avoid damage to the environment and people.



ATENÇÃO

Use somente módulo de Baterias substituíveis fornecidas exclusivamente pela Smar (Cod: 400-1209)

CAUTION

Use only replaceable Battery module supplied exclusively by Smar (Cod: 400-1209)

ATENÇÃO WARNING

Perigo de incêndio, explosão e queimadura grave. Não recarregue, desmonte, aqueça acima de 100°C, incinere ou exponha à água. Bateria não recarregável. Pode ser substituída em Área Classificada.

Risk of fire, explosion and severe burn. Do not recharge, disassemble, heat above 100°C, incinerate or expose content to water. Non-rechargeable battery. Can be replaced in Classified Area.

Fabricado em (Manufactured on): mm/aa

Serial

smar

ATENÇÃO WARNING

Perigo de incêndio, explosão e queimadura grave. Não recarregue, desmonte, aqueça acima de 100°C, incinere ou exponha à água. Bateria não recarregável. Pode ser substituída em Área Classificada.

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Fabricado em (Manufactured on): mm/aa

Serial

smar

ATENÇÃO WARNING

Perigo de incêndio, explosão e queimadura grave. Não recarregue, desmonte, aqueça acima de 100°C, incinere ou exponha à água. Bateria não recarregável. Pode ser substituída em Área Classificada.

Risk of fire, explosion and severe burn. Do not recharge, disassemble, heat above 100°C, incinerate or expose content to water. Non-rechargeable battery. Can be replaced in Classified Area.

Fabricado em (Manufactured on): mm/aa

Serial

smar



SPECIAL CONDITION FOR SAFE USE (X)

The plastic battery housing can be considered a potential source of electrostatic ignition and should not be rubbed or cleaned with a dry cloth.

The SMAR battery module can constitute a potential source of electrostatic ignition, it must be handled by a qualified person and only removed from the appropriate packaging at the time of installation.

The SMAR battery module can be replaced in a hazardous area. The module has a surface resistance greater than 1 GΩ and must be installed in wireless equipment by a qualified person.

Care must be maintained even during transport to and from the installation site and should only be removed from the antistatic packaging at the time of installation.

Accessories, Components, and Spare Parts

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

COMPONENTS AND SPARE PARTS LIST FOR TRANSMITTER		
DESCRIPTION	POSITION	CODE
COVER WITH WINDOW	1	400-0822-XX
COVER O'RINGS	2	
MAIN BOARD LOCKING SCREW	3	
MAIN BOARD GLL1392 (WITH DISPLAY AND FIXING SET)	4	400-1243
SENSOR LOCKING SCREW	5	
COVER LOCKING SCREW	6	
HEXAGONAL PLUG M20 x 1,5 316 BR-Exd	7	
HOUSING	8	400-1368-XX
IDENTIFICATION PLATE	9	
IDENTIFICATION PLATE SCREW	10	
RIVET OF IDENTIFICATION PLATE	11	
RADIO BOARD	12	400-1211
RADIO BOARD LOCKING SCREW	13	
BATTERY PACK	14	400-1209
BATTERY PACK LOCKING SCREW	15	
COVER WITHOUT WINDOW	16	
SCREW AND PLATE OF EXTERNAL GROUNDING	17	
ANTENNA	18	400-1214
NECK O'RING	19	
TERMINAL BLOCK HOUSING	20	
ELECTRONIC INPUT BOARD	21	400-1218
SENSOR CONNECTION	22	
NUT ROUND	23	
TT400WH SENSOR SET	24	400-1216

Interchangeability

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

NOTE

The input and main boards are matched at the factory 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 C) 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.

Section 4

TECHNICAL CHARACTERISTICS










Functional Specifications	
Input	See Tables 4.1, 4.2, and 4.3.
Battery	<p>Composed of 2 primary Lithium batteries (Li-SOCl₂) of 3.6 V, totaling 7.2 V of nominal voltage and nominal capacity @3 mA, at 2V 8.5Ah. Not rechargeable.</p> <p>Battery Life:</p> <ul style="list-style-type: none">- Update every 8s: 5.5 years- Burst mode to 8s, @25 °C, network with at least 3 neighbor devices: 6 years <p>Notes:</p> <p>The batteries module used in the transmitters must be provided exclusively by Smar (PACK BATTERY - Code 400-1209) and must be replaced in full when necessary.</p> <p>For specific battery composition details see Appendix B.</p>
Indicator	<p>4 1/2 -digit numerical and 5-character alphanumeric LCD indicator (optional).</p> <p>Function and status icon.</p> <p>Indication on the display of sensor failure or saturation.</p>
Communication Protocol	<p>HART Protocol Version 7, with set of commands TT400 WirelessHART™.</p> <p>A specific review of the HART transmitter must be managed according to the transmitter TT400 WirelessHART™.</p>
Measurement Type	<p>Temperature with one sensor;</p> <p>Differential temperature between two sensors;</p> <p>Temperature with two sensors considering the highest;</p> <p>Temperature with two sensors considering lowest;</p> <p>Average temperature with two sensors;</p> <p>Backup temperature with two sensors;</p> <p>Temperature generated by Callendar Van Dusen equation.</p>
Configuration	Remote configuration with external configurator via HART® Protocol, using DDL/EDDL.
Temperature Limits	<p>Ambient, process and storage: -40 to 85 °C (-40 to 185 °F)</p> <p>Digital Display: -20 to 80 °C (-4 to 176 °F) (Operation)</p> <p>-40 to 85 °C (-40 to 185 °F) (Without damage)</p>

Performance Specifications	
Accuracy	See Tables 4.1, 4.2, and 4.3.
Response Time	2 s.
Sensor Reading	Accuracy of A/D Converter: ±0.02% of the span.
Stabilization Time after the Power up – hot start up	Less than 17 seconds.

Physical Specifications	
Terminal Block	Four terminals for sensor connection.
Mounting	<p>In carbon steel SAE 1020 with electrostatic polyester painting or 316 SST.</p> <p>Accessories (bolts, nuts, washers, and U-clamps) in carbon steel or 316 SST.</p>
Weight	Up to 0.93 Kg (2.067 lb) without any optional part.
Identification Plate	316 SST plate with special plastic label.

Transmitter Specifications	
Sensor Input Treatment	AD with 50 and 60 Hz input noise rejection. Input Sensor trim in two points. Environment Temperature trim.
Primary Variable Treatment	Engineering unit conversion. Cold junction compensation. Input Sensor characterization (Callendar Van Dusen). Measured Type (single, differential, maximum, minimum, average).

Protected Operation Specifications	
Operation counter	Counting of the configuration change operations.
Configuration Protection	Configurations blocked by password. Write Protection via hardware and software.
Certification	See Appendix A.

Human Machine Interface Specifications																													
Status Indication on Display		<table><tr><th>Item</th><th>Icon</th><th>Description</th></tr><tr><td>1</td><td>PV</td><td>Primary Variable</td></tr><tr><td>2</td><td></td><td>Blinking when the transmitter is seeking wireless network</td></tr><tr><td>3</td><td></td><td>Blinking when connecting to the wireless network</td></tr><tr><td>4</td><td>MD</td><td>Transmitter operating on the wireless network</td></tr><tr><td>5</td><td></td><td>Failed to connect to the wireless network</td></tr><tr><td>6</td><td>ACK</td><td>Transmitter in burst mode</td></tr><tr><td>7</td><td>F(t)</td><td>Blinking when sending command in burst mode</td></tr><tr><td>8</td><td>SP</td><td>Lights when an event is sent by the device to the wireless network</td></tr></table>	Item	Icon	Description	1	PV	Primary Variable	2		Blinking when the transmitter is seeking wireless network	3		Blinking when connecting to the wireless network	4	MD	Transmitter operating on the wireless network	5		Failed to connect to the wireless network	6	ACK	Transmitter in burst mode	7	F(t)	Blinking when sending command in burst mode	8	SP	Lights when an event is sent by the device to the wireless network
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	7	F(t)	Blinking when sending command in burst mode																										
8	SP	Lights when an event is sent by the device to the wireless network																											

SENSOR	2, 3, or 4 wires					
	TYPE	RANGE °C	RANGE °F	MINIMUM SPAN °C	* DIGITAL ACCURACY °C	
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	
THERMOCOUPLER	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 4.1 - 2, 3, or 4 wires Sensor Characteristics

*Reading accuracy on the display and accessed by communication.

**Not applicable for the first 20% of 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 4.2 - mV Sensor Characteristics

*Reading accuracy on the display and accessed by communication.

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 4.3 - Ohm Sensor Characteristics

Ordering Code

MODEL TT400	SMART TEMPERATURE TRANSMITTER																
COD.		Communication Protocol															
W		WirelessHART™															
COD.		Security Option															
0		For use in measurement and control															
COD.		Local Indicator (1)															
0		Without Indicator															
1		With Indicator Digital															
COD.		Electrical Connection															
0		1/2 – 14 NPT (5)					A	M20 X 1.5 (5)									
1		3/4 – 14 NPT (with 316 SST adapter for 1/2 - 14 NPT) (6)					B	PG13.5 DIN (2)									
2		3/4 – 14 BPS (with 316 SST adapter for 1/2 - 14 NPT) (2)					Z	User's specification									
3		1/2 – 14 BPS (with 316 SST adapter for 1/2 - 14 NPT) (2)															
COD.		Blanket Plug															
I		316 SST															
C		Carbon Steel (3) (7) (10)															
COD.		Mounting Bracket															
0		Without Bracket					2	316 SST Bracket with 316 SST Accessories									
1		Carbon Steel Bracket with Carbon Steel Accessories					7	Carbon Steel Bracket with 316 SST Accessories									
COD.		Housing Material															
A		Aluminum (default) (IP/TYPE)					B	Aluminum – saline atmospheres (4) (IPW/TYPEX)									
I		316 SST – CF8M (ASTM – A351) (IP/TYPE)					H	Aluminum Copper Free (4) (IPW/TYPEX)									
J		316 SST – saline atmospheres (4) (IPW/TYPEX)															
COD.		Painting															
0		Gray Munsell N 6.5 Polyester (Default)															
8		Without Painting (8)															
9		Safety Blue Epoxy – Electrostatic Painting															
C		Safety Blue Polyester – Electrostatic Painting															
Z		Special Painting															
COD.		Certification Type															
N		Without Certification															
I		Intrinsic Safety (EX i)															
COD.		Certifying Body															
0		Without Certifying Body															
4		ATEX															
9		IECEX															
A		INMETRO (UL BR)															
COD.		Tag Plate (11)															
0		With TAG, when specified					2	User's specification									
1		Blanket															
COD.		Sensor Type															
1		RTD Cu10 – GE					F	Thermocouple type S - NBS									
2		RTD Ni120 – Edison Curve #7					G	Thermocouple type T - NBS									
3		RTD Pt50 – IEC					K	Thermocouple type L – DIN									
4		RTD Pt100 – IEC					P	Thermocouple type U – DIN									
5		RTD Pt500 – IEC					M	22 mV									
6		RTD Pt1000 – IEC					N	100 mV									
7		RTD Pt50 – JIS					O	500 mV									
8		RTD Pt100 – JIS					R	100 Ohm									
9		Thermocouple type B - NBS					S	400 Ohm									
A		Thermocouple type E - NBS					U	2K Ohm									
B		Thermocouple type J - NBS					Z	Other									
C		Thermocouple type K - NBS															
D		Thermocouple type N - NBS															
E		Thermocouple type R - NBS															
COD.		Sensor Connection (9)															
2		2-wires					4	4-wires									
3		3-wires					F	2-wires (2 sensors)									
TT400	-	W	0	1	-	0	C	1	-	A	0	N	0	0	-	4	3

NOTES

- | | |
|---|--|
| <p>(1) Values limited to 4 ½ digits; units limited to 5 characters.</p> <p>(2) Option not certified for use in explosive atmosphere.</p> <p>(3) Only available for electrical connections 1/2".</p> <p>(4) IP66/68W tested for 200h to according with standard NBR IEC 60529.</p> <p>(5) Certification Ex-d for FM / ATEX / IECEx / INMETRO.</p> <p>(6) Certification Ex-d for INMETRO.</p> | <p>(7) Not applicable for saline atmosphere.</p> <p>(8) Not available for aluminum housing.</p> <p>(9) For sensor selection, consult the sensor characteristics tables.</p> <p>(10) Only available for electrical connection ½".</p> <p>(11) Rectangular plate in 316 SST.</p> |
|---|--|

****OPTIONAL HART CONFIGURATION (1)**

TT400		MAIN CODE OF HART TRANSMITTER (CONTINUATION)							
	COD.	Burn-out							
	BD	Start Scale (According NAMUR NE43 specifications) (Default)							
	BU	End Scale (According NAMUR NE43 specifications)							
	COD.	LCD1 Indication							
	Y0	LCD1: Percentage (Default)							
	Y1	LCD1: Current - I (mA)							
	Y2	LCD1: Temperature (Engineering Unit)							
	COD.	LCD2 Indication							
	Y0	LCD2: Percentage (Default)							
	Y1	LCD2: Current (mA)							
	Y2	LCD2: Temperature (Engineering Unit)							
	COD.	PID Availability							
	P0	PID not available							
	COD.	Special Measurement Type (2)							
	F3	Callendar Van Dusen							
	F4	Special Sensor							
	COD.	Measurement Mode (3)							
T0	Differential								
T1	Backup								
T2	Average								
T3	Maximum								
T4	Minimum								
COD	Special Features								
ZZ	User's specifications								
TT400-W01-0C1-A0N00-43		BD	Y2	Y0	P0	F3	T2	*	TYPICAL MODEL NUMBER

*Leave it blank for item no options.

NOTES	
(1) Fill out with optional codes only if different from default.	
(2) Callendar Van Dusen defines user-specific linearization of resistance temperature sensor.	
(3) When working with two sensors connected to the terminal block.	

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"

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 Nemko AS (NB 0470) and UL International Demko AS (NB 0539).

LVD Directive 2014/35/EU – "Low Voltage"

According to 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"

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 C_i and L_i must be smaller than C_o and L_o 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 (120°) 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 35°C 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).

Battery Pack

Composed of 2 primary Lithium batteries (Li-SOCl₂) of 3.6 V, nominal voltage 7.2 V and nominal capacity @3 mA, at 2V 8.5Ah. For specific battery composition details see Appendix B.

The Battery Pack used in the transmitters must be supplied exclusively by Smar (BATTERY PACK – Code 400-1209) and must be fully replaced when necessary.

The plastic battery housing can be considered a potential source of electrostatic ignition and should not be rubbed or cleaned with a dry cloth.

The SMAR battery pack may constitute a potential source of electrostatic ignition, it must be handled by a qualified person and only removed from the appropriate packaging at the time of installation.

The SMAR battery pack can be replaced in a hazardous area.

The module has a surface resistance greater than 1 GΩ and must be installed in wireless equipment by a qualified person. Care must be maintained even during transport to and from the installation area and should only be removed from the antistatic packaging at the time of installation.

Properly follow the Battery Pack Replacement Procedure instructions in this manual.

Antenna (Wireless)

The plastic antenna housing can be considered a potential source of electrostatic ignition and should not be rubbed or cleaned with a dry cloth.

The plastic antenna housing has a surface resistance greater than 1GΩ and care should be taken to touch it only with insulating equipment and take precautions to continuously drain electrostatic charge.

Hazardous Locations Approvals

IECEX – UL

Intrinsic Safety (ULBR 22.0001X)

Ex ia IIC T6...T4 Ga
 Tamb: -20 °C to +85 °C T4
 Tamb: -20 °C to +60 °C T5
 Tamb: -20 °C to +40 °C T6

HART Communication: $U_i = 5V$ $I_i = 100\mu A$
 Sensor Terminals: $U_o = 5,4V$ $I_o = 27mA$ $P_o = 36,5 mW$ $C_o = *64,89\mu F$ $L_o = *48,8mH$
 * C_o and L_o values were not evaluated in combination in this application.

For the combination of C_o and L_o consider the following parameters:

$U_o = 5,4V$ $I_o = 27 mA$ $P_o = 36,5 mW$ $C_o = 2 \mu F$ $L_o = 7 mH$

Special Condition:

The certificate number is terminated by the letter "X" to indicate that Temperature Transmitter TT400 Wireless Hart version made with aluminum alloy housing, can only be installed in EPL Ga (Zone 0) if during installation the risk of impact or friction between the housing and the iron/steel parts be excluded.

The Essential Health and Safety Requirements are assured by compliance with:

IEC 60079-0:2017 General Requirements

IEC 60079-11:2011 Intrinsic Safety "I"

Drawings 102A2234, 102A2235

ATEX – UL

Intrinsic Safety (UL 22 ATEX 2670X)

Ex ia IIC T6...T4 Ga
 Tamb: -20 °C to +85 °C T4
 Tamb: -20 °C to +60 °C T5
 Tamb: -20 °C to +40 °C T6

HART Communication: $U_i = 5V$ $I_i = 100\mu A$
 Sensor Terminals: $U_o = 5,4V$ $I_o = 27mA$ $P_o = 36,5 mW$ $C_o = *64,89\mu F$ $L_o = *48,8mH$
 * C_o and L_o values were not evaluated in combination in this application.

For the combination of C_o and L_o consider the following parameters:

$U_o = 5,4V$ $I_o = 27 mA$ $P_o = 36,5 mW$ $C_o = 2 \mu F$ $L_o = 7 mH$

Special Condition:

The certificate number is terminated by the letter "X" to indicate that Temperature Transmitter TT400 Wireless Hart version made with aluminum alloy housing, can only be installed in EPL Ga (Zone 0) if during installation the risk of impact or friction between the housing and the iron/steel parts be excluded.

The Essential Health and Safety Requirements are assured by compliance with:

IEC 60079-0:2017 General Requirements

IEC 60079-11:2011 Intrinsic Safety "I"

Drawings 102A2236, 102A2237

INMETRO - UL

Segurança Intrínseca (UL-BR 22.1098X)

Ex ia IIC T6...T4 Ga
 Tamb: -20 °C a +85 °C T4
 Tamb: -20 °C a +60 °C T5
 Tamb: -20 °C a +40 °C T6

HART Communication: $U_i = 5V$ $I_i = 100\mu A$
 Sensor Terminals: $U_o = 5,4V$ $I_o = 27mA$ $P_o = 36,5 mW$ $C_o = *64,89\mu F$ $L_o = *48,8mH$
 *Os valores de C_o e L_o não foram avaliados em combinação nesta aplicação.

Para a combinação de Co e Lo considerar os seguintes parâmetros:

$U_o = 5,4V$ $I_o = 27\text{ mA}$ $P_o = 36,5\text{ mW}$ $C_o = 2\text{ }\mu F$ $L_o = 7\text{ mH}$

Observações:

O número do certificado é finalizado pela letra "X" para indicar que o Transmissor de Temperatura TT400 Wireless Hart equipado com invólucro fabricado em liga de alumínio, somente pode ser instalado em EPL Ga (Zona 0), se durante a instalação for excluído o risco de ocorrer impacto ou fricção entre o invólucro e peças de ferro/aço.

Normas Aplicáveis:

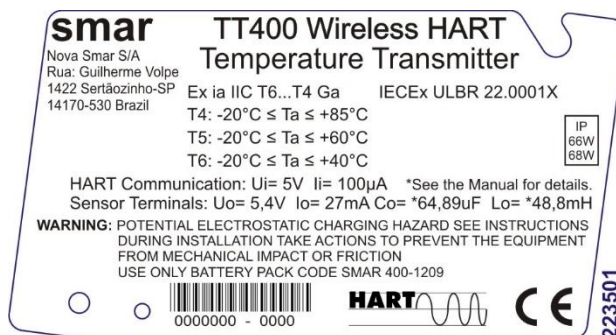
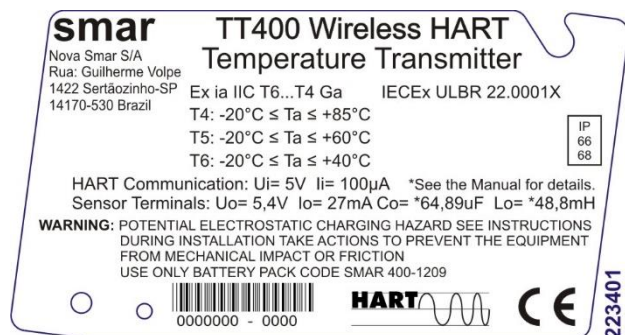
ABNT NBR IEC 60079-0:2020 Atmosferas explosivas - Parte 0: Equipamentos – Requisitos gerais

ABNT NBR IEC 60079-11:2013 Atmosferas explosivas - Parte 11: Proteção de equipamento por segurança intrínseca "i"

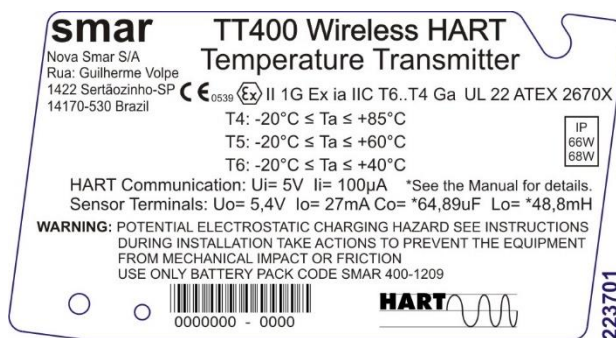
Desenhos 102A2238, 102A2239

Identification Plate

IECEX



ATEX



INMETRO



BATTERY SAFETY DATASHEET

Section 1 – Identification

Manufacturer: Tadiran

Model: TL-5920

US office address: 2001 Marcus Avenue, Suite 125E, Lake Success, NY 11040

Emergency Telephone: 1-800-424-9300

Information Telephone: 1-516-621-4980

Section 2 – Composition

Ingredients	%
Lithium Metal (Li)	<5%
Thionyl Chloride (SOCl ₂)	<47%
Carbon (C)	<6%
Aluminum Chloride (AlCl ₃)	<5%
Lithium Chloride (LiCl)	<2%
Glass	<1%
PVC	<1%
PTFE	<1%
Steel, nickel and inherent components	balance

Section 3 – Hazard Identification

The batteries described herein are hermetically sealed and are not hazardous when used according to the manufacturer's recommendations.

Batteries should not be exposed to short-circuit, recharged, punched, burned, crushed, immersed in water, forced to discharge, or placed in temperatures above the range specified for the product. In these cases, there is a risk of fire and explosion.

Section 4 – First aid

In case of rupture, explosion, or leakage, remove personnel from the contaminated area and ventilate it to release smoke, corrosive gases, and odor. Seek medical help immediately.

Eyes - flush with plenty of water for at least 15 minutes (remove contact lenses if possible) and then seek medical attention.

Skin - Remove contaminated clothing and flush affected skin with plenty of water for 15 minutes and then seek medical attention.

Inhalation - look for an area with fresh air, rest, use artificial respiration, if necessary, and seek medical attention.

Ingestion - rinse your mouth, do NOT induce vomiting, drink lots of water, and then seek medical attention.

Section 5 – Fire fighting

If the batteries are directly involved in fire DO NOT USE: WATER, SAND, CO₂ and DRY CHEMICAL POWDER EXTINGUISHERS.

If the batteries are in a location adjacent to the fire, it can be combated according to the combustible material (paper or plastic, for example). In this case, the use of large quantities of cold water would be an effective way to combat.

To firefighting use equipment and protective clothing that prevent contact with battery solution. The fire must be fought at a safe distance and after evacuation of the area.

Batteries may explode when exposed to: excessive heat (above 150 °C), recharged, discharged below 0V, punched and crushed. Hydrogen Chloride (HCl) and sulfur dioxide (SO₂) can be formed during thermal decomposition of Cl₂.

Section 6 – Leakage

The material contained in the batteries will leak only if exposed to abusive conditions.

On the occasion of leakage: contain the leakage if using protective clothing and ventilate the area well. Cover with Sodium Carbonate (Na₂CO₃) and keep away from water, rain, or snow. Put in a secure container and pour into proper trash, according to local regulatory standards.

Section 7 – Handling and storage

Never attempt to disassemble or modify the batteries as this may result in accident.

HANDLING – do not short-circuit the terminals or expose to temperatures above the range specified for the battery, overload, force discharge or thrown in fire. Do not punch, crush or immerse in water.

STORAGE – preferably store in an environment below 30 °C, dry and ventilated subject to less variation in temperature.

Do not store the batteries near heating equipment, nor expose to direct sunlight for long periods. Elevated temperatures may result in shortened batteries life and degrade their performance.

Do not store batteries in high humidity environment for long periods.

The batteries should not be recharged. High pressures can cause deformities and release of chemicals from the battery.

Ecological Information: When properly used or discarded, the batteries pose no danger to the environment. The batteries do not contain mercury, cadmium, or lead. Do not let internal components exposed to the marine environment.

Disposal: Absolutely not incinerate batteries. Dispose of batteries according to local regulations.

Transportation: Batteries are considered "Dangerous Goods" when transported in or out of equipment.

For additional information, see the manufacturer's website.

Appendix C

smar		SRF – Service Request Form for Temperature Transmitter		Proposal No.: (1)	
Company:		Unit:		Receipt of Remittance:	
COMMERCIAL CONTACT			CUSTOMER CONTACT		
Full name:			Full name:		
Position:			Position:		
Phone:		Extension:		Phone:	
Fax:		Extension:		Fax:	
Email:			Email:		
EQUIPMENT DATA					
Model:		Serial Number:		Firmware Version:	
Technology: () 4-20 mA () HART® () HART® SIS () WIRELESS HART® () ISP () FOUNDATION fieldbus™ () PROFIBUS PA					
PROCESS DATA					
Ambient Temperature (°C)		Work Temperature (°C)		Calibration Range	
Min:	Max:	Min:	Max:	Min:	Max:
Operation Time:			Failure Date:		
Sensor Type:					
Measurement type: () Double Sensor () Average between Sensors () Differential () Backup () Single				Application: (3) () Transmitter () Repeater	
FAILURE DESCRIPTION (Please, describe the behavior of the failure, if it is repetitive, how it exactly happens, and so on.)					
Did device detect the fail? (2) Yes () No ()		What is the final value of the current? (2) _____ (mA)		Message showed in the display: (2)	
MAINTENANCE INFORMATION					
Did you allow the upgrade in the firmware? Yes () No ()			Certification Plate: Will it maintained the certification? Yes () No ()		
Main Board Configuration () Original Factory Configuration () Default Configuration () Special Configuration (Should be informed by the client. Please, use the space below)					
OBSERVATIONS					
SUBMITTER INFORMATION					
Company:					
Submitted by:		Title:		Section:	
Phone:		Extension:		E-mail:	
Date:		Signature:			
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					
NOTES					
(1) This field should be filled out by the Smar.			(3) Required for Wireless HART® devices.		
(2) Required for SIS devices.					

