DENSITY/CONCENTRATION TRANSMITTER

DT302

FOUNDATION

AUG/25 - VERSION 3

smar
Technology Company

DT302

Density/Concentration Transmitter

FOUNDATION

CE · Eletrobras Cepel · FM APPROVED · ATEX · Ex · IECEx · DNV · PC · DEKRA · Nemko

smar
Technology Company

INTRODUCTION

The **DT302** is from the first generation of Fieldbus Foundation devices. It is a transmitter for concentration and density measurements. It is based on a field-proven capacitive sensor that provides reliable operation and high performance. The digital technology used in the **DT302** enables the choice of several types of transfer functions, an easy interface between the field and the control room and several interesting features that considerably reduce the installation, operation and maintenance costs.

The Concentration/Density transmitter **DT302 (Touché)** is a device to measure in continuous mode the concentration and density of liquids, directly in industrial process.

The **DT302** is composed for a probe with two repeater diaphragms into the process fluid. The probe is connected to a capacitive sensor, extern to the process, through the capillaries. A fill fluid transmits the process pressure in the two repeater diaphragms to the differential pressure sensor.

A temperature sensor into the probe and between the two repeater diaphragms makes the automatic compensation of any temperature variation of the process. The factory procedure of the probe and temperature sensor allow that small process temperature variations be fast informed to the transmitter, that using a specific software calculates with precision the value of density in the process.

According to the industrial process, the measured concentration by means **DT302** can be expressed in Density, Relative Density, Brix Degree, Baumé Degree, INPM Degree, Plato Degree, Solid %, etc.

The **DT302** is part of Smar's complete 302 line of Fieldbus Foundation devices.

Some of the advantages of bi-directional digital communications are known from existing smart transmitter protocols: Higher accuracy, multi-variable access, remote configuration and diagnostics, and multi-dropping of several devices on a single pair of wires.

The system controls variable sampling, algorithm execution and communication so as to optimize the usage of the network, not loosing time. Thus, high closed loop performance is achieved. Using Fieldbus technology, with its capability to interconnect several devices, very large control schemes can be constructed. In order too be user friendly the function block concept was introduced

The **DT302**, like the rest of the 302 family, has some Function Blocks built in, like Analog Input Block.

The need for implementation of Fieldbus in small as well as large systems was considered when developing the entire 302 line of Fieldbus Foundation devices.

They have common features and can be configured locally using a magnetic tool, eliminating the need for a configurator or console in many basic applications.

The **DT302** is available as a product on its own, but also replaces the circuit board for the DT301. They use the same sensor board. Refer to the maintenance section of this manual for instructions on upgrading. The **DT302** uses the same hardware and housing for the **DT302**.

The **DT302**, like its predecessor DT301, has some built-in blocks, eliminating the need for a separate control device. The communication requirement is considerably reduced, and that means less dead-time and tighter control is achieved, not to mention the reduction in cost. They allow flexibility in control strategy implementation.

ATTENTION
Get the best results of the **DT302** by carefully reading these instructions.
This product is protected by US patent numbers: **6,234,019; D439,855** and **5,827,963.**

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

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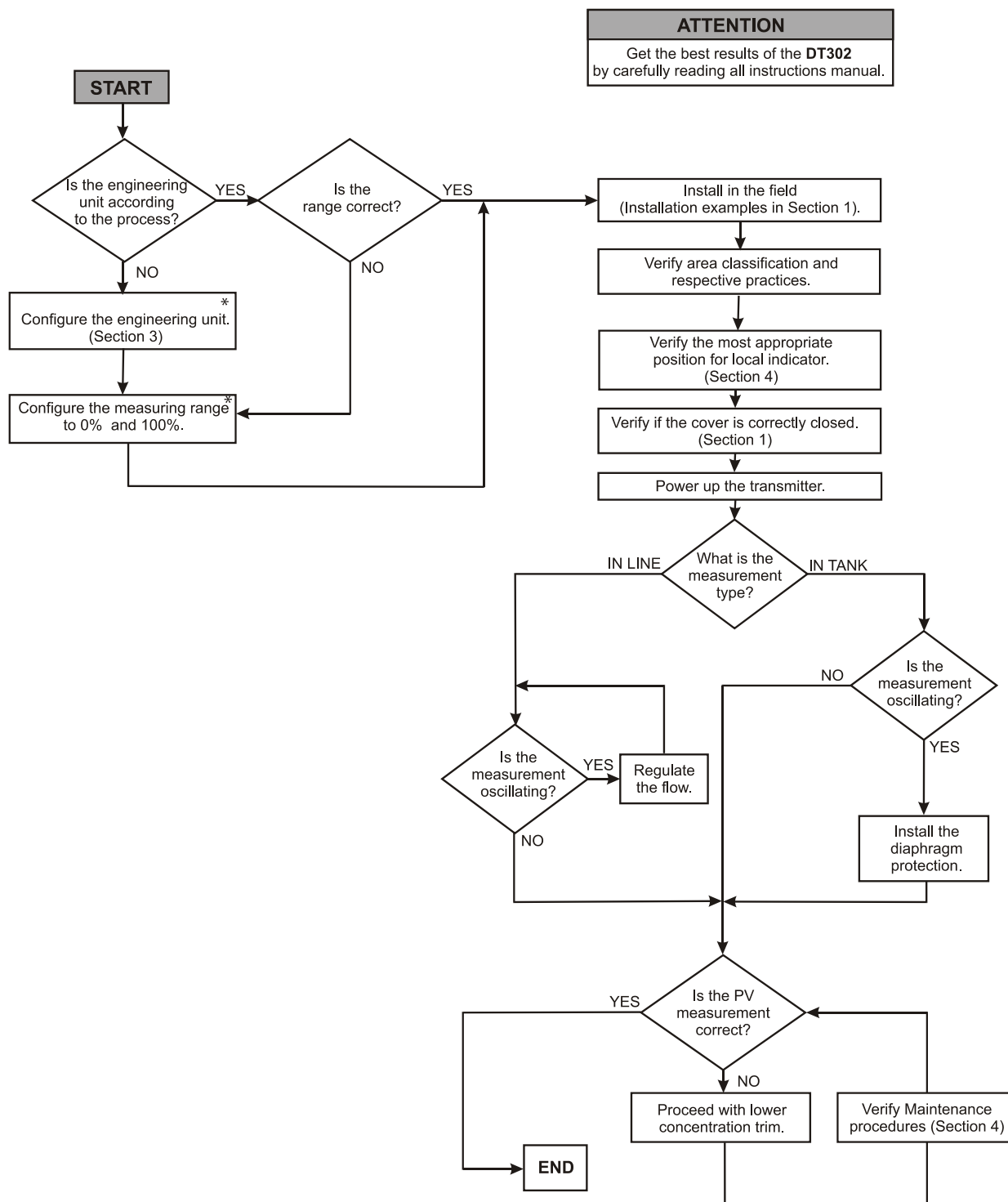
Always respect the instructions provided in the Manual. Smar is not responsible for any losses and/or damages resulting from the inadequate use of its equipments. It is the user's responsibility to know and apply the safety practices in his country.

TABLE OF CONTENTS

Installation Flowchart

ATTENTION
Get the best results of the **DT302** by carefully reading all instructions manual.

START

Is the engineering unit according to the process? —YES→ Is the range correct? —YES→ Install in the field (Installation examples in Section 1).

NO ↓ — Configure the engineering unit. (Section 3) *

Configure the measuring range to 0% and 100%. *

NO ↓ (range)

Verify area classification and respective practices.

Verify the most appropriate position for local indicator. (Section 4)

Verify if the cover is correctly closed. (Section 1)

Power up the transmitter.

What is the measurement type? — IN LINE / IN TANK

IN TANK → Is the measurement oscillating? — NO / YES

YES → Install the diaphragm protection.

Is the measurement oscillating? — YES → Regulate the flow. / NO

Is the PV measurement correct? — YES → **END** / NO → Proceed with lower concentration trim.

Verify Maintenance procedures (Section 4)

* More information in Section 3 from DT302 Operation, Maintenance and Instructions Manual.
** Tip: The Brix of water is 0 (zero)/ or H_2O density = 998.2@20^{0}C.

Section 1

INSTALLATION

The overall accuracy of a density measurement 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.

General

The **DT302** has a built-in temperature sensor to compensate for temperature variations. At the factory, each transmitter is submitted to a temperature cycle process, and the characteristics under different pressures and temperatures are recorded in the transmitter memory. At the field, this feature minimizes the temperature variation effect.

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

The transmitter should be installed in such a way as to avoid, as much as possible, direct exposure to the sun or any source of irradiated heat.

Humidity is fatal for electronic circuits. In areas subjected to high relative humidity, the O-rings for the electronic housing covers must be correctly placed and the covers must be completely closed by tightening them by hand until the O-rings are compressed. Do not use tools to close the covers. Removal of the electronics cover in the field should be reduced to the minimum necessary, as each time it is removed; the circuits are exposed to the humidity.

The electronic circuit is protected by a humidity proof coating, but frequent exposure to humidity may affect the protection provided. It is also important to keep the covers tightened in place. Every time they are removed, the threads are exposed to corrosion, since painting cannot protect these parts.

Although the transmitter is virtually insensitive to vibration, installation close to pumps, turbines or other vibrating equipment should be avoided.

Recommendation in using of DT302

The process fluid must always cover the two repeater diaphragms.

The maximum process fluid velocity over the two repeater diaphragms must be 0.3 m/s, what means a flow of 26 m³/h in a piping of ϕ 6". This information is according to fluids which viscosity is close to that water. For fluids where the viscosity is very different to that water viscosity should be analyzed. This limitation is due to the losing of load between the diaphragms. The temperature range of process fluid must be between -20ºC and 150ºC.

For applications in corrosive fluids, compatible material with the process fluid must be chosen. Materials that are not in contact with the process, but can be in contact with the corrosive atmosphere or process residues, also must be considered.

Verify if a possible leak of fill fluid (unless than 5ml), due an orifice in the diaphragm can contaminate the process. If it is not possible, please, chose a compatible fill fluid.

Verify if the fill fluid does not evaporate in the conditions of limit temperatures and limit pressures of the process.

Models of DT302

DT302I - Industrial Model, for general use.

DT302S- Sanitary Model, for food, pharmaceutical industries and other applications where is necessary sanitary conditions.

DT30XM – Immersion model, for applications where the above models are not possible or tanks with greater depths and allow the probe to be submerged.

The industrial model uses flanged connection according to the standard ANSI B16.5 or DIN 2526.

The sanitary model uses tri-clamp connection, allowing a fast connection to the process. The standard of finishing of the wet surface is 32Ra, highly polished, so that the probe is free of cracks, preventing the accommodation of food residues or bacteria, which could contaminate the process.

Mounting

Both models (**DT302I** and **DT302S**) have two mounting types: top mounting (straight type) and side mounting (curved type).

For **DT302M** only straight type configuration is possible.

The dimensions of both types, industrial and sanitary models, can be seen in the figures 1.1 to 1.4 and **M** model figures 1.5 and 1.6.

The installation can be made in open or pressurized tanks or through an external sampler device from the process.

Some examples are shown in the following figures, 1.7 to 1.21.

Choose a place with free access and free mechanical chock to install the device.

Use a valve in the process connection before the DT302. This simplifies the calibration and maintenance of the equipment.

A - Industrial Model – Straight Type

83
(3,26)

CONEXÃO ELÉTRICA
(ELETRICAL CONNECTION)

84
(3,30)

227 $^{0}_{+15}$
(8,94) + 0,59

Ø88,9
(3,5)

CONEXÃO FLANGEADA 4"
ASME B16.5 CLASSE 150#
300# 600# DN100/PN40

4" FLANGED CONNECTION
ASME B16.5 150# / 300#
600# / DN100 PN40

6
(0,23)

A + 15mm

250
(9,84)

EC

Ø87
(3,42)

EC mm (Inch)	A mm (Inch)
250 (9,84)	797 (31,34)
500 (19,68)	1047 (41,22)
800 (31,49)	1297 (51,06)
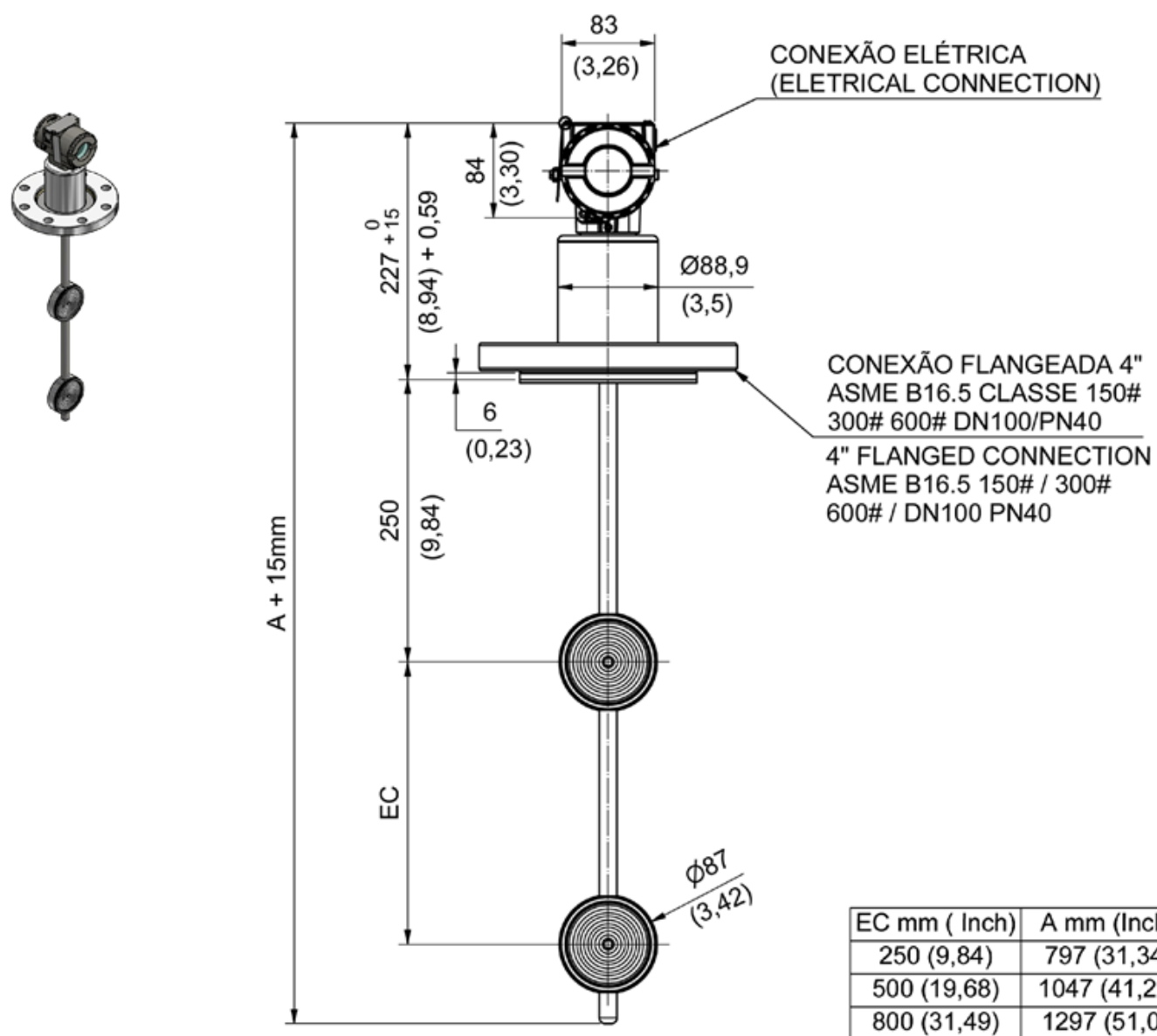
Figure 1.1 – DT302 Dimensional – Straight Industrial Model

B – Industrial Model – Curved Type

CONEXÃO ELÉTRICA
ELETRICAL CONNECTION

CONEXÃO FLANGEADA 4"
ASME B16.5 CLASSE 150#
300# 600# / DN100/PN40

4" FLANGED CONNECTION
ASME B16.5 150# / 300#
600# / DN100 PN40

DIAFRAGMA VOLTADO
P/ LADO DA CARCAÇA

DIAPHRAGM FACING
IS HOUSING SIDE

EC mm (Inch)	A mm (Inch)
250 (9,84)	470 (18,5)
500 (19,68)	720 (28,34)
800 (31,49)	970 (38,19)
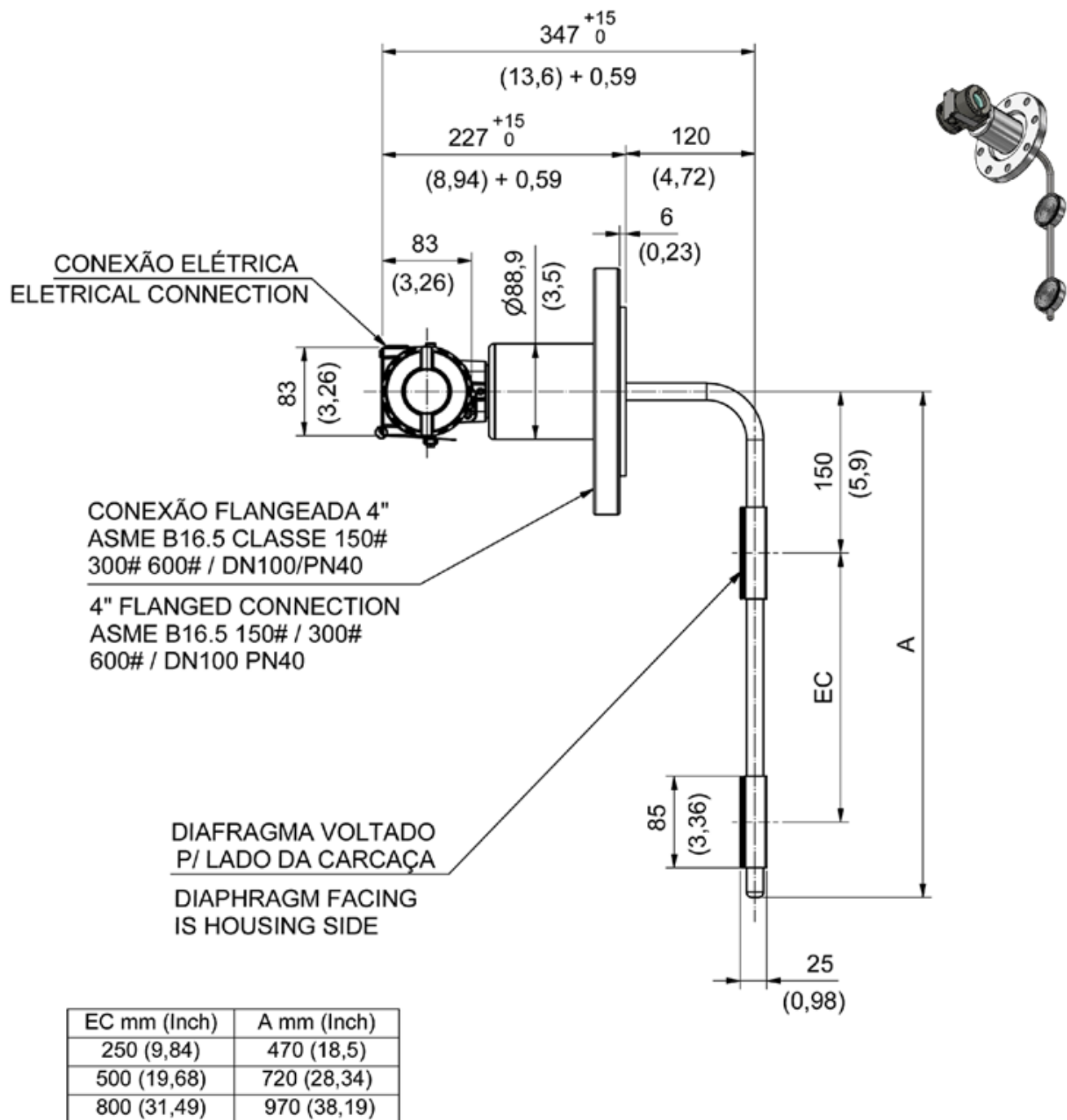
Figure 1.2 – DT302 Dimensional - Curved Industrial Model

C – Sanitary Model - Straight Type

CONEXÃO ELÉTRICA
ELETRICAL CONNECTION

83
(3,26)

84
(3,30)

258
(10,15)

Ø88,9
(3,5)

ABRAÇADEIRA TRICLAMP 4"
TRICLAMP CLAMP 4"

Ø120
(4,72)

250
(9,84)

A +15mm

TANK ADAPTER DT30XS RETO
TANK ADAPTER DT30XS STRAIGHT
101-B-8047
COD:70003252-7

EC

Ø87
(3,42)
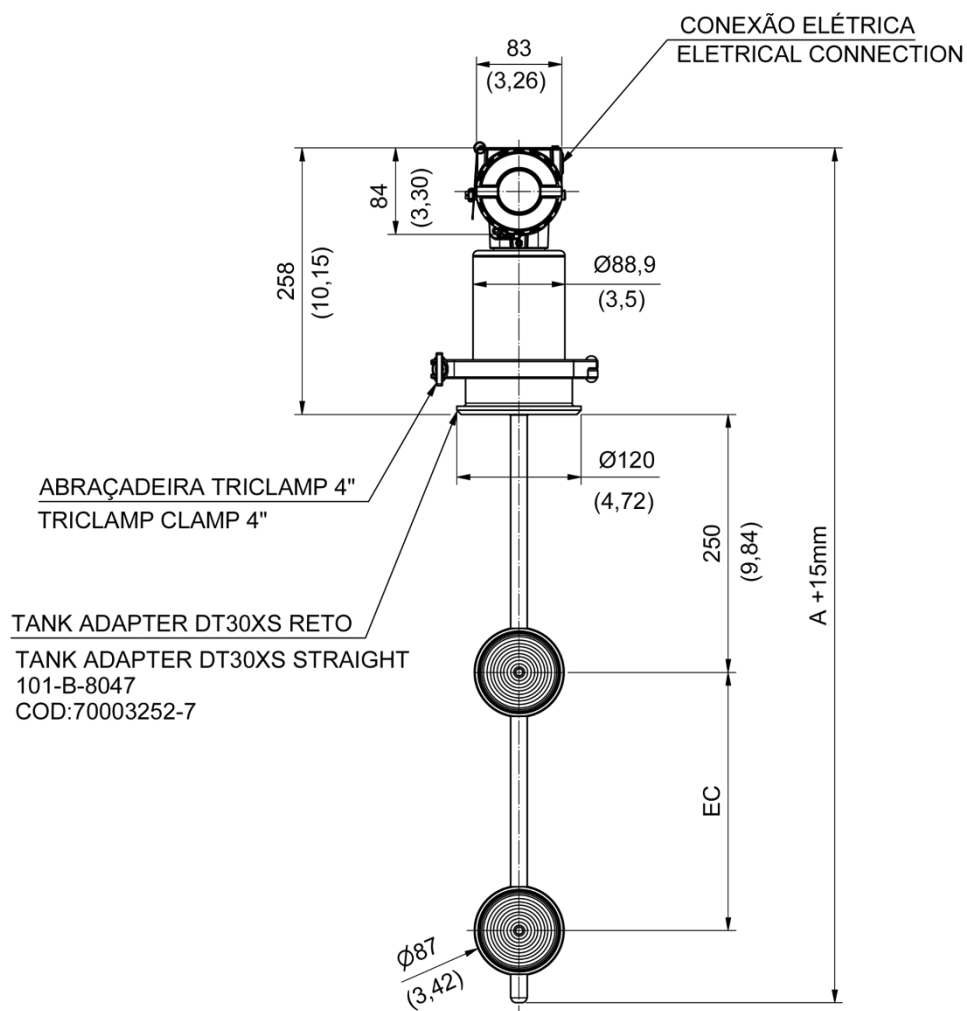
EC mm (Inch)	A mm (Inch)
250 (9,84)	828 (32,59)
500 (19,68)	1078 (42,44)
800 (31,49)	1328 (52,28)

Figure 1.3 – DT302 Dimensional - Straight Sanitary Model

D – Sanitary Model – Curved Type
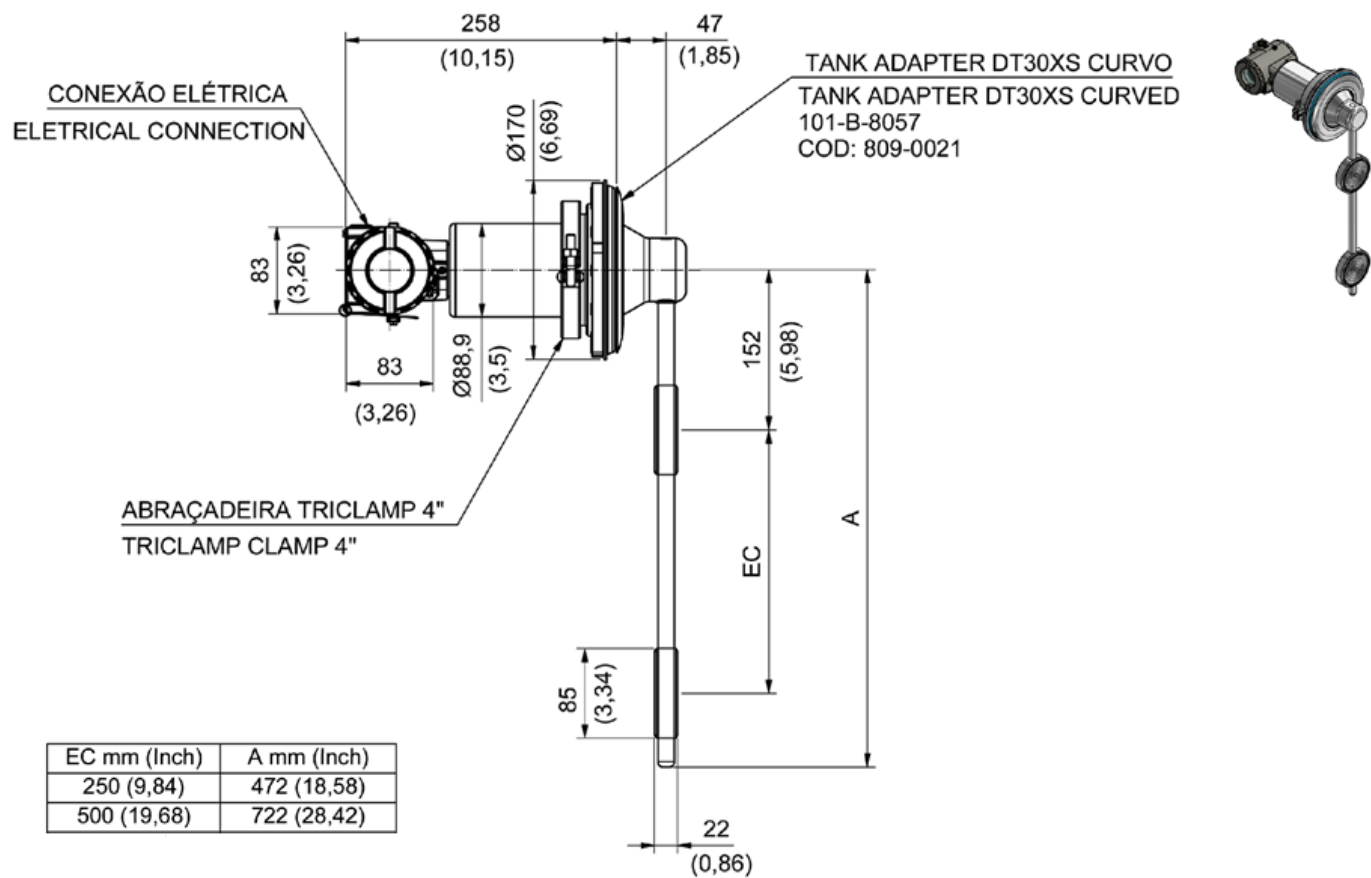
Figure 1.4 – DT302 Dimensional – Curved Sanitary Model

E – DT30XM Model (Stainless Steel Tubular Rod)

DT30XM	TUBO(Tube)	
EC	L Tubo	L (total)
250	1m	1645
250	2m	2645
250	3m	3645
500	1m	1895
500	2m	2895
500	3m	3895
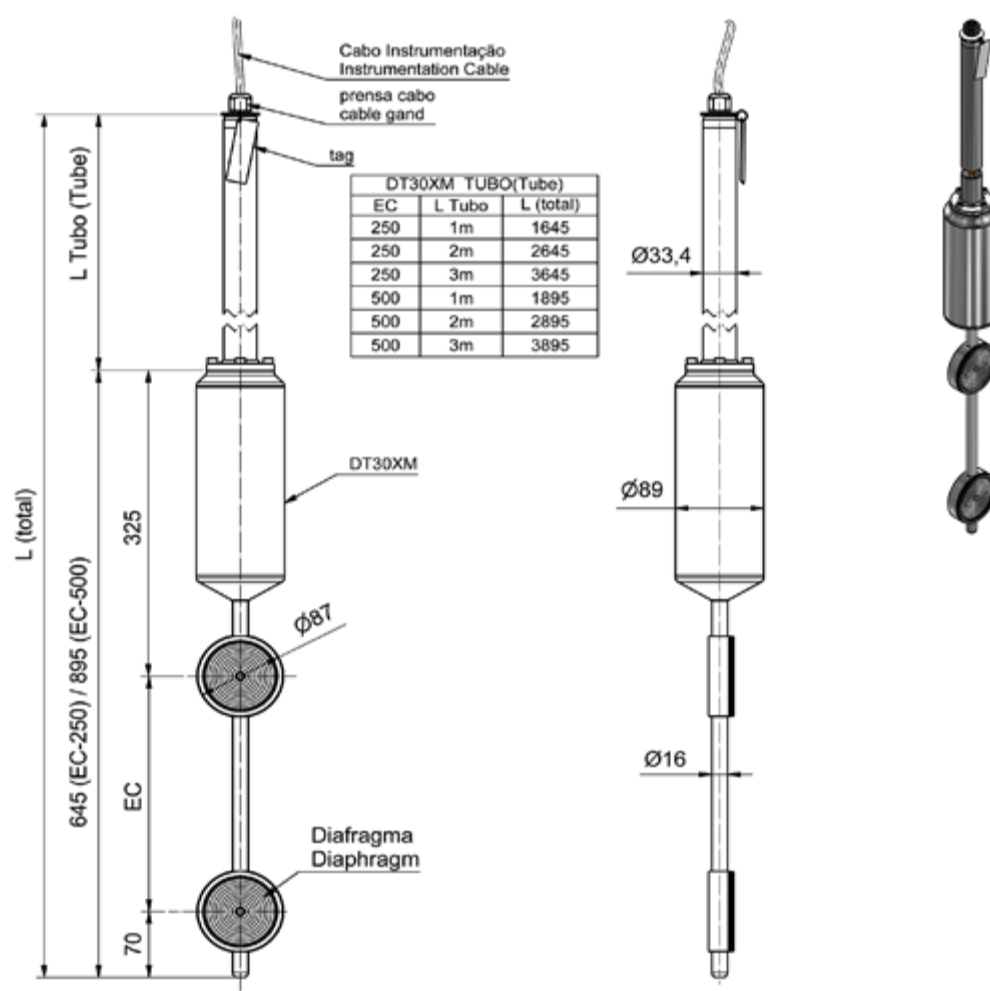
Figure 1.5 – DT302 Dimensional – SST Tubular Rod

F – DT30XM Model (Hose Rod)

DIMENSION DT30XM		
EC	L Mangote	L total
250	4m	4645
250	5m	5645
250	6m	6645
250	7m	7645
250	8m	8645
500	4m	4895
500	5m	5895
500	6m	6895
500	7m	7895
500	8m	8895
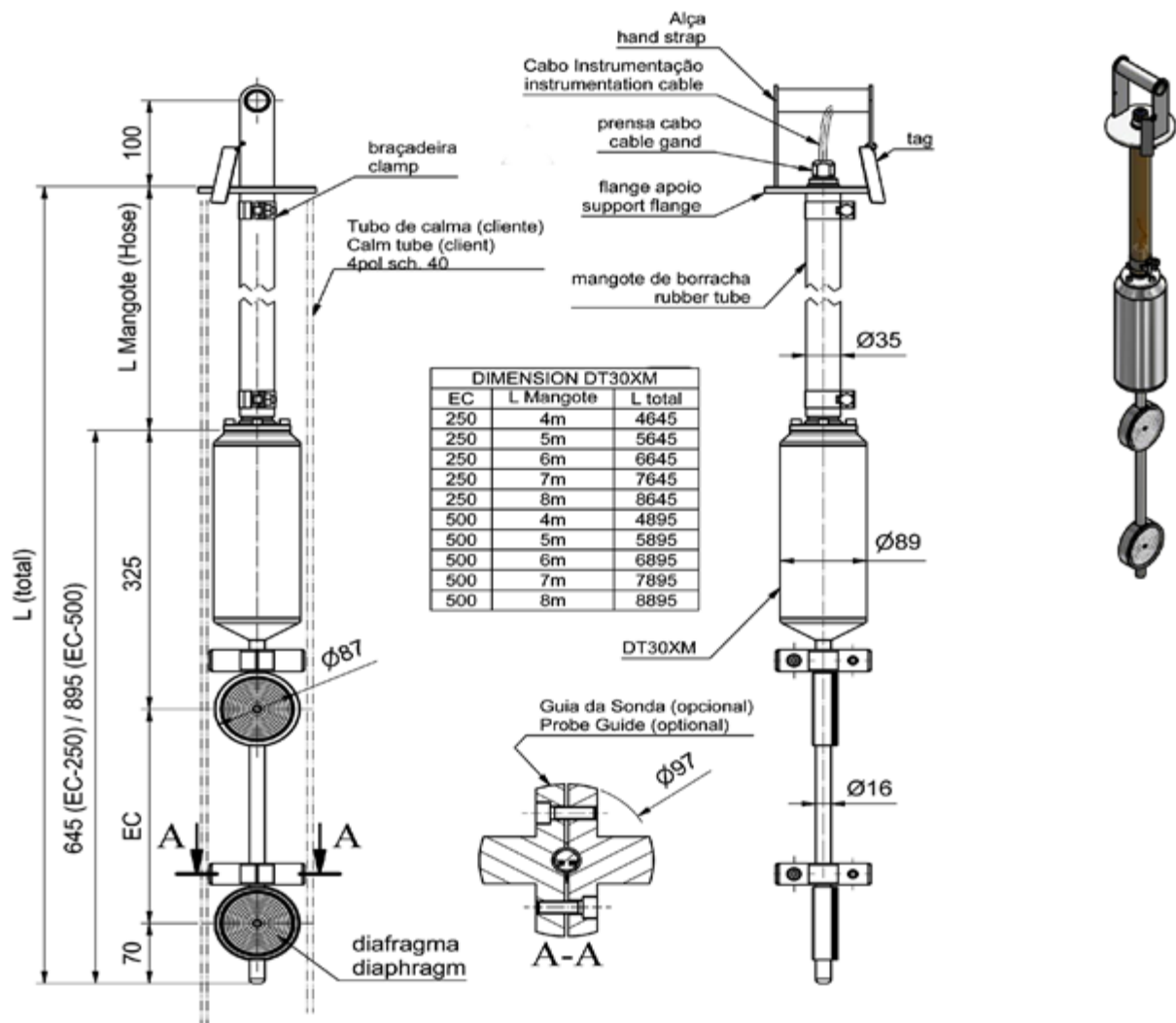
Figure 1.6 – DT302 Dimensional – Hose Rod

A – Typical Installation for Standpipe Tank

DT

PARAFUSOS SEXT. 5/8" X 4"
HEX BOLT 5/8" x 4"

PARAFUSOS SEXT. 5/8" X 1 1/2"
HEX BOLT 5/8" X 1 1/2"

197

51

68

TUBO 4" SCH:40
TUBE 4" SCH:40

500

250

493

835

847

950

POSIÇÃO DE MONTAGEM
DOS DIAFRAGMAS DO DT
DT DIAPHRAGM MOUNTING
POSITION

POSIÇÃO DE MONTAGEM
TUBO NORMALIZADOR
MOUNTING POSITION
TUBE NORMALIZER

45°

JUNTA DE VEDAÇÃO 3MM
SEALING JOINT 3MM

TUBO 12" SCH:20
TUBE 12" SCH:20

60

3

Ø229 FLANGE 4" X 150#

329

450

342

Figure 1.7 – Typical Installation for DT302 (A)

B – Typical Installation for 6¨ Up Flow Tank with Normalizer Tube

MAXIMUM FLOW = 15m³/h

8 Parafusos sext 5/8" UNC x 3"
8 Hex Bolts 5/8" UNC x 3"

ASME B16.5
NPS 4 CLASS 150 RF

300 [11,81]

78 [3,07]

128 [5,05]

110 [4,35]

581 [22,86]

SAIDA [OUTLET]

2" SCH.5S Ø60,3[2.37]

6" SCH. 5S Ø168,3[6.62]

3.1/2" SCH.10S Ø101,6 [4]

Posição dos rasgos do Tubo Normalizador [Holes Position of Normalizer Tube]

ENTRADA [INLET]
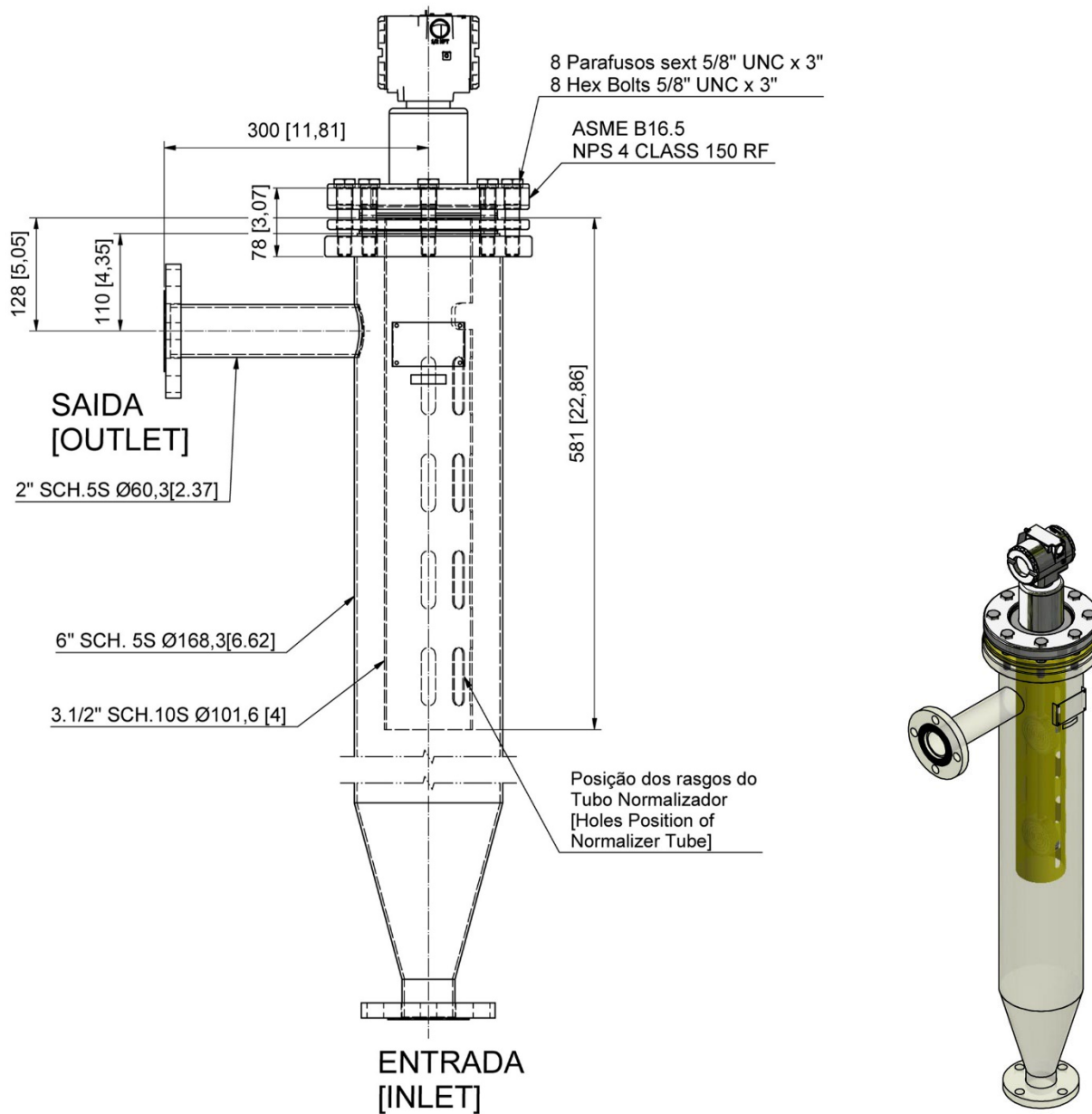
Figure 1.8 – Typical Installation for DT302 (B)

C – Typical Installation for Up Flow Tank of Overflow with Normalizer Tube

DT30X

8 bolts and nuts 5/8UNC

ASME B16.5
NPS 4 CLASS 150RF

453 [17,83]

70 [2,76]

120 [4,72]

330 [13]

102 [4,02]

250 [9,84]

250 [9,84]

250 [9,84]

Normalizer Tube - 581 [22,86]

1361 [53,58]

256 [10,09]

6" SCH. 5S

250 [9,84]

SAÍDA
[OUTLET]

Ø168,3 [Ø6,63]

ASME B16.5
NPS 6 CLASS 150RF

Posição dos Diafragmas
[Diaphragm Position]

Ø3.1/2" SCH. 10S

Ø12" SCH. 5S

Posição dos Orifícios
Tubo Normalizador
[Holes position of
Normalizer Tube]

ASME B16.5
NPS 6 CLASS 150RF

Ø280 [Ø11,02]

ENTRADA
[INLET]

Figure 1.9 – Typical Installation for DT302 (C)

D – Typical Installation for 6" Up flow Tank – Sanitary Model
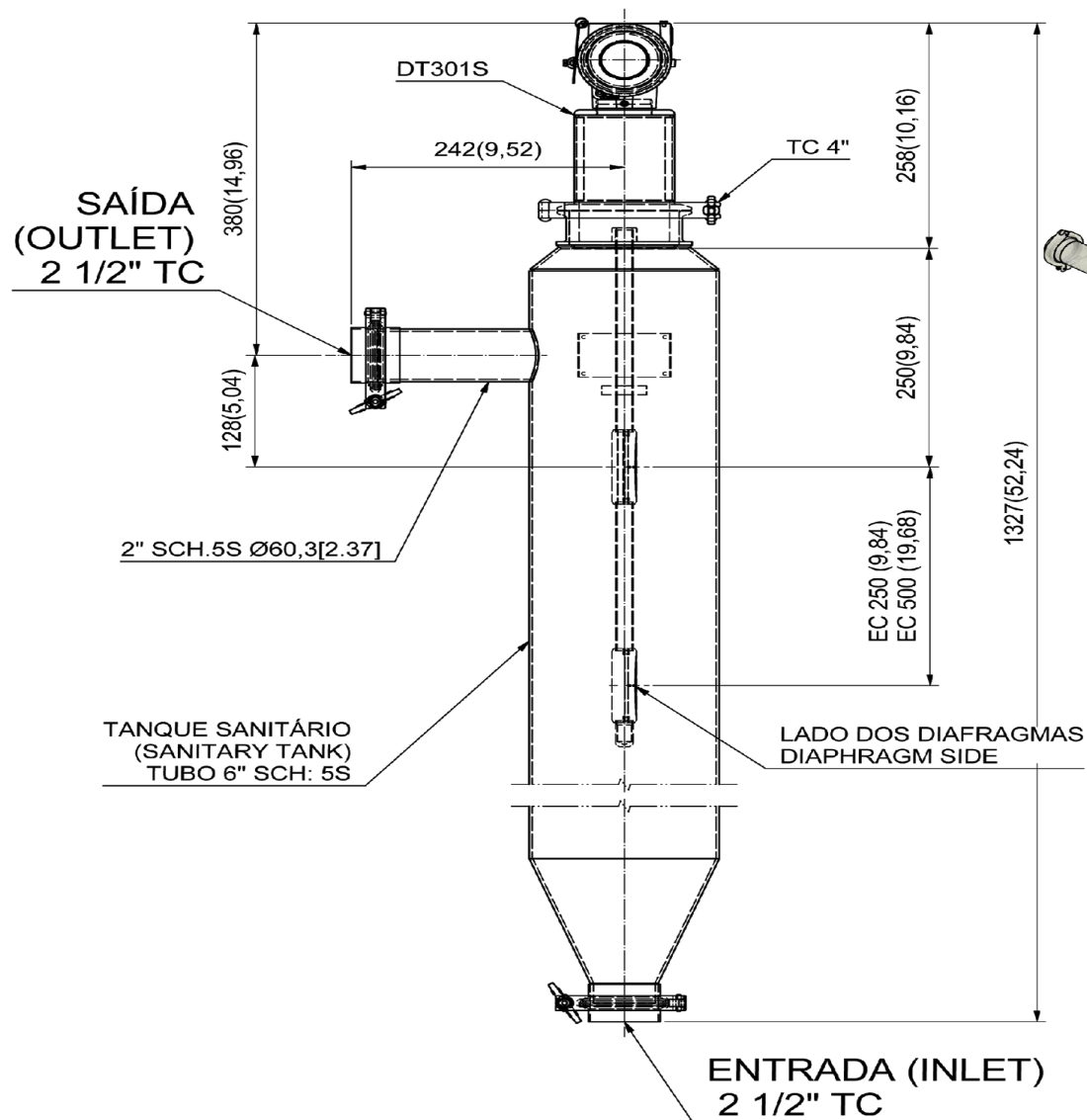
Figure 1.10 – Typical Installation for DT302 (D)

E – Typical Installation for 6¨ Up Flow Tank

MAXIMUM FLOW = 15m³/h

DT30X

ASME B16.5
NPS 2 CLASS 150 RF

300 [11,81]

230 [9,05]

113 [4,47]

8 parafusos e porcas sext 5/8"x 3"
8 Hex Bolts and Nuts 5/8"x 3"

250 [9,84]

SAIDA
[OUTLET]

2" SCH.5S Ø60,3[2.37]

1334 [52,52]

EC 250 (9,84)
EC 500 (19,68)

6" SCH. 5S Ø168,3[6.626]

Lado dos Diafragmas
[Diaphragm Side]

ASME B16.5
NPS 2 CLASS 150 RF

ENTRADA
[INLET]
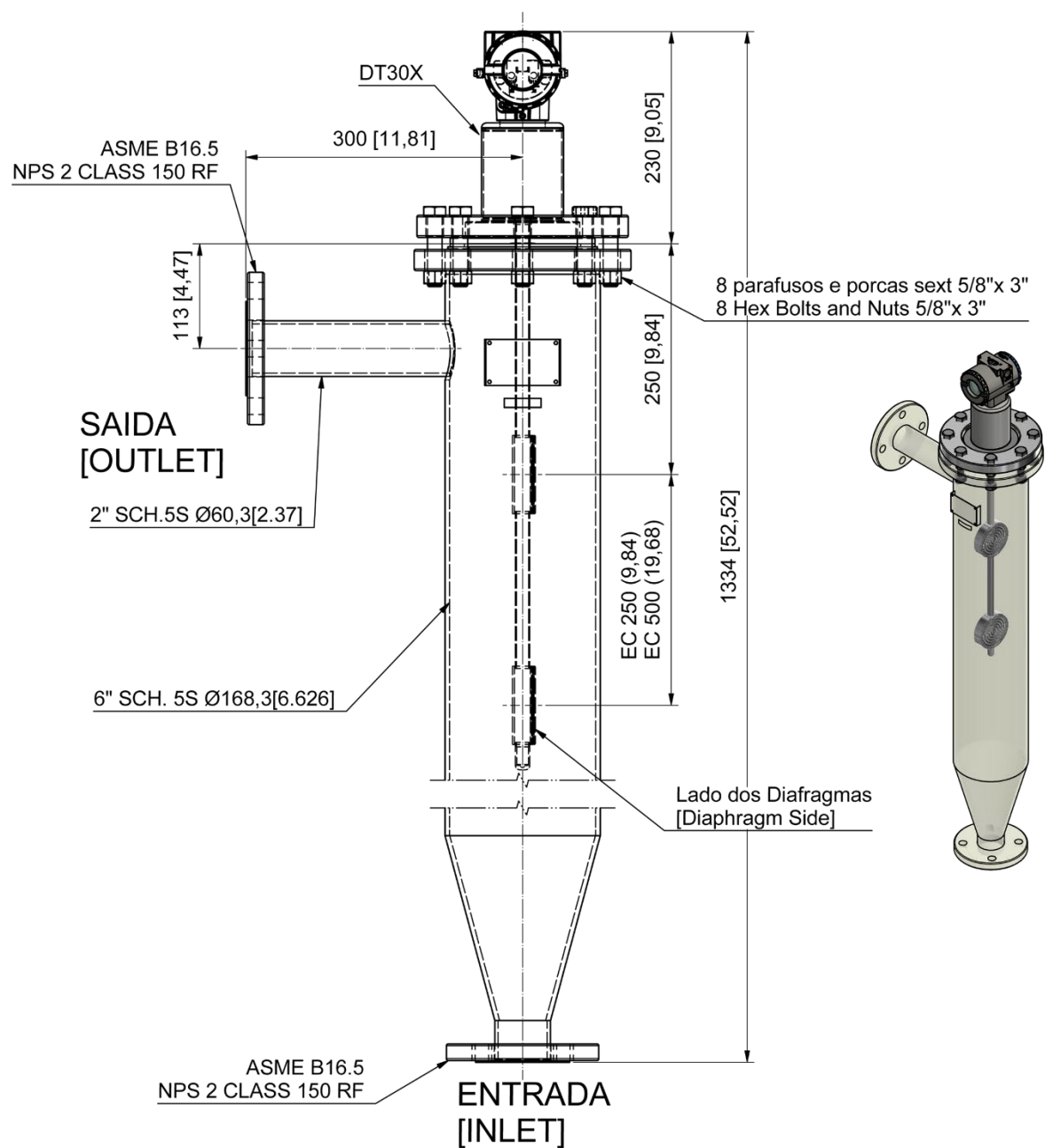
Figure 1.11 – Typical Installation for DT302 (E)

F – Typical Installation for 8¨ Up Flow Tank

MAXIMUM FLOW = 27m^3/h

Figure 1.12 – Typical Installation for DT302 (F)
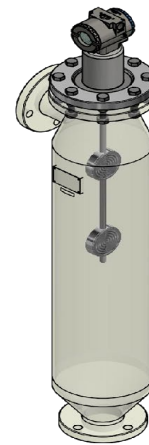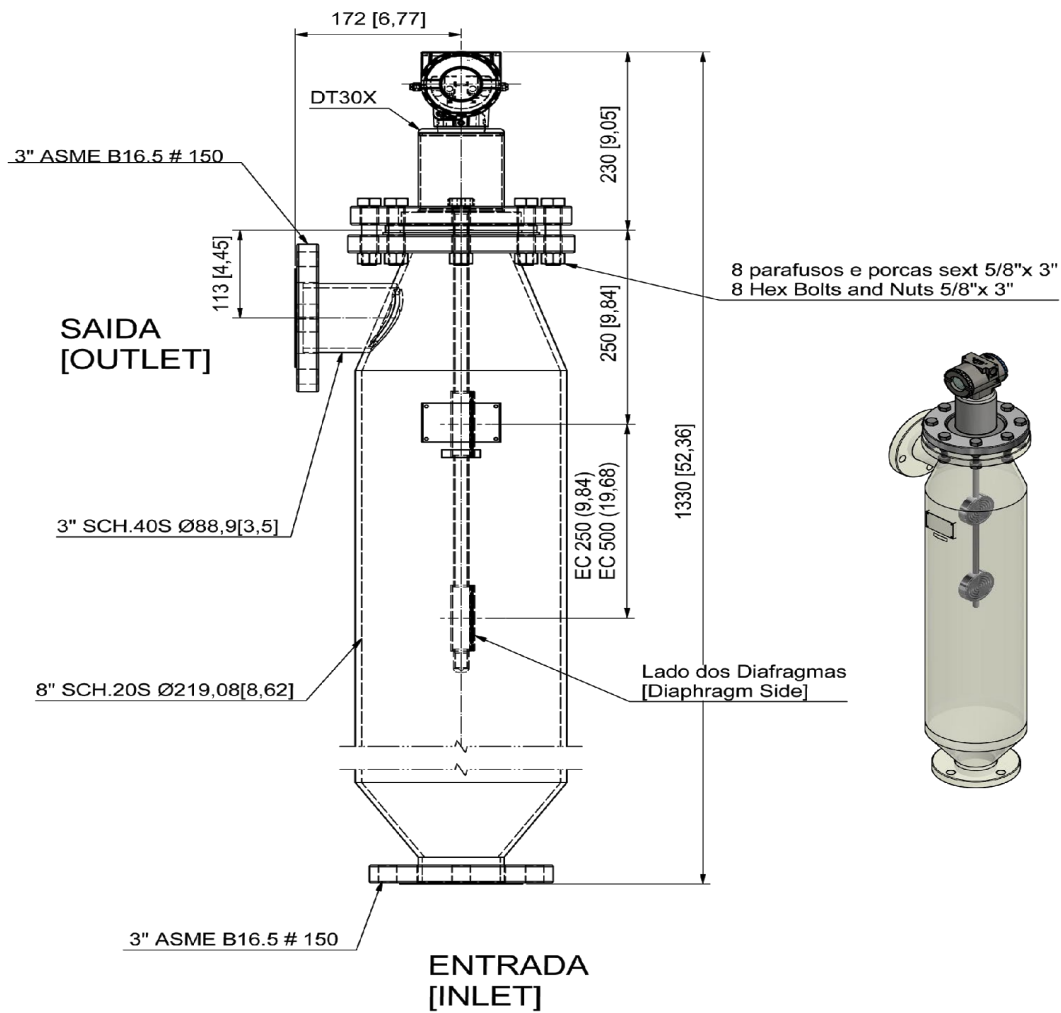
G - Typical Installation for 8¨ Up Flow Rubberized Tank

MAXIMUM FLOW = 27m^3/h
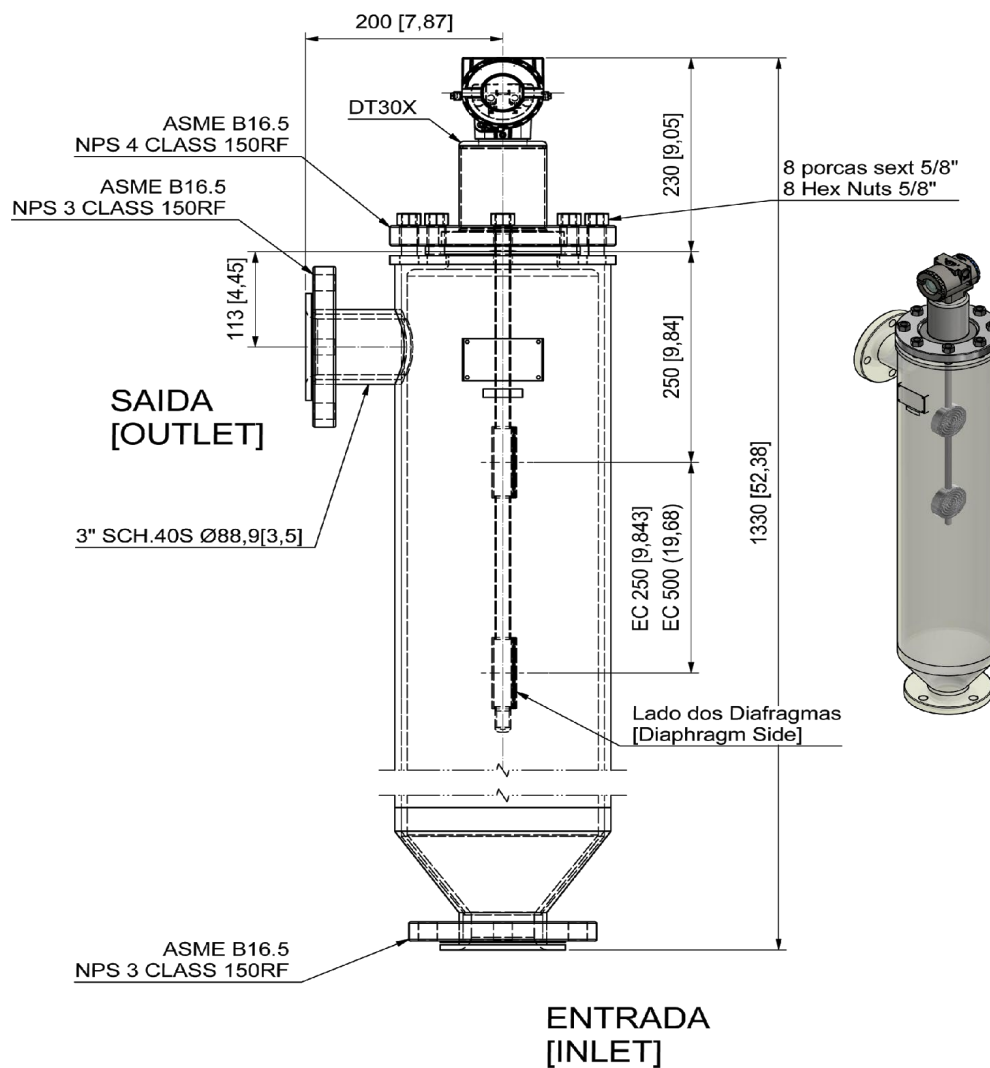
Figure 1.13 – Typical Installation for DT302 (G)

H - Typical Installation for 12¨ Up Flow Tank of Overflow

MAXIMUM FLOW = 65m³/h

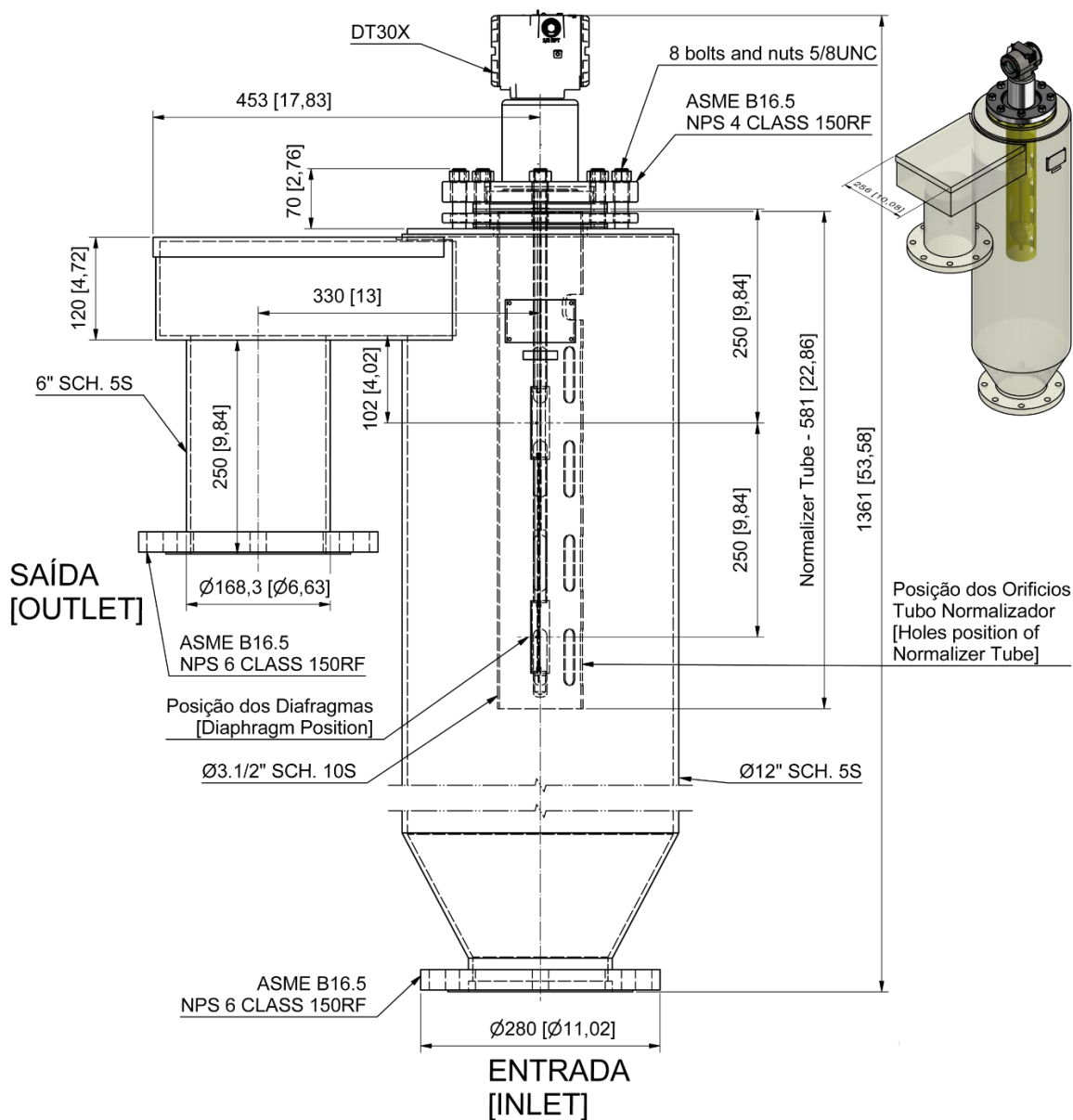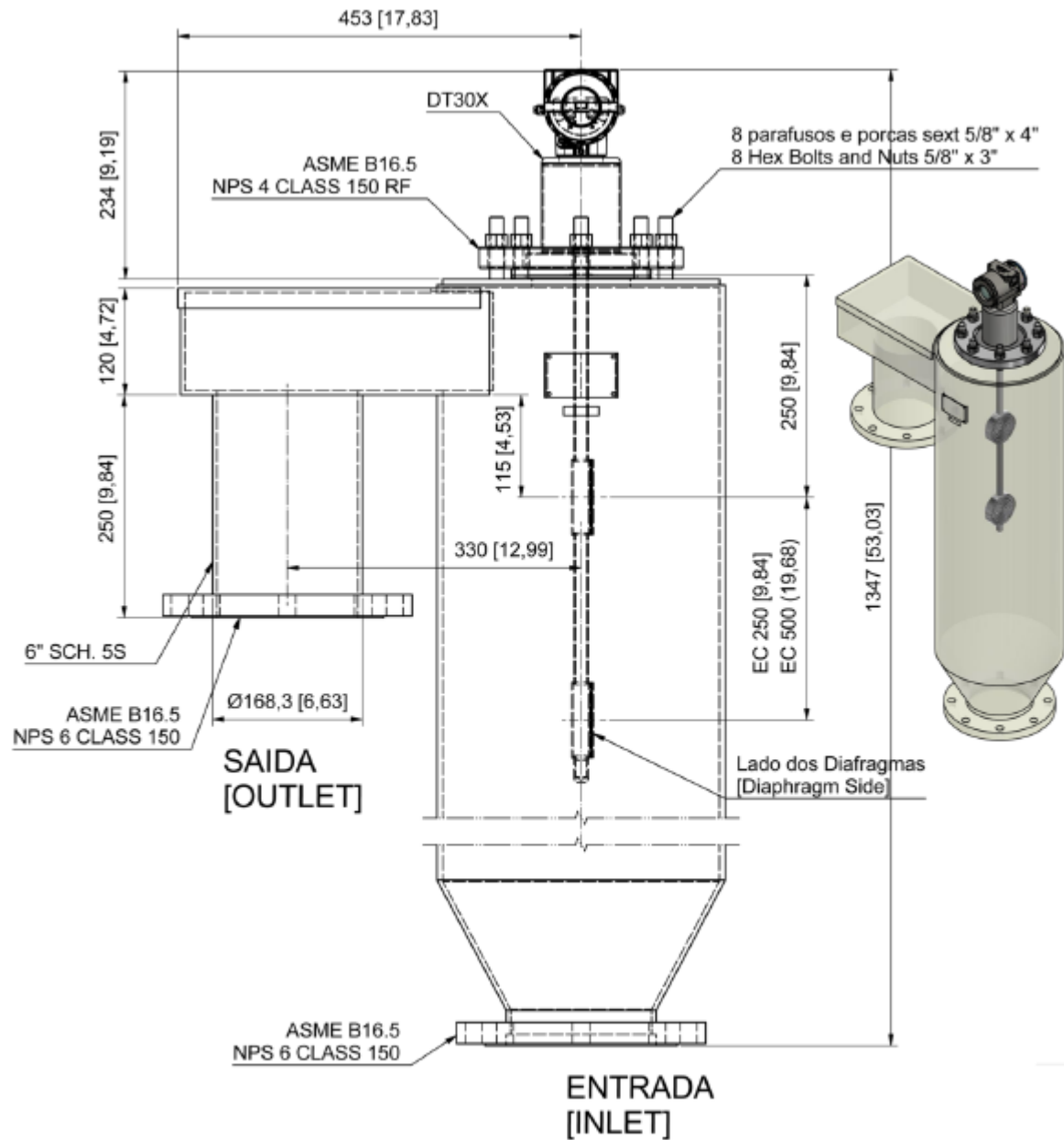*Figure 1.14 – Typical Installation for DT302 (H)*

I - Typical Installation for 12¨ Up Flow Rubberized Split Tank

MAXIMUM FLOW = 65m^3/h

DT30X

ASME B16.5
NPS 4 CLASS 150RF

300 [11,81]

230 [9,05]

250 [9,84]

8 parafusos e porcas sext 5/8" x 3"
8 Hex Bolts and Nuts 5/8" x 3"

SAIDA
[OUTLET]

ASME B16.5
NPS 3 CLASS 150RF

3" SCH.40S Ø88,9[3,5]

EC 250 [9,84]
EC 500 (19,68)

1402 [55,20]

12 parafusos e porcas sext 7/8" x 3"
12 Hex Bolts and Nuts 7/8" x 3"

ASME B16.5
NPS 12 CLASS 150RF

Ø483 [19,00]

Lado dos Diafragmas
[Diaphragm Side]

Ø324 [12,76]

ENTRADA
[INLET]

ASME B16.5
NPS 3 CLASS 150RF

Figure 1.15 – Typical Installation for DT302 (I)

J - Typical Installation in Tank (Industrial Model)

Figure 1.16 – Typical Installation for DT302 (J)

K - Typical Installation in Tank (Sanitary Model)

TRI-CLAMP ⌀4"

DT301

57
(2,24)

150
(5,9)

100
(3,93)

MINIMUM LEVEL

A

1 A

⊥ T

MINIMUM DIAMETER ⌀20"
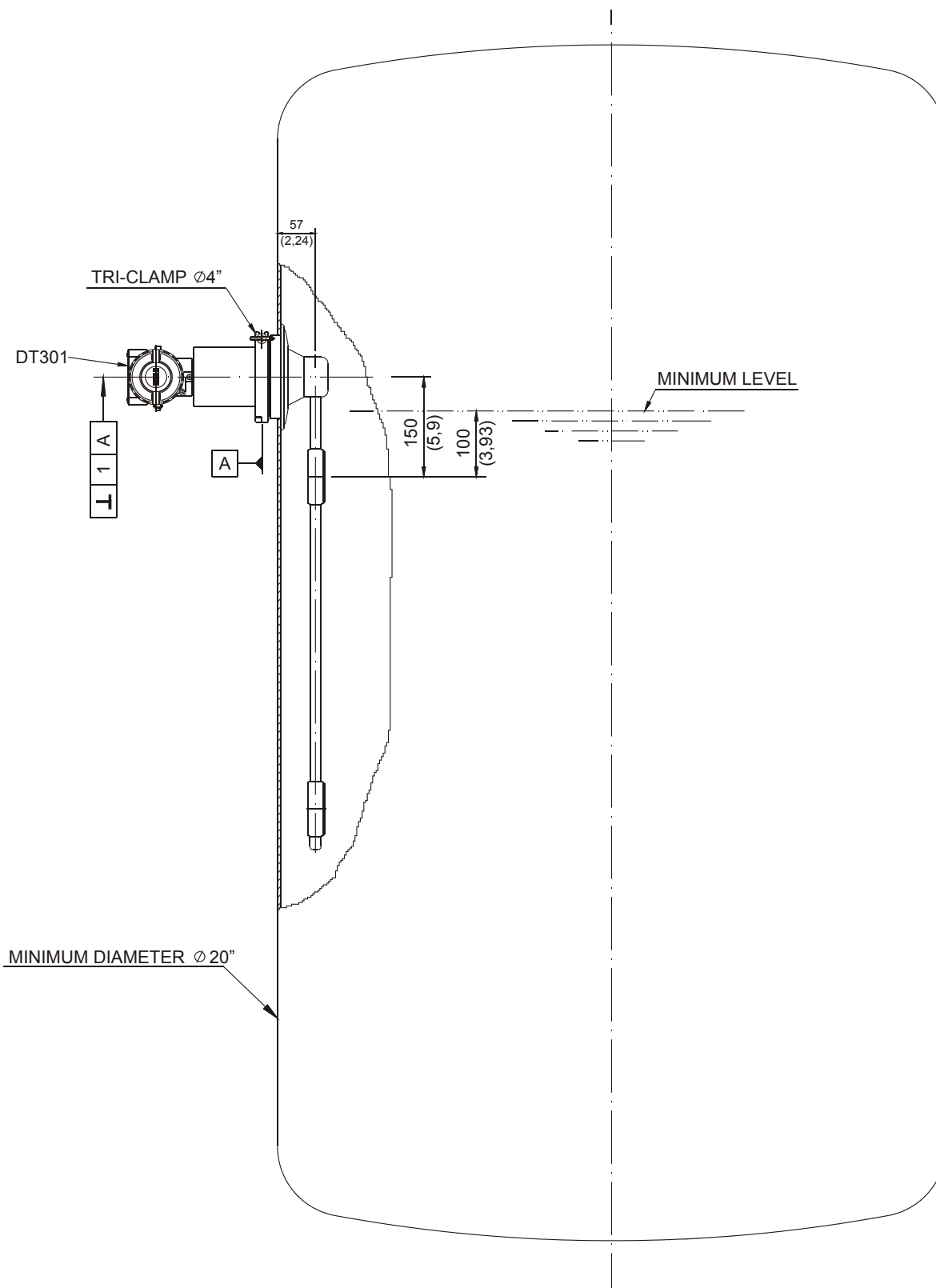
Figure 1.17 – Typical Installation for DT302 (K)

L - Typical Installation in Tank with Diaphragm Protection (Industrial Model)
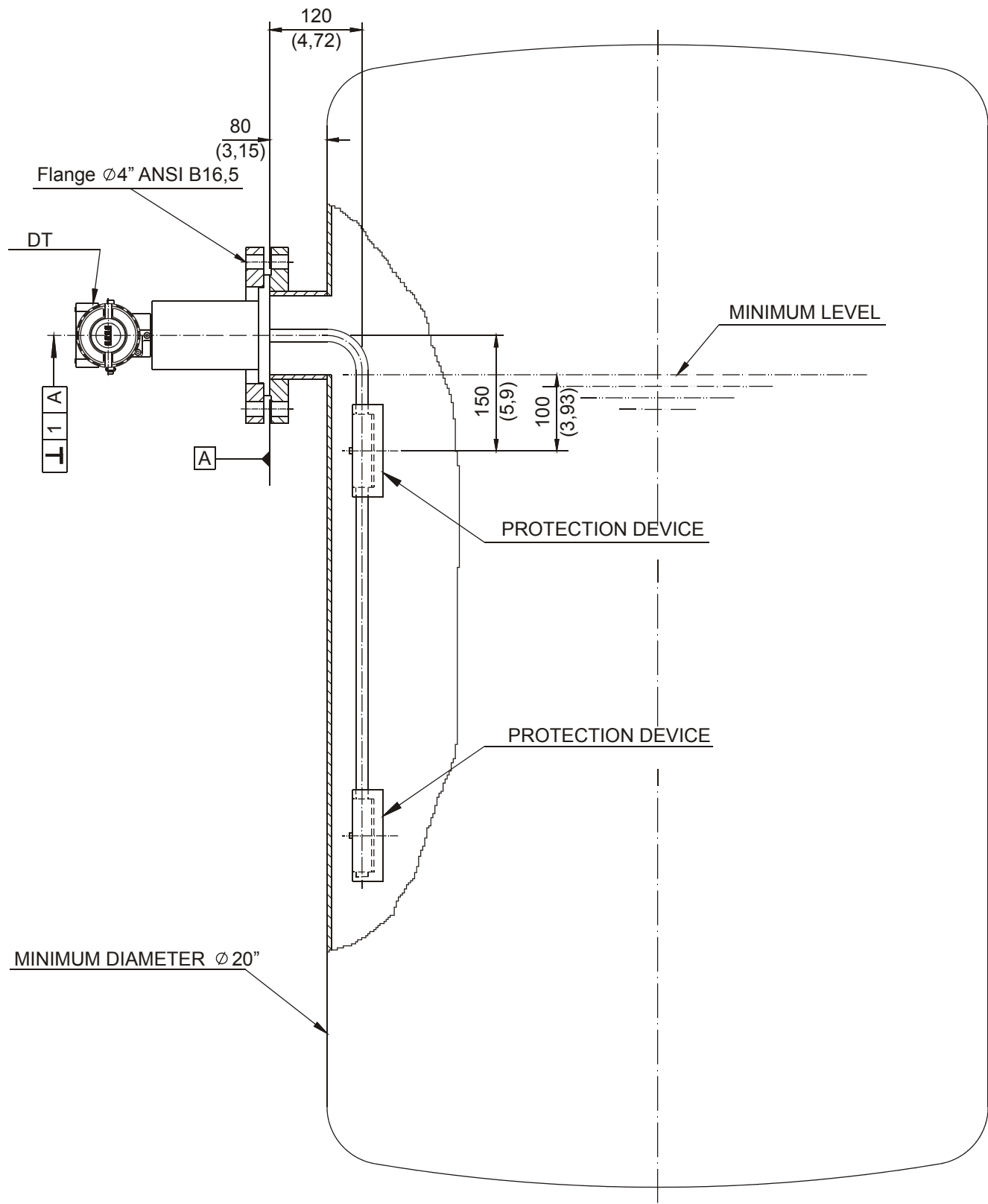
Figure 1.18 – Typical Installation for DT302 (L)

M - Typical Installation for Low Flow Tank with Bubble Breaker (Industrial Model)
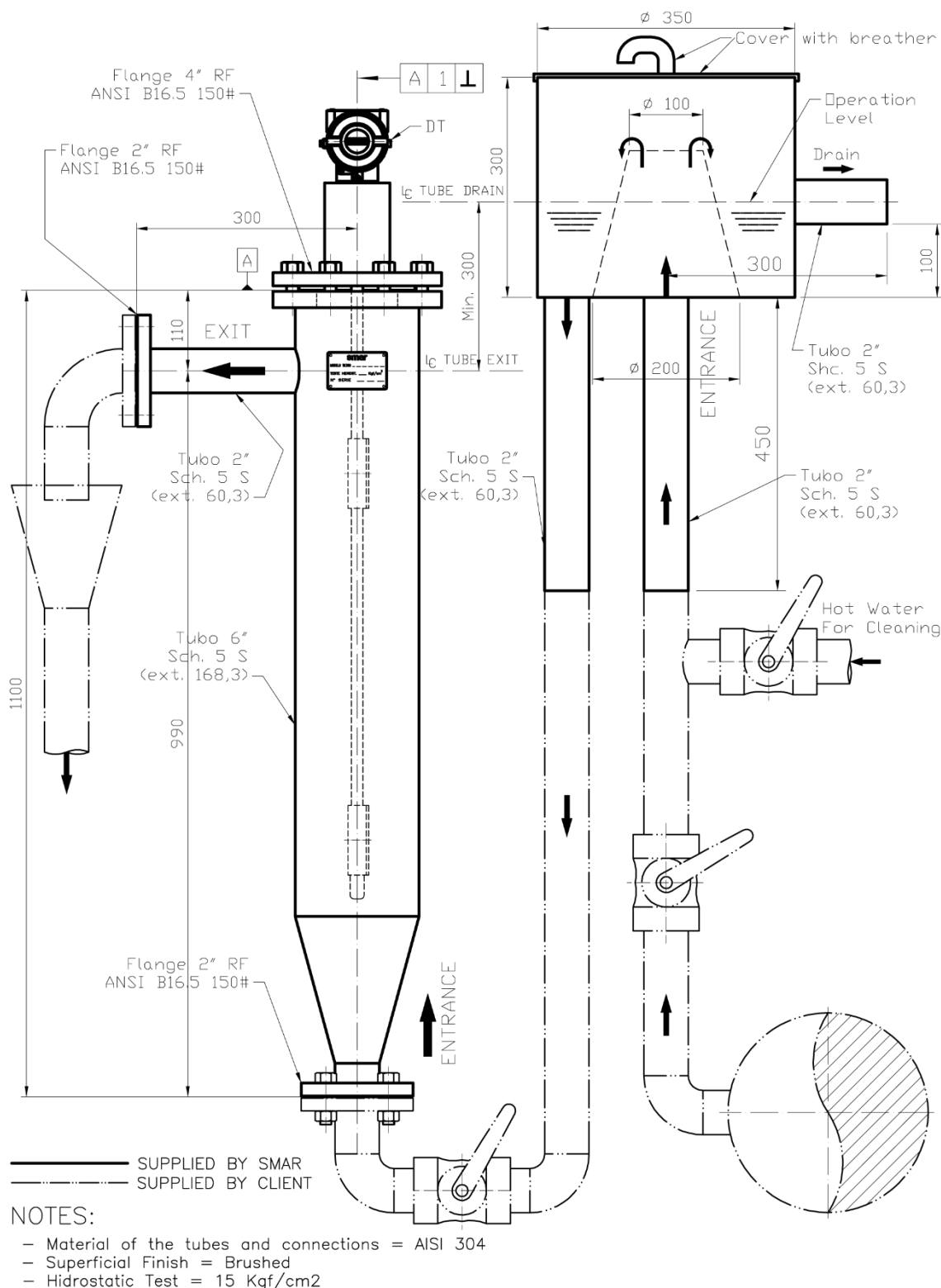
Figure 1.19 – Typical Installation for DT302 (M)

N - Typical Installation in Tank for Level Interface (Industrial Model)
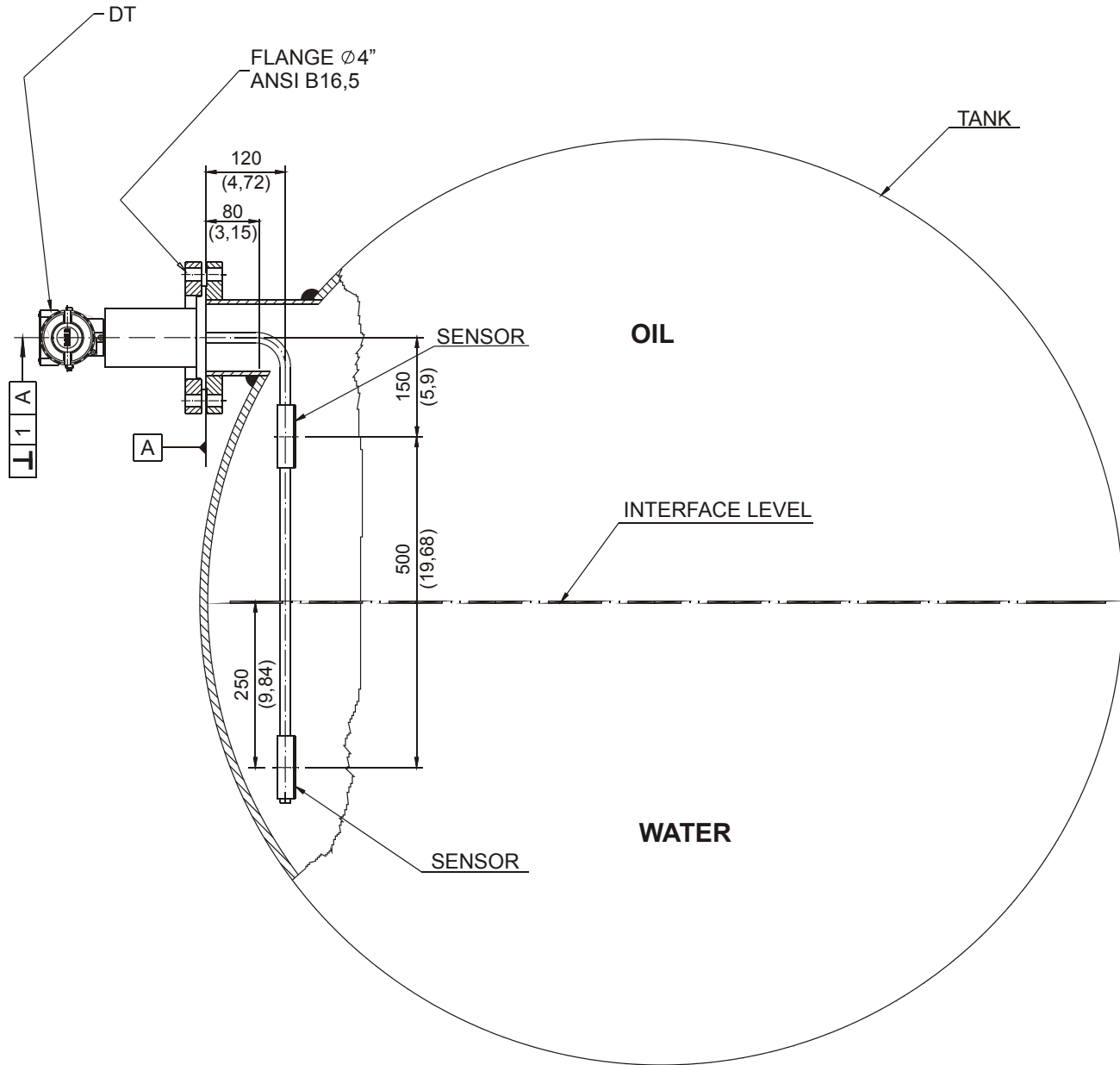
Figure 1.20 – Typical Installation for DT302 (N)

O - Typical Installation in Tank for Level Interface Stand Pipe (Industrial Model)
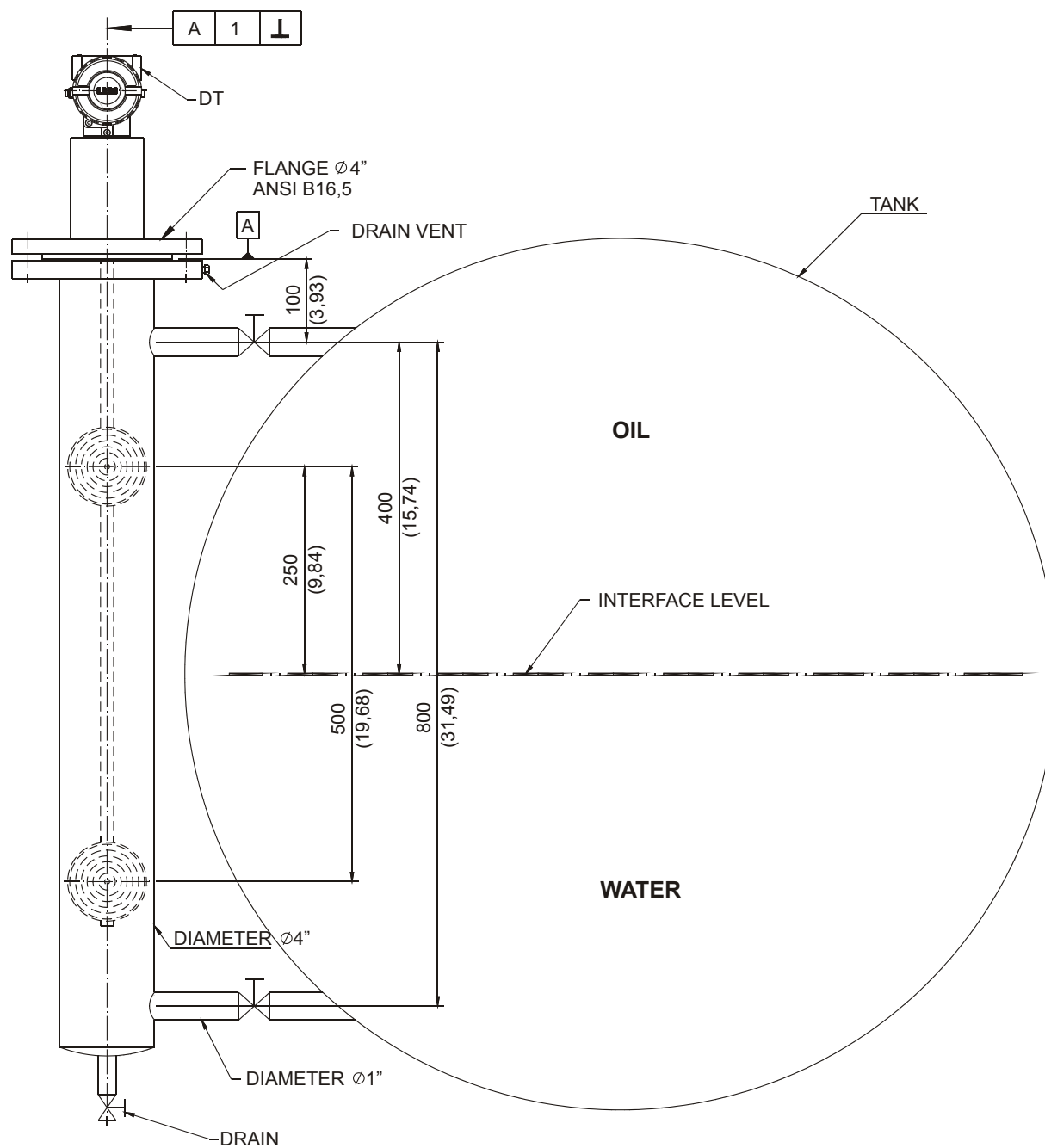
Figure 1.21 – Typical Installation for DT302 (O)

Housing Rotation

The housing can be rotated to get the digital display in better position. To rotate it, releases the Housing Rotation Set Screw. See next figure.

The digital display can also be rotated*. See Figure 4.2 – Four Possible Positions of the Display.*

COVER
LOCKING
SCREW

HOUSING ROTATION
SET SCREW
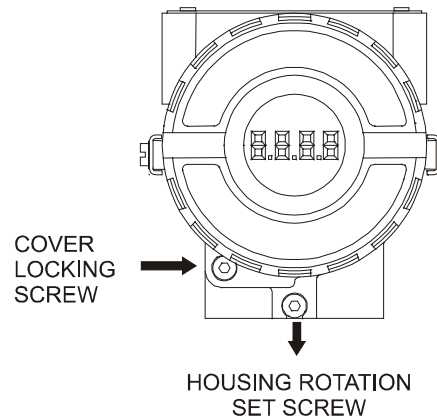
Figure 1.22 - Housing Rotation Set Screw

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

POWER SUPPLY
TERMINALS

GROUND
TERMINALS

COMUNICATIONS
TERMINALS
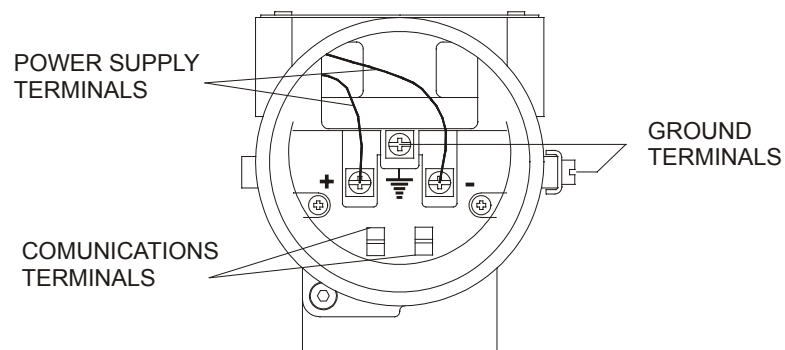
Figure 1.23 - Terminal Block

The **DT302** uses the 31.25 kbit /s voltage mode option for the physical signaling. All other devices on the same bus must use the same signaling. All devices are connected in parallel along the same pair of wires.

Various types of Fieldbus devices may be connected on the same bus.

The **DT302** receives power from the bus via the signal wiring. The power supply may come from a separate unit or from another device such as a controller or DCS.

In hazardous area, the number of devices may be limited by intrinsically safe restrictions.

The **DT302** is protected against reverse polarity, and can withstand ±35 VDC without damage, but it will not operate when in reverse polarity.

It is recommended to use twisted pair cables. The shield must also be grounded at only one end. The ungrounded tip must be carefully insulated.

Bus Topology and Network Configuration

Wiring

Other types of cable may be used, other than for conformance testing. Cables with improved specifications may enable longer trunk length or superior interface immunity. Conversely, cables with inferior specifications may be used subject to length limitations for trunk and spurs plus possible nonconformance to the RFI/EMI susceptibility requirements. For intrinsically safe applications, the inductance/ resistance ratio (L/R) should be less than the limit specified by the local regulatory agency for the particular implementation.

Bus topology and tree topology are supported. Both types have a trunk cable with two terminations. The devices are connected to the trunk via spurs. The spurs may be integrated in the device giving zero spur length. A spur may connect more than one device, depending on the length. Active couplers may be used to extend spur length.

Active repeaters may be used to extend the trunk length. The total cable length, including spurs, between any two devices in the Fieldbus should not exceed 1900m.

The connection of the couplers must be between 15 and 250m.
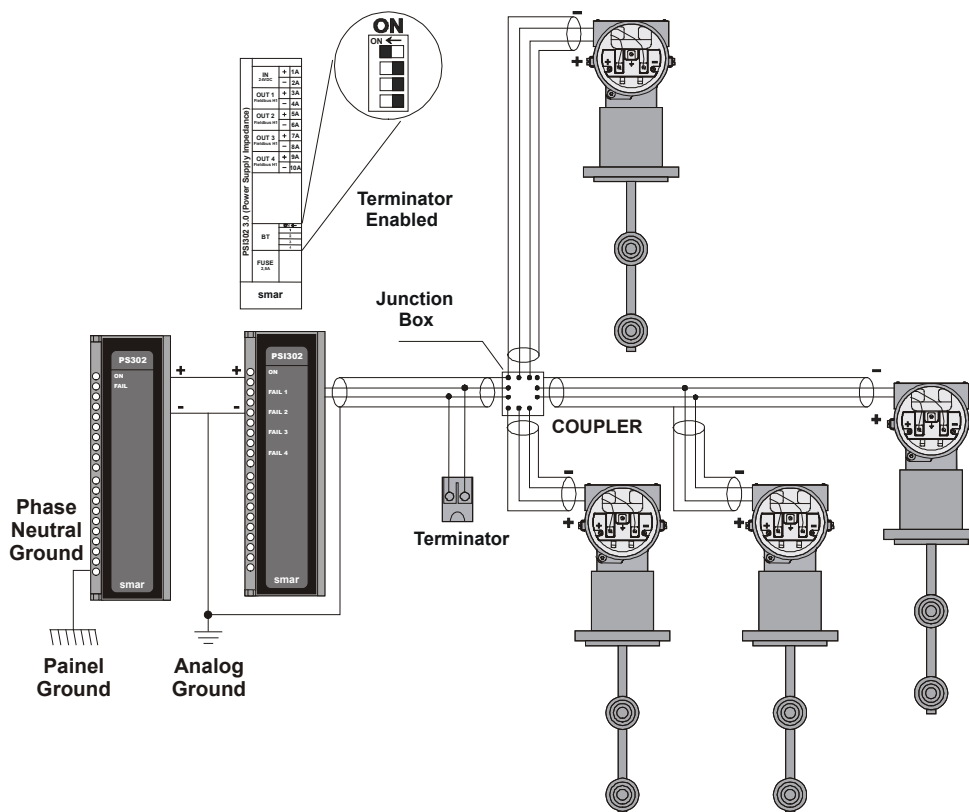
Figure 1.24 - Bus Topology
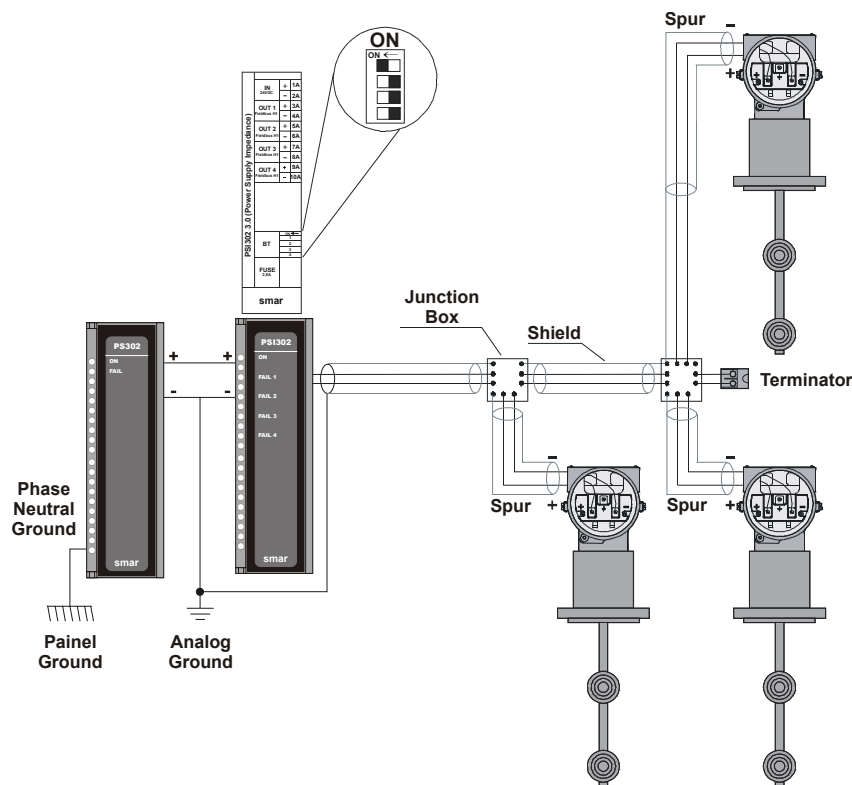
Figure 1.25 - Tree Topology

Intrinsic Safety Barrier

When the Fieldbus is in hazardous location with Explosive Atmosphere, the protection type "intrinsic safety (Ex-i)" can be used with a barrier inserted on the trunk between the power supply and the Fieldbus bus.

Use of DF47-12 or DF47-17 is recommended.

Jumper Configuration

In order to work properly, the jumpers J1 and W1 located in the **DT302** main board must be correctly configured (See *Table 1.1 - Description of the Jumpers*).

J1	This jumper enables the simulation mode parameter in the AI block.
W1	This jumper enables the local adjustment programming tree.

Table 1.1 - Description of the Jumpers

Power Supply

The **DT302** receives power from the bus via the signal wiring. The power supply may come from a separate unit or from another device such as a controller or DCS.

The voltage should be between 9 to 32 Vdc for non-intrinsic safe applications.

A special requirement applies to the power supply used in an intrinsically safe bus and depends on the type of barrier used.

Use of **PS302** is recommended as power supply.

Installation in Hazardous Areas

Refer to Appendix A for certifications information.

OPERATION

The **DT302** Concentration Density Transmitter use capacitive sensors (capacitive cells) as pressure sensing elements. This is exactly the same sensor as the DT301 series uses, the sensor modules are therefore interchangeable.
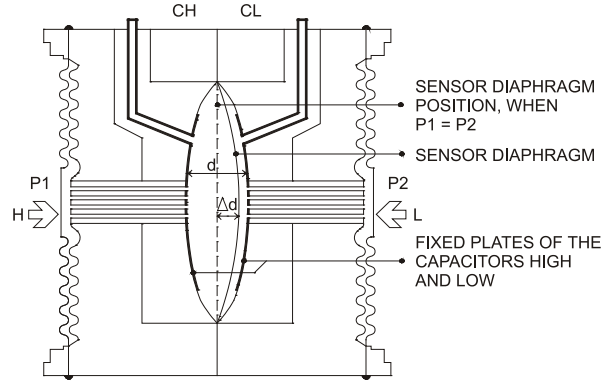
Figure 2.1 - Capacitive Cell

Functional Description - Sensor

Where,
P_1 and P_2 are the pressures and $P_1 \geq P_2$
CH = Capacitance between the fixed plate on P_1 side and the sensing diaphragm.
CL = Capacitance between the fixed plate on the P_2 side and the sensing diaphragm.
d = Distance between CH and CL fixed plates.
Δd = Sensing diaphragm's deflection due to the differential pressure $\Delta P = P_1 - P_2$.

Knowing that the capacitance of a capacitor with flat, parallel plates may be expressed as a function of plate area (A) and distance (d) between the plates:

$$C \approx \frac{\varepsilon \times A}{d}$$

Where,
ε = Dielectric constant of the medium between the capacitor's plates.

$$CH \approx \frac{\varepsilon \times A}{(d/2) + \Delta d} \quad \text{and} \quad \frac{\varepsilon \times A}{(d/2) - \Delta d} \approx CL$$

However, should *CH* and *CL* be considered as capacitances of flat and parallel plates with identical areas, then:

However, should the differential pressure (ΔP) applied to the capacitive cell not deflect the sensing diaphragm beyond d/4, it is possible to assume ΔP as proportional to Δd, that is:
$$\Delta P \propto \Delta \mathrm{d}$$

By developing the expression (CL - CH)/(CL + CH), it follows that:

$$\frac{CL - CH}{CL + CH} = \frac{2\Delta d}{d}$$

As the distance (d) between the fixed plates CH and CL is constant. It is possible to conclude that the expression (CL - CH)/ (CL + CH) is proportional to Δd and, therefore, to the differential pressure to be measured.

Thus it is possible to conclude that the capacitive cell is a pressure sensor formed by two capacitors whose capacitance varies according to the applied differential pressure.

Functional Description – Electronics

Refer to the block diagram. The function of each block is described below.

PROBE **SENSOR ASSEMBLY** **MAIN CIRCUIT BOARD**

DISPLAY BOARD
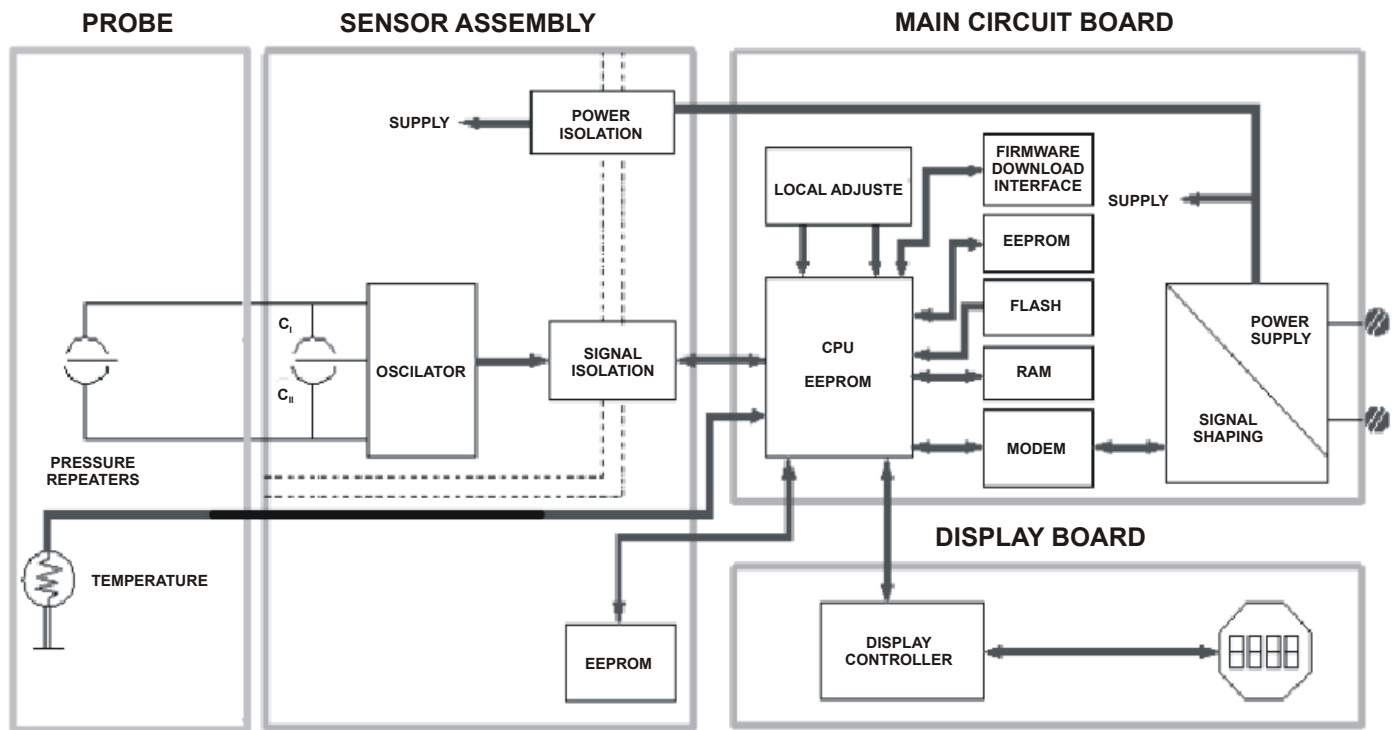
Figure 2.2 - DT302 Block Diagram Hardware

Probe
Part of the transmitter directly in contact with the process.

Pressure Repeaters
It transfers to the capacitive sensor the differential pressure detected in the process.

Temperature Sensor
It captures the process fluid temperature.

Oscillator
This oscillator generates a frequency as a function of sensor capacitance.

Signal Isolator
The control signals from the CPU and the signal from the oscillator are isolated to avoid ground loops.

Central Processing Unit (CPU), RAM, FLASH and EEPROM
The CPU is the intelligent portion of the transmitter, being responsible for the management and operation of measurement, block execution, self-diagnostics, and communication. The program is stored in a FLASH memory for easy upgrade and saving data on power-down event occurrence. For temporary storage of data there is a RAM. The data in the RAM is lost if the power is switched off, however the main board has a nonvolatile EEPROM memory where the static data configured that must be retained is stored. Examples of such data are the following: calibration, links, and identification data.

Sensor EEPROM
Another EEPROM is located within the sensor assembly. It contains data pertaining to the sensor's characteristics at different pressures and temperatures. This characterization is done for each sensor at the factory. It also contains the factory settings; they are useful in case of main board replacement, when it does an automatic upload of data from the sensor board to main board.

Fieldbus Modem
Monitors line activity, modulate and demodulate communication signals, inserts, and deletes start and end delimiters, and checks integrity of frame received.

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

Power Isolation
Isolates the signals to and from the input section, the power to the input section must be isolated.

Display Controller
Receives data from the CPU identifying which segments on the liquid crystal display to turn on. The controller drives the backplane and the segment control signals.

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

Display

The indicator, constituted by the liquid crystal display, can show one or two variables in according to the user's selection. When it is shown two variables, the indicator will alternate between both with an interval of approximately 3 seconds.

Beyond the numeric and alphanumeric fields, the display shows some alphanumeric icons to indicate the transmitter states. The figure 2.3 shows the segment configuration used by DT302 transmitter.

Monitoring

The DT302 transmitter is continually in the monitoring mode. In this mode, the indication at the display alternates between the primary and secondary variable, according to the user's configuration. The indicator has the capacity to show the value, the engineering unit, and the variable type, simultaneously with most of the state indications. See in the figure 2.4 a sample of a DT302 standard indication.
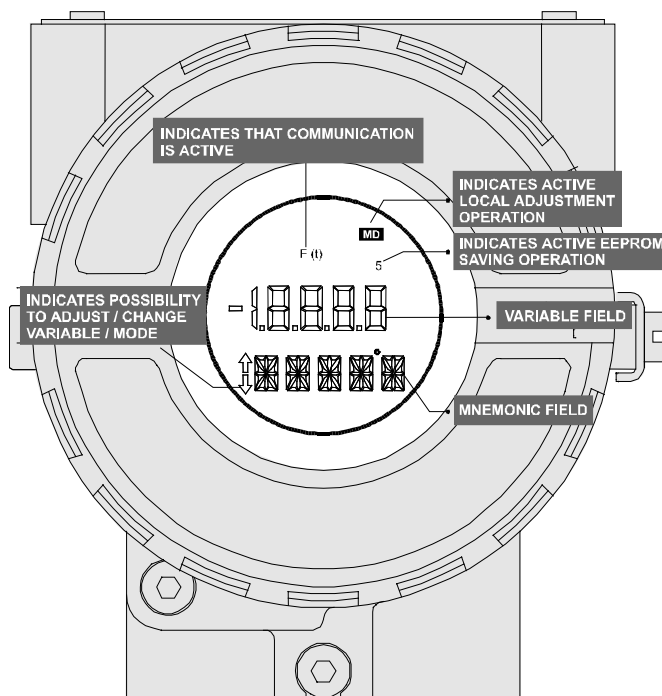
Figure 2.3 - LCD Indicator
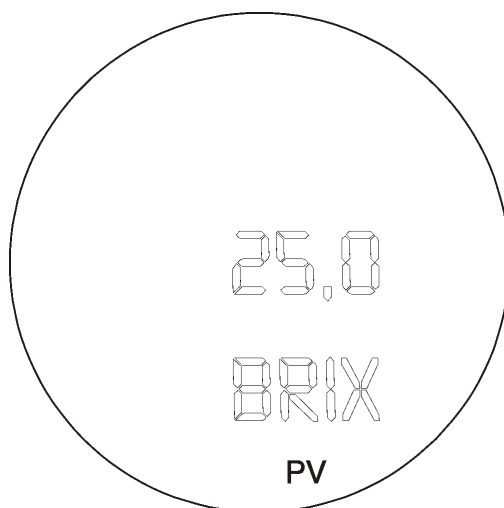
Figure 2.4 – Typical Monitoring Mode Display Showing PV, in this case 25.0 BRIX

CONFIGURATION

One of the many advantages of Fieldbus is that device configuration is independent of the configurator. The **DT302** may be configured by a third-party terminal or operator console. Any configurator is therefore not addressed here.

The **DT302** contain one input transducer block, one resource, one display transducer block and functions blocks. Functions Blocks are not covered in this manual. For explanation and details see the "Functions Blocks Manual".

Transducer Block

Transducer block insulates function block from the specific I/O hardware, such as sensors, actuators. Transducer block controls access to I/O through manufacturer specific implementation. This permits the transducer block to execute as frequently as necessary to obtain good data from sensors without burdening the function blocks that use the data. It also insulates the function block from the manufacturer specific characteristics of certain hardware.

By accessing the hardware, the transducer block can get data from I/O or passing control data to it. The connection between Transducer block and Function block is called channel. These blocks can exchange data from its interface. Normally, transducer blocks perform functions, such as linearization, characterization, temperature compensation, control, and exchange data to hardware.

Transducer Block Diagram

See transducer block diagram below.

Figure 3.1 – Transducer Block Diagram

Concentration/Density Transducer Block Parameter Description

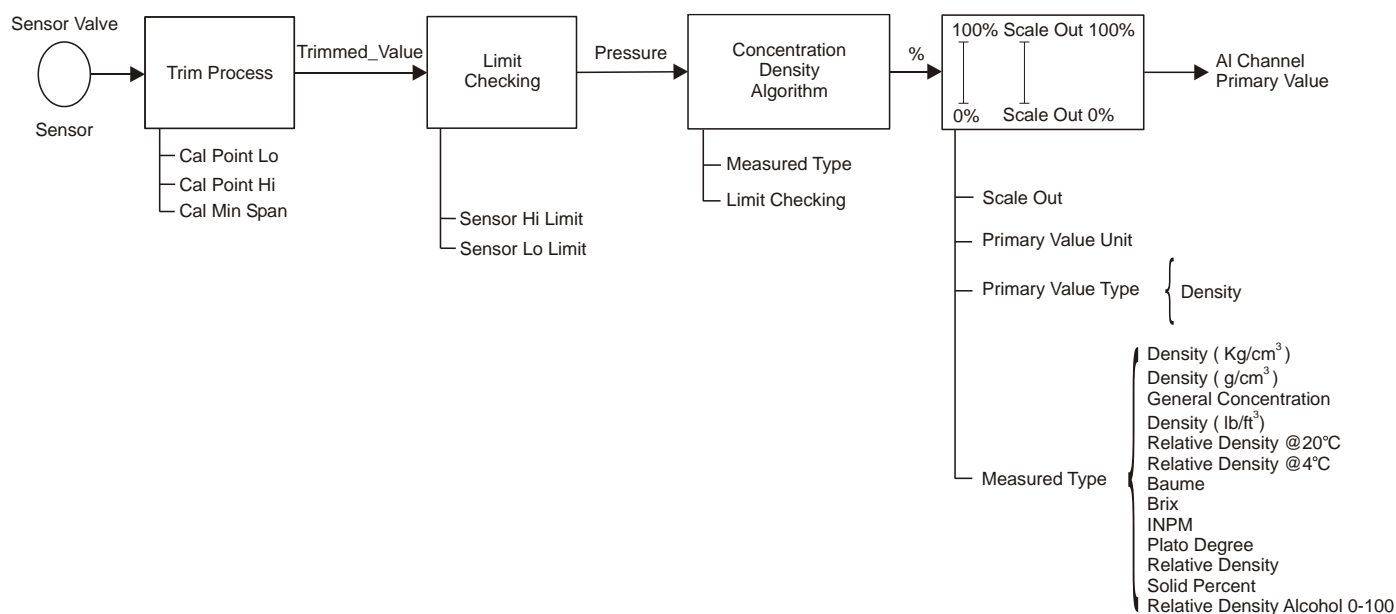| Parameter	Description
ST_REV	Indicates the level of static data.
TAG_DESC	Transducer block description.
STRATEGY	This parameter is not checked and processed by transducer block.
ALERT_KEY	Number of identification in the plant.
MODE_BLK	Indicates the operation mode of transducer block.
BLOCK_ERR	Indicates the status associated with hardware or software in the transducer.
UPDATE_EVT	Alert for any static data.
BLOCK_ALM	Used for configuration, hardware, and other fail.
TRANSDUCER_DIRECTORY	Used to select several transducer blocks.
TRANSDUCER_TYPE	Indicates the type of transducer according to its class.
XD_ERROR	Used to indicate calibration status.
COLLECTION_DIRECTORY	Specifies the number of transducer index into transducer block.
PRIMARY_VALUE_TYPE	Defines the calculation type for transducer block.
PRIMARY_VALUE	Value and status used by channel.
PRIMARY_VALUE_RANGE	High and low range limit values, the engineering unit code and the number of digits to the right of the decimal point to be used for primary value.
CAL_POINT_HI	Highest calibrated value.
CAL_POINT_LO	Lowest calibrated value.
CAL_MIN_SPAN	Minimum calibration span value allowed. This minimum span information is necessary to ensure that when calibration is done, the two calibrated points (high and low) are not too close together.
CAL_UNIT	Device description engineering units code index for the calibration values.
SENSOR_TYPE	Type of sensor.
SENSOR_RANGE	Range of sensor.
SENSOR_SN	Serial number of sensor.
SENSOR_CAL_METHOD	Method of last sensor calibration. ISO defines several standard methods of calibration. This parameter is intended to record that method, or if some other method was used.
SENSOR_CAL_LOC	Location of last sensor calibration. This describes the physical location at which the calibration was performed.
SENSOR_CAL_DATE	Date of the last sensor calibration.
SENSOR_CAL_WHO	Name of person who is in charge of last calibration.
SENSOR_ISOLATION_MTL	Defines the construction material of the isolating diaphragms.
SENSOR_FLUID	Defines the type of fill fluid used in the sensor
SECONDARY_VALUE	Secondary value (temperature value), related to the sensor.
SECONDARY_VALUE_UNIT	Engineering units to be used with SECONDARY_VALUE.
PRESS_LIN_NORMAL	Linear normalized pressure value.
PRESS_NORMAL	Normalized pressure value.
PRESS_CUTOFF	Cutoff pressure value.
CUTOFF_FLAG	Bypass flag for Pressure value.
DIGITAL_TEMPERATURE	Digital temperature value.
DIFF	Differential pressure value.
YDIFF	Differential pressure value.
CAPACITANCE_LOW	Low capacitance value.
CAPACITANCE_HIGH	High capacitance value.
BACKUP_RESTORE	This parameter is used to do backup or to restore configuration data.
SENSOR_RANGE_CODE	Indicates the sensor range code.
COEFF_POL0	Polynomial coefficient 0.
COEFF_POL1	Polynomial coefficient 1.
COEFF_POL2	Polynomial coefficient 2.
COEFF_POL3	Polynomial coefficient 3.
COEFF_POL4	Polynomial coefficient 4.
COEFF_POL5	Polynomial coefficient 5.
COEFF_POL6	Polynomial coefficient 6.
COEFF_POL7	Polynomial coefficient 7.
COEFF_POL8	Polynomial coefficient 8.
COEFF_POL9	Polynomial coefficient 9.
COEFF_POL10	Polynomial coefficient 10.
COEFF_POL11	Polynomial coefficient 11.
POLYNOMIAL_VERSION	Indicates the polynomial version.
CHARACTERIZATION_TYPE	Indicates the type of characterization curve.
CURVE _BYPASS_LD	Enable and disable the characterization curve.
CURVE_LENGTH	Indicates the length of characterization curve.
CURVE_X	Input points of characterization curve.
CURVE_Y	Output points of characterization curve.
CAL_POINT_HI_BACKUP	Indicates the backup for high calibration point.

Parameter	Description
CAL_POINT_LO_ BACKUP	Indicates the backup for low calibration point.
CAL_POINT_HI_FACTORY	Indicates the factory high calibration point.
CAL_POINT_LO_FACTORY	Indicates the factory low calibration point.
CAL_TEMPERATURE	Defines the temperature calibration point.
DATASHEET	Indicates information about the sensor.
ORDERING_CODE	Indicates information about the sensor and control from factory production.
MAXIMUM_MEASURED_PRESSURE	Indicates the maximum pressure measured.
MAXIMUM_MEASURED_TEMPERATURE	Indicates the maximum temperature measured.
ACTUAL_OFFSET	Indicates the actual calibrated offset.
ACTUAL_SPAN	Indicates the actual span offset.
MAXIMUM_OFFSET_DEVIATION	Defines the maximum offset before an alarm is generated.
MAXIMUM_GAIN_DEVIATION	Defines the maximum gain before an alarm is generated.
OVERPRESSURE_LIMIT	Defines the maximum overpressure limit before an alarm is generated.
MAXIMUM_NUMBER_OF_OVERPRESSURE	Defines the maximum number of overpressure before an alarm is generated.
GRAVITY	Gravity acceleration used in concentration/density calculation. The unit is m/s².
HEIGHT	Distance between the two pressure sensors. The unit is m.
MEASURED_TYPE	When the transducer type is density, it allows to measure: 0 - Density (g/cm³), 1 - Density (Kg/m³), 2 - Relative Density @ 20°C (g/cm³), 3 - Relative Density @ 4°C (g/cm³), 4 - Baume, 5 - Brix, 6 - Plato Degree, 7 - INPM, 8 - Relative Density Alcohol 0 - 100, 9 - Solid Percent, 10 - Density (lb/ft³), 11 - API
LIN_DILATATION_COEF	Linear dilatation coefficient.
PRESSURE_COEFFICIENT	Coefficient of pressure.
TEMP_ZERO	Offset coefficient used to calculate the temperature.
TEMP_GAIN	Gain coefficient used to calculate the temperature.
ZERO_ADJUST_TEMP	Temperature of zero adjustment.
HEIGHT_MEAS_TEMP	Temperature of measurement of distance between the pressure sensors.
AUTO_CAL_POINT_LO	This parameter enables the lower self-calibration point. The sensor should be in air and the MEASURED_TYPE and XD_SCALE.UNIT should be Kg/cm³. The calibration point is 1.2 Kg/cm³.
AUTO_CAL_POINT_HI	This parameter enables the upper self-calibration point. The sensor should be on water and the MEASURED_TYPE and XD_SCALE.UNIT should be Brix. The calibration point is 0 Brix.
SOLID_POL_COEFF_0	Solid percent polynomial coefficient 0.
SOLID_POL_COEFF_1	Solid percent polynomial coefficient 1.
SOLID_POL_COEFF_2	Solid percent polynomial coefficient 2.
SOLID_POL_COEFF_3	Solid percent polynomial coefficient 3.
SOLID_POL_COEFF_4	Solid percent polynomial coefficient 4.
SOLID_POL_COEFF_5	Solid percent polynomial coefficient 5.
SOLID_LIMIT_LO	Solid percent limit low.
SOLID_LIMIT_HI	Solid percent limit high.
PRESS_COMP	Value used by the factory.
SIMULATE_PRESS_ENABLE	Enable the concentration simulation mode.
SIMULATE_PRESS_VALUE	Simulate pressure value in mmH$_2$O at 68 °F. Used together with SIMULATE_PRESS_ENABLE.
SIMULATE_DENSITY_VALUE	Density value used to obtain the correspondent pressure.
CALCULATED_PRESS_VALUE	Pressure calculated according to the SIMULATE_DENSITY_VALUE.
CALC_PRESS_CAL_POINT_LO	Calculated pressure value by AUTO_CAL_POINT_LO procedure.
CALC_PRESS_CAL_POINT_HI	Calculated pressure value by AUTO_CAL_POINT_HI procedure.
DT_RANGE_CODE	**DT302** range code, depending on the probe size: 250 mm: Range 1 (0 to 3 g/cm³) Range 2 (0 to 10 g/cm³) 500 mm: Range 1 (0 to 2 g/cm³) Range 2 (0 to 10 g/cm³) 800 mm: Range 1 (0.35 to 1,6 g/cm³) Range 2 (0.35 to 7 g/cm³)
DENSITY_KGM3	Density Value in Kg/m3.
DENSITY_STATUS	Density status information such as temperature between limits.
CONC	18 polynomial terms.
HI_LIM_DENS	Density upper limit for generic concentration.
LO_LIM_DENS	Density lower limit for generic concentration.
HI_LIM_TEMP	Temperature upper limit for generic concentration.
LO_LIM_TEMP	Temperature lower limit for generic concentration.
K_DENS	Density constant used to calculate generic concentration.
K_TEMP	Temperature constant used to calculate generic concentration.
MOUNTING_POSITION	Indicates de probe assembly position (direct or reverse).

Table 3.1 – Concentration/Density Transducer Block Parameter Description

Concentration/Density Transducer Block Parameter Attributes

Relative Index	Parameter Mnemonic	Object Type	Data Type	Store	Size	Access	Default –value
1	ST_REV	Simple	Unsigned16	S	2	R/W	0
2	TAG_DESC	Simple	VisibleString	S	32	R/W	TRD BLOCK
3	STRATEGY	Simple	Unsigned16	S	2	R/W	0
4	ALERT_KEY	Simple	Unsigned8	S	1	R/W	0
5	MODE_BLK	Record	DS-69	S	4	R/W	O/S
6	BLOCK_ERR	Simple	Bit String	D	2	R	
7	UPDATE_EVT	Record	DS-73	D	5	R	
8	BLOCK_ALM	Record	DS-72	D	13	R	
9	TRANSDUCER_DIRECTORY	Simple	Array of Unsigned16	N	Variable	R	
10	TRANSDUCER_TYPE	Simple	Unsigned16	N	2	R	100
11	XD_ERROR	Simple	Unsigned8	D	1	R	0
12	COLLECTION_DIRECTORY	Simple	Array of Unsigned 32	S	Variable	R	
13	PRIMARY_VALUE_TYPE	Simple	Unsigned16	S	2	R/W	107
14	PRIMARY_VALUE	Record	DS-65	D	5	R	0
15	PRIMARY_VALUE_RANGE	Record	DS-68	S	11	R	
16	CAL_POINT_HI	Simple	Float	S	4	R/W	5080.0
17	CAL_POINT_LO	Simple	Float	S	4	R/W	0.0
18	CAL_MIN_SPAN	Simple	Float	S	4	R	0.0
19	CAL_UNIT	Simple	Unsigned16	S	2	R	1149
20	SENSOR_TYPE	Simple	Unsigned16	S	1	R/W	117
21	SENSOR_RANGE	Record	DS-68	S	11	R	0-100%
22	SENSOR_SN	Simple	Unsigned32	S	4	R/W	0
23	SENSOR_CAL_METHOD	Simple	Unsigned8	S	1	R/W	103
24	SENSOR_CAL_LOC	Simple	VisibleString	S	32	R/W	NULL
25	SENSOR_CAL_DATE	Simple	Time of Day	S	7	R/W	
26	SENSOR_CAL_WHO	Simple	VisibleString	S	32	R/W	NULL
27	SENSOR_ISOLATION_MTL	Simple	Unsigned16	S	2	R/W	2
28	SENSOR_FLUID	Simple	Unsigned16	S	2	R/W	1
29	SECONDARY_VALUE	Record	DS-65	D	5	R	0
30	SECONDARY_VALUE_UNIT	Simple	Unsigned16	S	2	R	1001 (°C)
31	PRESS_LIN_NORMAL	Record	DS-65	D	5	R	0
32	PRESS_NORMAL	Record	DS-65	D	5	R	0
33	PRESS_CUTOFF	Record	DS-65	D	5	R	0
34	CUTOFF_FLAG	Simple	Unsigned8	S	1	R/W	True
35	DIGITAL_TEMPERATURE	Record	DS-65	D	5	R	0
36	DIFF	Simple	Float	D	4	R	0
37	YDIFF	Simple	Float	D	4	R	0
38	CAPACITANCE_LOW	Simple	Float	D	4	R	0
39	CAPACITANCE_HIGH	Simple	Float	D	4	R	0
40	BACKUP_RESTORE	Simple	Unsigned8	S	1	R/W	0
41	SENSOR_RANGE_CODE	Simple	Unsigned16	S	2	R/W	1
42	COEFF_POL0	Simple	Float	S	4	R/W	-1
43	COEFF_POL1	Simple	Float	S	4	R/W	0
44	COEFF_POL2	Simple	Float	S	4	R/W	1
45	COEFF_POL3	Simple	Float	S	4	R/W	0
46	COEFF_POL4	Simple	Float	S	4	R/W	2
47	COEFF_POL5	Simple	Float	S	4	R/W	0
48	COEFF_POL6	Simple	Float	S	4	R/W	0
49	COEFF_POL7	Simple	Float	S	4	R/W	0
50	COEFF_POL8	Simple	Float	S	4	R/W	0
51	COEFF_POL9	Simple	Float	S	4	R/W	0
52	COEFF_POL10	Simple	Float	S	4	R/W	0
53	COEFF_POL11	Simple	Float	S	4	R/W	25
54	POLYNOMIAL_VERSION	Simple	Unsigned8	S	1	R/W	32
55	CHARACTERIZATION_TYPE	Simple	Unsigned8	S	1	R/W	255
56	CURVE _BYPASS_LD	Simple	Unsigned16	S	2	R/W	Enable&Backup Cal
57	CURVE_LENGTH	Simple	Unsigned8	S	1	R/W	5

Relative Index	Parameter Mnemonic	Object Type	Data Type	Store	Size	Access	Default –value
58	CURVE_X	Record	Array of Float	S	20	R/W	
59	CURVE_Y	Record	Array of Float	S	20	R/W	
60	CAL_POINT_HI_BACKUP	Simple	Float	S	4	R	5080
61	CAL_POINT_LO_ BACKUP	Simple	Float	S	4	R	0
62	CAL_POINT_HI_FACTORY	Simple	Float	S	4	R	5080
63	CAL_POINT_LO_FACTORY	Simple	Float	S	4	R	0
64	CAL_TEMPERATURE	Simple	Float	S	4	R/W	17.496
65	DATASHEET	Record	Array of Unsigned8	S	10	R/W	
66	ORDERING_CODE	Simple	VisibleString	S	50	R/W	NULL
67	MAXIMUM_MEASURED_PRESSURE	Simple	Float	S	4	R/w	- INF
68	MAXIMUM_MEASURED_TEMPERATURE	Simple	Float	S	4	R/W	- INF
69	ACTUAL_OFFSET	Simple	Float	S	4	R	
70	ACTUAL_SPAN	Simple	Float	S	4	R	
71	MAXIMUM_OFFSET_DEVIATION	Simple	Float	S	4	R/W	0.5
72	MAXIMUM_GAIN_DEVIATION	Simple	Float	S	4	R/W	2.0
73	OVERPRESSURE_LIMIT	Simple	Float	S	4	R/W	+ INF
74	MAXIMUM_NUMBER_OF_OVERPRESSURE	Simple	Float	S	4	R/W	0
75	GRAVITY	Simple	Float	S	4	R/W	9.80665
76	HEIGHT	Simple	Float	S	4	R/W	0.500
77	MEASURED_TYPE	Simple	Float	S	4	R/W	0
78	LIN_DILATATION_COEF	Simple	Float	S	4	R/W	0.000016
79	PRESSURE_COEFFICIENT	Simple	Float	S	4	R/W	
80	TEMP_ZERO	Simple	Float	S	4	R/W	-30
81	TEMP_GAIN	Simple	Float	S	4	R/W	0.5
82	ZERO_ADJUST_TEMP	Simple	Float	S	4	R/W	20
83	HEIGHT_MEAS_TEMP	Simple	Float	S	4	R/W	0.5
84	AUTO_CAL_POINT_LO	Simple	Float	S	4	R/W	0
85	AUTO_CAL_POINT_HI	Simple	Float	S	4	R/W	0
86	SOLID_POL_COEFF_0	Simple	Float	S	4	R/W	0
87	SOLID_POL_COEFF_1	Simple	Float	S	1	R/W	1
88	SOLID_POL_COEFF_2	Simple	Float	S	4	R/W	0
89	SOLID_POL_COEFF_3	Simple	Float	S	4	R/W	0
90	SOLID_POL_COEFF_4	Simple	Float	S	4	R/W	0
91	SOLID_POL_COEFF_5	Simple	Float	S	4	R/W	0
92	SOLID_LIMIT_LO	Simple	Float	S	4	R/W	0
93	SOLID_LIMIT_HI	Simple	Float	S	4	R/W	100
94	PRESS_COMP	Simple	Float	D	4	R	0
95	SIMULATE_PRESS_ENABLE	Simple	Unsigned 8	D	1	R/W	Disable
96	SIMULATE_PRESS_VALUE	Simple	Float	D	4	R/W	0
97	SIMULATE_DENSITY_VALUE	Simple	Float	D	4	R/W	0
98	CALCULATED_PRESS_VALUE	Simple	Float	D	4	R	0
99	CALC_PRESS_CAL_POINT_LO	Simple	Float	D	4	R	0
100	CALC_PRESS_CAL_POINT_HI	Simple	Float	D	4	R	0
101	DT_RANGE_CODE	Simple	Unsigned 8	S	1	R/W	0
102	DENSITY_KGM3	Simple	Float	S	4	R	-
103	DENSITY_STATUS	Simple	Unsigned	S	1	R	-
104	CONC	Record	Array of Float	D	72	R/W	0
105	HI_LIM_DENS	Simple	Float	D	4	R/W	0
106	LO_LIM_DENS	Simple	Float	D	4	R/W	0
107	HI_LIM_TEMP	Simple	Float	D	4	R/W	0
108	LO_LIM_TEMP	Simple	Float	D	4	R/W	0
109	K_DENS	Simple	Float	D	4	R/W	1
110	K_TEMP	Simple	Float	D	4	R/W	1
111	MOUNTING_POSITION	Simple	Unsigned	D	1	R/W	-

Table 3.2 – Concentration/Density Transducer Blocks Parameter Attributes

Concentration/Density Transducer Block View Object

Relative Index	Parameter Mnemonic	View_1	View_2	View_3	View_4
1	ST_REV	2	2		2
2	TAG_DESC				
3	STRATEGY				2
4	ALERT_KEY				1
5	MODE_BLK	4			
6	BLOCK_ERR	2			
7	UPDATE_EVT				
8	BLOCK_ALM				
9	TRANSDUCER_DIRECTORY				
10	TRANSDUCER_TYPE	2	2	5	2
11	XD_ERROR	1			
12	COLLECTION_DIRECTORY			5	
13	PRIMARY_VALUE_TYPE		2	5	
14	PRIMARY_VALUE	5			
15	PRIMARY_VALUE_RANGE				11
16	CAL_POINT_HI		4	5	
17	CAL_POINT_LO		4	4	
18	CAL_MIN_SPAN			4	4
19	CAL_UNIT			4	2
20	SENSOR_TYPE			4	2
21	SENSOR_RANGE				11
22	SENSOR_SN				4
23	SENSOR_CAL_METHOD				1
24	SENSOR_CAL_LOC				
25	SENSOR_CAL_DATE				
26	SENSOR_CAL_WHO				
27	SENSOR_ISOLATION_MTL				2
28	SENSOR_FLUID				2
29	SECONDARY_VALUE	5			
30	SECONDARY_VALUE_UNIT		2		
31	PRESS_LIN_NORMAL				
32	PRESS_NORMAL				
33	PRESS_CUTOFF				
34	CUTOFF_FLAG				
35	DIGITAL_TEMPERATURE				
36	DIFF				
37	YDIFF				
38	CAPACITANCE_LOW				
39	CAPACITANCE_HIGH				
40	BACKUP_RESTORE				1
41	SENSOR_RANGE_CODE				2
42	COEFF_POL0				4
43	COEFF_POL1				4
44	COEFF_POL2				4
45	COEFF_POL3				4
46	COEFF_POL4				4
47	COEFF_POL5				4
48	COEFF_POL6				4
49	COEFF_POL7				4
50	COEFF_POL8				4
51	COEFF_POL9				4
52	COEFF_POL10				4
53	COEFF_POL11				4
54	POLYNOMIAL_VERSION				1
55	CHARACTERIZATION_TYPE		1		
56	CURVE _BYPASS_LD		2	52	
57	CURVE_LENGTH		1		
58	CURVE_X		20		
59	CURVE_Y		20		
60	CAL_POINT_HI_BACKUP		4		
61	CAL_POINT_LO_ BACKUP		4		
62	CAL_POINT_HI_FACTORY				
63	CAL_POINT_LO_FACTORY				
64	CAL_TEMPERATURE				

Relative Index	Parameter Mnemonic	View_1	View_2	View_3	View_4
65	DATASHEET				
66	ORDERING_CODE				
67	MAXIMUM_MEASURED_PRESSURE				
68	MAXIMUM_MEASURED_TEMPERATURE				
69	ACTUAL_OFFSET				
70	ACTUAL_SPAN				
71	MAXIMUM_OFFSET_DEVIATION				
72	MAXIMUM_GAIN_DEVIATION				
73	OVERPRESSURE_LIMIT				
74	MAXIMUM_NUMBER_OF_OVERPRESSURE				
75	GRAVITY				
76	HEIGHT				
77	MEASURED_TYPE				
78	LIN_DILATATION_COEF				
79	PRESSURE_COEFFICIENT				
80	ZERO_ADJUST_TEMP				
81	HEIGHT_MEAS_TEMP				
82	TEMP_ZERO				
83	TEMP_GAIN				
84	AUTO_CAL_POINT_LO				
85	AUTO_CAL_POINT_HI				
86	SOLID_POL_COEFF_0				
87	SOLID_POL_COEFF_1				
88	SOLID_POL_COEFF_2				
89	SOLID_POL_COEFF_3				
90	SOLID_POL_COEFF_4				
91	SOLID_POL_COEFF_5				
92	SOLID_LIMIT_LO				
93	SOLID_LIMIT_HI				
94	PRESS_COMP				
95	SIMULATE_PRESS_ENABLE				
96	SIMULATE_PRESS_VALUE				
97	SIMULATE_DENSITY_VALUE				
98	CALCULATED_PRESS_VALUE				
99	CALC_PRESS_CAL_POINT_LO				
100	CALC_PRESS_CAL_POINT_HI				
101	DT_RANGE_CODE				
102	DENSITY_KGM3				
103	DENSITY_STATUS				
104	CONC				
105	HI_LIM_DENS				
106	LO_LIM_DENS				
107	HI_LIM_TEMP				
108	LO_LIM_TEMP				
109	K_DENS				
110	K_TEMP				
111	MOUNTING_POSITION				
	TOTAL	21 bytes	68 bytes	52 bytes	99 bytes

Table 3.3 Concentration/Density Transducer Block View Object

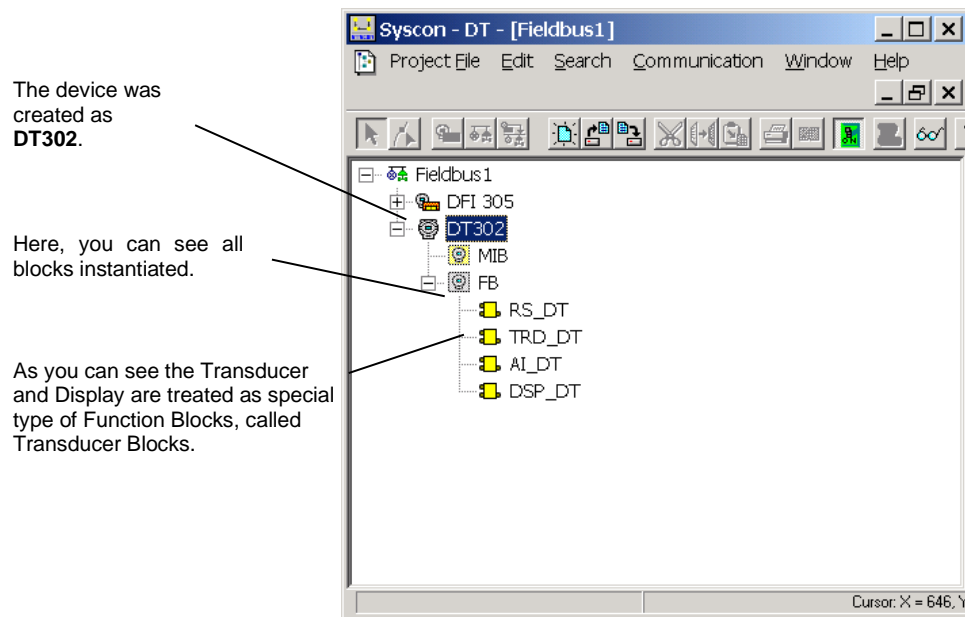## *How to Configure the Transducer Block*

The transducer block has an algorithm, a set of contained parameters and a channel connecting it to a function block.

The algorithm describes the behavior of the transducer as a data transfer function between the I/O hardware and other function block. Transducer parameters cannot be linked to inputs and outputs of other blocks. They can be divided into Standard and Manufacturer Specific.

The standard parameters will be present for such class of device, as density, pressure, temperature, actuator, etc., whatever is the manufacturer. Oppositely, the manufacturers' specific ones are defined only for its manufacturer. As common manufacturer specific parameters, we have calibration settings, material information, linearization curve, etc.

When a standard routine is performed, such as a calibration, the user is conducted step by step by a method. The method is generally defined as guideline to help the user to make common tasks. The

configuration tool identifies each method associated to the parameters and enables the interface to it. The Syscon (System Configurator) configuration software from Smar, for example, can configure many parameters of the blocks.

The device was created as **DT302**.

Here, you can see all blocks instantiated.

As you can see the Transducer and Display are treated as special type of Function Blocks, called Transducer Blocks.

Figure 3.2 - Function and Transducers Blocks

To configure the Transducer Block, is necessary to select it and right click with the mouse to choose 'On Line Configuration'.
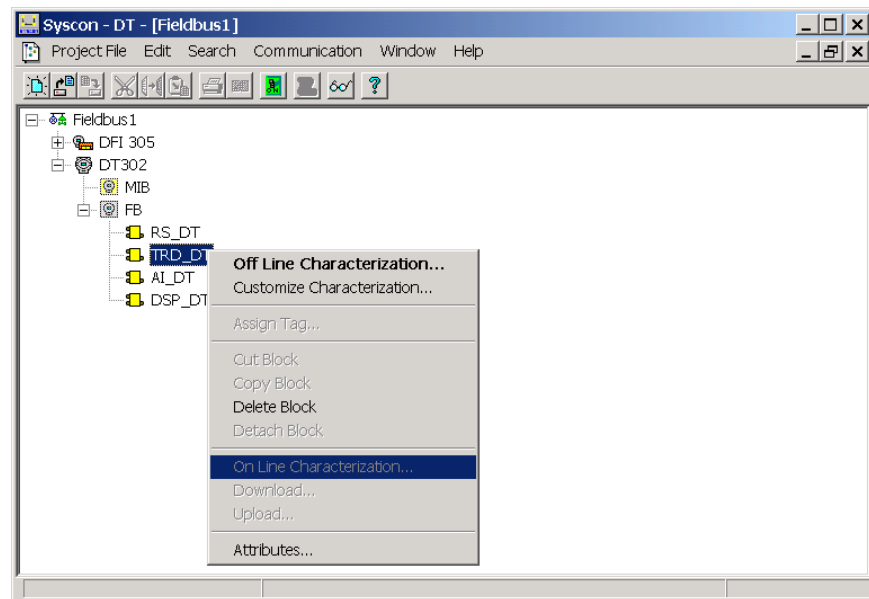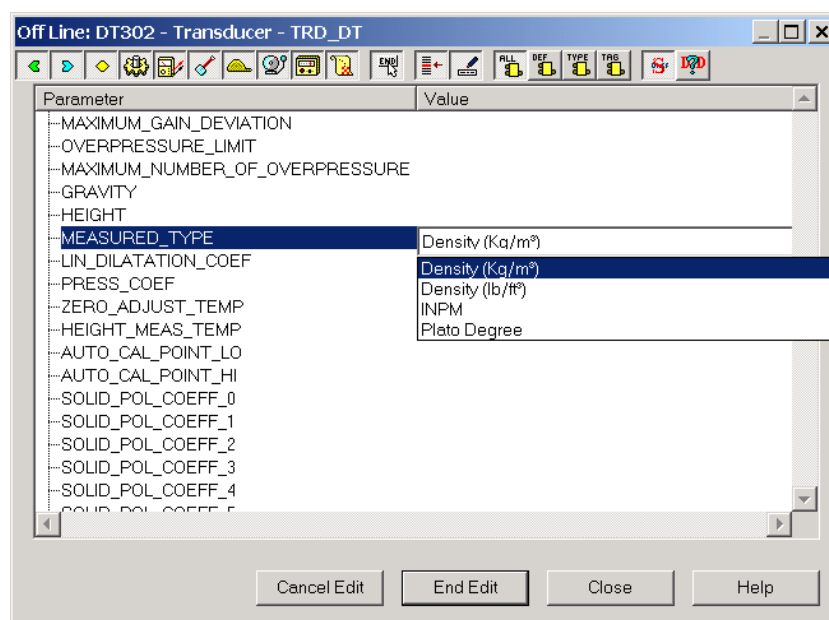

Figure 3.3 - Online Configuration – Transducer
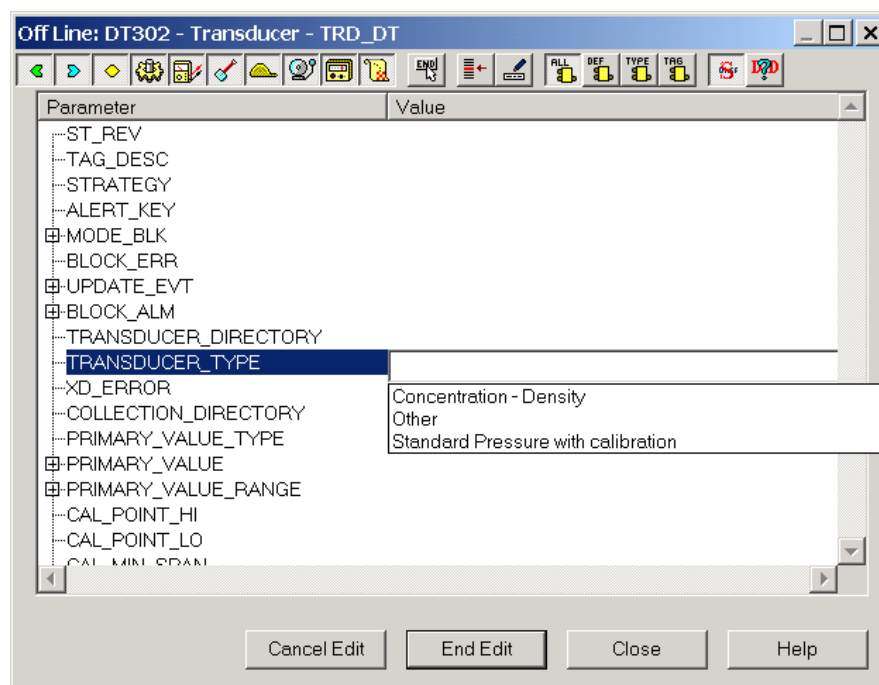
Figure 3.4 - Transducer Type Configuration

Using this window, the user can set the transducer type according to the application, selecting "Density".

Figure 3.5 - Measured Type Configuration

Also, the user can select the Measured Type, choosing Density (g/cm³), Density (Kg/m³), Relative Density @ 20°C (g/cm³), Relative Density @ 4°C (g/cm³), Baumé, Brix, Plato Degree, INPM, Relative Density Alcohol 0 - 100, Solid Percent, Density (lb/ft³) and API.

Engineering Unit Selection

The user can also choose the Measured_Type:
- Density (g/cm³)
- Density (Kg/m³)
- Relative Density @ 20°C
- Relative Density @ 4°C
- Generic Concentration
- Baume
- Brix
- Plato Degree
- INPM
- GL
- Solid Percent
- Density (lb/ft³)
- API.

Solid Percent (% sol)
The concentration/ density transmitter **DT302** offers resources with the objective of relating Baume degree to solid percent.

**The general equation to determine the solid percent is:**

%sol = a0 + a1 bme^1 + a2 bme^2 + a3 bme^3 + a4bme^4 + a5 bme^5

The table and the graph below indicate the application of the **DT302** polynomial that relates Baume degree to solid percent, generating the polynomial:

$y = 0.004768x^4 - 0.760813x^3 + 45.407284x^2 - 1200.648795x + 11919.089787.$

	X	Y
1	Bme	%SOL.
2	35	56
3	36	56,7
4	37	57
5	37,7	57,5
6	38	57,9
7	38,3	58,2
8	38,4	58,3
9	38,5	59
10	38,6	59,2
11	39	59,3
12	39,4	59,6
13	39,7	60
14	41	60,5
15	42	61,2
16	43	61,8

POLYNOMIAL REGRESSION

$y = 0.004768x^4 - 0.760813x^3 + 45.407284x^2 - 1200.648795x + 11919.089787$
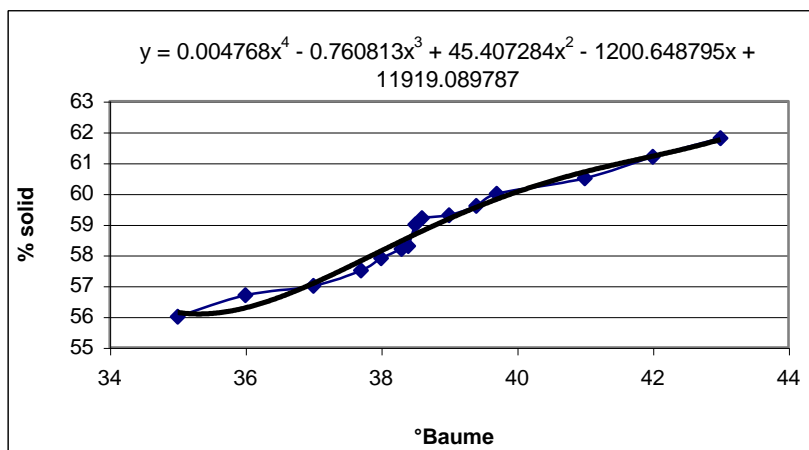
Generic Concentration Percentage (% conc)
For applications that demand other relation among measures, the polynomial used is:

$f(a,d,t) = a_0 + a_1 d + a_2 d^2 + a_3 d^3 + a4 d^4 + a_5 d^5 + a_6 d t + a_7 d^2 t + a_8 d^3 t + a_9 d t^2 + a_{10} d t^3 + a_{11} d^2 t^2 + a_{12} d^3 t^3 + a_{13} t + a_{14} t^2 + a_{15} t^3 + a_{16} t^4 + a_{17} t^5$
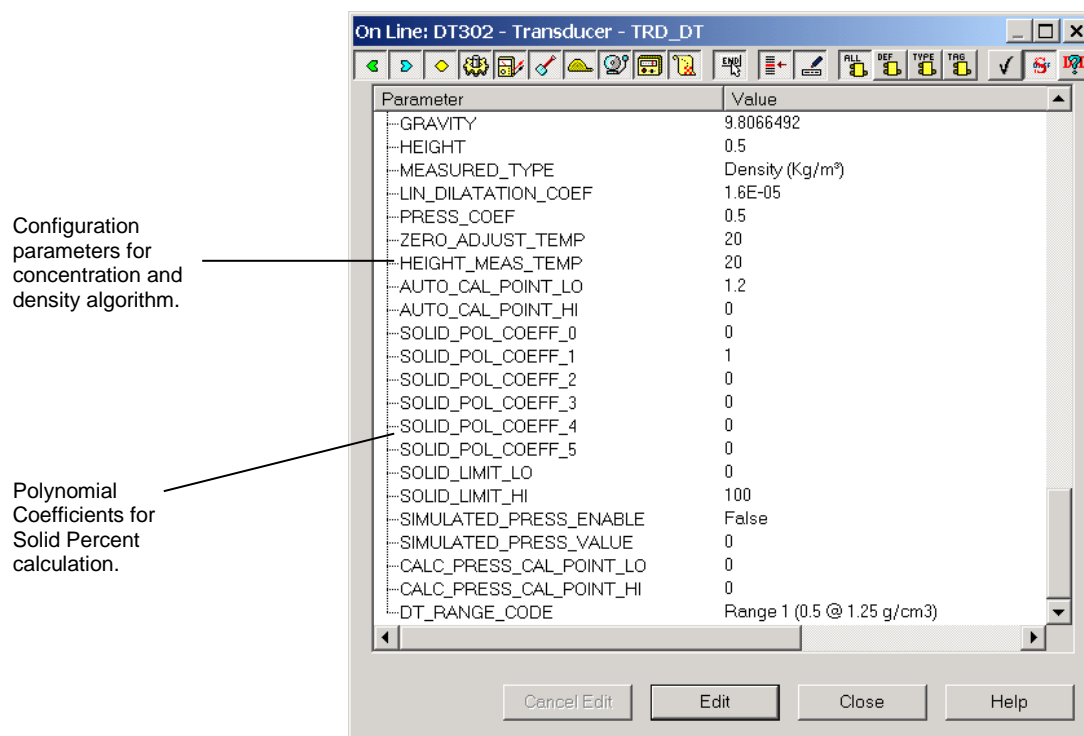
This function is applied to a higher number of applications. It relates three measurements: density, temperature and concentration.

As the digital display used in DT302 is of 4 ½ digits, the maximum indicated value would be 19999. When selecting the unit, be certified that in your application the value won't surpass 19999.

WARNING
The XD_SCALE from transducer block should follow the measured type unit and its range; otherwise an error is going to appear in the XD_ERROR.

Configuration parameters for concentration and density algorithm.

Polynomial Coefficients for Solid Percent calculation.

Figure 3.6 – Density Parameters

Concentration/Density Values for scale of AI XD_SCALE					
Measured Type	Range 1		Range 2		**AI Unit**
	Lower	Upper	Lower	Upper	
Density (g/cm³)	0	3	0	10	g/cm³
Density (Kg/m³)	0	3000	0	10000	Kg/m³
Density (lb/ft³)	0	187,28	0	624,28	lb/ft³
Relative Density @ 20°C	0	3	0	10	-
Relative Density @ 4°C	0	3	0	10	-
Baume	-5	55	-5	55	degBaum
Brix	-10	110	-10	110	degBrix
Plato Degree	-10	110	-10	110	%Plato
INPM	-10	110	-10	110	INPM
GL	-10	110	-10	110	GL
Solid Percent	-10	110	-10	110	%Soli/wt
API	-10	110	-10	110	API

How to Configure the Analog Input Block

The Analog Input block takes the input data from the Transducer block, selected by channel number, and makes it available to other function blocks at its output. When the Measured Type is changed in the transducer block, the unit and the range of XD_SCALE must be changed too. Optionally, a filter may be applied in the process value signal, whose time constant is PV_FTIME.

Considering a step change to the input, this is the time in seconds to the PV reaches 63.2 % of the final value. If the PV_FTIME value is zero, the filter is disabled. For more details, please, see the Function Blocks Specifications.

To configure the Analog Input Block in offline mode, please, go to the main menu and select "Device Offline Configuration - Analog Input Block. Using this window, the user can configure the block mode operation, selects the channel, scales and unit for input and output value and the damping.
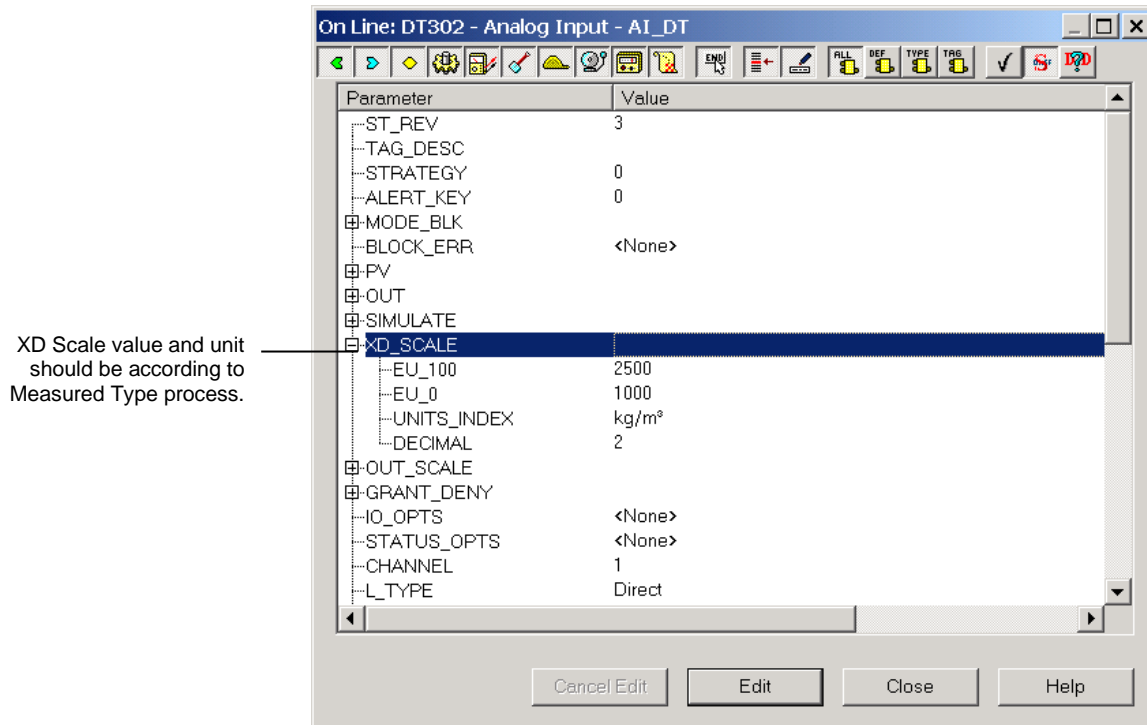
XD Scale value and unit should be according to Measured Type process. ———

Figure 3.7 – AI Block – XD_SCALE Configuration

Lower and Upper Concentration/ Density Calibration

Each sensor has a characteristic curve that establishes a relation between the applied pressure, the sensor signal, and the measured concentration/density. This curve is determined for each sensor and it is stored in a memory together with the sensor. When the sensor is connected to the transmitter circuit, the content of its memory is made available to the microprocessor.

Sometimes the value on the transmitter display and transducer block reading may not match the applied pressure.

The reasons may be:
- The transmitter mounting position.
- The user's pressure standard differs from the factory standard.
- The transmitter had its original characterization shifted by over pressurization, over heating or by long term drift.

The calibration is used to match the reading with the correct concentration/density.

Please, sure that the **DT302** is measuring concentration/density. Open the Transducer Block and see the Transducer Type parameter. Please, see the following figure:
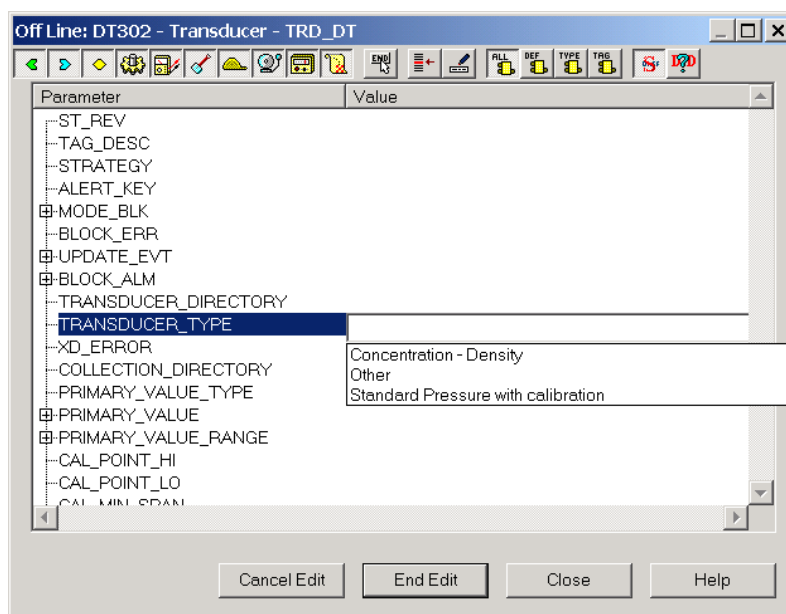
Figure 3.8 – Transducer Block – Transducer Type Selection

If is required an adjustment of unit, please just select the desired unit using the measured type parameter according to the application. If the adjust requires a changing of measured values, please, calibrate the device with reference, according to these steps:

• Wait the process stabilization and collect a sample.
• Determine in laboratory the value of density/concentration of stabilized process.

Using the **Syscon** (or any configuration tool), the user can select the measured type and the lower and upper calibration procedure.

If the user selects lower or upper page, the following window is shown and the user can see the actual calibrated point, the primary value and status and the result of calibration procedure:

The user can see the actual concentration/ density lower calibrated point and the matched pressure value.
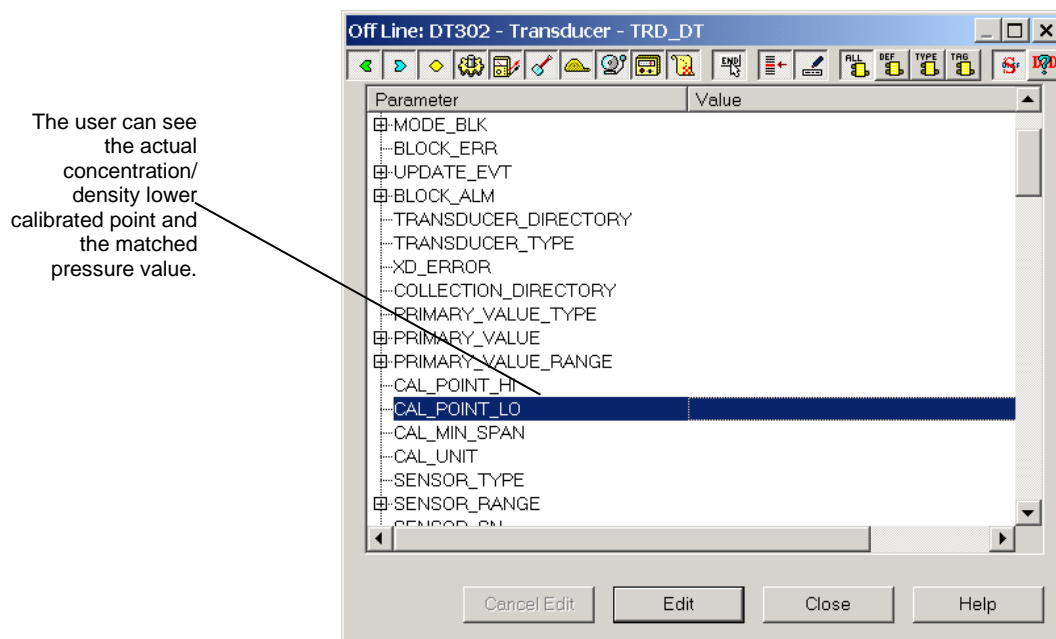
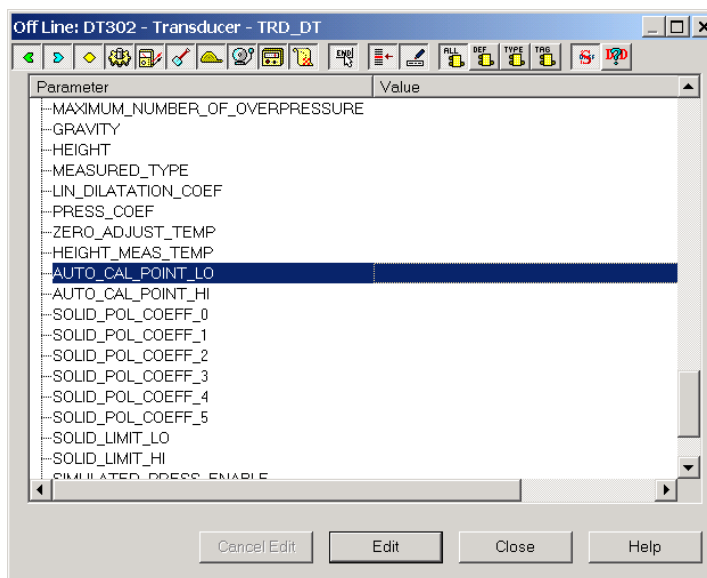*Figure 3.9 – Concentration / Density Calibration*

The calibrated point must be inside of the sensor range limits allowed for each type of concentration/density measuring.

Lower and Upper Concentration/ Density Self-Calibration

With self-calibration it is possible to perform an accurate calibration of the equipment. In this procedure the air density is used as reference (in Kg/m³) and water concentration (in BRIX). These references are used because it is easy to have it on the field.
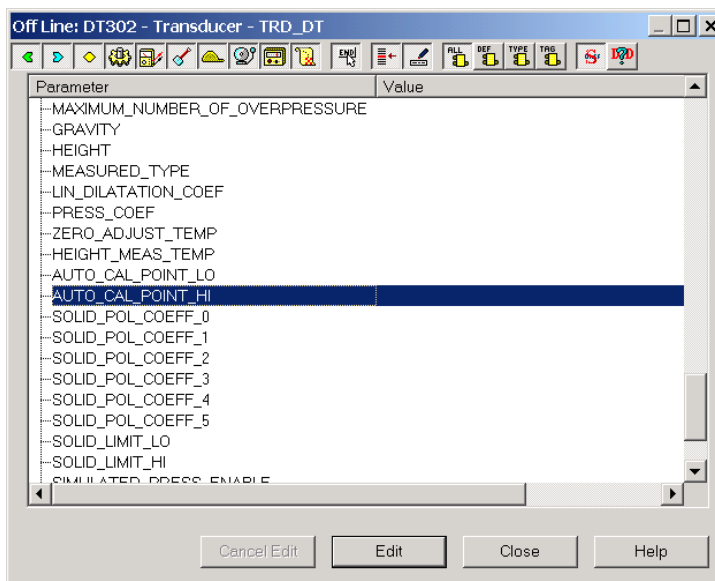
Lower Calibration (Air Self-Calibration)
Place the **DT302** in work position (vertical) and facing the air, wait approximately **5** minutes for stabilization. To execute the lower calibration, write a value to AUTO_CAL_POINT_LO. Any value written will calibrate internally the transmitter in 1.2 Kg/m³. Notice that the MEASURED_TYPE parameter should be configured to Density (Kg/m³).

Figure 3.10 – Lower Concentration / Density Self-Calibration

Upper Calibration (Water Self-Calibration)
After air calibration, place the **DT302** in work position (vertical) and in water, immersing both diaphragms, wait approximately **5** minutes for stabilization and then writes a value to AUTO_CAL_POINT_HI. Any value written will calibrate internally the transmitter in 0.0 BRIX. Notice that the MEASURED_TYPE parameter should be configured to BRIX.

Figure 3.11 – Upper Concentration / Density Self-Calibration

Via Local Adjustment

Concentration/Density Calibration

The calibration process is always with reference, it means that the user must apply to the transmitter the measuring conditions. To calibrate via local adjustment, firstly is necessary to configure the TRDTY, LOWER and UPPER in the Display Function Block. For details, please see the section 'Display Transducer Block'.

Please, see the following table for the transducer parameters involved in the calibration process:

Parameter (Name)	Parameter (Relative Index)	Item (Element)	Mnemonic
TRANSDUCER_TYPE	10	-	TRDTY
CAL_POINT_LO	17	-	LO
CAL_POINT_HI	16	-	HI

The adjustment is done following these steps:

- Wait the process stabilization and collect a sample;
- Determine in laboratory the value of density/concentration of stabilized process;
- To enter the local adjustment mode, place the magnetic tool in the orifice "Z" until flag "MD" lights up in the display. Remove the magnetic tool from "Z" and place it in the orifice "S". Remove and reinsert the magnetic tool in "S" until the message "LOC ADJ" is displayed. The message will be displayed during approximately 5 seconds after removing the magnetic tool from "S". Insert the magnetic tool in "Z" and browse up to the TRDTY parameter to select the Transducer Type to "Density". Then, browse up to the LOWER or UPPER to make the calibration process, informing the determined value for the collected sample, for example, if the density is 1000 Kg/m^3, then with the magnetic tool in the orifice "S", write for example, in UPPER parameter this value and remove the magnetic tool. After returning to monitoring, the Primary Value will indicate the calibrated value for this stabilized condition.

The calibration process procedure for LOWER and UPPER is identical. It is only necessary to inform the concentration/density for the collected sample.

Limit Conditions for Concentration / Density Calibration:
For every writing operation in the transducer blocks there is an indication for the operation associate with the writing method. These codes appear in parameter XD_ERROR. Every time a calibration is performed. Code 16, for example, indicates a successfully performed operation.

Measured Type	Range 1		Range 2		AI Unit
	Lower	Upper	Lower	Upper	
Density (g/cm³)	0	3	0	10	g/cm³
Density (Kg/m³)	0	3000	0	10000	Kg/m³
Density (lb/ft³)	0	187,28	0	624,28	lb/ft³
Relative Density @ 20°C	0	3	0	10	-
Relative Density @ 4°C	0	3	0	10	-
Baume	-5	55	-5	55	degBaum
Brix	-10	110	-10	110	degBrix
Plato Degree	-10	110	-10	110	%Plato
INPM	-10	110	-10	110	INPM
GL	-10	110	-10	110	GL
Solid Percent	-10	110	-10	110	%Soli/wt
API	-10	110	-10	110	API

Table title: **Limits for Concentration/Density Calibration**

Notes: 1. Reference value @ 20°C
2. Over range limits +/- 10%

NOTE
Exit from calibration mode via local adjustment occurs automatically when the magnetic screwdriver is not being used for a few seconds. Keep it in the hole even if the LOWER or UPPER parameter shows the desired value. They must be activated once calibration is complete.

Limit Conditions for Pressure Calibration:

For every writing operation in the transducer blocks there is an indication for the operation associate with the writing method. These codes appear in parameter XD_ERROR. Every time a calibration is performed. Code 16, for example, indicates a successfully performed operation.

Upper:

SENSOR_RANGE_EUO < NEW_UPPER < SENSOR_HI_LIMIT * 1.25
Otherwise, Invalid calibration request.
(NEW_UPPER - TRIMMED_VALUE) < SENSOR_HI_LIMIT * 0.1
Otherwise, Excessive correction.
(NEW_UPPER - CAL_POINT_LO) >CAL_MIN_SPAN * 0,75
Otherwise, Invalid calibration request.

Lower:

SENSOR_RANGE.EU0 < NEW_LOWER < SENSOR_HI_LIMIT * 1.25
Otherwise, Invalid calibration request
SENSOR_LO_LIMIT < TRIMMED _VALUE < SENSOR_HI_LIMIT * 1.25
Otherwise, Out of range.
NEW_LOWER - TRIMMED _VALUE | < SENSOR_HI_LIMIT * 0.1
Otherwise, Excessive correction.
CAL_POINT_HI - NEW_LOWER | > CAL_MIN_SPAN * 0.75
Otherwise, Invalid calibration request.

If all limit conditions are according to these rules, the operation will be well succeeded.

NOTE
Codes for XD_ERROR:
16: Default Value Set
22: Out of Range
26: Invalid Calibration Request
27: Excessive Correction.

Self-Calibration

To make the self-calibration using the local adjustment, firstly is necessary to configure the AUTO_CAL_POINT_LO (LO) and AUTO_CAL_POINT_HI (HI) into the Display Function Block. For details, please see the section 'Display Transducer Block'.

Please, see the following table for the transducer parameters involved in the calibration process:

Parameter (Name)	Parameter (Relative Index)	Item (Element)	Mnemonic
TRANSDUCER_TYPE	10	--	TRDTY
MEASURED_TYPE	77	--	MEAST
AUTO_CAL_POINT_LO	84	--	LO
AUTO_CAL_POINT_HI	85	--	HI

To perform the Lower calibration, firstly the user should apply air to the sensors and then using the magnetic tool browses up to LO parameter and only writes a value. Any value written will calibrate internally the transmitter in 0.00 mmH$_2$O.

To perform the Upper calibration, firstly the user should insert the sensors in water and then using the magnetic tool browses up to HI parameter and only writes a value. In this situation, the applied pressure will be according to the distance between the sensors and the local gravity (500.0 mmH$_2$O).

Temperature Calibration

Write in parameter CAL_TEMPERATURE any value in the range -10°C to +120°C. After that, check the calibration performance using parameter SECONDARY_VALUE.

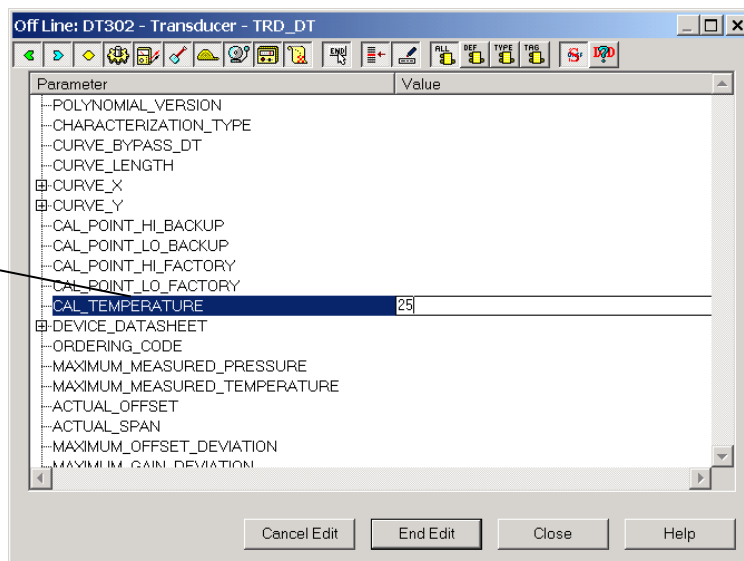By adjusting this parameter to the current temperature, the device's temperature indication is adjusted.

Figure 3.12 – Temperature Calibration Configuration Screen

Sensor Data Reading

Always when **DT302** is on, is verified if the serial number of the sensor in the sensor board is the same that the saved serial number in EEPROM in the main board. When these numbers are different (a swap of sensor set or main board was carried through) the data stored in the EEPROM of sensor board is copied to the EEPROM of the main board.

Through the parameter BACKUP_RESTORE, also this reading can be made, choosing the option "Sensor Data Restore". The operation, in this case, is done independent of the sensor serial number. Through the option "Sensor Data Backup", the sensor data stored in the main board EEPROM memory can be saved in the EEPROM of the sensor board. (This operation is done at factory).

Through this parameter, we can recover default data from factory about sensor and last saved calibration settings, as well as making the rescue of calibrations. There are the following options:

- **Factory Cal Restore:**   Recover last calibration settings done at factory;
- **Last Cal Restore:**   Recover last calibration settings done by user and saved as backup;
- **Default Data Restore:**   Restore all data as default;
- **Sensor Data Restore:**   Restore sensor data saved in the sensor board and copy them to main board EEPROM memory.
- **Factory Cal Backup:**   Copy the actual calibration settings to the factory ones;
- **Last Cal Backup:**   Copy the actual calibration settings to the backup ones;
- **Sensor Data Backup:**   Copy the sensor data at main board EEPROM memory to the EEPROM memory located at the sensor board;
- **None:**   Default value, no action is done.

This parameter is used to save or restore the default, factory or user configuration stored at the sensor module.
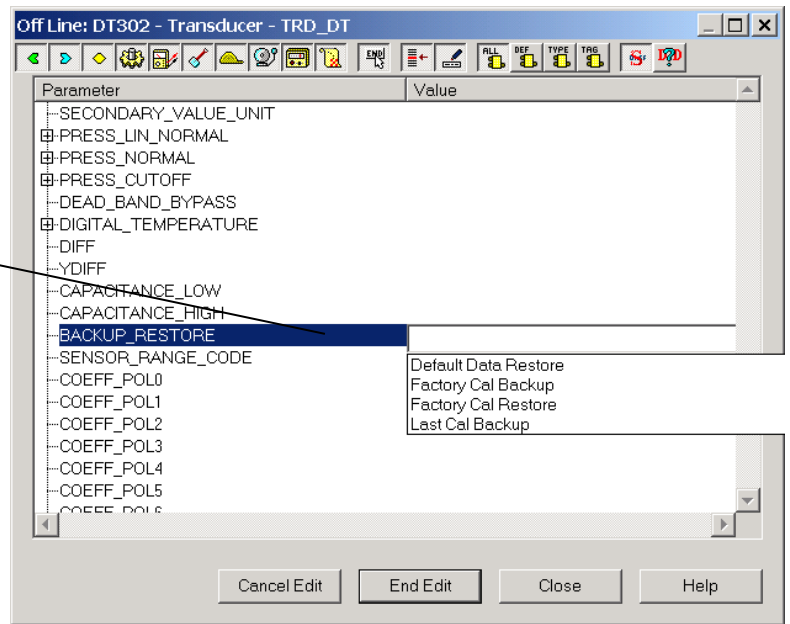
Figure 3.13 – Backup Restore Option

Transducer Display – Configuration

Using the Syscon or any other configuration tool is possible to configure the Display Transducer block. As the name described it is a transducer due the interfacing of its block with the LCD hardware.

The Transducer Display is treated as a normal block by any configuration tool. It means, this block has some parameters, and those ones can be configured according to customer's needs.

The user can choose up to seven parameters to be shown at LCD display; they can be parameters just for monitoring purpose or for acting locally in the field devices by using a magnetic tool. The first two parameters will be toggle in the display.

Display Transducer Block

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

The interface with the user is described very detailed on the "General Installation, Operation and Maintenance Procedures Manual". Please take a detailed look at this manual in the chapter related to "Programming Using Local Adjustment". It is significantly the resources on this transducer display, also all the Series 302 field devices from Smar has the same methodology to handle with it. So, since the user has learned once, he is capable to handle all kind of field devices from Smar.

All functions blocks and transducers defined according Profibus PA have a description of their features written, by the Device Description Language. This feature permits that third-party configuration tools enabled by Device Description Service technology can interpret these features and make them accessible to configure. The Function Blocks and Transducers of Series 302 have been defined rigorously according to the Foundation Fieldbus specifications in order to be interoperable to other parties.

To work with the local adjustment using the magnetic tool, it is necessary to previously prepare the parameters related with this operation via SYSCON (System Configuration).

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

Definition of Parameters and Values

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

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

Sub_Index
In case the user wants to visualize a certain tag, configure the index_relative equal to zero, and the sub-index equal to one (refer to paragraph Structure Block in the Function Blocks Manual).

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

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

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

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

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

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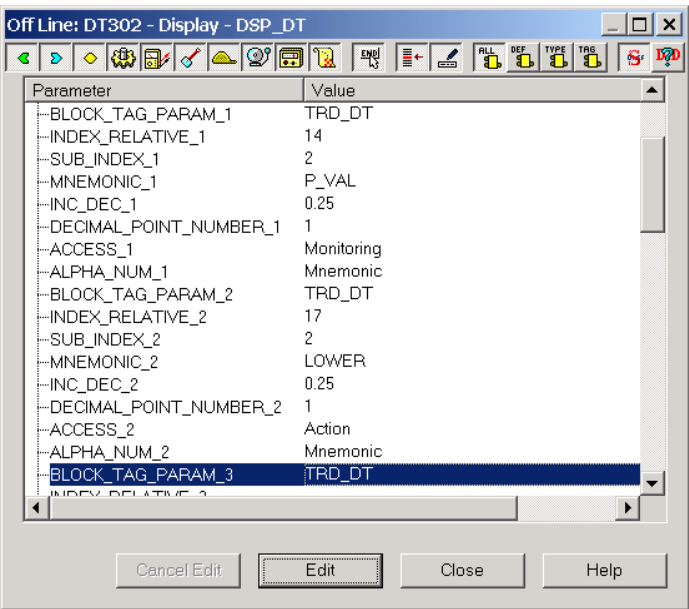

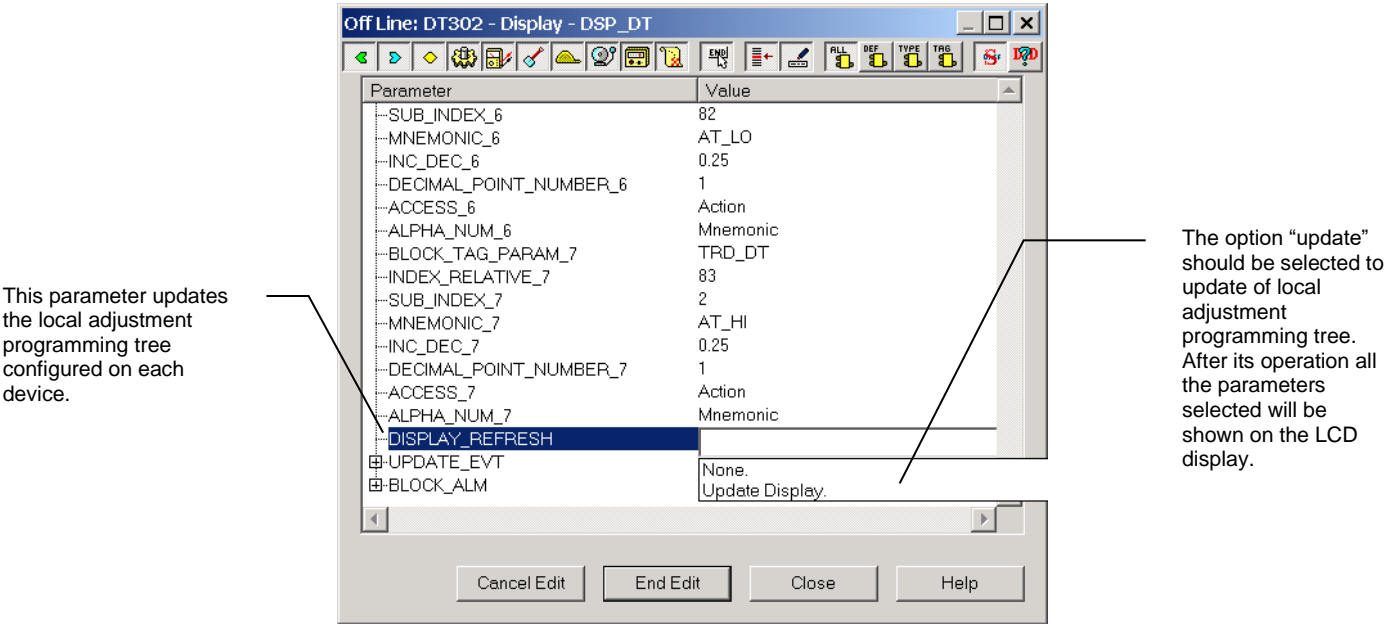*Figure 3.14 – Parameters for Local Adjustment Configuration*

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

The option "update" should be selected to update of local adjustment programming tree. After its operation all the parameters selected will be shown on the LCD display.

Figure 3.15 – Parameters for Local Adjustment Configuration

Calibrating Using Local Adjustment

In order to follow the example bellow the Display Transducer block should be configured to show these parameters: CAL_POINT_HI (mnemonic UPPER), CAL_POINT_LO (mnemonic LOWER) and TAG (mnemonic TAG).

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

This magnetic tool enables adjustment of the most important parameters of the blocks. It also enables pre-configuration of the communication.

The jumper W1 on top of the main circuit board (figure 3.17) must be in place and the transmitter must be fitted with the digital display for access to the local adjustment. Without the display the local adjustment is not possible.

To enter the local adjustment mode, place the magnetic tool in orifice "Z" until flag "MD" lights up in the display. Removes magnetic tool from "Z" and place it in orifice "S". Remove and reinsert the magnetic tool in "S" until the message "LOC ADJ" is displayed.

The message will be displayed during approximately 5 seconds after the user removes the magnetic tool from "S". By placing the magnetic tool in "Z" the user will be able to access the local adjustment/monitoring tree.
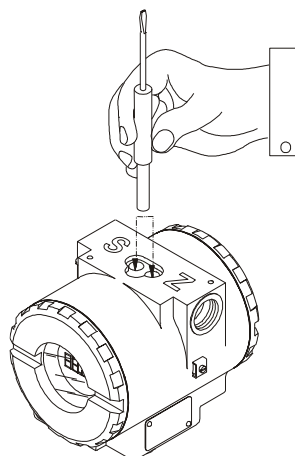
Figure 3.16 - Local Adjustment

Table 3.4 shows the actions on the **Z** and **S** holes on the **DT302** when Local Adjustment is enabled.

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

Table 3.4 - Purpose of the holes on the Housing

J1 Jumper Connections

If J1 (see figure 3.17) is connected to ON, then simulation mode in the AI block is enabled.

W1 Jumper Connections

If W1 (see figure 3.17) is connected to ON, the local adjustment programming tree is enabled, and then important block parameters can be adjusted.
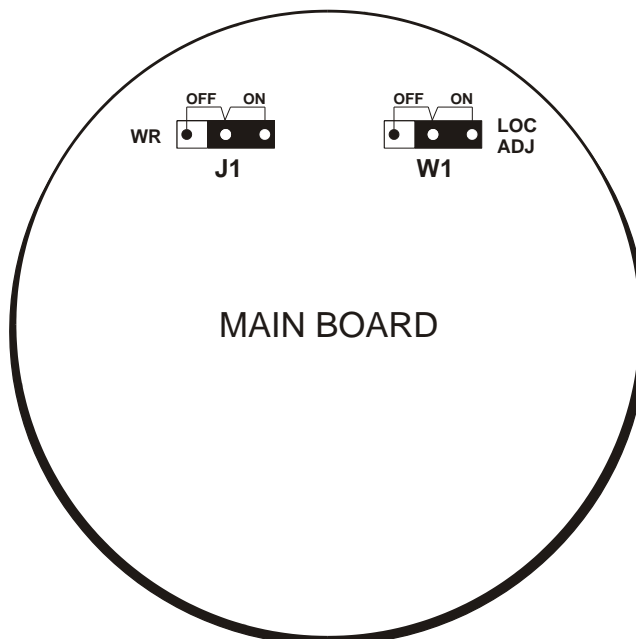

Figure 3.17 - J1 and W1 Jumpers

In order to start the local adjustment, place the magnetic tool in orifice Z and wait until letters MD are displayed.

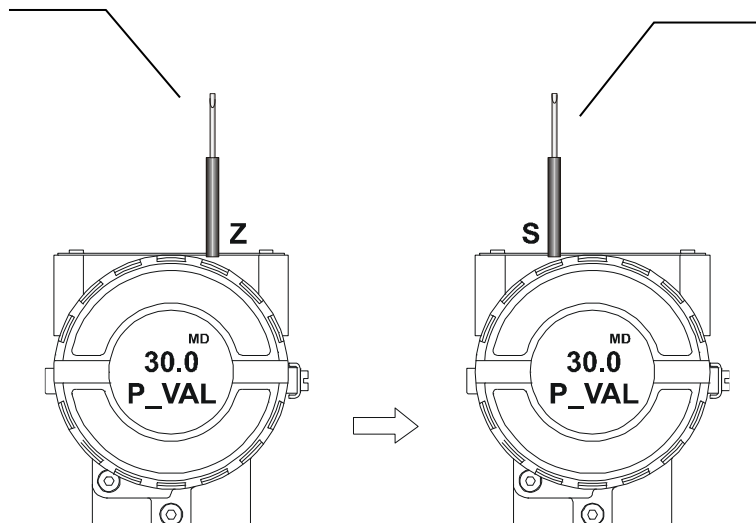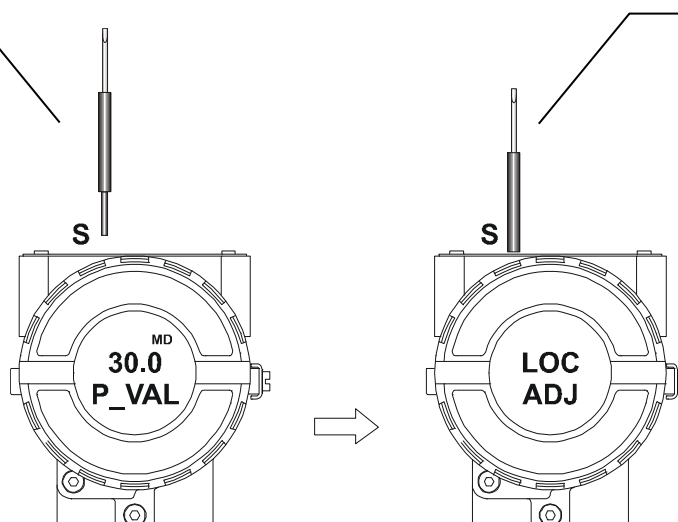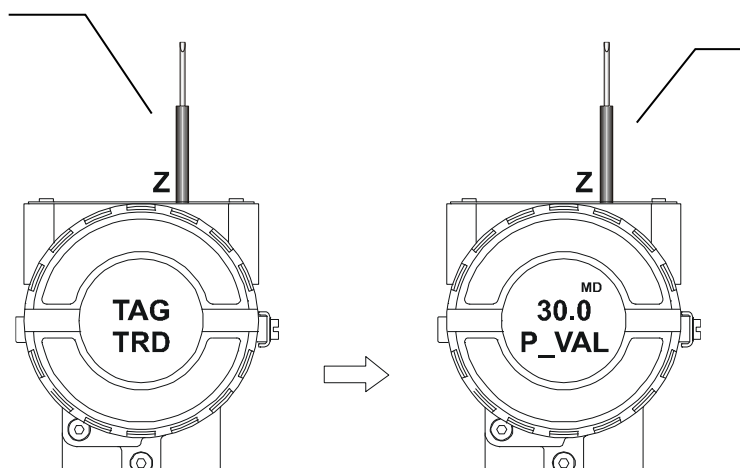Place the magnetic tool in orifice S and wait for 5 seconds.

Figure 3.18 - Step 1 - DT302

Remove the magnetic tool from orifice S.

Insert the magnetic tool in orifice S and once more LOC ADJ should be displayed.

S

MD
30.0
P_VAL

S

LOC
ADJ

*Figure 3.19 - Step 2 - DT302*

Place the magnetic tool in orifice Z. If this is the first configuration, the option shown on the display is the TAG with its corresponding mnemonic configured by the SYSCON. Otherwise, the option shown on the display will be the one configured in the prior operation. By keeping the tool inserted in this orifice, the local adjustment menu will rotate.

In this option the first variable (P_VAL) is showed with its respective value. If it is wanted it to be static, place the tool in S and keep it there.

Z

TAG
TRD

Z

MD
30.0
P_VAL

Figure 3.20 - Step 3 - DT302

To calibrate the lower value (LOWER), insert the magnetic tool in orifice S as soon as LOWER is shown in the display. An arrow pointing upward (↑) increments the value and an arrow pointing downward (↓) decrements the value. To increment the value, keep the tool inserted in S until the desired value is set.
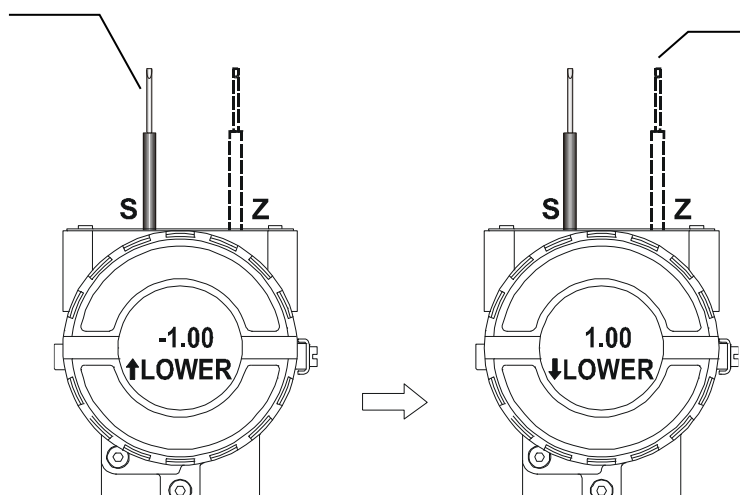
To decrement the lower value, place the magnetic tool in orifice Z to shift the arrow to the downward position and then, by inserting and keeping the tool in orifice S, it is possible to decrement the lower value.

S   Z

-1.00
↑LOWER

S   Z

1.00
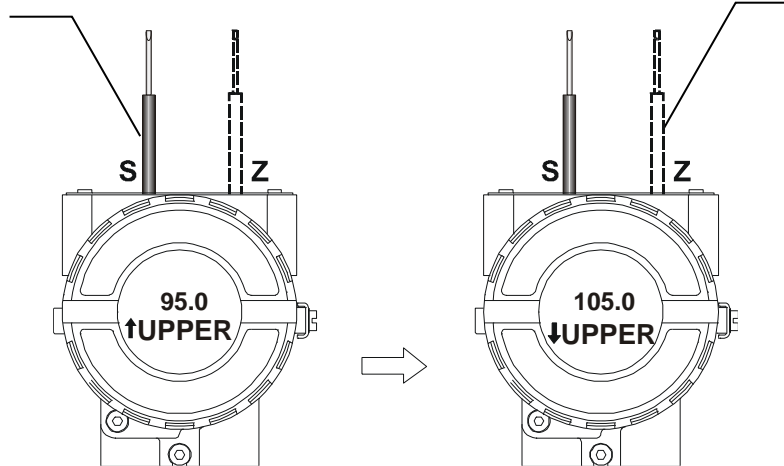**↓LOWER**

Figure 3.21 - Step 4 - DT302

To calibrate the upper value (UPPER), insert the magnetic tool in orifice S as soon as upper is shown in the display. An arrow pointing upward (↑) increments the valve and an arrow pointing downward (↓) decrements the value. To increment the value, keep the tool inserted in S until the desired value is set.

To decrement the upper value, place the magnetic tool in orifice Z to shift the arrow to the downward position and then; by insetting and keeping the tool in orifice S, it is possible to decrement the upper value.

S   Z   S   Z

95.0
↑UPPER

105.0
↓UPPER

Figure 3.22 - Step 5 - DT302

MAINTENANCE PROCEDURES

General

DT302 Concentration/ Density 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 end users do not try to repair printed circuit boards. Spare circuit boards may be ordered from Smar whenever necessary.

The **DT302** has been designed to operate for many years without malfunctions. The process application can require periodic cleaning of the repeater diaphragms, and then the flanges may be easily removed and reinstalled. The transmitter eventually can require maintenance, and then it may be changed in the field. In this case, the possibly damaged sensor should be returned to Smar for evaluation and, if necessary, repair. Refer to the item "Returning Materials" at the end of this Section. The table 4.1 shows the symptoms and the probable source of problem cause:

SYMPTOM	PROBABLE SOURCE OF PROBLEM
NO COMMUNICATION	• *Transmitter Connections* Check wiring polarity and continuity. Check for short-circuit or ground loops. Check if the power supply connector is connected to main board. Check if the shield is not used as a conductor. It should be grounded at one end only.
	• *Power Supply* Check power supply output. The voltage must be between 9 - 32 VDC at the **DT302** terminals. Noise and ripple should be within the following limits: a) 16 mV peak to peak from 7.8 to 39 KHz. b) 2 V peak to peak from 47 to 63 Hz for non-intrinsic safety applications and 0.2 V for intrinsic safety application. c) 1.6 V peak to peak from 3.9 MHz to 125 MHz.
	• *Network Connection* Check that the topology is correct, and all devices are connected in parallel. Check that two Terminators are OK and correctly positioned. Check that the Terminators are according to the specifications. Check length of trunk and spurs. Check spacing between couplers.
	• *Network Configuration* Check the network communication configuration.
	• *Electronic Circuit Failure* Check the main board for defect by replacing it with a spare one.
INCORRECT READING	• *Transmitter Connections* Check for intermittent short-circuits, open circuits and grounding problems. Check if the sensor is correctly connected to the **DT302** terminal block.
	• *Noise, Oscillation* Adjust damping. Check grounding of the transmitters housing. Check that the shielding of the wires between 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 **DT302** has been configured to. Check if process is within the range of the sensor and the **DT302**.

Table 4.1 - Symptoms and Probable Source of Problem

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

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

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

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

The operations to follow are:

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

2) Power on the equipment;

3) As soon as Factory Init is shown on the display, take off the tools and wait for the "**5**" symbol on the right upper corner of the display to unlit, thus indicating the end of the operation, otherwise the information will not be saved.

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

ATTENTION
In general, in every change that needs to be persisted, such as after a download, the information is saved in FRAM. During this operation, the "5" symbol appears on the display and you must not turn off the transmitter, otherwise the information will not be persisted (saved).

Procedure to change the DT302 Main Electronic Board

- Replace the main electronic board
- Read from sensor (Backup menu).
- Trim the temperature with two temperatures 30°C apart.
- This procedure must be done, when the temperature is steady, a temperature standard must be used as a reference to adjust the DT temperature.
- After the temperature trim, make the self-calibration.

Disassembly Procedure

WARNING
Do not disassemble with power on.

Figures 4.3 and 4.4 show transmitter's exploded view and will help you to understand the text below. The numbers between parentheses are relating to the enumeration of the items of the related drawing.

Group of the Probe

To have access to the probe for cleaning, it is necessary to remove it from the process. Remove the transmitter loosening the flange.

Cleaning should be done carefully to avoid damaging of the delicate isolating diaphragms. Use of a soft cloth and a nonacid solution is recommended.

To remove the sensor from the electronic housing, the electrical connections (in the field terminal side) and the main electronic board connector must be disconnected.

Loosen the hex screw **(6)** and carefully unscrew the electronic housing from the sensor, observing that the flat cable is not excessively twisted.

WARNING
To avoid damage do not rotate the electronic housing more than 270⁰ starting from the fully threaded without disconnecting the electronic circuit from the sensor and from the power supply. See Figure 4.1.

Figure 4.1 - Safe Housing Rotation

Electronic Circuit

To remove the circuit board **(3)**, loosen the two screws that anchor the board.

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.

Pull the main board out of the housing and disconnect the power supply and the sensor connectors.

Reassemble Procedure

WARNING
Do not assemble the main board with power on.

Group of the Probe

The bolts, nuts, flanges and other parts should be inspected for corrosion or other eventual damage. Damaged parts should be replaced.

The fitting of the sensor must be done with the main board out of the electronic housing. Mount the sensor to the housing turning clockwise until it stops. Then turn it counterclockwise until it faces the protective cover (1) parallel to the process flange. Tighten the hex screw (5) to lock the housing to the sensor. Only after that is recommended to install the main board.

Electronic Circuit

Plug sensor connector and power supply connector to main board. Attach the display to the main board. Observe the four possible mounting positions. The Smar mark indicates up position.
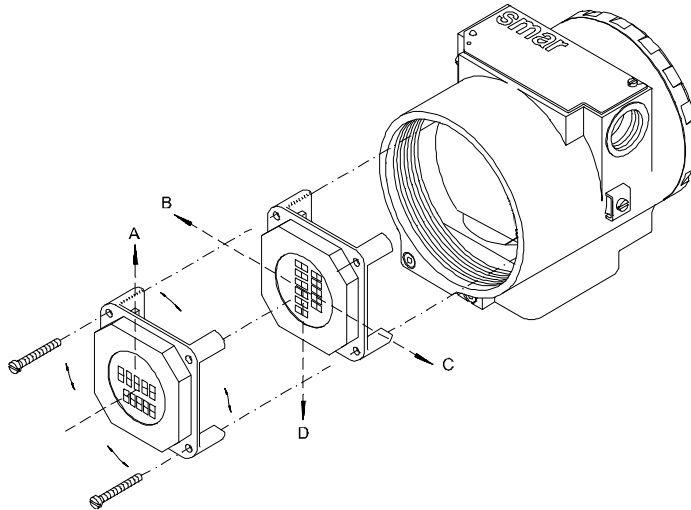
Figure 4.2 - Four Possible Positions for Display

Anchor the main board and display with their screws.

After tightening the protective cover **(1)**, mounting procedure is complete. The transmitter is ready to be energized and tested.

Interchangeability

To obtain an accurate and better temperature compensated response. Each sensor is submitted to a factory characterization process and the specific data is stored in an EEPROM located in the sensor body.

Every time the power is turned on, the main circuit reads the sensor serial number, should it differ from the number stored in the memory. The circuit understands that there is a new sensor and the following information is transferred from the sensor to the main circuit.

- Temperature compensation coefficients.
- Sensor's trim, including characterization curve.
- Sensor characteristics: type, range, diaphragm material and fill fluid.

The other transmitter characteristics are stored in the main circuit memory and are not affected by sensor change.

Data transfer from the sensor to the main circuit can be performed by parameter BACKUP_RESTORE previously explained. In case of changing of the main board, the information of the sensor, as described above are updated. However, the transmitter information such as upper value and lower value must be reconfigured.

Upgrading DT301 to DT302

The sensor and housing of the DT301 is exactly the same as the **DT302**. By changing the circuit board of the DT301 it becomes a **DT302**.

Upgrading the DT301 to a **DT302** is therefore very much the same as the procedure for replacing the main board described above.

To remove the circuit board **(3)**, loosen the two screws that anchor the board. Caution with the circuit boards must be taken as mentioned above. Pull the DT301 main board out of the housing and disconnect the power supply and the sensor connectors.

Put in the **DT302** main board reversing the procedure for removing the DT301 circuit.

Returning Materials

If it becomes necessary to return the transmitter and/or configurator to Smar, simply contact our office, informing the defective instrument's 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.

Accessories

ACCESSORIES	
ORDERING CODE	**DESCRIPTION**
SD1	Magnetic Tool for Local Adjustment
PS302	Power Supply
FDI302	Field Device Interface
BT302	Terminator
DF47-12 or DF47-17	Intrinsic Safety Barrier
SB302	Insulated Intrinsic Safety Barrier

Exploded View
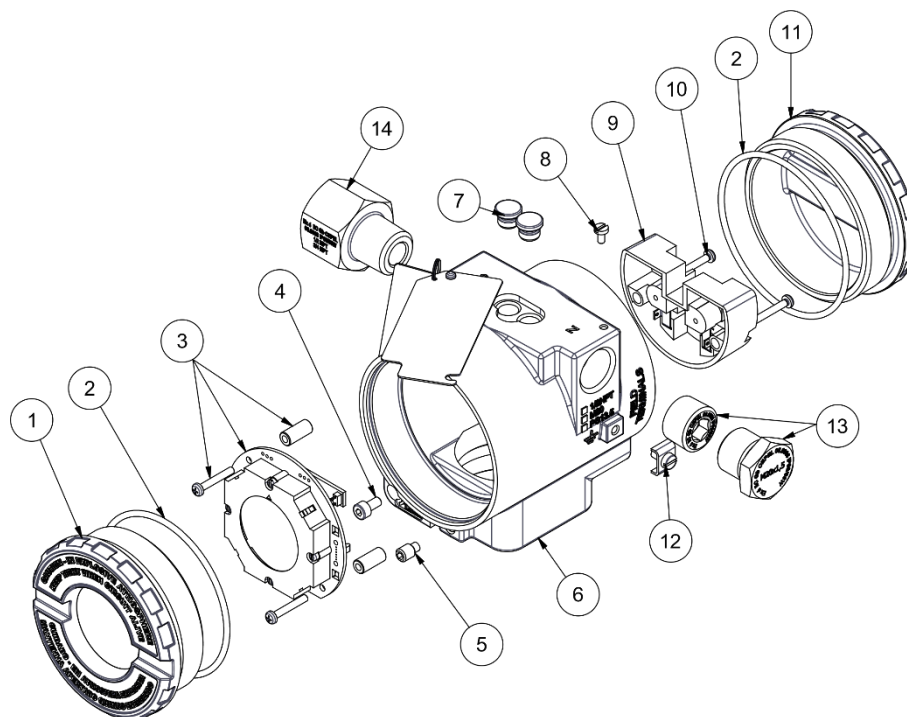
SPARE PARTS LIST		
DESCRIPTION	**POSITION**	**CODE**
COVER WITH WINDOW FOR INDICATION	1	400-1307-1xx
COVER O-RING	2	204-0122
MAIN ELECTRONIC CIRCUIT BOARD	3	400-1356 (NOTE)
COVER LOCKING SCREW	4	204-0120
SENSOR LOCKING SCREW	5	400-1121
HOUSING	6	400-1314-6xx
LOCAL ADJUSTMENT PROTECTION COVER	7	204-0114
IDENTIFICATION PLATE FIXING SCREW	8	204-0116
TERMINAL BLOCK	9	400-0059
TERMINAL HOLDING SCREW	10	204-0119
COVER WITHOUT WINDOW	11	400-1307-0xx
EXTERNAL GROUND SCREW	12	204-0124
M20 X 1.5 External Socket Plug in 316 SST BR-EX D	13	400-0810
PG13.5 External Socket Plug in 316 SST	13	400-0811
1/2" NPT BR-Ex-d Internal Socket Set Plug in 316 SST	13	400-1484
3/4 NPT Adapter in 316 SST BR-EX D	14	400-0812

| NOTE ITEM 3 |
|---|
| Access https://www.smar.com/en/support, in General Support, look for Compatibility Note and consult the document. |

NOTE ITEM 13
The spare part 400-1484, Internal Hexagonal Plug 1/2" NPT 316SST BR-Ex-d, was standardized in 316SST material and will be used in all line of housings (aluminum, copper free aluminum or 316SST). With or without CEPEL certificate.

400-1314	HOUSING				
	COD.	Communication Protocol			
	F	Foundation Fieldbus			
		COD.	Electrical Connection		
		0	½ NPT		
		A	M20x1.5		
		B	PG13.5		
			COD.	Material	
			H0	Aluminum (IP/Type)	
			H1	Stainless steel (IP/Type	
			H2	Aluminum for saline atmosphere (IPW/Type X)	
			H4	Aluminum Copper Free (IPW/Type X)	
				COD.	Painting
				P0	Gray Munsell N6.5
				P8	Without painting
				P9	Safety Blue Epoxy – Electrostatic painting
400-1314	F	0	H0	P0	TYPICAL MODEL

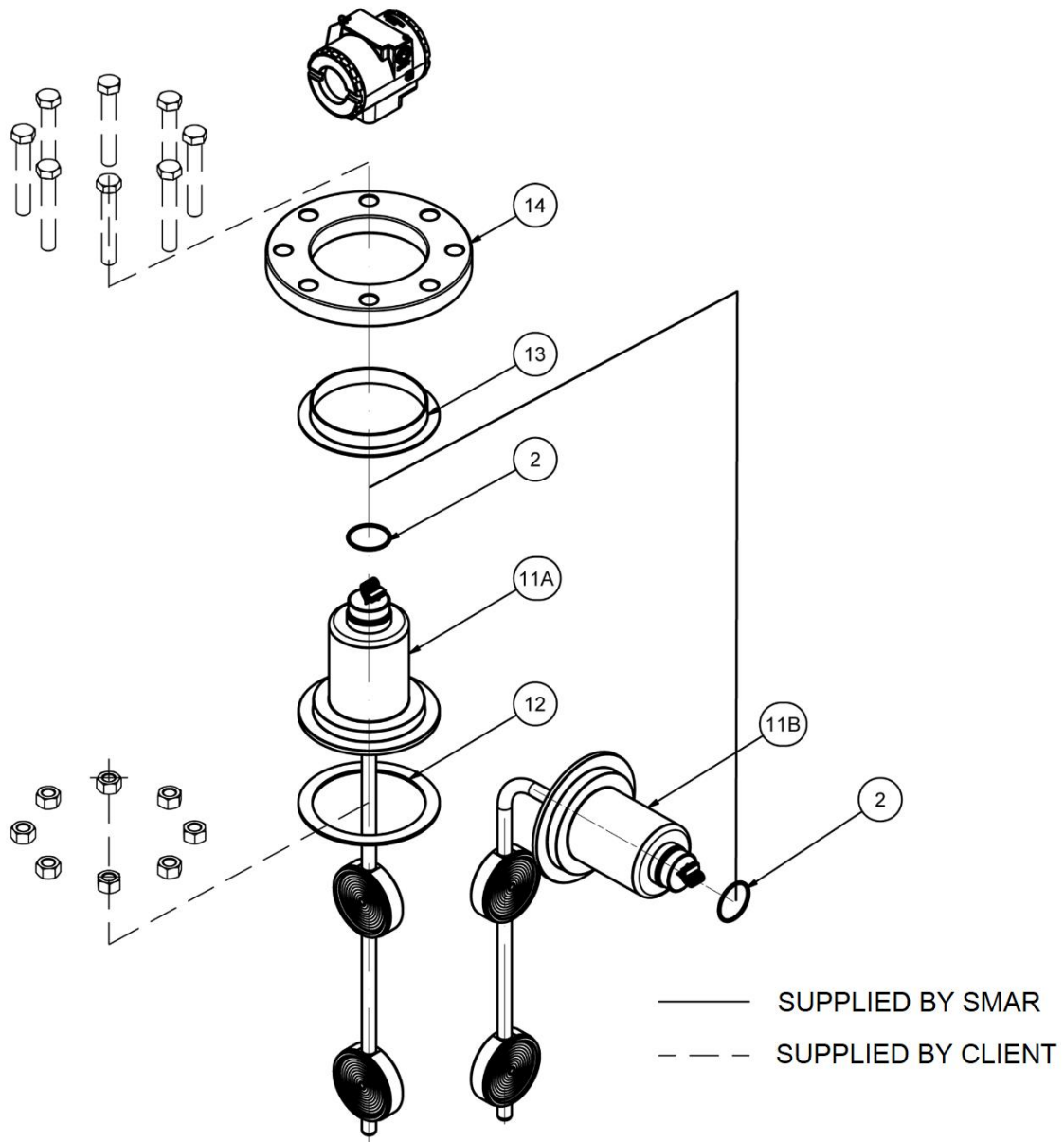| 400-1307	Cover			
	COD.	Type		
	0	With window		
	1	Without window		
		COD.	Material	
		H0	Aluminum (IP/Type)	
		H1	Stainless steel (IP/Type)	
			COD.	Painting
			P0	Gray Munsell N6.5
			P8	Without painting
			P9	Safety Blue Epoxy – Electrostatic painting
400-1307	1	H0	P0	TYPICAL MODEL
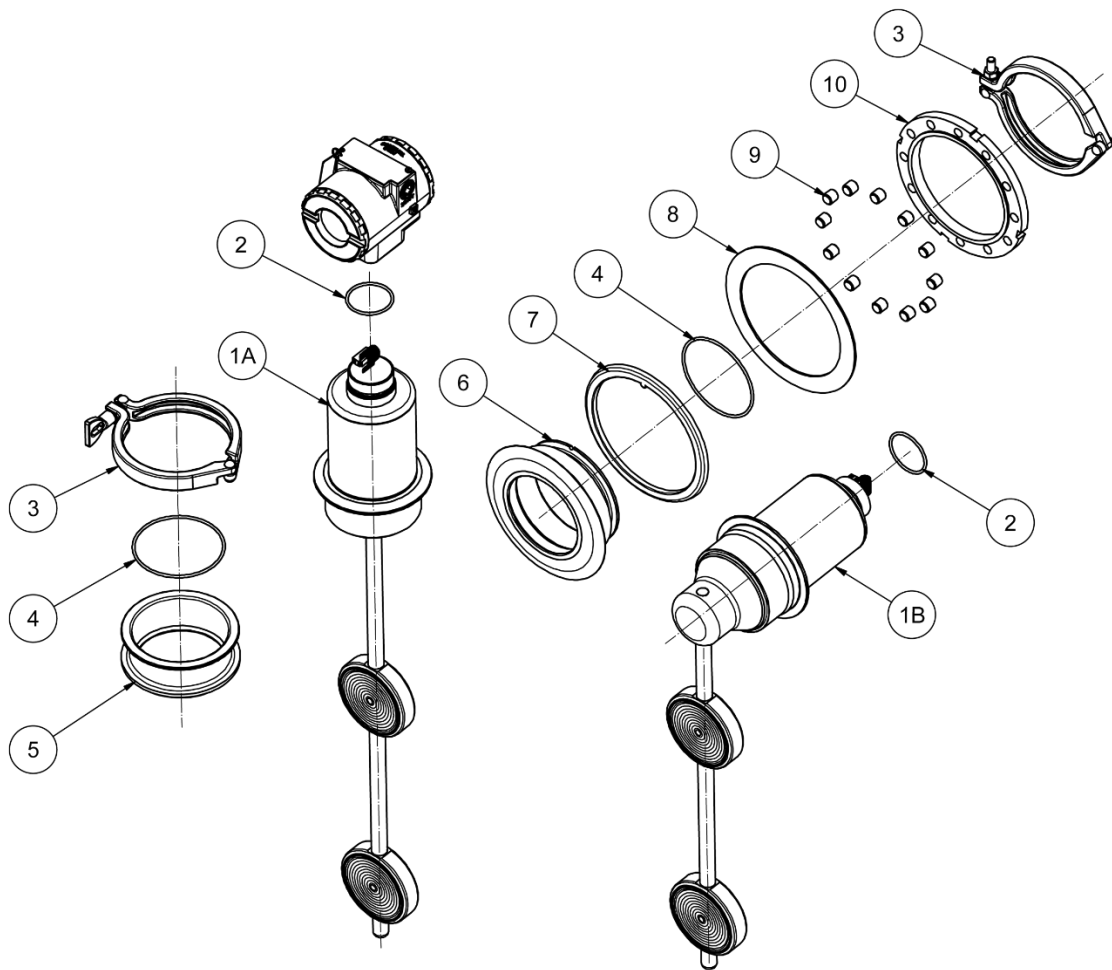
Figure 4.3 - DT302 Exploded View - Sanitary Model

Figure 4.4 - DT302 Exploded View - Industrial Model

Spare parts

SPARE PARTS LIST			
DESCRIPTION OF PARTS	**POSITION**	**CODE**	**CATEGORY (NOTE 1)**
O-RINGS (NOTE 4)			
Neck, Buna-N	2	204-0113	B
Process connection, Buna-N (**Sanitary Model**)	4	400-0815	B
PROCESS CONNECTION – INDUSTRIAL MODEL			
Flange 4" – 150# ANSI B-16.5, 316L SST	14	400-0237	
Flange 4" – 300# ANSI B-16.5, 316L SST	14	400-0238	
Flange 4" – 600# ANSI B-16.5, 316L SST	14	400-0239	
Flange DN 100, PN 25 / 40, DIN 2526 – Form D, 316L SST	14	400-0240	
Teflon Gasket	12	400-0720	
Teflon Insulation Joint	13	400-0863	
PROCESS CONNECTION - SANITARY MODEL			
Tank Adapter for Straight Model 316L SST	5	400-0241	
Tri-Clamp de 4", 316L SST (Clamp 304/ Nut 316L)	3	400-0242	
Tank Adapter for Curve Model 316L SST	6	400-0721	
Silicon O'Ring	7	400-0722	
Protection Flange	8	400-0723	
Tightening Flange	10	400-0724	
Tightening Flange Screw	9	400-0725	
PROBE			
Industrial Probe	11A or 11B	(NOTE 5)	B
Sanitary Probe	1A or 1B	(NOTE 5)	B

Table 4.2 - Spare Parts List

NOTE 1: For category A, it is recommended to keep, in stock, 25 parts installed for each set, and for category B, 50.
NOTE 2: Includes Terminal Block, Bolts, and Identification plate without certification.
NOTE 3: The main board of **DT302** and probe are items.
NOTE 4: O-rings are packaged in packs of 12 units.
NOTE 5: To specify sensors, use the following tables.

400-0243-S	Sanitary Model Probe			
	COD.	**RANGE**		
	1	0 to 3 g/cm^3 (1)		
	2	0 to 10 g/cm^3		
		COD.	**Diaphragm Material**	
		I	316L SST	
		U	Hastelloy C276	
			COD.	**Fill Fluid**
			N	Propylene Glycol – Neobee M2O – Food Grade
				COD.	**Mounting**
				1	Straight
				2	Curved
400-0243-S	**1**	**I**	**N**	**1**

Note 1: Values referring to the 250 mm probe between centers. For a 500 mm probe, range 1 ranges from 0 to 2 g/cm^3.

400-0243-I	Industrial Model Probe				
CODE	**RANGE**				
1	0 to 3 g/cm^3 (1)				
2	0 to 10 g/cm^3 (2)				
	CODE	**Diaphragm Material / Probe**			
	H	Hastelloy C276 / Hastelloy C276			
	I	316L SST / 316L SST			
	L	316L SST HALLAR Plated/ 316L SST HALLAR Plated			
	U	Hastelloy C276 / 316L SST			
	Z	Others - Specify			
		CODE	**Fill Fluid**		
		N	Propylene Glycol – Neobee M2O		
		S	DC 200/20 - Silicone Oil		
			CODE	**Mounting**	
			1	Straight	
			2	Curved	
400-0243-I	**1**	**H**	**S**	**1**	

Note 1: Values referring to the 250 mm probe between centers. For a 500 mm probe, range 1 ranges from 0 to 2 g/cm^3 and 800 mm probe, varies from 0 to 1.8 g/cm^3.

Note 2: Values referring to probes of 250 and 500 mm between centers. For 800 mm probe, range 2 ranges from 0 to 7 g/cm^3.

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).

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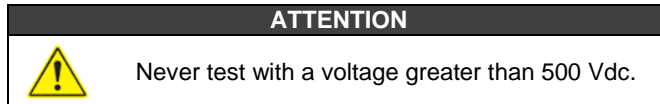
5. The value obtained must be greater than or equal to 2GΩ and the voltage application time must be at least 1 second and at most 5 seconds.

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.

TECHNICAL CHARACTERISTICS

Filling Fluids

The filling fluid selection shall consider its physical properties in what concerns to pressure temperature limits and chemical compatibility with the process fluid. The latter is an important consideration in case the filling fluid happens to meet the process fluid, should a leakage occur.

Table 5.1 presents the filling fluids, which are available for the **DT302**, together with physical properties and applications.

FILLING FLUID	VISCOSITY (cSt) at 25ºC	DENSITY (g/cm³ at 25ºC)	THERMAL EXPANSION COEFICIENT (1/ºC)	APPLICATIONS
Silicone DC 200/20	20	0.95	0.00107	General purpose – Standard
Propylene Glycol (Neobee M20) Food Grade	9.8	0.90	0.001	Beverage and pharmaceutical food grade

Table 5.1 - Properties of Filling Fluids

Functional Specifications

Output Signal
Digital, only. Foundation^{TM} Fieldbus, 31.25 kbit/s, voltage mode with bus power.

Power Supply
Bus powered: 9 - 32 Vdc.
Quiescent current consumption: 12 mA.

Indicator
4 ½ -digit numerical and 5-character alphanumerical LCD indicator.

Hazardous Area Certifications
See Appendix A for further information.

Temperature Limits
Ambient: -40   to   85º C   (-40   to   185º F)
Process: -20   to 150º C   (-04   to   302º F)
Storage: -40   to 100º C   (-40   to   212º F)
Digital Display: -10   to   60º C   (14   to   140º F)

Static Pressure Limit
70 kgf/cm^2 (7 MPa) (1015 PSI).

Turn-on Time
Approximately 5 seconds.

Volumetric Displacement
Less than 0.15 cm^3 (0.01 in^3)

Humidity Limits
0 to 100% RH.

Temperature Compensation
Automatic.

Performance Specifications

Reference conditions: temperature 25°C (77°F), power supply of 24 Vdc, atmospheric pressure, silicone oil fill fluid,316L diaphragm and range full - scale calibration.

RANGE	ACCURACY (1)	AMBIENT TEMPERATURE EFFECT / 10°C	STABILITY (For 3 Months)	STATIC PRESSURE EFFECT (2) (per 1 kgf/cm^2)
1	±0.0004 g/cm^3 (±0.1 °Brix)	0.003 kg/m^3	0.021 kg/m^3	0.001 kg/m^3
2	±0.0007 g/cm^3	0.013 kg/m^3	0.083 kg/m^3	0.004 kg/m^3

(1) Linearity, hysteresis, and repeatability effects are included.
(2) This is systematic error that can be eliminated by calibrating at the operating static pressure.

Table 5.2 - Performance Specifications

Power Supply Effect
±0.005 of calibrated FS per volt.

Electro-Magnetic Interference Effect
Designed to comply with IEC 61326-1:2006, IEC 61326-2-3:2006, IEC 61000-6-4:2006 and IEC 61000-6-2:2005.

Physical Specifications

Electrical Connection
½ -14 NPT, Pg 13.5 or M20 x 1.5".

Process Connection
Industrial model: AISI316L Stainless Steel Flange, in accordance with ASME B16.5 or EN1092-1 (Former DIN2526).
Sanitary model: AISI316L Stainless Steel Triclamp (Clamp 304/ Nut 316L).

Wetted Parts
Isolating diaphragms: 316L SST or Hastelloy C276.
Probe material: 316L SST or 316L SST with Halar
O-ring for sanitary model: Buna-N, Viton™ or Teflon™

Non-wetted Parts
Electronic Housing: injected low copper aluminum with polyester painting or 316 SST housing, with Buna-N o-rings on cover (NEMA 4X, IP67).
Fill fluid: Silicone (DC200/20), Neobee M20 Propylene Glycol.
Identification plate: 316 SST.
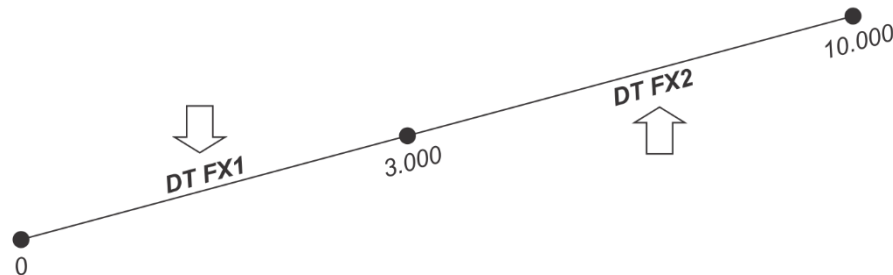
Mounting
Side or top mounting.

Weight
Sanitary model: 9 kg (20 lb) - Industrial model: 12 kg (26 lb).

Ordering Code

MODEL	SANITARY CONCENTRATION/DENSITY TRANSMITTER											
	CODE	**Range**		**Minimum Span**								
	1	0 to 3 g/cm^3		0.025 g/cm^3		**Note**: These measurement ranges are provided for our standard Density Transmitter, 250 mm of distance between diaphragms (centers) on the probe and are valid for straight and curved devices. For instruments with distance between centers of 500, please see table 5.1						
	2	0 to 10 g/cm^3		0.025 g/cm^3								
		CODE	**Wetted Parts Material**									
		I	316L SST									
		U	Probe in 316 SST and Diaphragms in Hastelloy C276									
			CODE	**Fill Fluid**								
			N	Neobee - M20 Propylene Glycol – Food Grade								
			S	DC 200/20 - Silicone Oil								
				CODE	**Local Indicator**							
				0	Without Indicator							
				1	With Digital Indicator							
					CODE	**Electrical Connection**						
					0	½ - 14 NPT **(4)**						
					1	½ - 14 NPT x ¾ NPT (Al 316) – With Adapter **(5)**						
					2	½ - 14 NPT x ¾ BSP (Al 316) – With Adapter **(6)**						
					3	½ - 14 NPT x ½ BSP (Al 316) – With Adapter **(6)**						
					A	M20 X1.5 **(4)**						
					B	PG 13.5 DIN **(6)**						
					Z	Others - Specify						
						CODE	**Mounting**					
						1	Straight – distance between centers 500 mm					
						2	Curved – distance between centers 500 mm					
						3	Straight – distance between centers 250 mm					
						4	Curved – distance between centers 250 mm					
							CODE	**Process Connection**				
							J	Tri-clamp – 4"				
							K	SMS thread diameter 89 RD120-4				
								CODE	**Wetted O-Rings Material**			
								B	Buna-N			
								V	Viton			
								T	Teflon			
									CODE	**Tank Adapter**		
									0	Without Tank Adapter (Supplied by Customer)		
									2	Curved DT30XS with adapter for D>4m tank		
									3	Curved DT30XS with adapter for 1.2m < D < 3.8m tank		
									4	Curved DT30XS with adapter for 0.5m < D < 1m tank		
									5	Straight DT30XS with adapter (welded)		
										CODE	**Tri-Clamp**	
										0	Without Tri-clamp	
										1	With Tri-clamp in 304 SST	
											CODE	**Continues next page**
DT302S	**1**	**I**	**N**	**1**	**0**	**2**	**J**	**B**	**1**	**1**	*****	← **TYPICAL MODEL NUMBER**

* Leave it blank for no optional items.

MODEL	SANITARY CONCENTRATION/DENSITY TRANSMITTER (CONTINUATION)					
	CODE	Identification Plate				
	I4	ATEX (EX-I, EX-D) (Gas)				
	I5	INMETRO (EX-D, EX-I) (Gas)				
	I6	Without certification				
	I7	ATEX (EX-I) (Mining)				
	IJ	ATEX (EX-D) (Gas)				
	IO	INMETRO (Dust)				
		CODE	Housing Material (1) (2)			
		H0	Aluminum (IP/Type)			
		H1	316 SST (IP/Type)			
		H2	Aluminum for Saline Atmosphere (IPW/TypeX) **(3)**			
		H3	316 SST for Saline Atmosphere (IPW/TypeX) **(3)**			
		H4	Copper Free Aluminum (IPW/TypeX) **(3)**			
			CODE	Special (See notes)		
			Z0	Not Applicable		
			ZZ	See notes		
				CODE	Tag Plate	
				J0	With Tag	
				J1	Blank	
					CODE	Painting
					P0	Gray Munsell N 6,5
					P2	Blue Safety – Atmospheric Zone – Petrobras N1021
					P3	Black Polyester
					P8	Without Painting
					P9	Blue Safety Epoxy – Electrostatic Painting

						CODE	Manufacturing Standard
						S0	Smar

DT302S	/	I6	H0	Z0	J0	P0	S0	⬅ **TYPICAL MODEL**

* Leave it blank for no optional items.

Notes
(1) IPX8 tested in 10 meters of water column for 24 hours.
(2) Ingress Protection: IP66/68 protection degree according to IEC60529 standard.
(3) IPW / TypeX tested for 200 hours according to NBR 8094 / ASTM B 117 standard.
(4) Certification Ex-d for ATEX / IECEx / INMETRO.
(5) Certification Ex-d for INMETRO.
(6) Options not certified for Explosive Atmosphere.

Table 5.1		
Dimensions between diaphragms (centers) mm	Limit Values	
	Measuring range Fx1	Measuring range Fx2
mm	Kg/m^3	Kg/m^3
250	0-3000	0-10000
500	0-2000	0-10000

MODEL	INDUSTRIAL CONCENTRATION/DENSITY TRANSMITTER		
	CODE	**Range**	**Minimum Span**
	1	0 to 3 g/cm³	0.025 g/cm³	**Note**: These measurement ranges are provided for our standard Density Transmitter, 250 mm of
	2	0 to 10 g/cm³	0.025 g/cm³	distance between diaphragms (centers) on the probe and are valid for straight and curved devices. For instruments with distance between centers of 500 and 800mm, please see table 5.2

	CODE	**Diaphragm Material / Probe**
	H	Hastelloy C276 / Hastelloy C276
	I	316L SST / 316L SST
	U	Hastelloy C276 / 316L SST
	L	316L SST with Halar coating/ 316L SST with Halar coating
	Z	Others - Specify

	CODE	**Fill Fluid**
	N	Neobee - M20 Propylene Glycol – Food Grade
	S	DC 200/20 - Silicone Oil

	CODE	**Local Indicator**
	0	Without Indicator
	1	With Digital Indicator

	CODE	**Electrical Connection**
	0	½ - 14 NPT **(4)**
	1	½ - 14 NPT x ¾ NPT (316 SST) – With Adapter **(5)**
	2	½ - 14 NPT x ¾ BSP (316 SST) – With Adapter **(6)**
	3	½ - 14 NPT x ½ BSP (316 SST) – With Adapter **(6)**
	A	M20 X1.5 **(4)**
	B	PG 13.5 DIN **(6)**
	Z	Others - Specify

	CODE	**Mounting**
	1	Straight – distance between centers 500 mm
	2	Curved – distance between centers 500 mm
	3	Straight – distance between centers 800 mm
	4	Curved – distance between centers 800 mm
	5	Straight – distance between centers 250 mm
	6	Curved – distance between centers 250 mm
	7	Straight – distance between centers 250 mm with normalized tube
	Z	Special – See notes

	CODE	**Process Connection**
	5	4" ANSI B – 16.5
	A	DN 100 DIN 2526 – FORM D
	Z	Others – Specify

	CODE	**Pressure Class**
	1	150# ANSI B – 16.5
	2	300# ANSI B – 16.5
	3	600# ANSI B – 16.5
	C	PN25/40
	Z	Others – Specify

	CODE	**Flange Face**
	0	RF
	2	RTJ

	CODE	**Continues next page**
	*****	

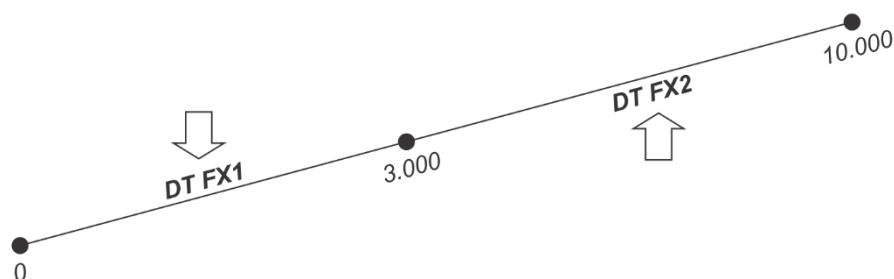| DT302I	1	I	S	1	0	1	5	1	0	*

← **TYPICAL MODEL**

* Leave it blank for no optional items.

MODEL	INDUSTRIAL CONCENTRATION/DENSITY TRANSMITTER (CONTINUATION)						
	CODE	**Identification Plate**					
	I4	ATEX (EX-I, EX-D) (Gas)					
	I5	INMETRO (EX-D, EX-I) (Gas)					
	I6	Without certification					
	I7	ATEX (EX-I) (Mining)					
	IJ	ATEX (EX-D) (Gas)					
	IO	INMETRO (Dust)					
		CODE	**Housing Material (1) (2)**				
		H0	Aluminum (IP/Type)				
		H1	316 SST (IP/Type)				
		H2	Aluminum for Saline Atmosphere (IPW/TypeX) **(3)**				
		H3	316 SST for Saline Atmosphere (IPW/TypeX) **(3)**				
		H4	Copper Free Aluminum (IPW/TypeX) **(3)**				
			CODE	**Special (See notes)**			
			ZZ	See notes			
				CODE	**Painting**		
				P0	Gray Munsell N 6,5		
				P2	Blue Safety – Atmospheric Zone – Petrobras N1021		
				P3	Black Polyester		
				P8	Without Painting		
				P9	Blue Safety Epoxy – Electrostatic Painting		
					CODE	**Tag Plate**	
					J0	With Tag	
					J1	Blank	
						CODE	**Manufacturing Standard**
						S0	Smar
							CODE	**Optional Items**
							*	

DT302I	/	I6	H0	ZZ	J0	P0	S0		← **TYPICAL MODEL**

* Leave it blank for no optional items.

Optional Items

Diaphragm Thickness	**N0** - Standard
Strengthening of the Probe	**R0 -** Standard
	R1 – With strengthening of the probe
Mounting Position	**E0 -** Standard
	E1 – Reverse position

Notes
(1) IPX8 tested in 10 meters of water column for 24 hours.
(2) Ingress Protection: IP66/68 protection degree according to IEC60529 standard.
(3) IPW / TypeX tested for 200 hours according to NBR 8094 / ASTM B 117 standard.
(4) Certification Ex-d for ATEX / IECEx / INMETRO
(5) Certification Ex-d for INMETRO
(6) Options not certified for Explosive Atmosphere.

Table 5.2		
Dimensions between diaphragms (centers) mm	**Limit Values**	
	Measuring range Fx1	**Measuring range Fx2**
mm	**Kg/m³**	**Kg/m³**
250	0-3000	0-10000
500	0-2000	0-10000
800	Unavailable	350-7000

MODEL		SUBMERSIBLE CONCENTRATION/DENSITY TRANSMITTER							
	COD.	**Range**			**Minimum Span**				
	1	0	to	3 kg/cm³	0,025 g/cm³	**Note**: These measurement ranges are provided for our standard Density Transmitter, 250 mm of			
	2	0	to	10 kg/cm³	0,025 g/cm³	distance between diaphragms (centers) on the probe and are valid for straight and curved devices. For instruments with distance between centers of 500, please see table 5.3.			
		COD.	**Diaphragm Material / Probe**						
		I	316L SST/316L SST						
			COD.	**Distance Between Centers**					
			1	250 mm					
			2	500 mm					
				COD.	**Fill Fluid**				
				S	DC 200/20 - Silicone Oil				
					COD.	**Normalizer Tube r**			
					0	Without tube			
					1	With 316 SST tube			
						COD.	**Probe Type**		
						1	316 SST Tubular Rod		
						2	Flanged Hose		
							COD.	**Probe Length**	
							1	1 meter	
							2	2 meters	
							3	3 meters	
							4	4 meters	
							5	5 meters	
							6	6 meters	
							7	7 meters	
							8	8 meters	
								COD.	**Power Supply Cable Length**
								1	10 meters
								2	15 meters
DT302M	**1**	**I**	**1**	**S**	**0**	**1**	**1**	**1**	**TYPICAL MODEL**

MODEL		SUBMERSIBLE CONCENTRATION/DENSITY TRANSMITTER (CONTINUATION)			
	COD.	**Identification Plate**			
	I6	Without certification			
		COD.	**Tag Plate**		
		J0	With Tag		
		J1	Blank		
			COD.	**Centralizer**	
			1	Standard	
			2	With centralizer	
				COD.	**Probe Strengthening**
				R0	Standard
DT302M	**I6**	**J0**	**1**	**R0**	**TYPICAL MODEL**

Table 5.3		
Dimensions between diaphragms (centers) mm	**Limit Values**	
	Measuring range Fx1	**Measuring range Fx2**
mm	**Kg/m³**	**Kg/m³**
250	0-3000	0-10000
500	0-2000	0-10000

Appendix A
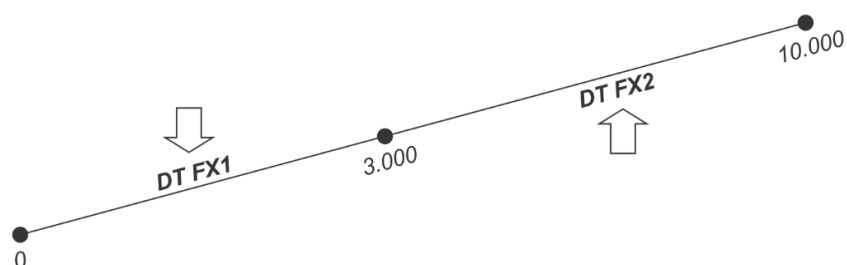
CERTIFICATIONS INFORMATION

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"
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"
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.

PED Directive 2014/68/EU - "Pressure Equipment"
This product is in compliance with Article 4 paragraph 3 of the Pressure Equipment Directive 2014/68/EU and was designed and manufactured in accordance with the sound engineering practice. This equipment cannot bear the CE marking related to PED compliance. However, the product bears the CE marking to indicate compliance with other applicable European Community Directives.

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
In hazardous areas with intrinsic safety or 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

DNV
Explosion Proof (Nemko 03ATEX1375X)
II 2G Ex d IIC T6 Gb
Ambient Temperature: -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:
EN 60079-0:2012 General Requirements
EN 60079-1:2007 Flameproof Enclosures "d"

Drawing 102A-1387, 102A-1482

DEKRA
Intrinsic Safety (DMT 03 ATEX E 359)
I M1 Ex ia I Ma
II 1/2 G Ex ia IIC T4/T5/T6, EPL Ga/Gb

FISCO Field Device
Supply circuit for the connection to an intrinsically safe FISCO fieldbus circuit:
U_i = 24 Vdc, I_i = 380 mA, P_i = 5.32 W, C_i ≤ 5 nF, L_i = Neg
Parameters of the supply circuit comply with FISCO model according to Annex G EN 60079-11:2012, replacing EN 60079-27: 2008.

Ambient Temperature:
-40ºC ≤ T_a ≤ +60ºC (T4)
-40ºC ≤ T_a ≤ +50ºC (T5)
-40ºC ≤ T_a ≤ +40ºC (T6)

The Essential Health and Safety Requirements are assured by compliance with:
EN 60079-0:2009 + A11:2013 General Requirements
EN 60079-11:2012 Intrinsic Safety "i"
EN 60079-26:2015 Equipment with equipment protection level (EPL) Ga

Drawing 102A-1387, 102A-1482, 102A-1268, 102A-1483

INMETRO NCC
Segurança Intrínseca (NCC 24.0150X)
Ex ia IIC T* Ga
Ex ia IIIC T* Da
Equipamento de Campo FISCO
U_i = 30 V I_i = 380 mA P_i = 5,32 W C_i = 5,0 nF L_i = desp
Tamb: -20 °C a +50 °C para T5 ou T_{200}100 ºC
Tamb: -20 °C a +65 °C para T4 ou T_{200}135 ºC
IP66/68 ou IP66W/68W

Prova de Explosão (NCC 24.0151)
Ex db IIC T6 Ga/Gb
Ex tb IIIC T85 ºC Da/Db
Tamb: -20 °C a +40 °C
IP66/68 ou IP66W/68W

Observações:
O número do certificado é finalizado pela letra "X" para indicar que para a versão do Transmissor de Densidade, modelos DT302 e DT303 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 102A1359, 102A1226, 102A1995, 102A1996, 102A2078

Identification Plate

ATEX / IECEx

smar DT302   Density Transmitter
BR - 14160
Sertãozinho
Brazil   II 1/2G Ex ia IIC T4/T5/T6 Ga/Gb   BVS 03 ATEX E 359 ( )   IP66
-40°C ≤ Ta ≤ +60°C
Pi = 5,32 W   Ui = 24 VDC   Ii = 380 mA   Li = neg   Ci ≤ 5 nF   IP68 10m/24h
II 2G Ex d IIC T6 Gb   Nemko 03 ATEX 1375X ( )
Tamb = -20°C to 60°C   U = 28 VDC
0000000 - 0000   CE 0470   **138703**

smar DT302   Density Transmitter
BR - 14160
Sertãozinho
Brazil   II 1/2G Ex ia IIC T4/T5/T6 Ga/Gb   BVS 03 ATEX E 359 ( )   IP66W
-40°C ≤ Ta ≤ +60°C
Pi = 5,32 W   Ui = 24 VDC   Ii = 380 mA   Li = neg   Ci ≤ 5 nF   IP68W 10m/24h
II 2G Ex d IIC T6 Gb   Nemko 03 ATEX 1375X ( )
Tamb = -20°C to 60°C   U = 28 VDC
0000000 - 0000   CE 0470   **148203**

smar DT302   Density Transmitter
BR - 14160
Sertãozinho
Brazil   I M1 Ex ia I Ma   BVS 03 ATEX E 359   IP 66 68
-40°C ≤ Ta ≤ +60°C
Pi = 5,32 W
Ui = 24 VDC   Ii = 380 mA   Li = neg   Ci ≤ 5 nF
0000000 - 0000   CE 0470   **126801**

smar DT302   Density Transmitter
BR - 14160
Sertãozinho
Brazil   I M1 Ex ia I Ma   BVS 03 ATEX E 359   IP 66W 68W
-40°C ≤ Ta ≤ +60°C
Pi = 5,32 W
Ui = 24 VDC   Ii = 380 mA   Li = neg   Ci ≤ 5 nF
0000000 - 0000   CE 0470   **148301**

INMETRO NCC

smar DT302 Transmissor de Densidade
Nova Smar SA Av. Dr. Antônio Furlan Jr, 1028 | Sertãozinho - SP - Brasil | 14170-480
Segurança   Ex db IIC T6 Ga/Gb   NCC 24.0151   ( )
Ex ia IIC T4/T5 Ga   NCC 24.0150 X ( )
Tamb= -20° a 65°C (T4)   -20° a 50°C (T5)
Ui= 30V Ii= 380mA Pi= 5,32W Ci= 5nF Li= desp
FISCO Field Device   IP66 ou IP68 10m/24h
0000000 - 0000   CE   **135905**

smar DT302 Transmissor de Densidade
Nova Smar SA Av. Dr. Antônio Furlan Jr, 1028 | Sertãozinho - SP - Brasil | 14170-480
Segurança   Ex db IIC T6 Ga/Gb   NCC 24.0151   ( )
Ex ia IIC T4/T5 Ga   NCC 24.0150 X ( )
Tamb= -20° a 65°C (T4)   -20° a 50°C (T5)
Ui= 30V Ii= 380mA Pi= 5,32W Ci= 5nF Li= desp
FISCO Field Device   IP66W ou IP68W 10m/24h
0000000 - 0000   CE   **122605**

smar DT302 Transmissor de Densidade
Nova Smar SA Av. Dr. Antônio Furlan Jr, 1028 | Sertãozinho - SP - Brasil | 14170-480
Segurança   Ex db IIB T6 Ga/Gb   NCC 24.0151   ( )
Ex ia IIB T4/T5 Ga   NCC 24.0150 X ( )
Tamb= -20° a 65°C (T4)   -20° a 50°C (T5)
Ui= 30V Ii= 380mA Pi= 5,32W Ci= 5nF Li= desp
P1/P2 Pintura FISCO Field Device   IP66W ou IP68W 10m/24h
0000000 - 0000   CE   **199503**

smar DT302 Transmissor de Densidade
Nova Smar SA Av. Dr. Antônio Furlan Jr, 1028 | Sertãozinho - SP - Brasil | 14170-480
Segurança   Ex db IIB T6 Ga/Gb   NCC 24.0151   ( )
Ex ia IIB T4/T5 Ga   NCC 24.0150 X ( )
Tamb= -20° a 65°C (T4)   -20° a 50°C (T5)
Ui= 30V Ii= 380mA Pi= 5,32W Ci= 5nF Li= desp
P1/P2 Pintura FISCO Field Device   IP66 ou IP68 10m/24h
0000000 - 0000   CE   **199603**

smar DT302 Transmissor de Densidade
Nova Smar SA Av. Dr. Antônio Furlan Jr, 1028 | Sertãozinho - SP - Brasil | 14170-480
Segurança   Ex tb IIIC T85°C Db   NCC 24.0151   ( )
Ex ia IIIC T_{200}135°C/T_{200}100°C Da   NCC 24.0150 X ( )
Tamb= -20° a 65°C (T_{200}135°C) -20° a 50°C (T_{200}100°C)
Ui= 30V Ii= 380mA Pi= 5,32W Ci= 5nF Li= desp
IP66 ou IP68 10m/24h
0000000 - 0000   CE   **207804**

smar	**SRF – Service Request Form** **Density Transmitters**	**Proposal No.:**

Company:	**Unit:**	**Invoice:**

COMMERCIAL CONTACT		**TECHNICAL CONTACT**	
Full Name:		**Full Name:**	
Function:		**Function:**	
Phone:	**Extension:**	**Phone:**	**Extension:**
Fax:		**Fax:**	
Email:		**Email:**	

EQUIPMENT DATA		
Model:	**Serial Number:**	**Sensor Number:**
Technology: ( ) HART® ( ) FOUNDATION fieldbus ( ) PROFIBUS PA		**Firmware Version:**

PROCESS DATA

Process Fluid:

Calibration Range		**Ambient Temperature (ºF)**		**Process Temperature (ºF)**		**Process Pressure**	
Min.:	**Max.:**	**Min.:**	**Max.:**	**Min.:**	**Max.:**	**Min.:**	**Max.:**
Static Pressure		**Vacuum**		**Density**		**Concentration**	
Min.:	**Max.:**	**Min.:**	**Max.:**	**Min.:**	**Max.:**	**Min.:**	**Max.:**

Normal Operation Time:	**Failure Date:**

FAILURE DESCRIPTION
(Please, describe the failure. Can the error be reproduced? Is it repetitive?)

OBSERVATIONS

USER INFORMATION

Company:

Contact: 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 www.smar.com.br/en/contact-us.