DT302 - smar

FIRST IN FIELDBUS

OPERATION & MAINTENANCE
INSTRUCTION MANUAL

FIELDBUS CONCENTRATION DENSITY TRANSMITTER

FEB / 05

DT302

VERSION 3

FOUNDATION

DT302ME

smar

web: www.smar.com

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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 capillares. 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 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.

Get the best results of the DT302 by carefully reading this manual , the "General – Installation, Operation and Maintanance Procedures" and the "Function Blocks Instruction" Manuals.

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.

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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 0.4m/sec, what means a flow of 26 m^3/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.
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 permitted, 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.

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 treatment of wet superficial is made according to the standard of rough 32 Ra. This method is according to the recommendation of 3A standard that is the sanitary standard largely used by food, medicines and drink industries.

Fixation

We have two types of fixation:

Top installation (DT302: straight type).

Lateral installation (DT302: side type).

The dimensions of both types for industrial and sanitary models can be seen in the following figures.

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.

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

A – INDUSTRIAL MODEL SIDE MOUNTING

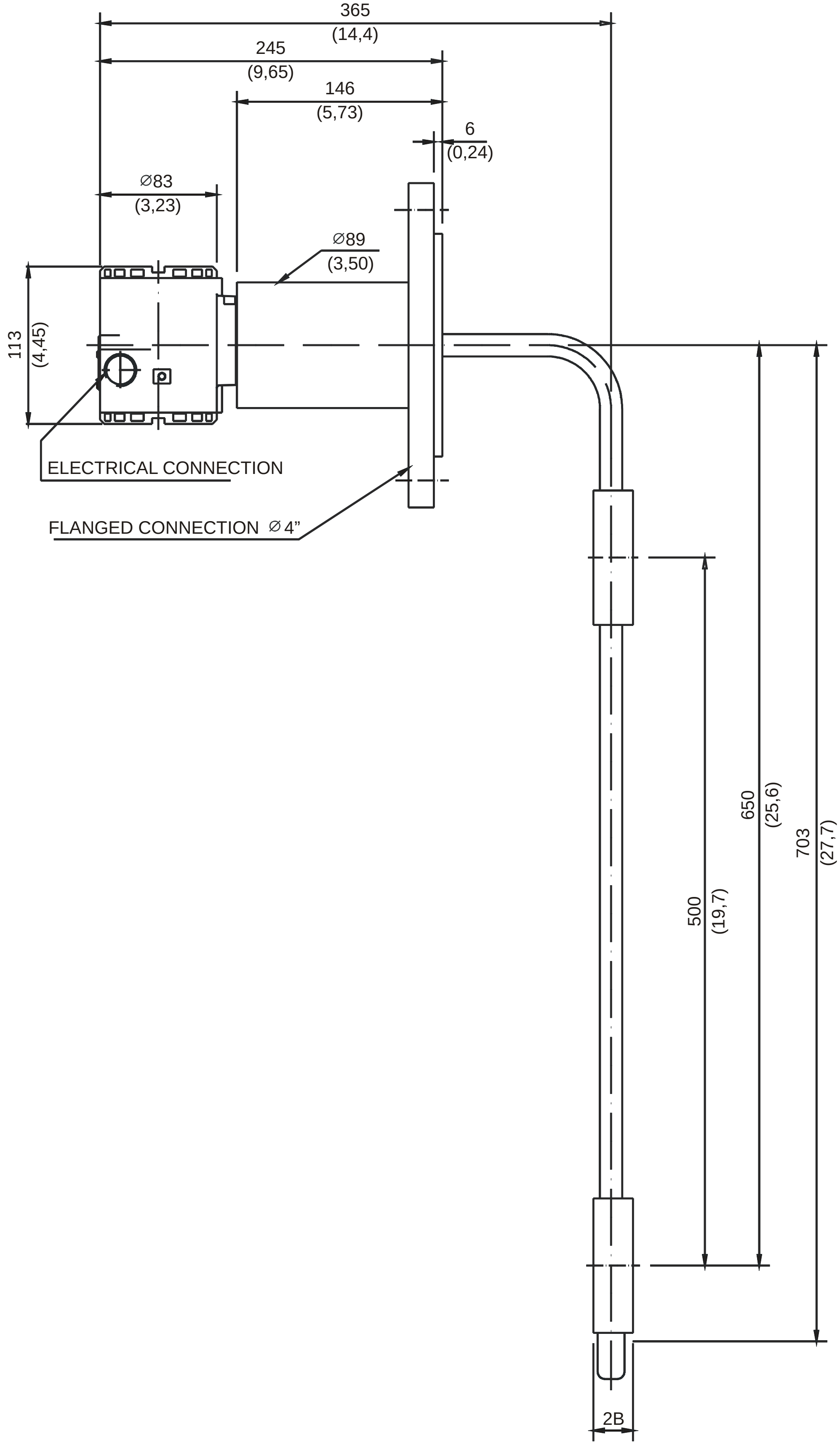


Fig. 1.1 – DT302 Dimensionals (A)

B – SANITARY MODEL TOP MOUNTING

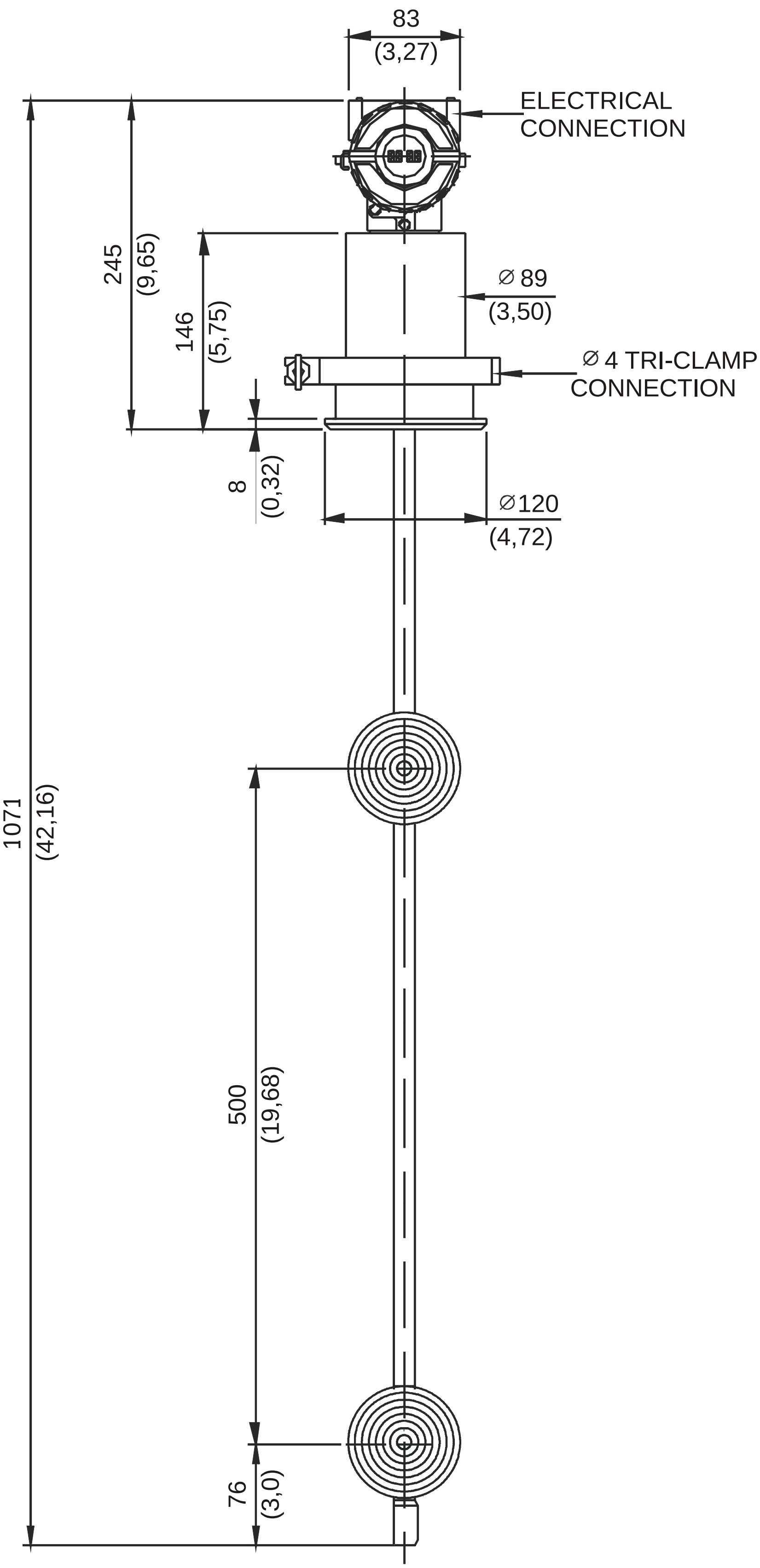


Fig. 1.1 – DT302 Dimensionals (B)

C – SANITARY MODEL SIDE MOUNTING

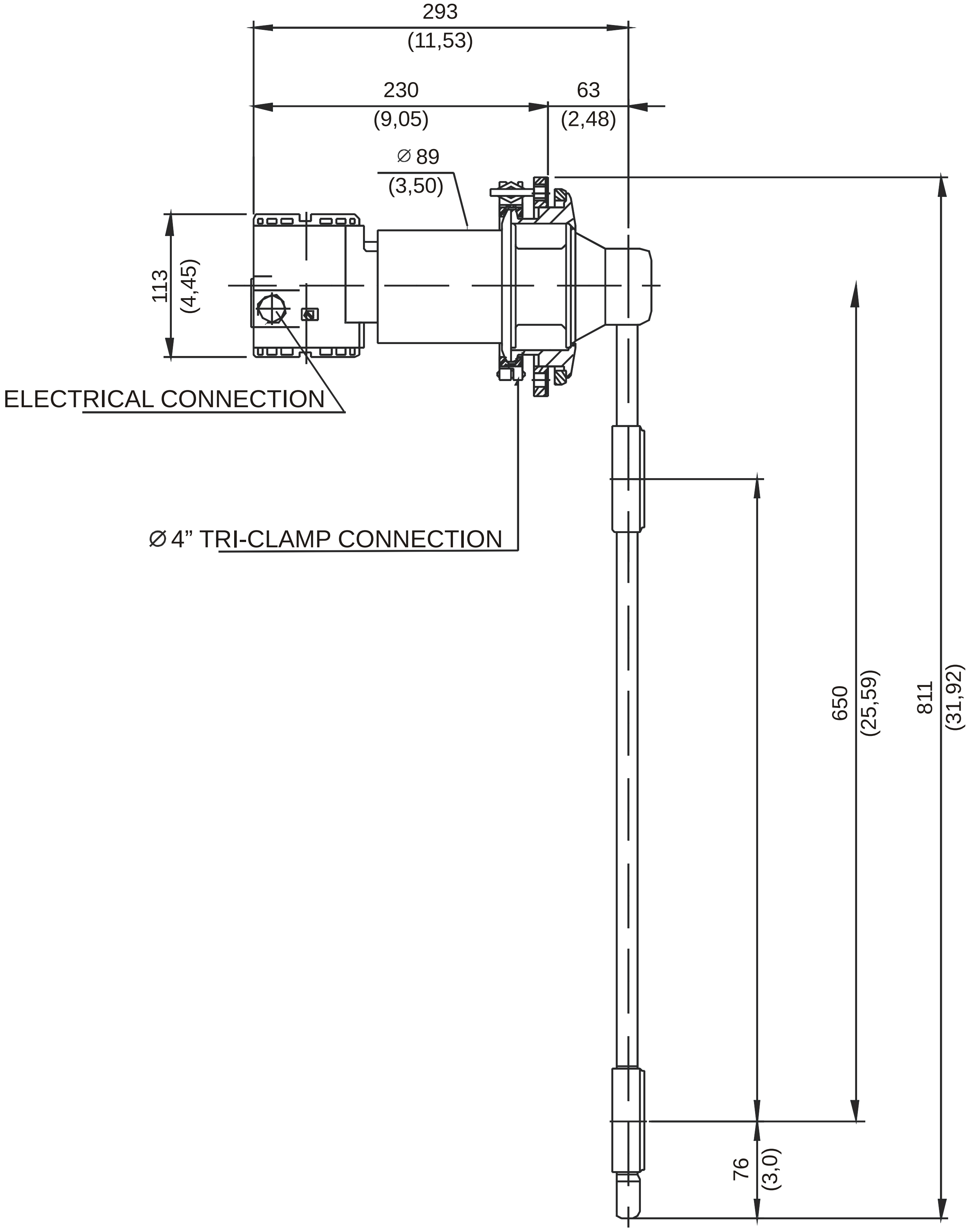


Fig. 1.1 – DT302 Dimensionals (C)

D – INDUSTRIAL MODEL TOP MOUNTING

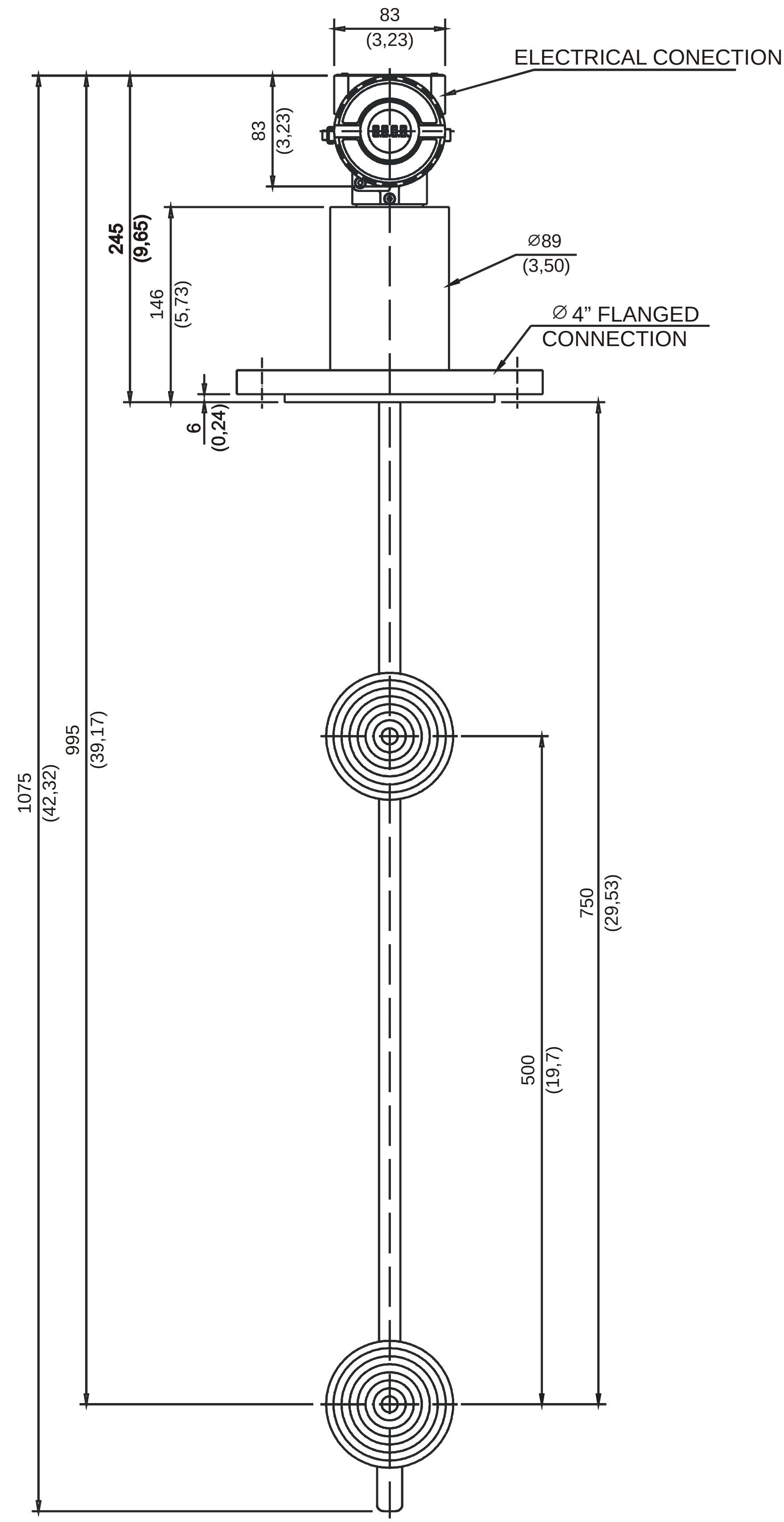


Fig. 1.1 – DT302 Dimensionals (D)

A – TYPICAL INSTALLATION FOR LOW FLOW TANK (INDUSTRIAL MODEL)

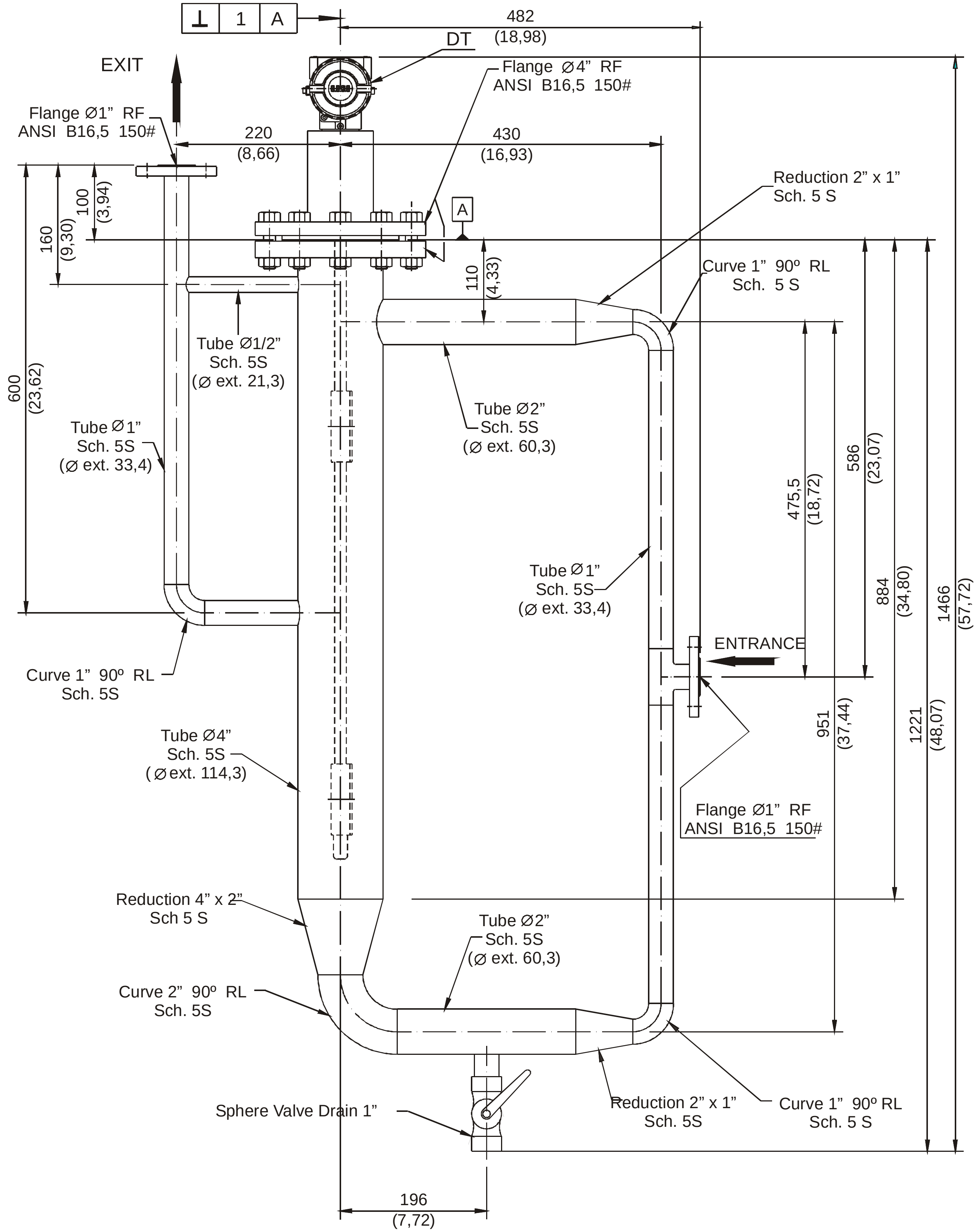


Fig. 1.2 – Typical Installation for DT302 (A)

B – TYPICAL INSTALLATION FOR FLOW TANK (SANITARY MODEL)

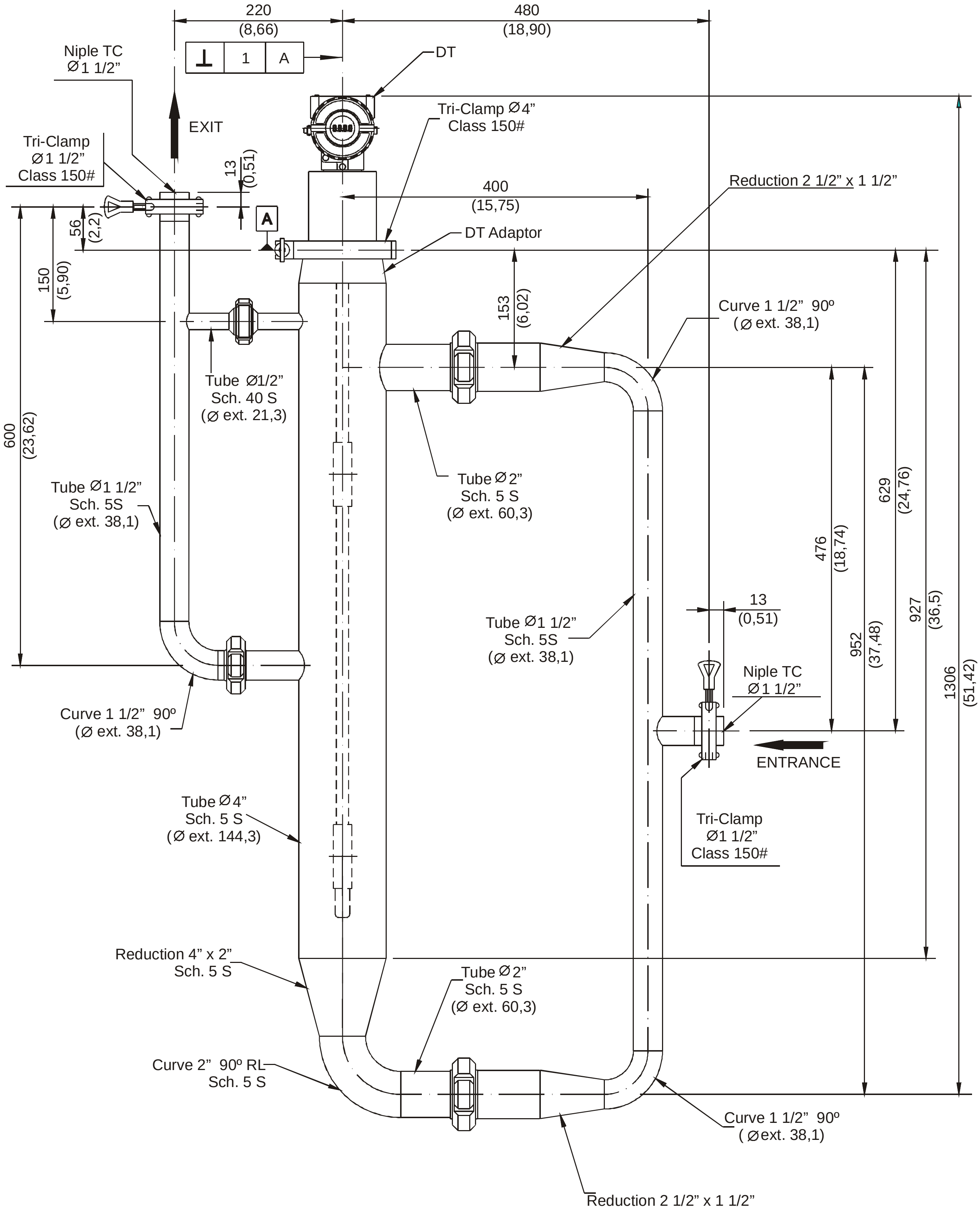


Fig. 1.2 – Typical Installation for DT302 (B)

C – TYPICAL INSTALLATION FOR HIGH FLOW TANK (INDUSTRIAL MODEL)

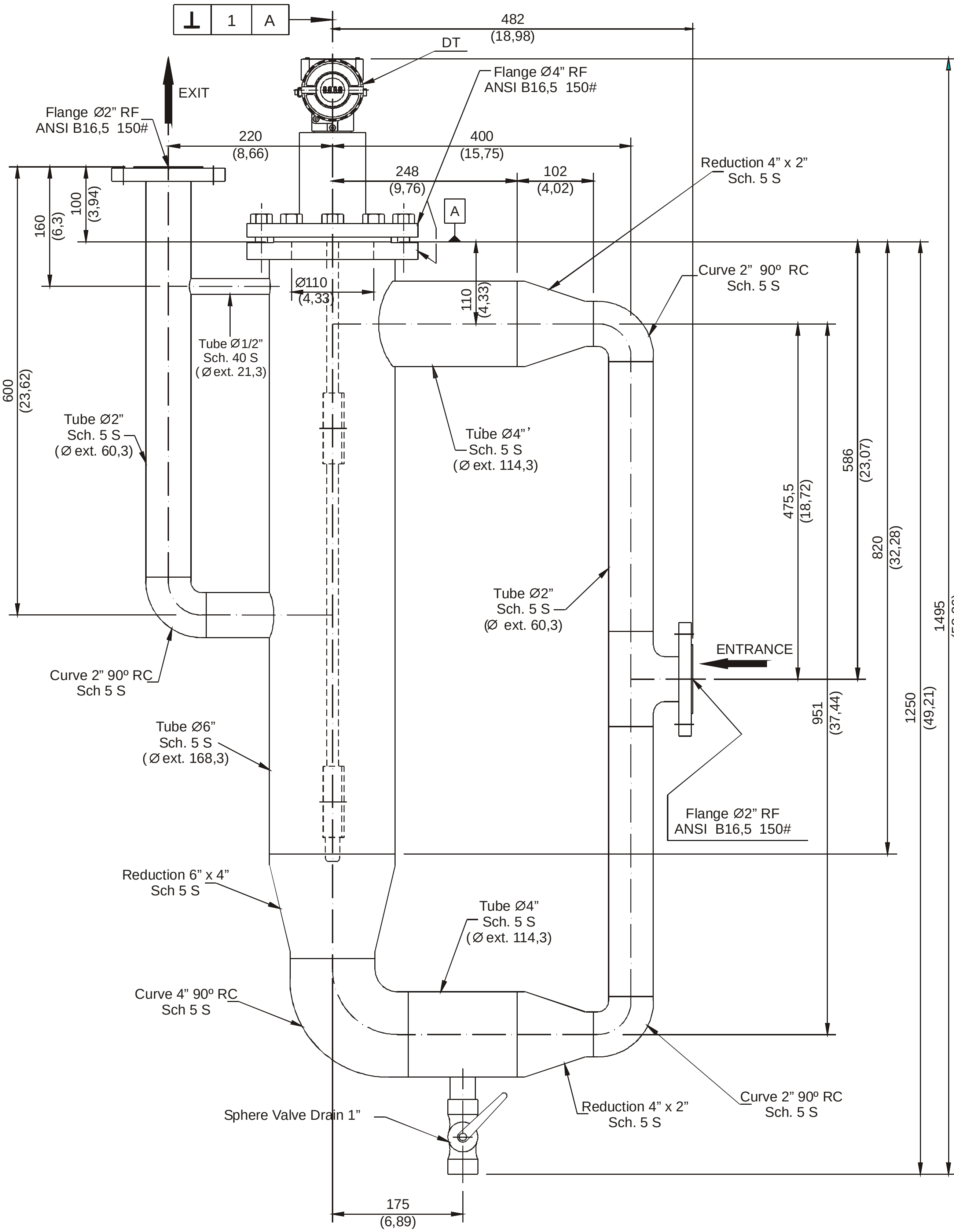


Fig. 1.2 – Typical Installation for DT302 (C)

D – TYPICAL INSTALLATION IN OVERFLOW TANKS

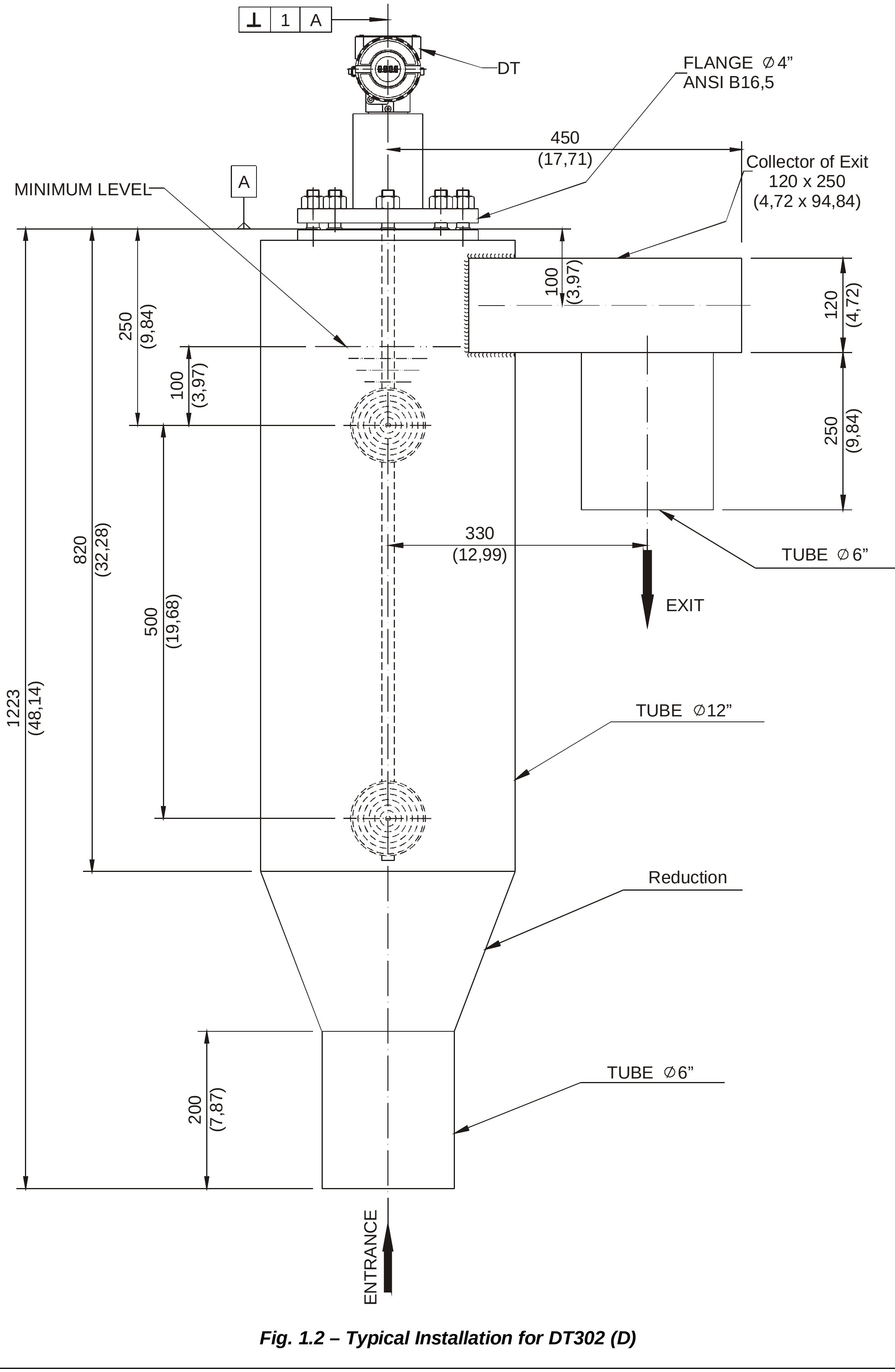


Fig. 1.2 – Typical Installation for DT302 (D)

E – TYPICAL INSTALLATION IN TANK (INDUSTRIAL MODEL)

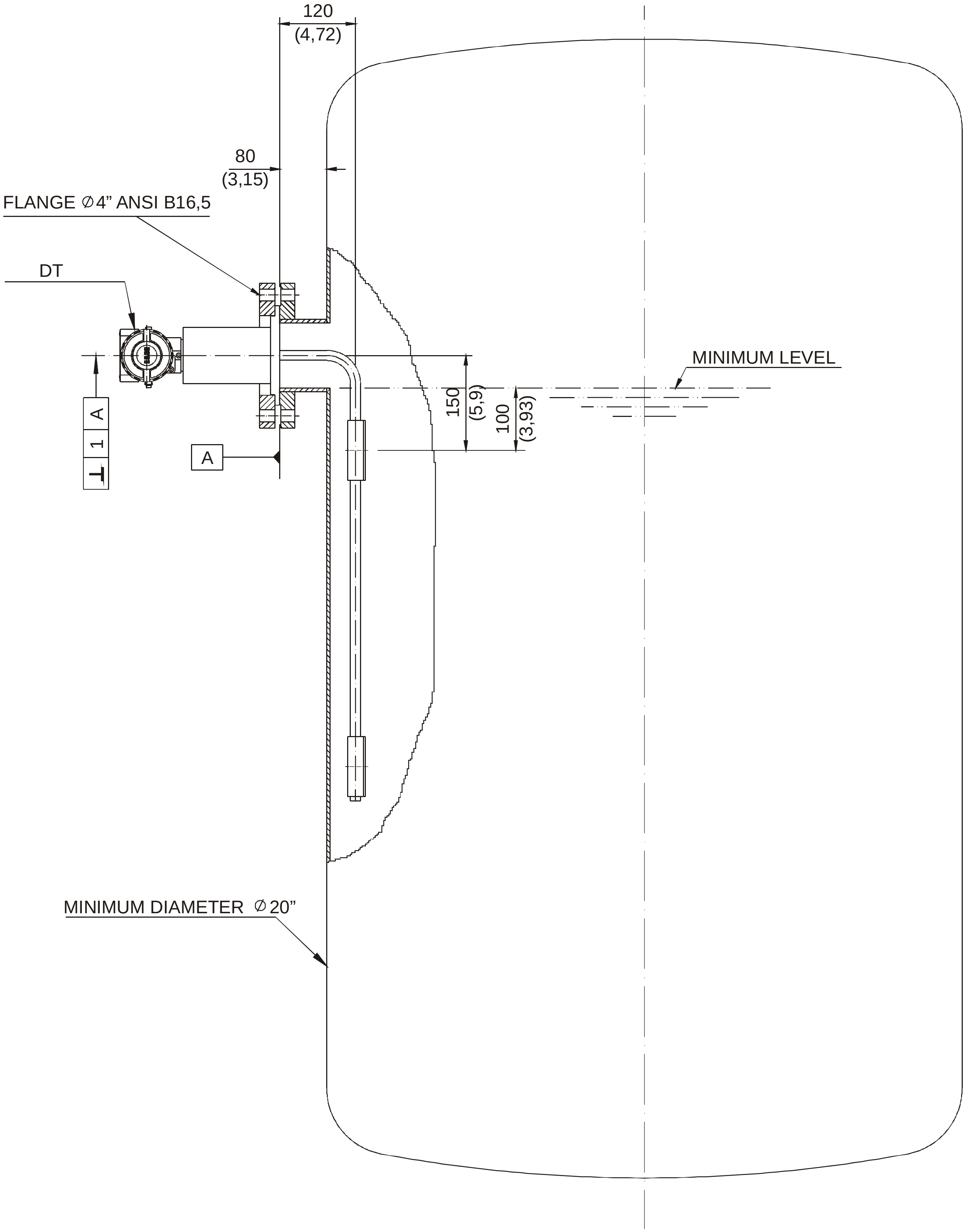


Fig. 1.2 – Typical Installation for DT302 (E)

F – TYPICAL INSTALLATION IN TANK (SANITARY MODEL)

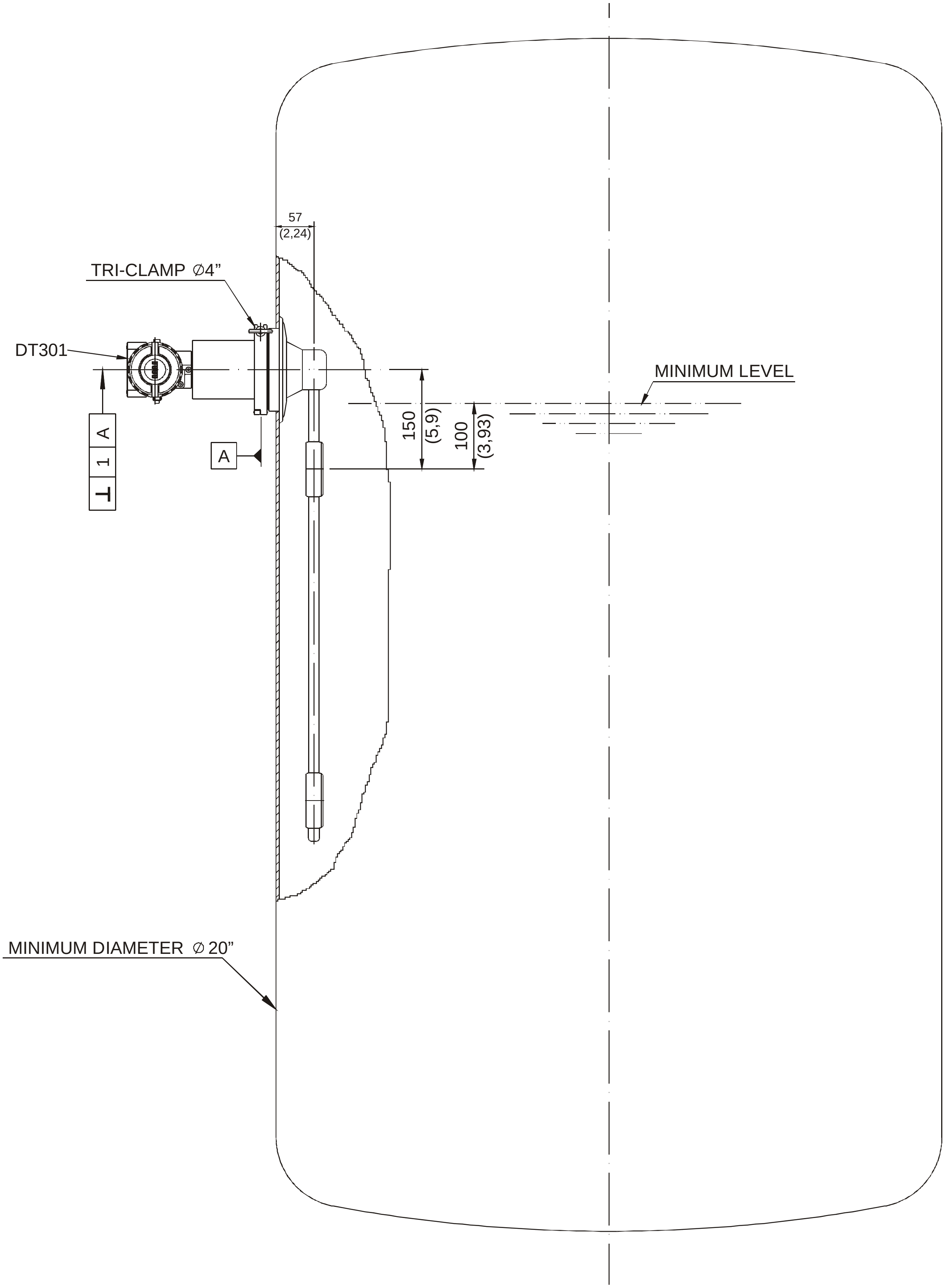


Fig. 1.2 – Typical Installation for DT302 (F)

G - TYPICAL INSTALLATION IN TANK (INDUSTRIAL MODEL)

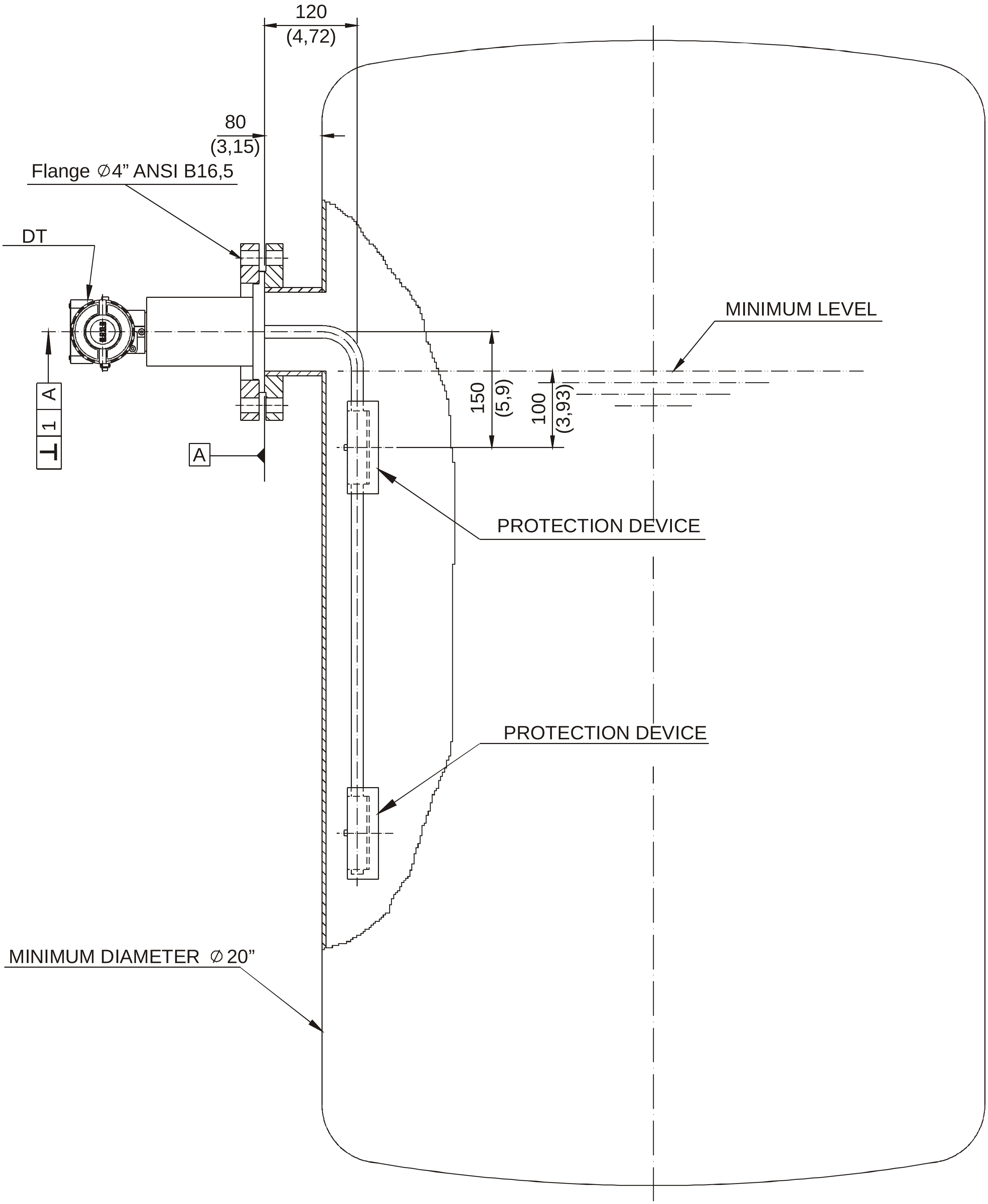


Fig. 1.2 – Typical Installation for DT302 (G)

H - TYPICAL INSTALLATION FOR LOW FLOW TANK WITH

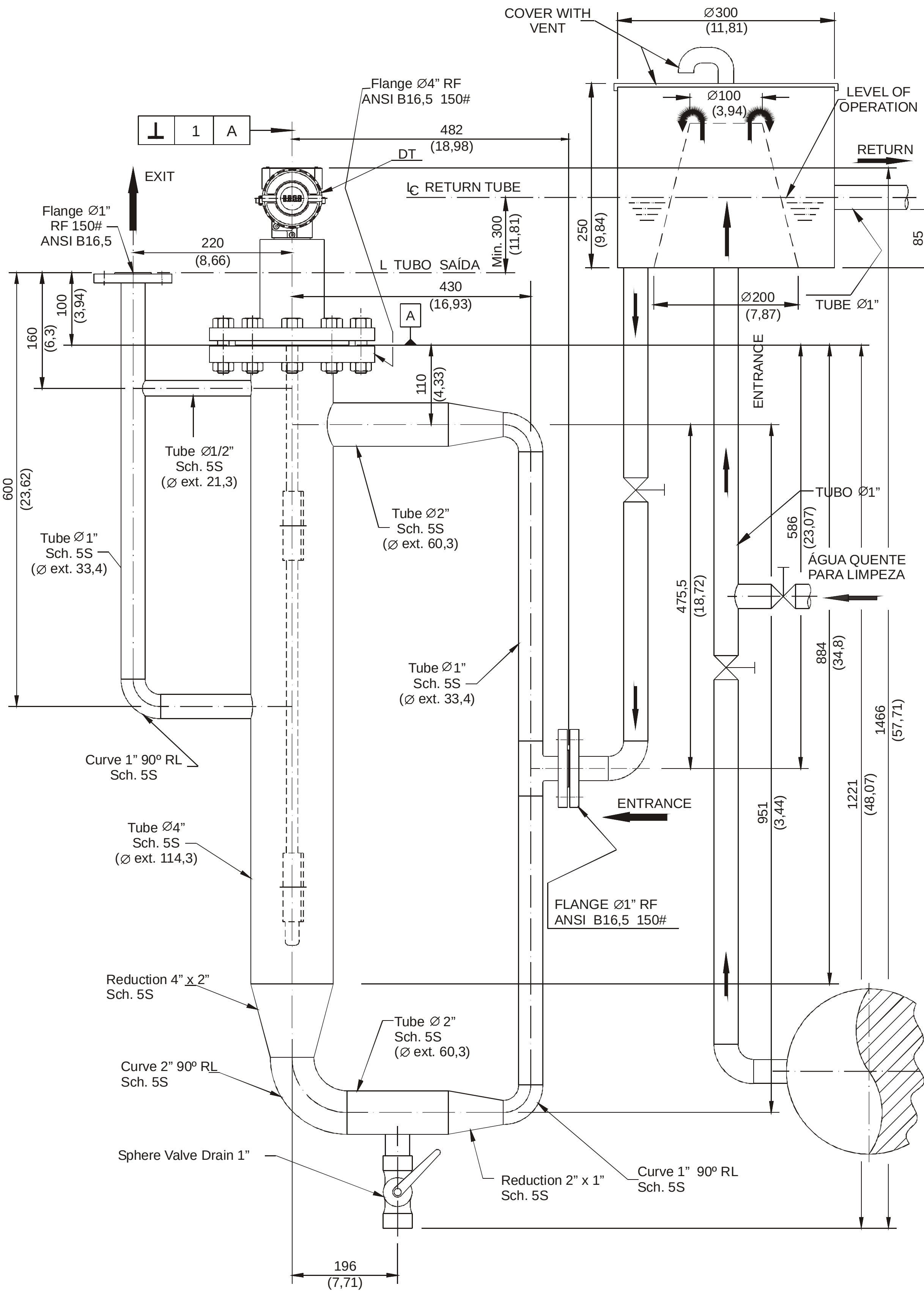


Fig. 1.2 – Typical Installation for DT302 (H)

I - TYPICAL INSTALLATION IN TANK FOR INTERFACE LEVEL (INDUSTRIAL MODEL)

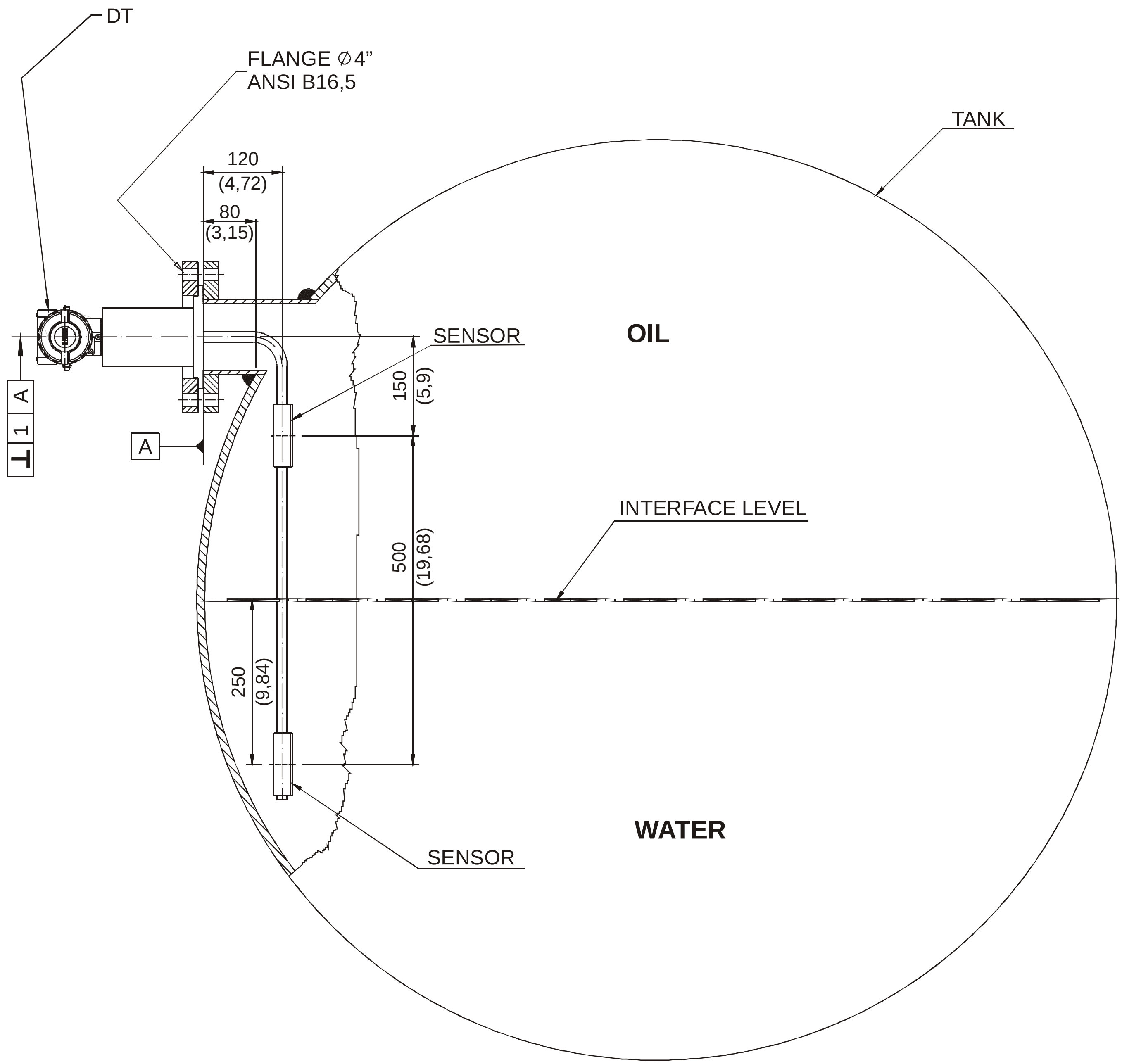


Fig. 1.2 – Typical Installation for DT302 (I)

J - TYPICAL INSTALLATION IN TANK FOR STAND PIPE INTERFACE LEVEL (INDUSTRIAL MODEL)

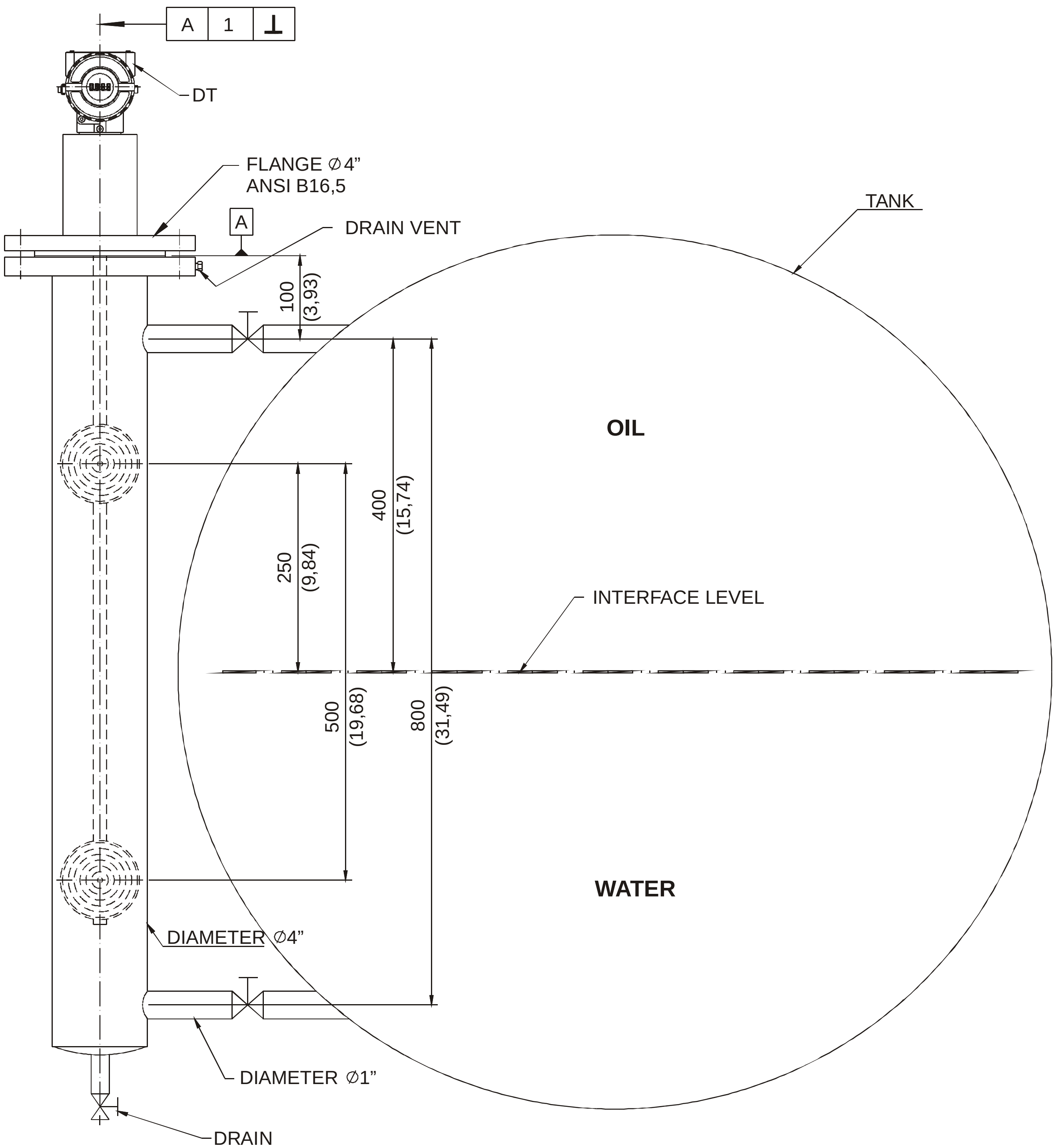


Fig. 1.2 – Typical Installation for DT302 (J)

Housing Rotation

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

WARNING

EXPLOSION PROOF INSTALLATIONS
The electronic housing and the sensor assembly in potentially explosive atmospheres must have a minimum of 6 threads fully engaged. The provided joint allows 1 turn extra. Try to adjust the display window position by rotating the housing clockwise. If the thread reaches the end before the desired position, then rotate the housing counterclockwise, but not by more than one turn of the thread end. Transmitters have a stopper that restricts housing rotation to one turn. .

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

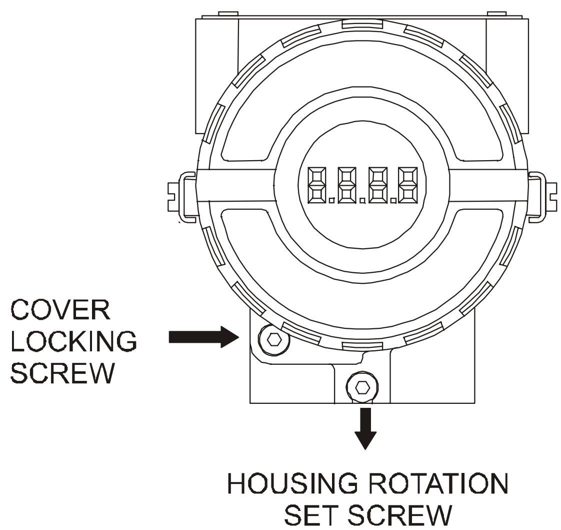


Figure 1.3 - Housing Rotation Set Screw

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

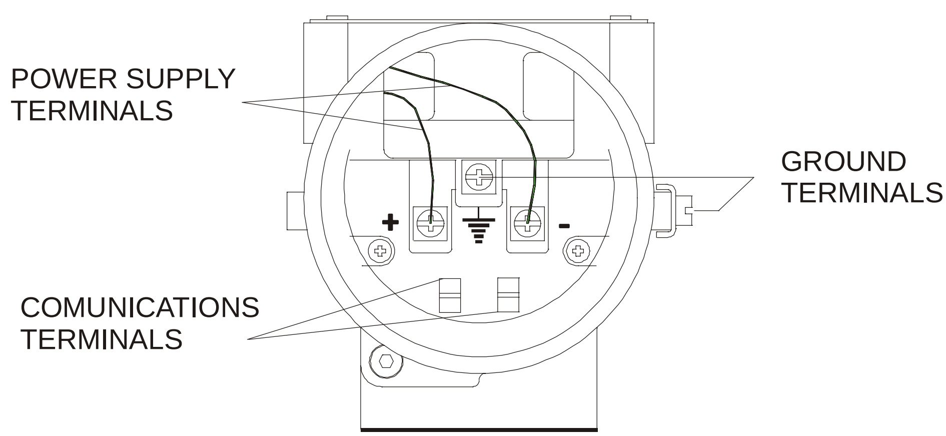


Figure 1.4 - Terminal Block

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, according to the barriers limitation.

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

NOTE

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

WARNING

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

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

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

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

NOTE

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

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 (See Figure 1.5 – Bus Topology) and tree topology (See Figure 1.6 – 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.

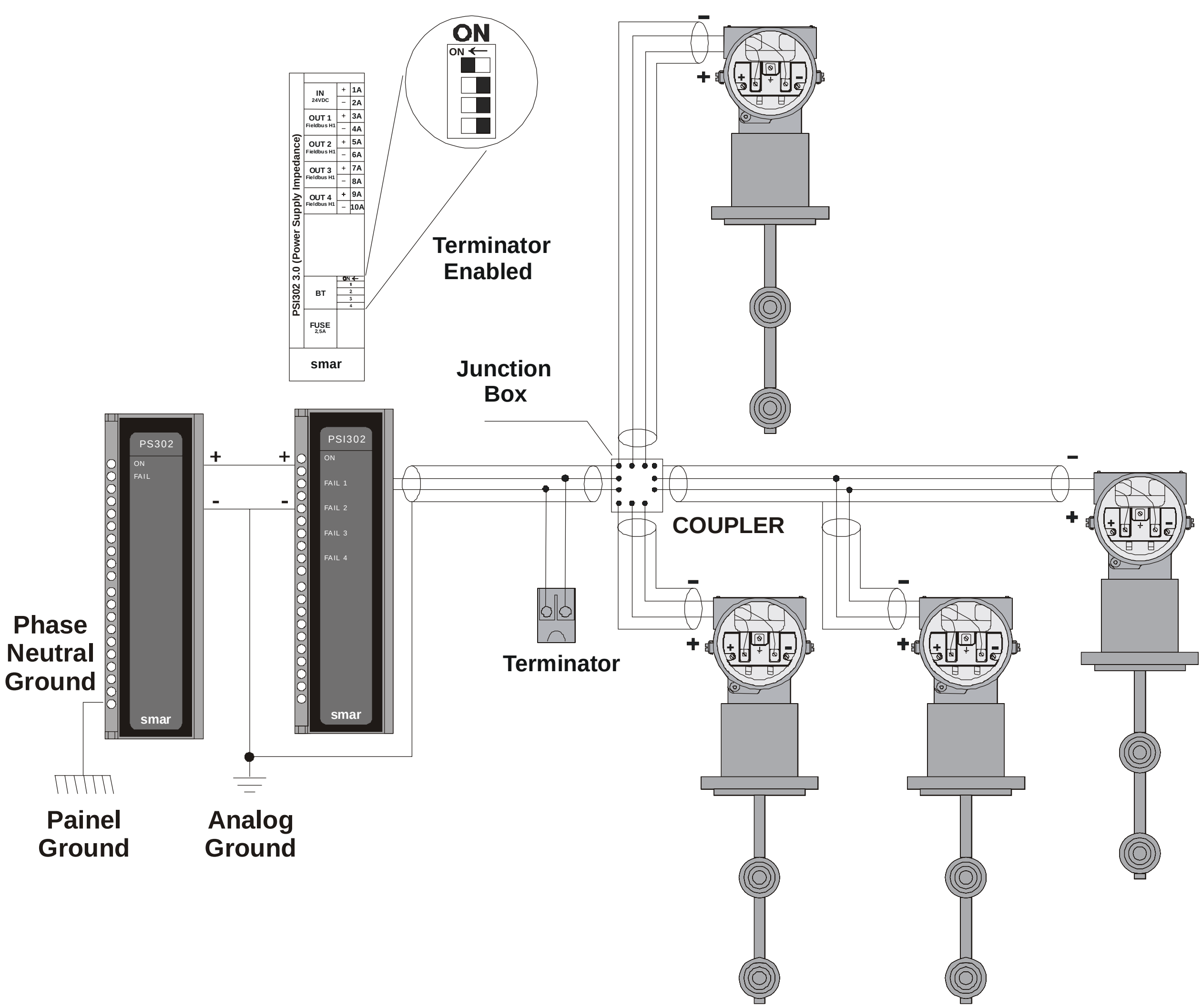


Figure 1.5 - Bus Topology

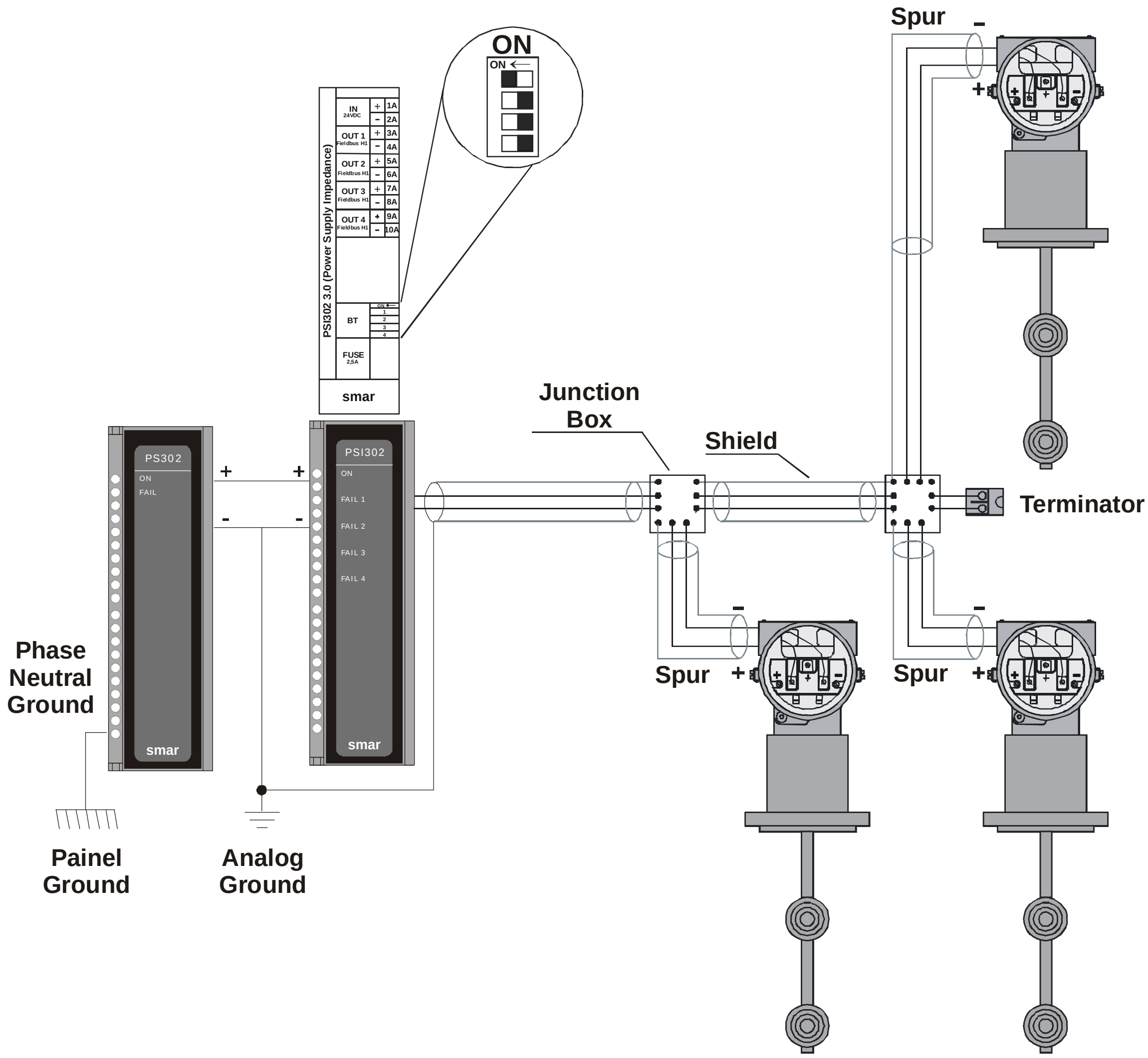


Figure 1.6 - Tree Topology

Intrinsic Safety Barrier

When the Fieldbus is in an area requiring intrinsic safety, a barrier must be inserted on the trunk between the power supply and the power supply end terminator.

Use of **SB302** 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.

Operation

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

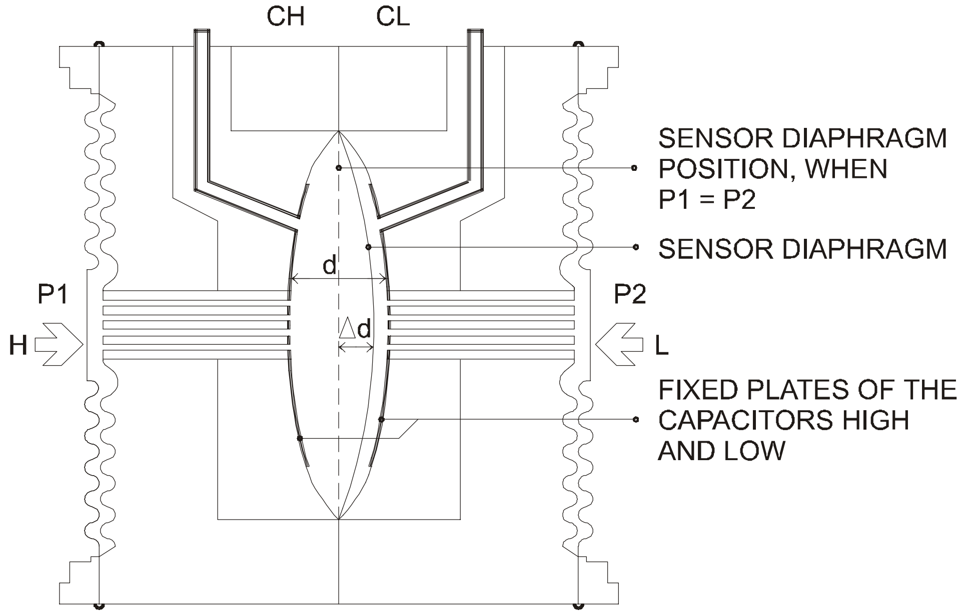


Figure 2.1 - Capacitive Cell

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.

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

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 Figure 2.2 - DT302 Block Diagram Hardware.
The function of each block is described below.

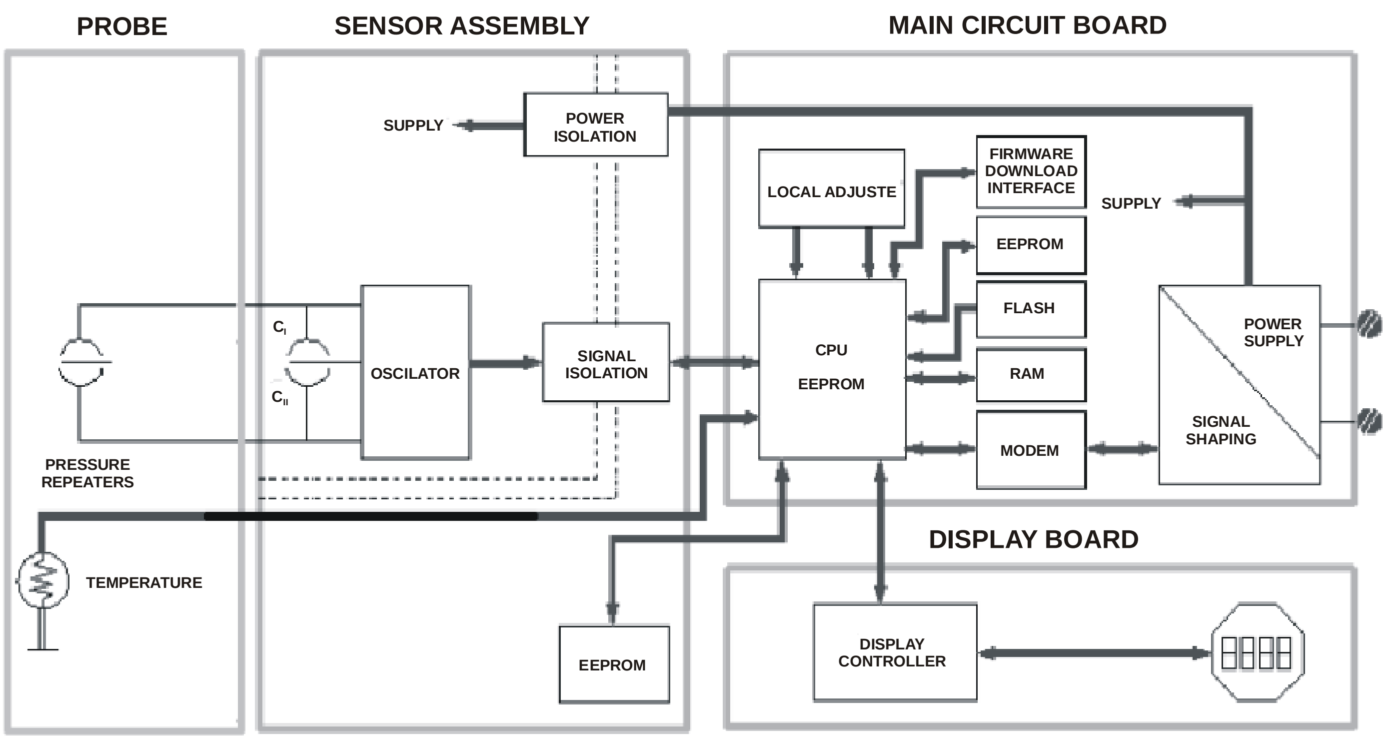


Figure 2.2 - DT302 Block Diagram Hardware

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 use 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.

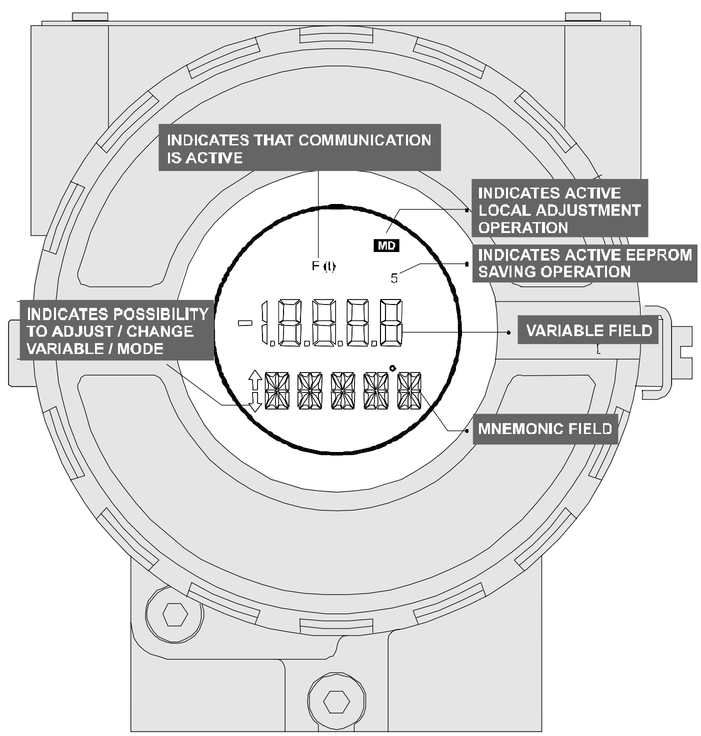


Figure 2.3 - LCD Indicator

Configuration

One of the many advantages of Fiedlbus is that device configuration is independent of the configurator. The **DT302** may be configured by a third party terminal or operator console. Any particular 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 detais of functions blocks, 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.

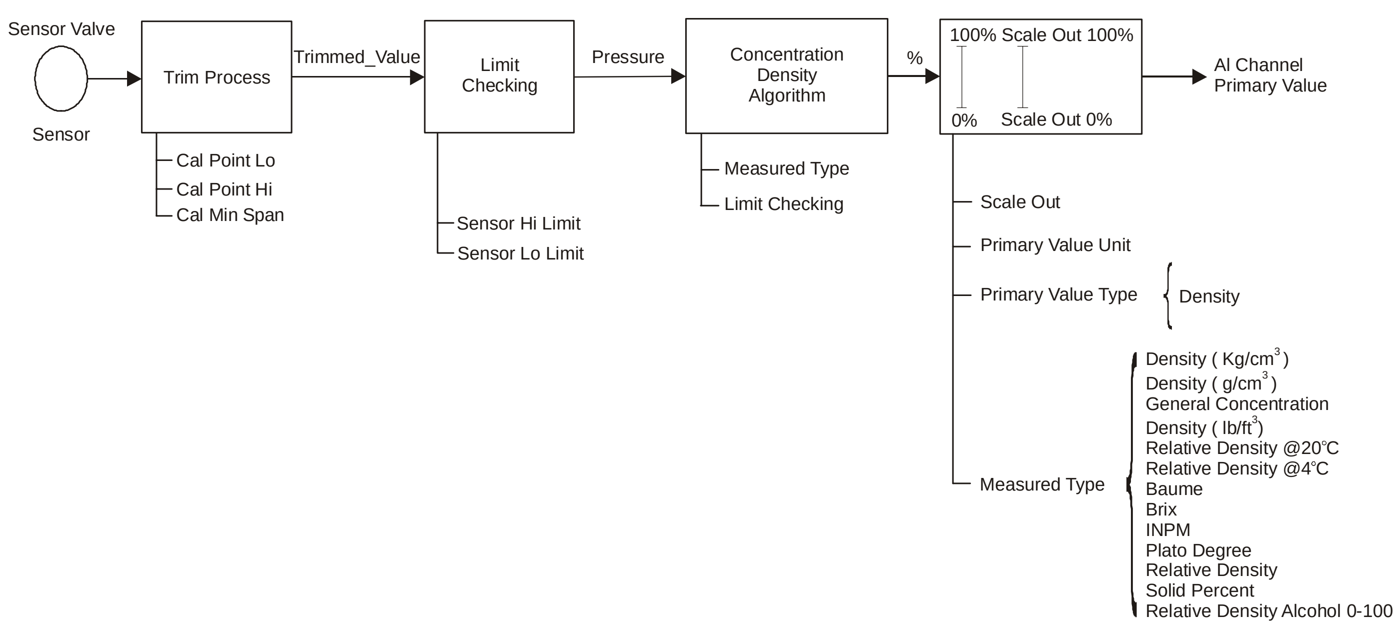


Figure 3.1 – Transducer Block Diagram

Concentration Density Transducer Block Parameter Description

Parameter	Description
ST_REV	Indicates the level of static data.
TAG_DESC	Description of Transducer Block.
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 theTransducer.
UPDATE_EVT	It is the alert for any static data.
BLOCK_ALM	It is used for configuration, hardware and others fails.
TRANSDUCER_DIRECTORY	It is used to select several Transducer Blocks.
TRANSDUCER_TYPE	Indicates the type of Transducer according to its class.
XD_ERROR	It is 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	It is the value and status used by channel.
PRIMARY_VALUE_RANGE	The 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	The highest calibrated value.
CAL_POINT_LO	The lowest calibrated value.
CAL_MIN_SPAN	The 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	The Device Description engineering units code index for the calibration values.
SENSOR_TYPE	The type of sensor.
SENSOR_RANGE	The range of sensor.
SENSOR_SN	The serial number of sensor.
SENSOR_CAL_METHOD	The 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	The location of last sensor calibration. This describes the physical location at which the calibration was performed.
SENSOR_CAL_DATE	The date of the last sensor calibration.
SENSOR_CAL_WHO	The 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	The secondary value (temperature value), related to the sensor.
SECONDARY_VALUE_UNIT	The engineering units to be used with SECONDARY_VALUE.
PRESS_LIN_NORMAL	The Linear Normalized Pressure value.
PRESS_NORMAL	The Normalized Pressure value.
PRESS_CUTOFF	The Cutoff Pressure value.
CUTOFF_FLAG	The bypass flag for Pressure value.
DIGITAL_TEMPERATURE	The digital temperature value.
DIFF	The differential pressure value.
YDIFF	The y differential pressure value.
CAPACITANCE_LOW	The low capacitance value.
CAPACITANCE_HIGH	The 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	The polynomial coefficient 0.
COEFF_POL1	The polynomial coefficient 1.
COEFF_POL2	The polynomial coefficient 2.
COEFF_POL3	The polynomial coefficient 3.
COEFF_POL4	The polynomial coefficient 4.
COEFF_POL5	The polynomial coefficient 5.
COEFF_POL6	The polynomial coefficient 6.
COEFF_POL7	The polynomial coefficient 7.
COEFF_POL8	The polynomial coefficient 8.
COEFF_POL9	The polynomial coefficient 9.
COEFF_POL10	The polynomial coefficient 10.
COEFF_POL11	The 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.

Parameter	Description
CURVE_Y	Output points of characterization curve.
CAL_POINT_HI_BACKUP	Indicates the backup for high calibration point.
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	The gravity aceleration used in concentration/density calculation. The unit is m/s^2.
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/cm^3), 1 - Density (Kg/m^3), 2 - Relative Density @ 20°C (g/cm^3), 3 - Relative Density @ 4°C (g/cm^3), 4 - Baume, 5 - Brix, 6 - Plato Degree, 7 - INPM, 8 - Relative Density Alcohol 0 - 100, 9 - Solid Percent, 10 - Density (lb/ft^3) 11 - API
LIN_DILATATION_COEF	Linear Dilatation Coefficient.
PRESSURE_COEFFICIENT	Coefficient of Pressure.
TEMP_ZERO	Offset coefficient used to calculate the positioner temperature.
TEMP_GAIN	Gain coefficient used to calculate the positioner 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/cm_3. The calibration point is 1.2 Kg/cm^3.
AUTO_CAL_POINT_HI	This parameter enables the upper self-calibration point. The sensor should be on water and the MEASURED_TYPE AND XD_SCALDE.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_2O 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: Range 1 (0.5 @ 1.8 g/cm^3) Range 2 (1.0 @ 2.5 g/cm^3) Range 3 (2.0 @ 5.0 g/cm^3)

Table 3.1 - Concentration DensityTransducer 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
58	CURVE_X	Record	Array of Float	S	20	R/W	
59	CURVE_Y	Record	Array of Float	S	20	R/W	

Relative Index	Parameter Mnemonic	Object Type	Data Type	Store	Size	Access	Default –value
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

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			

Relative Index	Parameter Mnemonic	View_1	View_2	View_3	View_4
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				
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				

Relative Index	Parameter Mnemonic	View_1	View_2	View_3	View_4
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				
	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. The set of contained parameters, it means, you are not able to link them to other blocks and publish the link via communication, defines the user interface to the transducer block. 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 you perform a standard routine as a calibration, you are conducted step by step by a method. The method is generally defined as guide line 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.

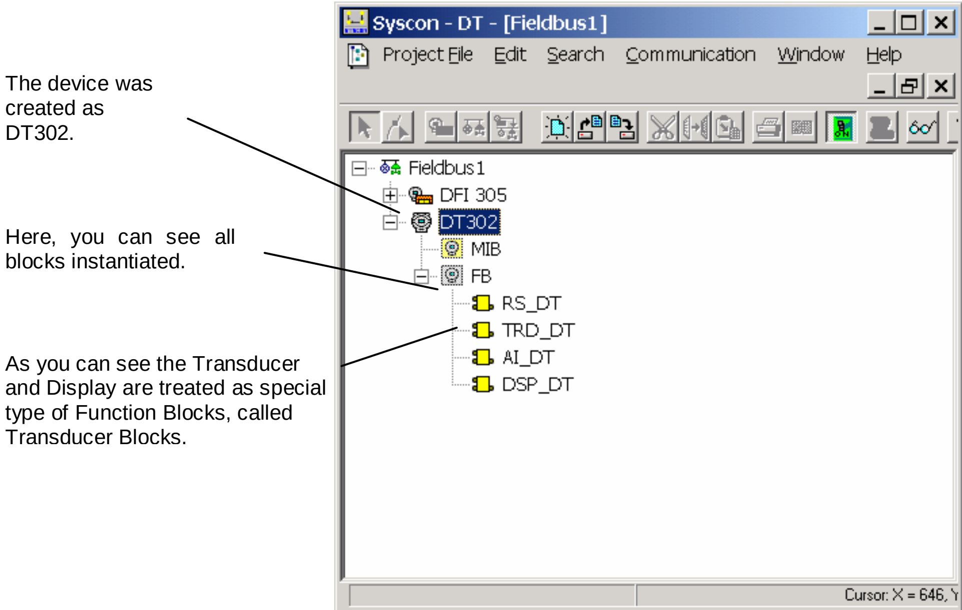


Figure 3.2 - Function and Transducers Blocks

To make the configuration of Transducer Block, we need to select this block and right click with the mouse to choose 'On Line Configuration'.

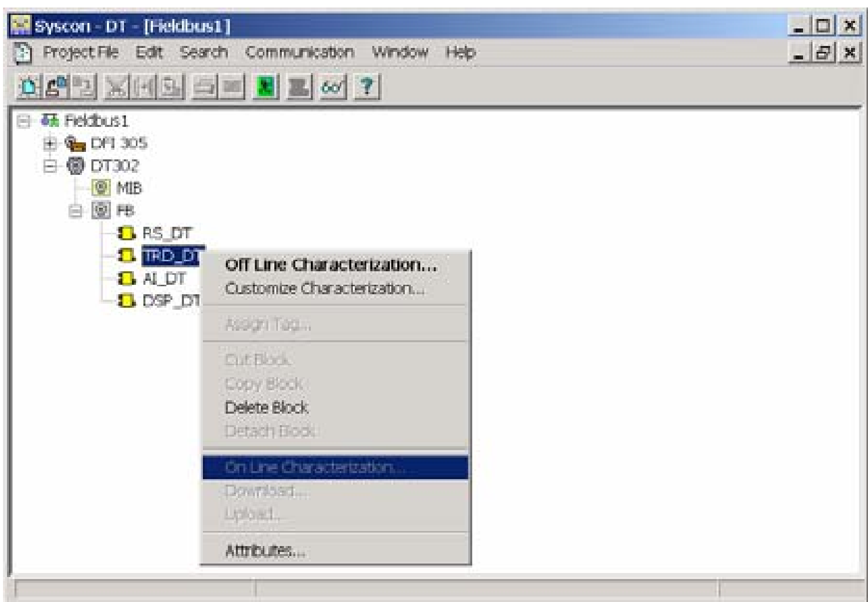


Figure 3.3 - Online Configuration - Transducer

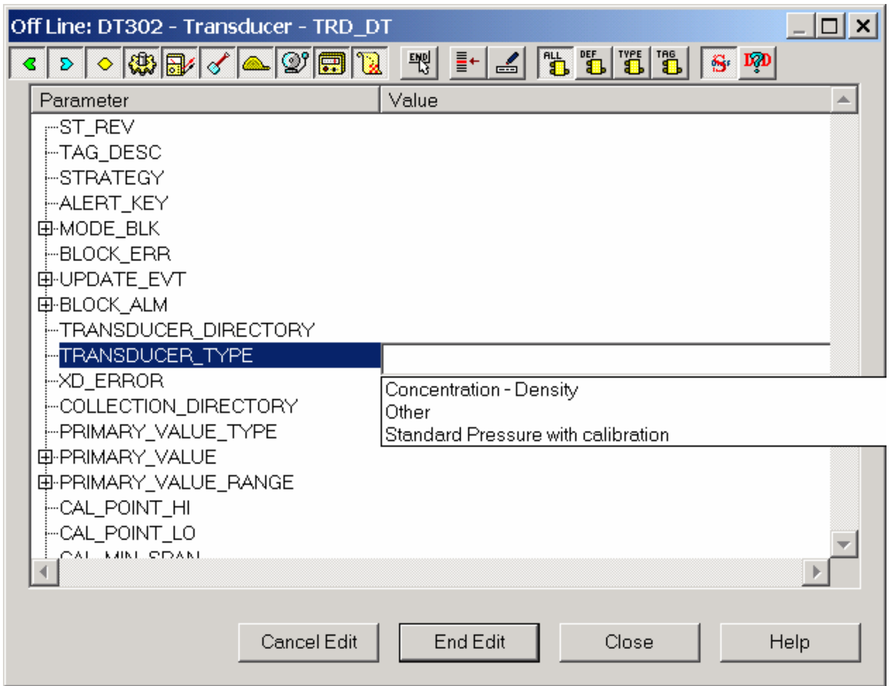


Figure 3.4 - Transducer Type Configuration

Using this window, the user can set the Transducer Type according to the application, selecting "Density" or “Pressure”. The pressure selection is suitable only when is necessary the pressure calibration.

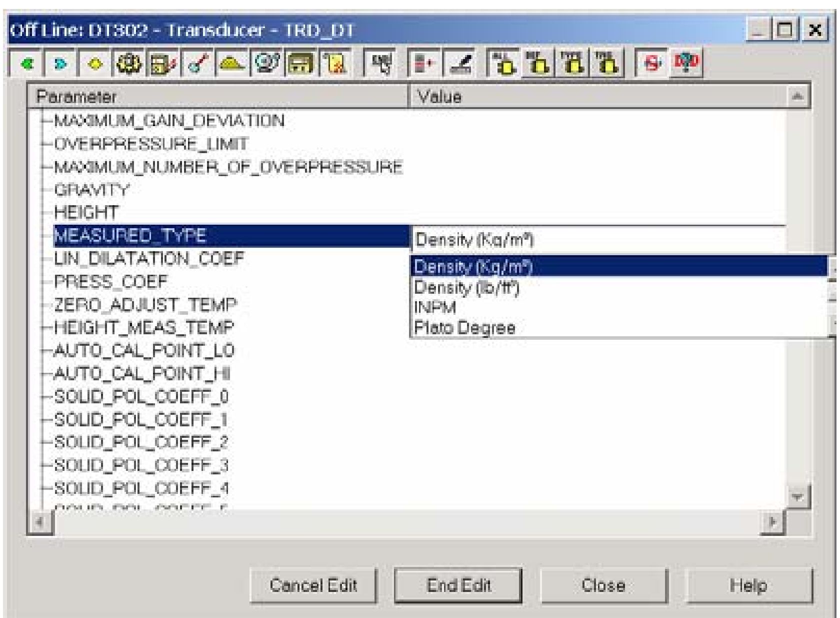


Figure 3.5 - Measured Type Configuration

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), Baume, Brix, Plato Degree, INPM, Relative Density Alcohol 0 - 100, Solid Percent, Density (lb/ft³) and API.

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.

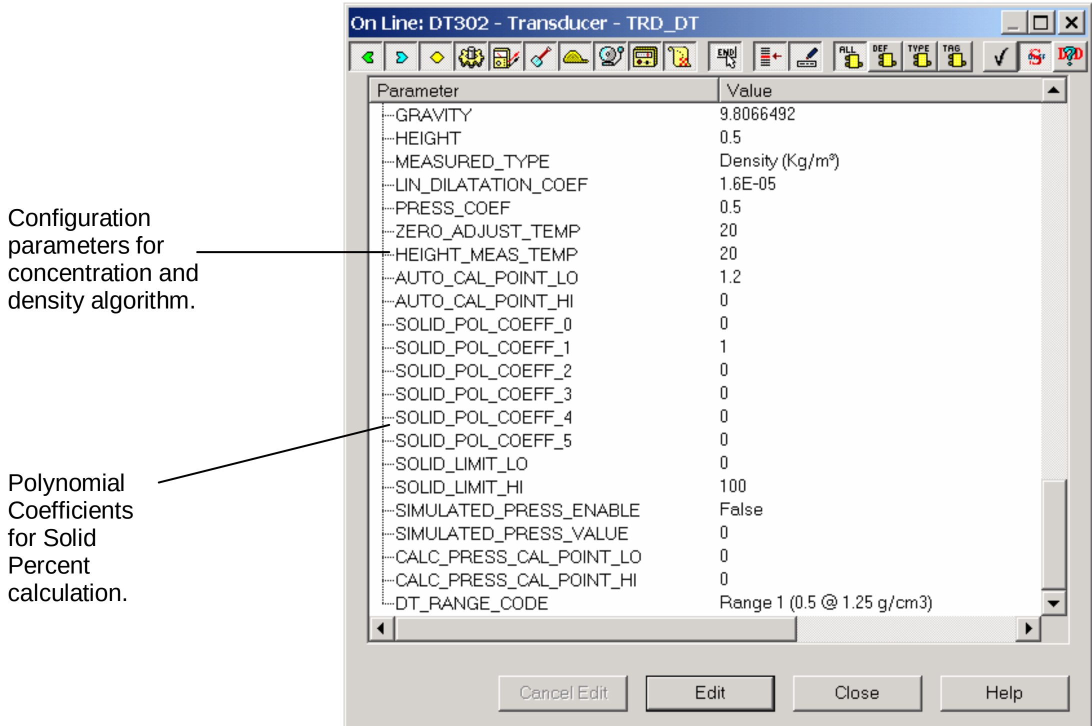


Figure 3.6 – Density Parameters

AI XD_SCALE.unit for Concentration/Density							
Measured Type	Range 1		Range 2		Range 3		**AI Unit**
	Lower	Upper	Lower	Upper	Lower	Upper	
Density (g/cm^3)	0.445	1.98	0.9	2.75	2.25	5.5	g/cm^3
Density (Kg/m^3)	445.0	1980.0	900.0	2750.0	2250.0	5500.0	Kg/m^3
Density (lb/ft^3)	27.9	124.3	55.8	171.6	140.4	343.2	lb/ft^3
Relative Density @ 20°C (g/cm^3)	0.445	1.98	0.9	2.75	2.25	5.5	Kg/m^3
Relative Density @ 4°C (g/cm^3)	0.445	1.98	0.9	2.75	2.25	5.5	Kg/m^3
Baume	-5.2	57.2	-	-	-	-	degBaum
Brix	-10.0	110.0	-	-	-	-	degBrix
Plato Degree	-10.0	110.0	-	-	-	-	%Plato
INPM	-10.0	110.0	-	-	-	-	INPM
Relative Density Alcohol 0 100	-10.0	110.0	-	-	-	-	Alcohol 0 100
Solid Percent	-10.0	55.0	-	-	-	-	%Soli/wt

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 acording to Measured Type process.

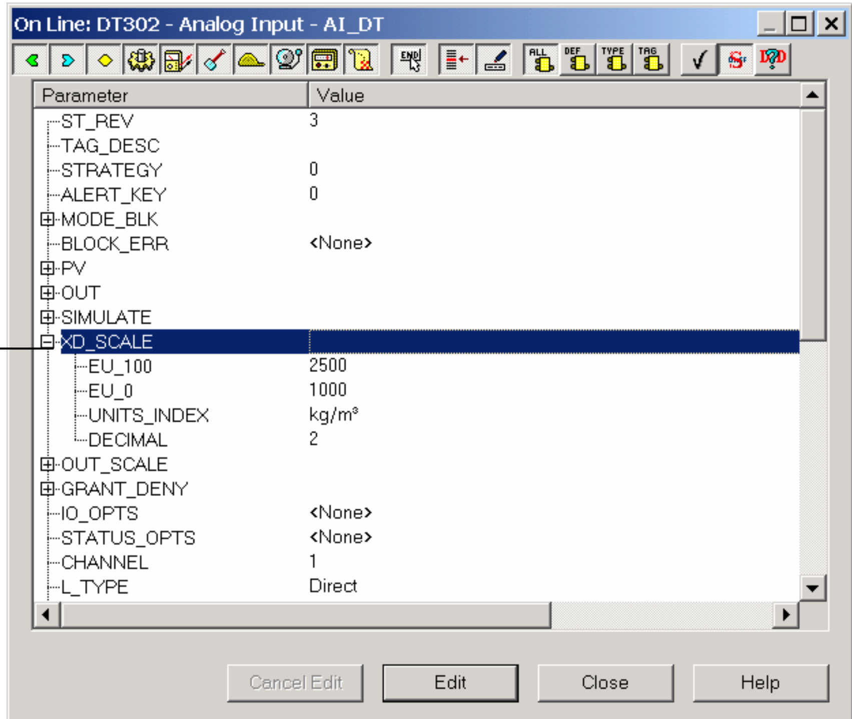


Figure 3.7 – AI Block – XD_SCALE configuration

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:

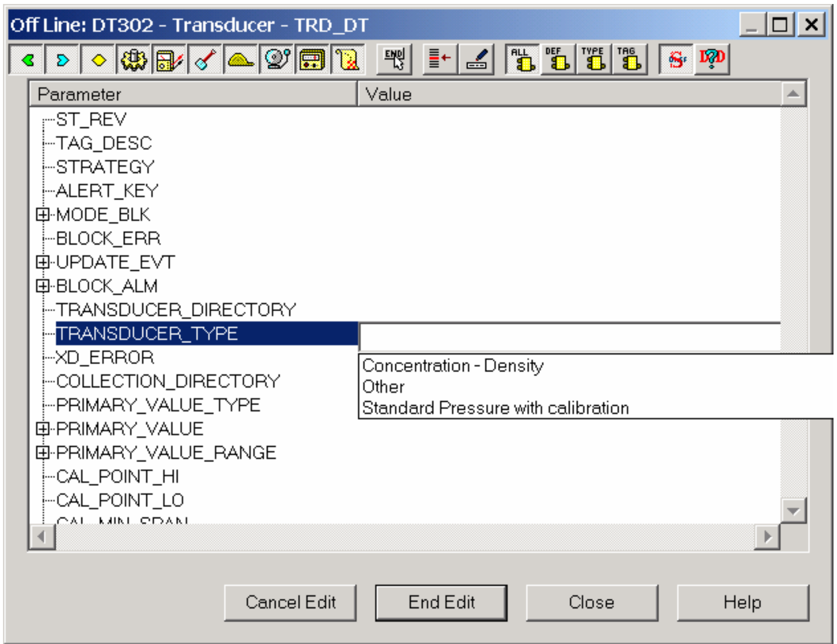


Figure 3.8 – Transducer Block – Transducer Type selection

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 stabilizes 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.

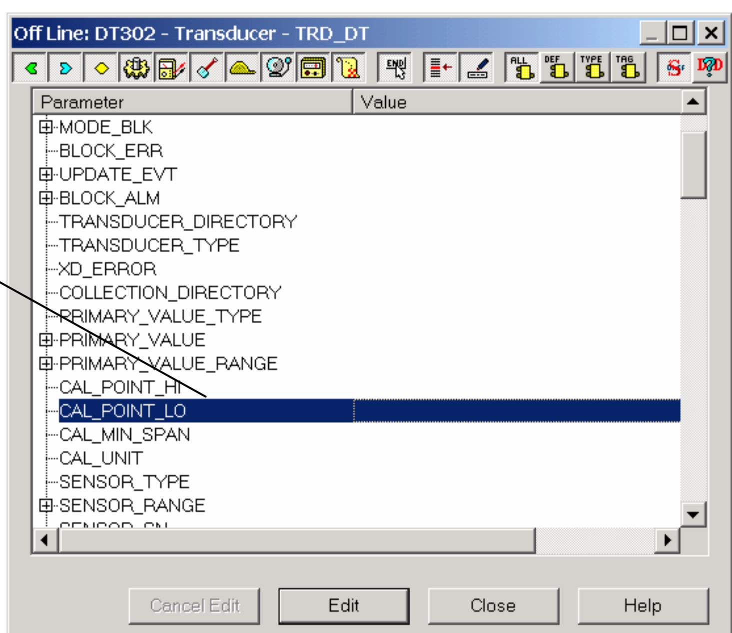


Figure 3.9 – Concentration / Density Calibration

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 the self-calibration is it possible to make a precise calibration without losing the device accuracy. In this procedure is used as reference the density of the air in Kg/m$_3$ and the concetration of the water in BRIX. These references are used because it is easy to have it on the field
To execute the Lower calibration, firstly the user should apply air to the sensors and then writes a value to AUTO_CAL_POINT_LO. Any value writen will calibrate internally the transmitter in 0.00 mmH_2O. Notice that the MEASURED_TYPE and XD_SCALE. UNIT should be configured to Kg/m^3.

The user can see the actual Concentration / Density lower calibrated point and the matched pressure value (0.0 mmH_2O).

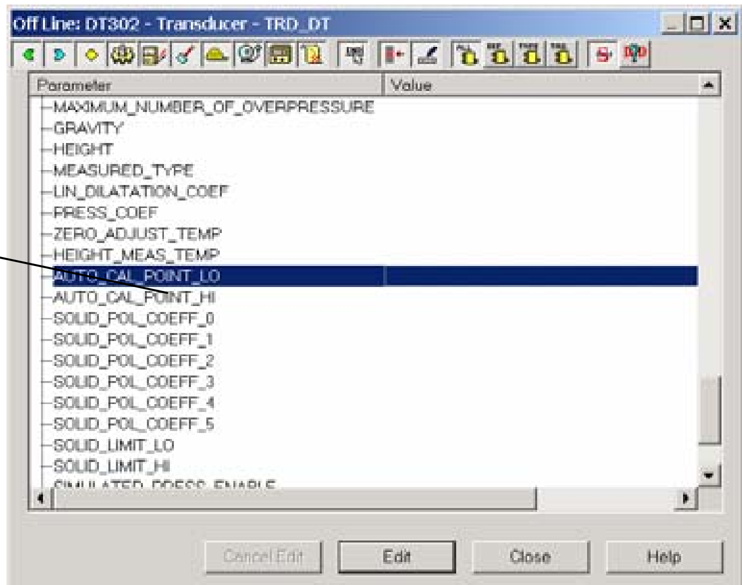


Figure 3.10 – Lower concentration / Density Self-Calibration

To execute the Upper calibration, firstly the user should insert the sensors in water and then writes a value to AUTO_CAL_POINT_HI. In this situation, the applied pressure will be according to the distance between the sensors and the local gravity (500.0 mmH_2O). Notice that the MEASURED_TYPE and XD_SCALE.UNIT should be configured to BRIX.

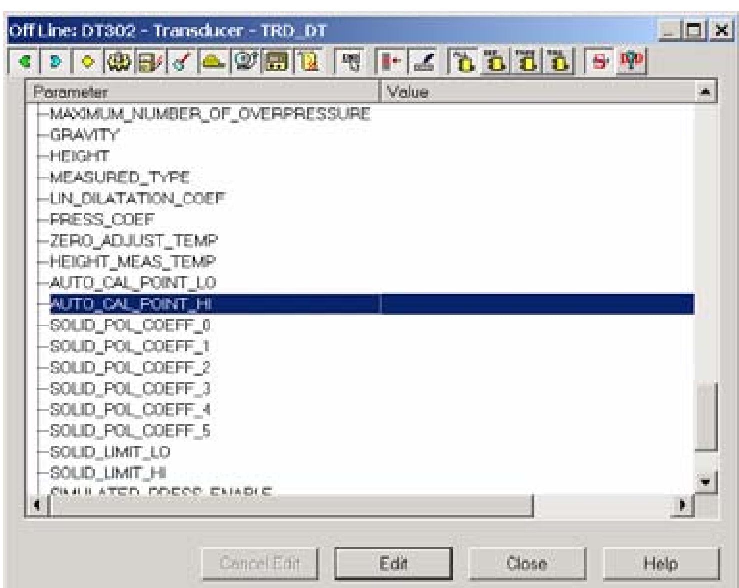


Figure 3.11 – Upper Concentration / Density Self-Calibration

Pressure Calibration

Via *SYSCON*

It is possible to calibrate the transmitter by means of parameters CAL_POINT_LO and CAL_POINT_HI.

Firstly the user must select the Transducer Type to "Pressure".

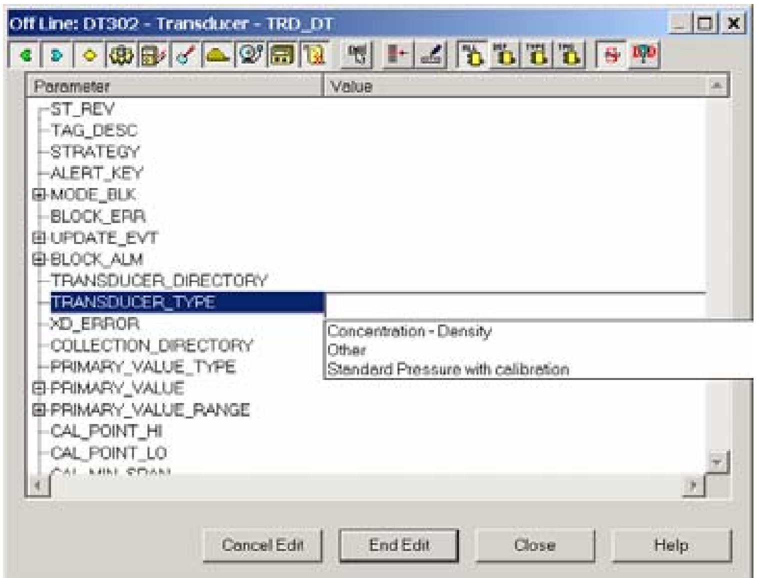


Figure 3.12 – SYSCON – Transducer Type Selection

A convenient engineering unit should be chosen before starting the calibration. This engineering unit is configured in the XD_SCALE inside the AI block. After its configuration the parameters related to calibration will be converted to this unit. Then, select Zero/Lower or Upper calibration menu.

The Engineering Units can be choosen from the Sensor Units list box.

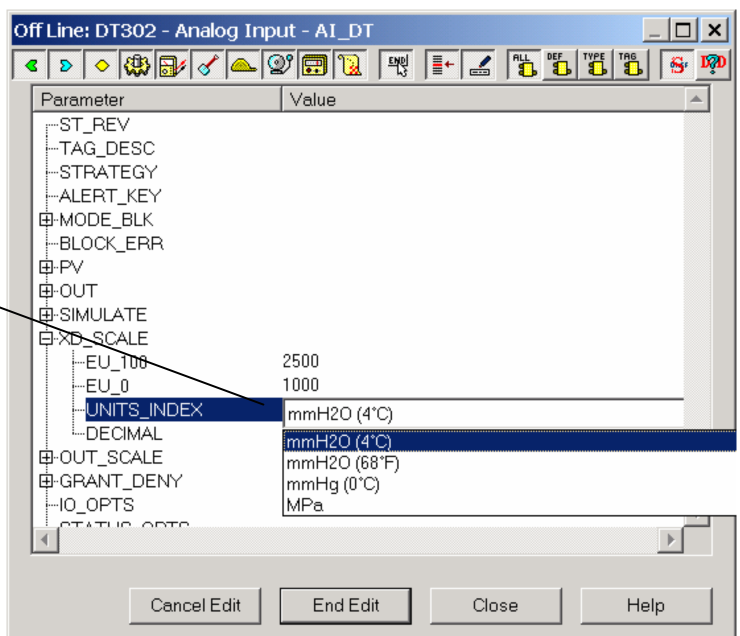


Figure 3.13 – Pressure Unit Selection

The following engineering unit's codes are available:

UNIT
InH_2O @ 68 °F
InHg @ 0 °C
ftH_2O @ 68 °F
mmH_2O @ 68 °F
mmHg @ 0 °C
Psi
Bar
Mbar
g/cm²
k/cm²
Pa
Kpa
Torr
Atm
Mpa
inH_2O @ 4 °C
mmH_2O @ 4 °C

Table 3.4 – Engineering Unit's Code

The SENSOR_HI_LIM and SENSOR_LO_LIM parameters define the maximum and minimum values the sensor is capable of indicating, the engineering units used, and the decimal point.

Let's take the lower value as an example:

Apply to the input zero or a few pressure value and wait until the readout of pressure stabilizes. Write zero or other value in parameter CAL_POINT_LO. For each value written a calibration is performed at the desired point.

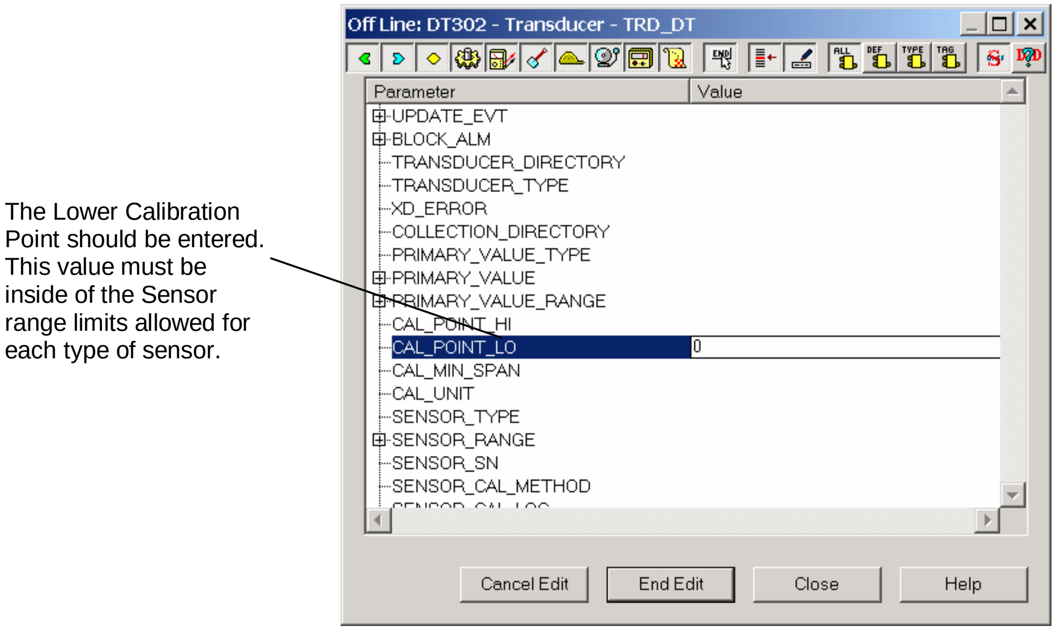


Figure 3.14 – Lower Pressure Calibration

Let's take the upper value as an example:
Apply to the input as the upper value a pressure of 1000mmH_2O and wait until the readout of pressure stabilizes. Then, write the upper value as, for example, 1000mmH_2O in parameter CAL_POINT_HI. For each value written a calibration is performed at the desired point.

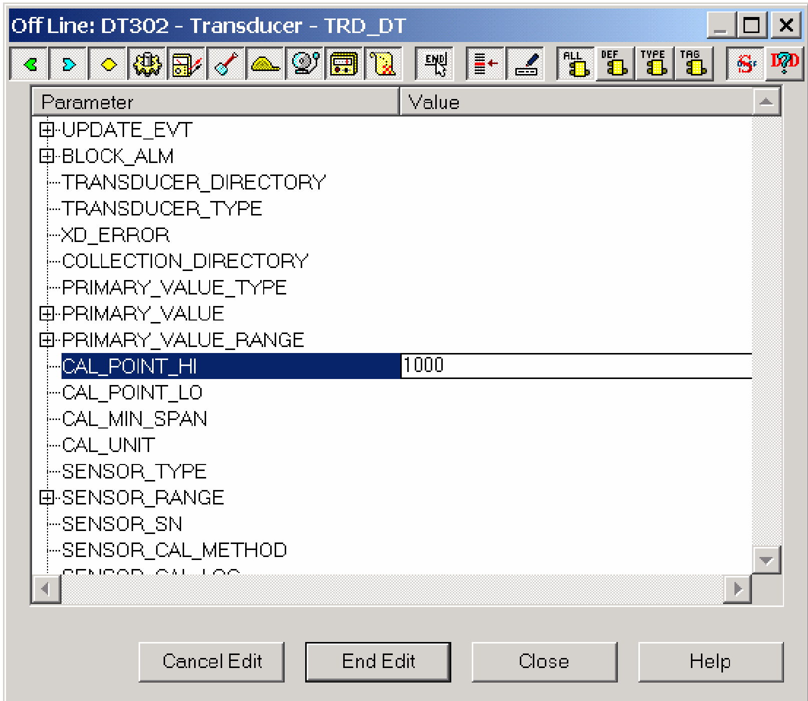


Figure 3.15 – Upper Pressure Calibration

WARNING
It is recommendable, for every new calibration, to save existing trim data, by means of parameter BACKUP_RESTORE, using option "Last Cal Backup".

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. In order 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 resumed 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 stabilizes and collect a sample;
- Determine in laboratory the value of density/concentration of stabilized process;

- In order 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.

Limits for Concentration/Density Calibration						
Measured Type	Range 1		Range 2		Range 3	
	Lower	Upper	Lower	Upper	Lower	Upper
Density (g/cm^3)	0.445	1.98	0.9	2.75	2.25	5.5
Density (Kg/m^3)	445.0	1980.0	900.0	2750.0	2250.0	5500.0
Density (lb/ft^3)	27.9	124.3	55.8	171.6	140.4	343.2
Relative Density @ 20°C (g/cm^3)	0.445	1.98	0.9	2.75	2.25	5.5
Relative Density @ 4°C (g/cm^3)	0.445	1.98	0.9	2.75	2.25	5.5
Baume	-5.2	57.2	-	-	-	-
Brix	-10.0	110.0	-	-	-	-
Plato Degree	-10.0	110.0	-	-	-	-
INPM	-10.0	110.0	-	-	-	-
Relative Density Alcohol 0 100	-10.0	110.0	-	-	-	-
Solid Percent	-10.0	55.0	-	-	-	-

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

Pressure Calibration

The pressure calibration is also with reference, it means that the user must apply pressure to the transmitter. In order to calibrate, firstly follow the steps:

- Wait the process stabilizes;
- In order 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 “Pressure”. Then, browse up to the LOWER or UPPER to make the calibration process, informing the applied pressure.

Let’s take the upper value as an example:
Apply to the input a pressure of 5000mmH_2O.
Wait until the pressure value stabilizes and then actuates parameter UPPER until it reads 5000.

For the lower value the procedure is the same, but we need to actuate in the parameter LOWER.

NOTE
Calibration mode exit via local adjustment occurs automatically should the magnetic tool not be used during some seconds. Keep in that even when parameters LOWER or UPPER already present the desired value, they must be actuated so that calibration is performed.

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 succeded.

NOTE

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

Self-Calibration

In order 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 resumed 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 execute 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 writen will calibrate internally the transmitter in 0.00 mmH_2O.

To execute 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_2O).

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.

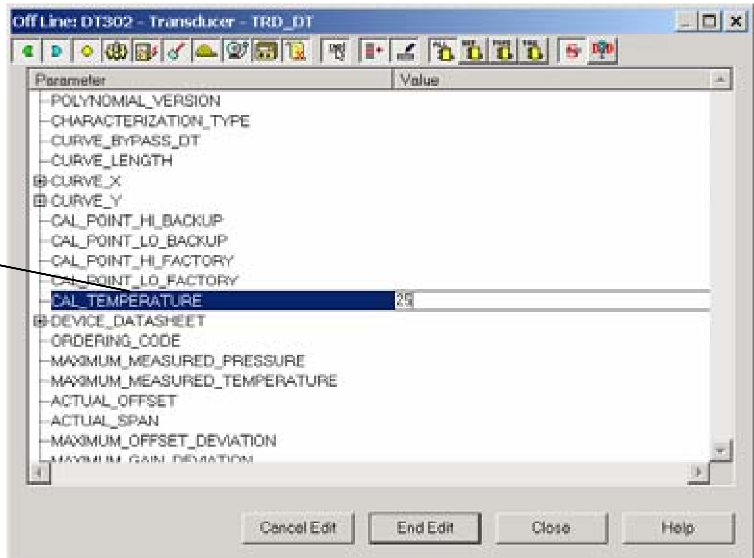


Figure 3.16 – Temperature calibration Configuration Screen

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 E2PROM 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 E2PROM of sensor board is copied to the E2PROM 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 made 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 E2PROM 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. We have the following options:

- **Factory Cal Restore:** Recover last calibration settings made at factory;
- **Last Cal Restore:** Recover last calibration settings made 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 E2PROM 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 E2PROM memory to the E2PROM 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.

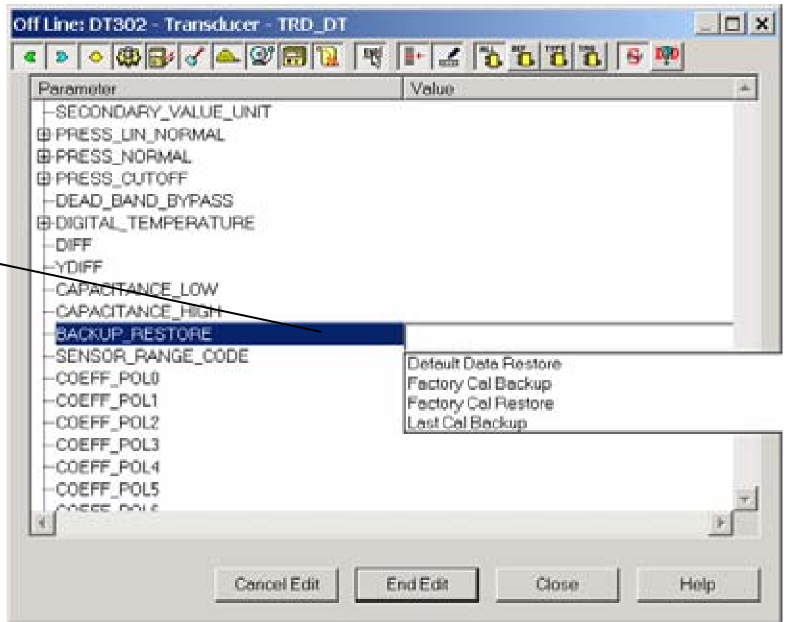


Figure 3.17 – Backup Restore Option

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 customer 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 fit his 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 permits 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 function block and transducers defined according Profibus PA have a description of their features written, by the Device Description Language.This feature permits that third parties 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 the Foundation Fieldbus specifications in order to be interoperable to other parties.

In order 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 in order to able, a possible configuration by means of the local adjustment. As an example, let's suppose that you don't want to show some parameters; in this case, simply write an invalid Tag in the parameter 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 you want to visualize a certain tag, opt for the index relative equal to zero, and for the sub-index equal to one (refer to paragraph Structure Block in the Function Blocks Manual).

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

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

This parameter allows switching up to 6 parameters on the LCD during the monitoring.

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).

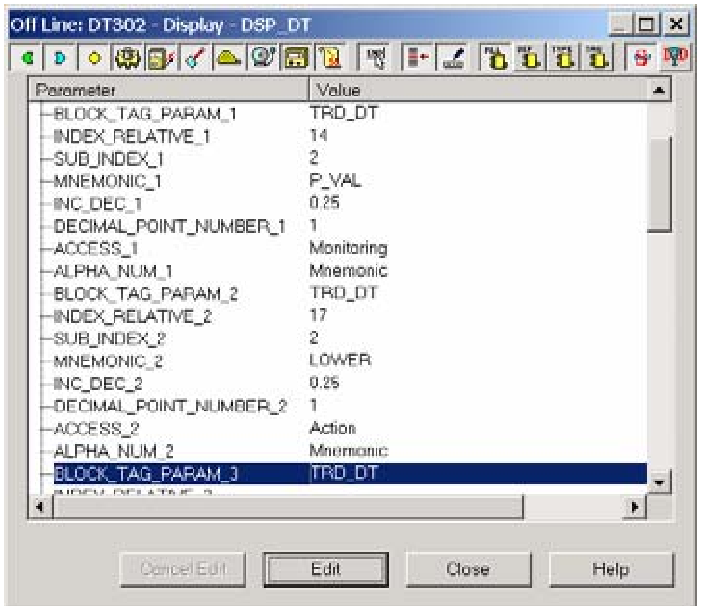
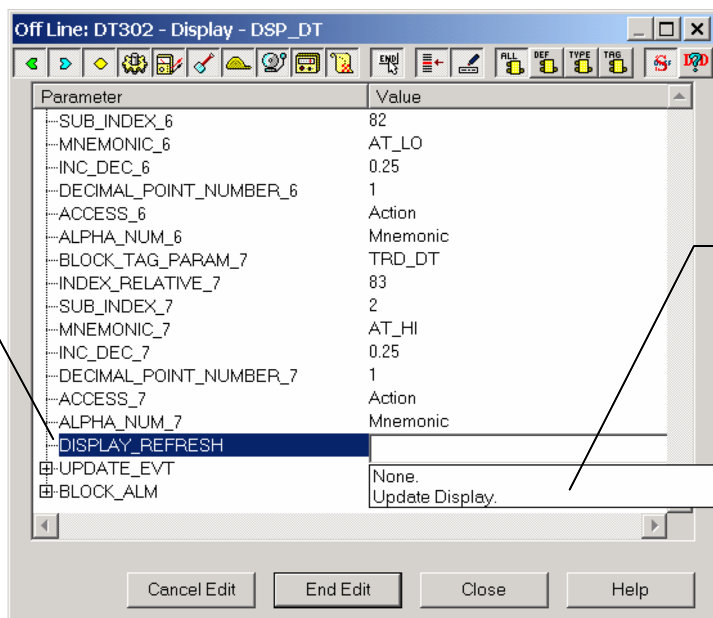


Figure 3.18 – Parameters for Local Adjustment Configuration

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



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

Figure 3.19 – 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 positioner 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 must be in place and the positioner must be fitted with the digital display for access to the local adjustment. Without the display the local adjustment is not possible.

In order 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.

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

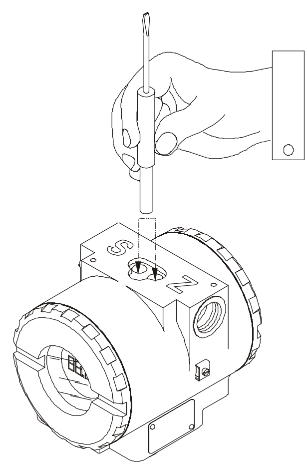


Figure 3.20 - Local Adjustment

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 3.21) is connected to ON, then simulation mode in the AI block is enabled.

W1 Jumper Connections

If W1 (see figure 3.21) is connected to ON, the local adjustment programming tree is enabled and then important block parameters can be adjusted and communication can be pre-configured via local adjustment.

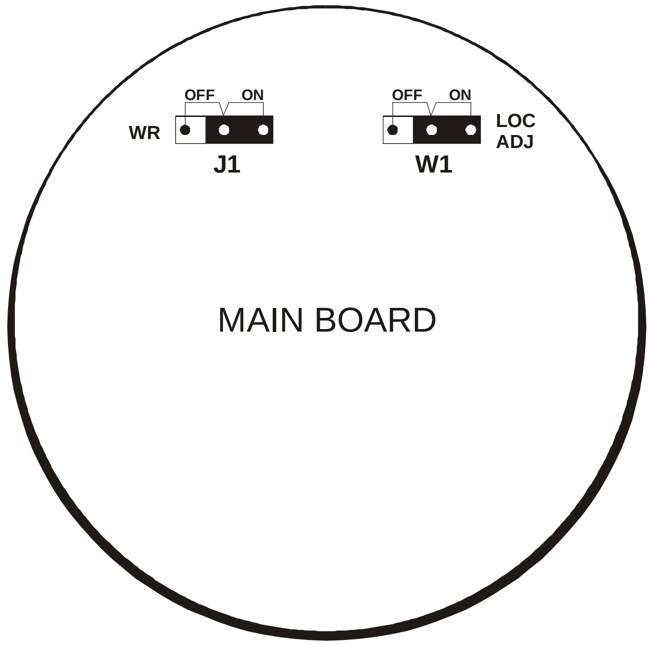


Figure 3.21 - J1 and W1 Jumpers

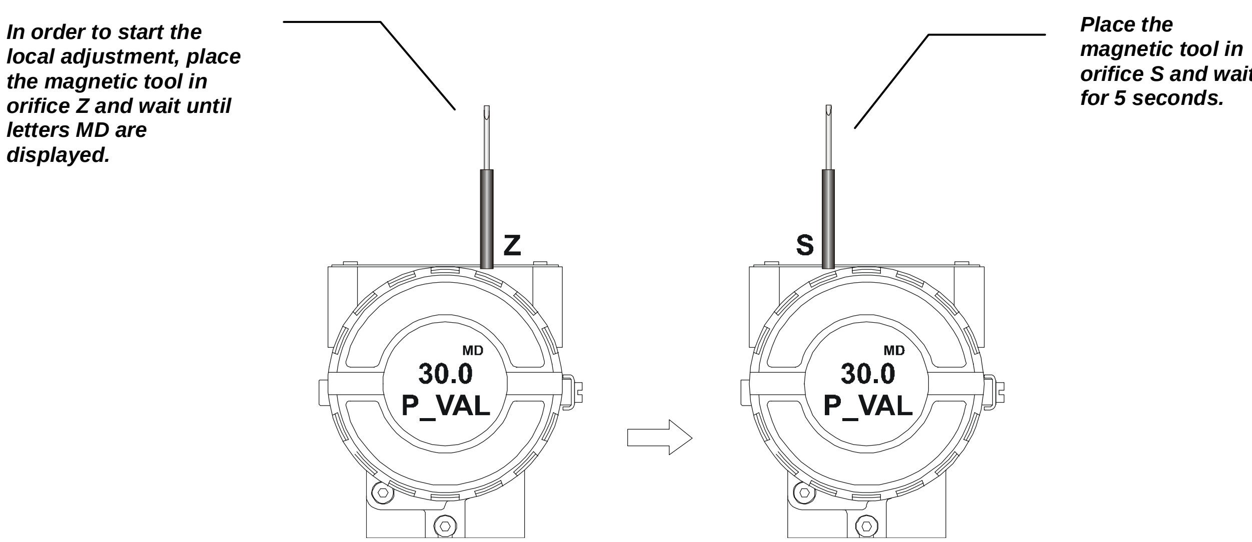
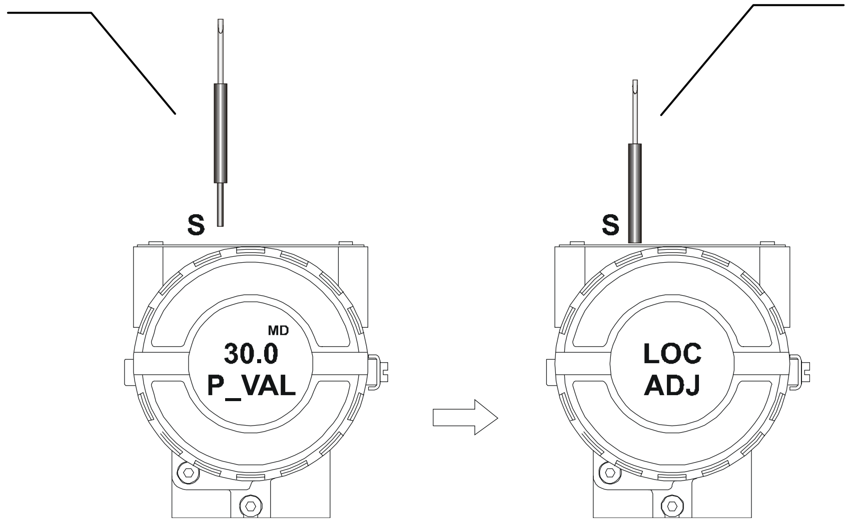


Figure 3.22 - Step 1 - DT302

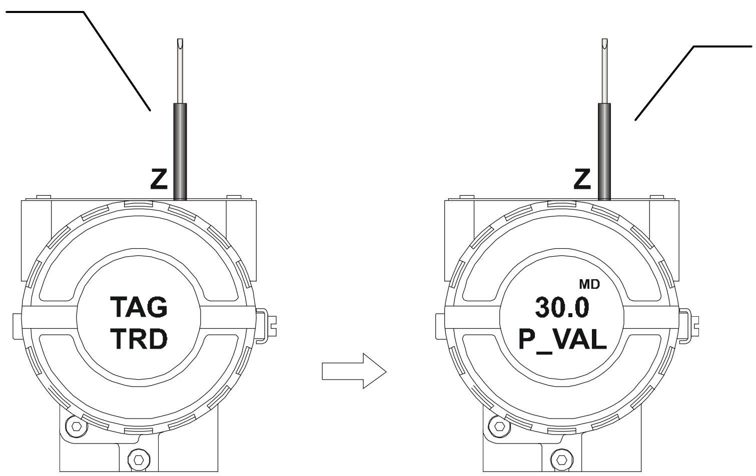
Remove the magnetic tool from orifice S.



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

Figure 3.23 - Step 2 - DT302

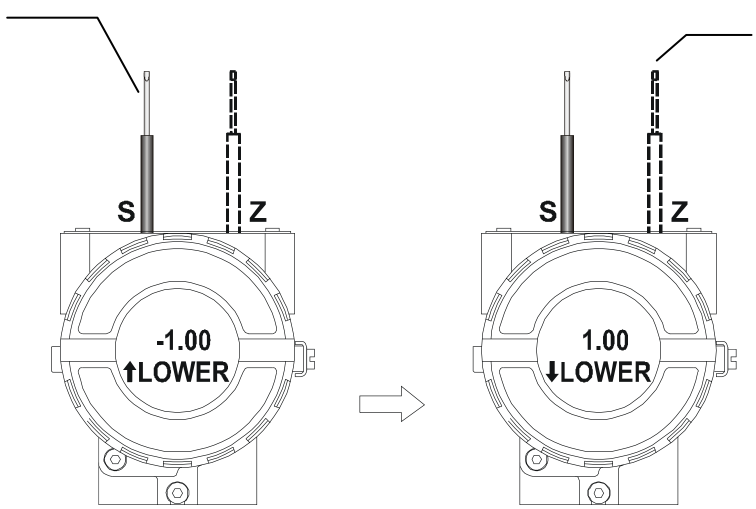
Place the magnetic tool in orifice Z. If this is the first configuration, the option shown on the display is the TAG with its corresponding mnemonic configured by the SYSCON. Otherwise, the option shown on the display will be the one configured in the prior operation. By keeping the tool inserted in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

Figure 3.24 - Step 3 - DT302

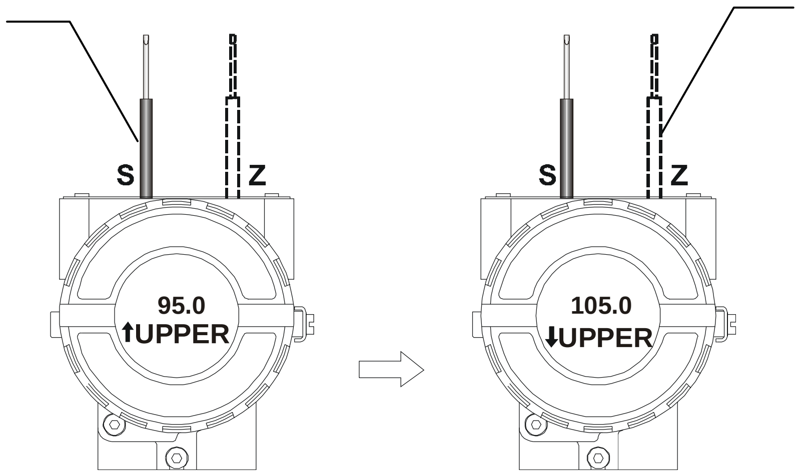
In order to calibrate the lower value (LOWER), insert the magnetic tool in orifice S as soon as LOWER is shown in the display. An arrow pointing upward (↑) increments the value and an arrow pointing downward (↓) decrements the value. In order to increment the value, keep the tool inserted in S until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



In order 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.

Figure 3.25 - Step 4 - DT302

In order 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. In order to increment the value, keep the tool inserted in S until the desired value is set.



In order 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.

Figure 3.26 - Step 5 - DT302

Section 4

Maintenance Procedures

General

SMAR 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 shorts or ground loops. Check if the power supply connector is connected to main board. Check if the shield is not used as a conductor. It should be grounded at one end only.
	• ***Power Supply*** Check power supply output. The voltage must be between 9 - 32 VDC at the **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 table above follow the Note below:

NOTE
The Factory Init should be tried as a last option to recover the equipment control when the equipment presents some problem related to the function blocks or the communication. **This operation must only be carried out by authorized technical personnel and with the process offline, since the equipment will be configured with standard and factory data.** This procedure resets all the configurations run on the equipment, after which a partial download should be performed. Two magnetic tools should be used to this efect,. On the equipment, withdraw the nut that fixes the identification tag on the top of the housing, so that access is gained to the "**S**" and "**Z**" holes. The operations to follow are: 1) Switch off the equipment, insert the magnetic tools and keep them in the holes (the magnetic end in the holes); 2) Feed the equipment; 3) As soon as Factory Init is shown on the display, take off the tools and wait for the "**S**" symbol on the right upper corner of the display to unlit, thus indicating the end of the operation. This procedure makes effective the entire factory configuration and will eliminate eventual problems with the function blocks or with the equipment communication.

Disassembly Procedure

WARNING
Do not disassemble with power on.

The *Figure 4.3 and Figure 4.4 show* exploded view of the transmitter and will help to visualize the following explanations.
The numbers between parentheses are relating to the enumeration of the items of the related drawing.

GROUP OF THE PROBE (16A, 16B, 19A or 19B)
To have access to the probe for cleaning, it is necessary to remove it from the process.
Remove the transmitter loosening the against-flange.
Cleaning should be done carefully in order 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 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.

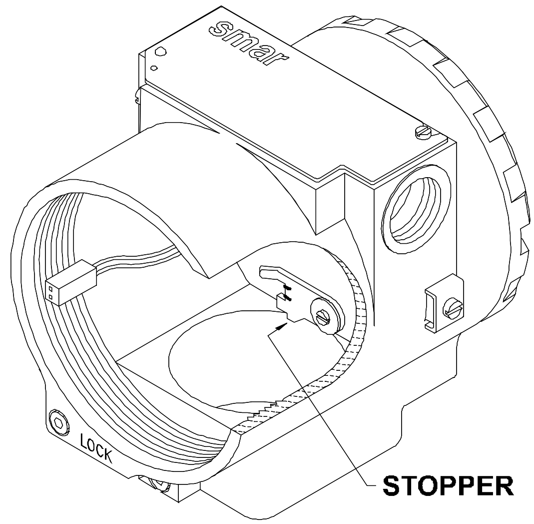


Figure 4.1 - Sensor Rotation Stopper

NOTE
The transmitters have a stopper that can be released to allow the sensor to rotate more than one turn. (See Figure 4.1 - Sensor Rotation Stopper).

WARNING
Do not rotate the electronic housing more than 180° without disconnecting the electronic circuit from the sensor and from the power supply.

Electronic Circuit

To remove the circuit board **(5)**, loosen the two screws **(3)** 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 (16A, 16B, 19A or 19B)
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 **(6)** 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. (Figure 4.2 - Four Possible Positions of the Display). The **SMAR** mark indicates up position.

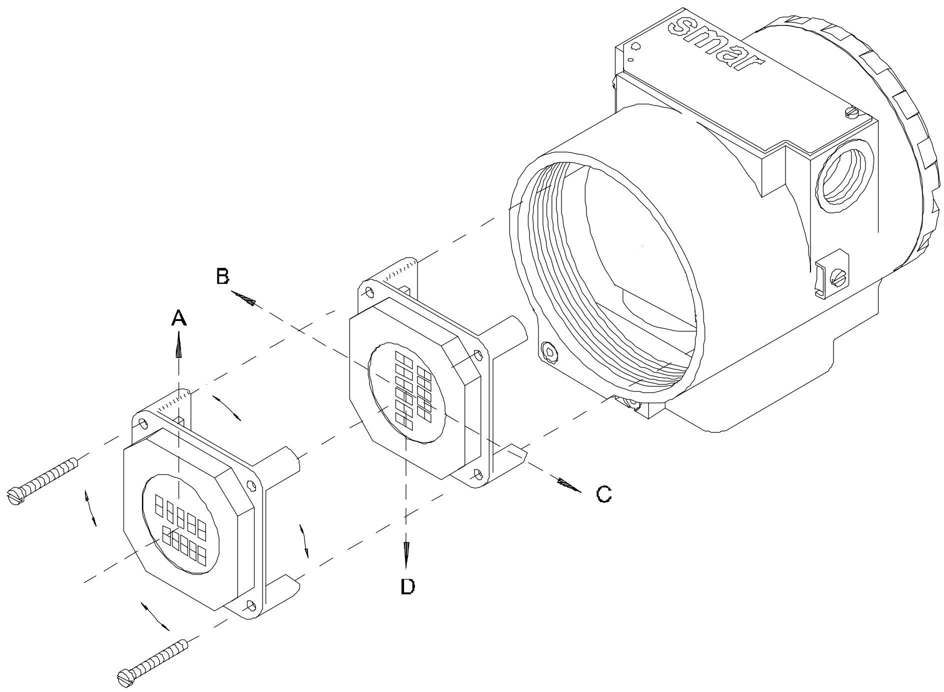


Figure 4.2 - Four Possible Positions of the Display

Anchor the main board and display with their screws **(3)**.

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

Interchangeability

In order 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 5-point 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 also be forced by parameter BACKUP_RESTORE previously explained. In case of changing of the main board, the information of the sensor, as described above are up-to-date.

Upgrading DT301 to DT302

The sensor and casing 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 **(5)**, loosen the two screws (3) 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 to **SMAR**, simply contact our office, informing the defective instrument's serial number, and return it to our factory.

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

ACCESSORIES	
ORDERING CODE	**DESCRIPTION**
SD1	Magnetic Tool for Local Adjustment
BC1	Fieldbus/RS232 Interface
PS302	Power Supply
FDI302	Field Device Interface
BT302	Terminator
DF47	Intrinsic Safety Barrier
DF48	Fieldbus Repeater

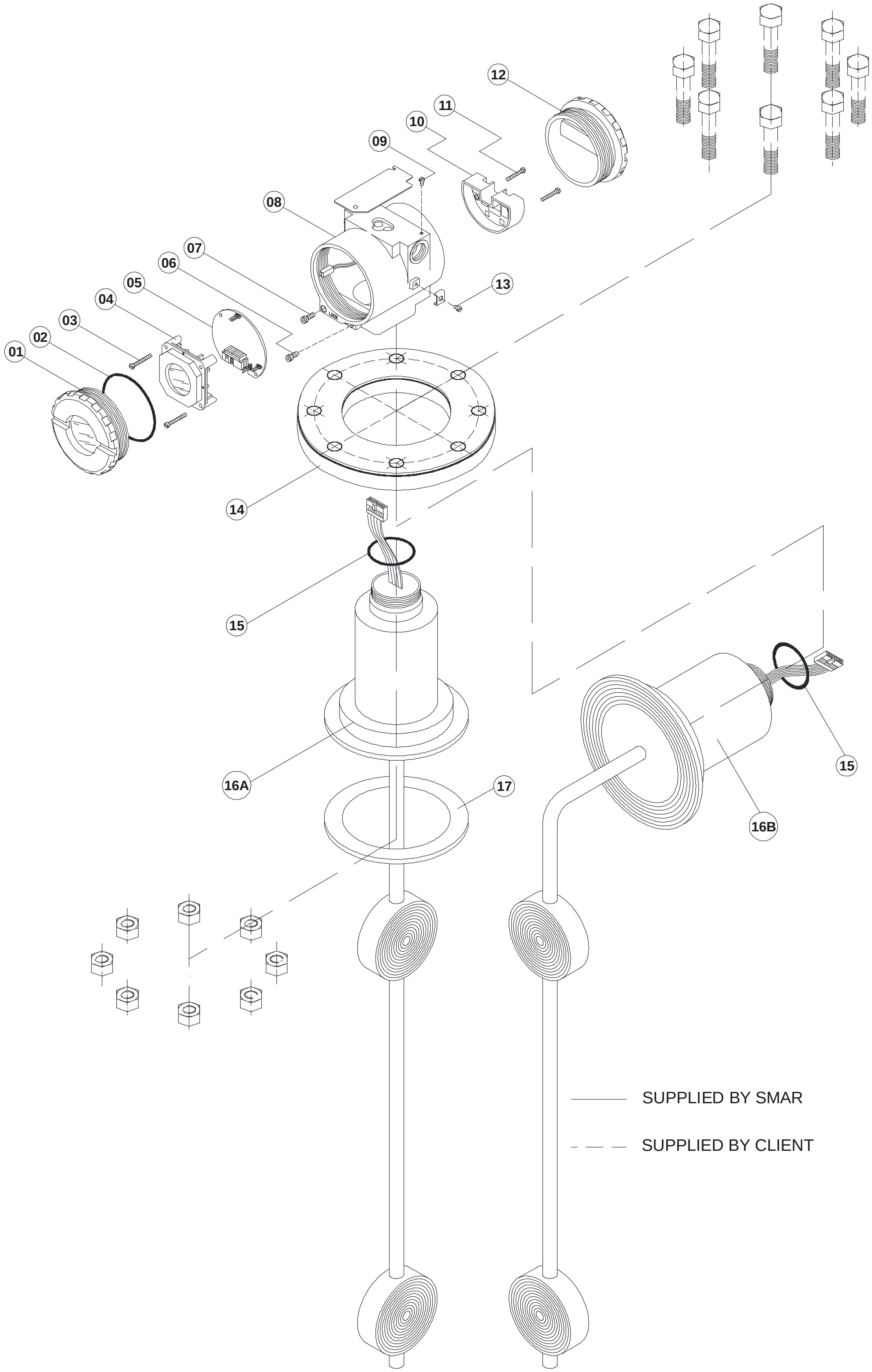


Figure 4.3 - Exploded View Draw for DT302 - Industrial Model

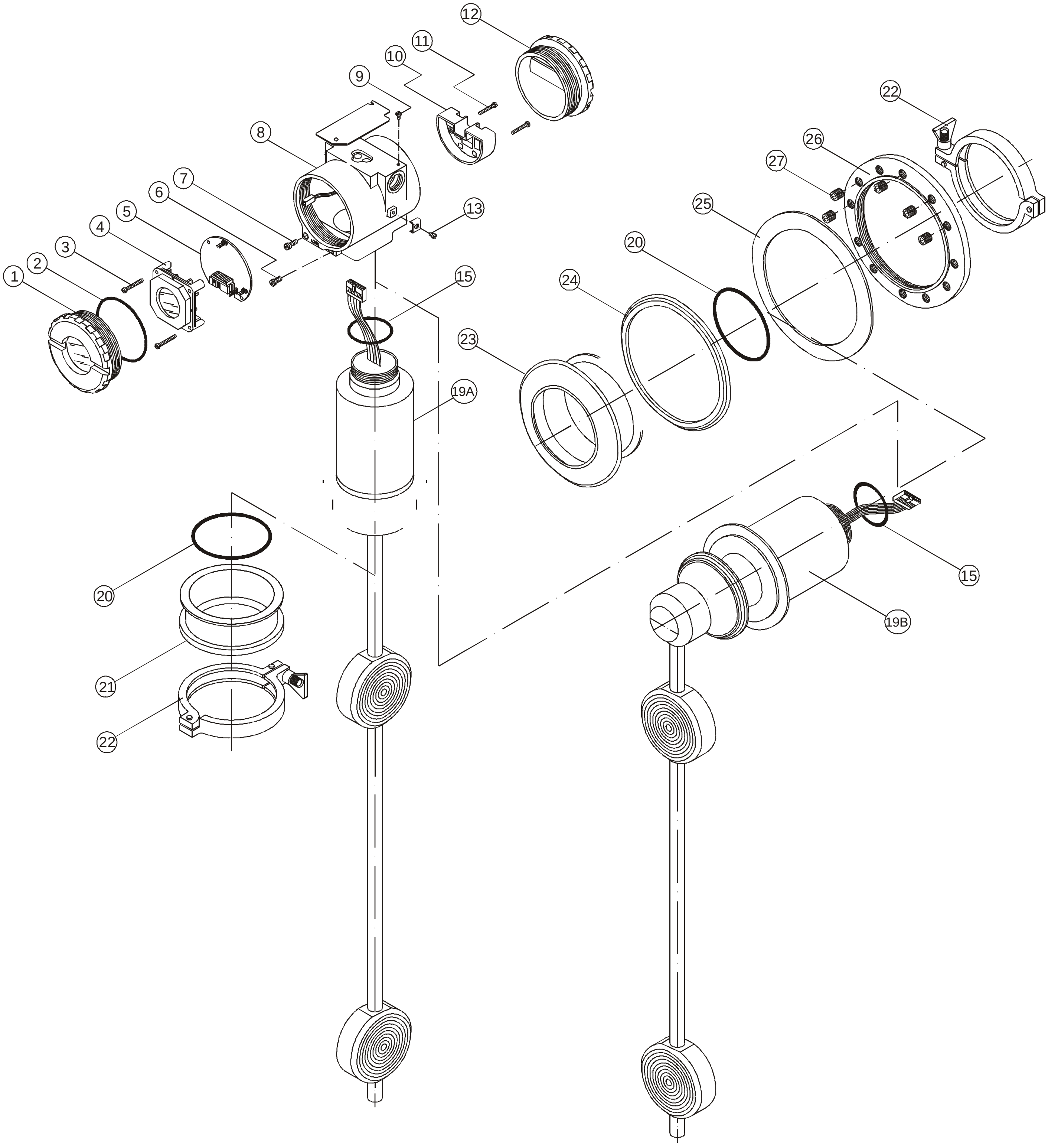


Figure 4.4 - Exploded View Draw for DT302 - Sanitary Model

SPARE PARTS LIST			
DESCRIPTION OF PARTS	**POSITION**	**CODE**	**CATEGORY (NOTE 1)**
HOUSING, Aluminum (NOTE 2)			
½ - 14 NPT	8	400-0252	
M20 x 1.5	8	400-0253	
PG 13.5 DIN	8	400-0254	
HOUSING, 316 SS (NOTE 2)			
½ - 14 NPT	8	400-0255	
M20 x 1.5	8	400-0256	
PG 13.5 DIN	8	400-0257	
COVER (INCLUDES O'RING)			
Aluminum	1 and 12	204-0102	
316 SS	1 and 12	204-0105	
COVER WITH WINDOW FOR INDICATION (INCLUDES O’RING)			
Aluminum	1	204-0103	
316 SS	1	204-0106	
COVER LOCKING SCREW	7	204-0120	
SENSOR LOCKING SCREW	6	204-0121	
EXTERNAL GROUND SCREW	13	204-0124	
IDENTIFICATION PLATE FIXING SCREW	9	204-0116	
DIGITAL INDICATOR	4	214-0108	
TERMINAL INSULATOR	10	314-0123	
MAIN ELECTRONIC CIRCUIT BOARD (NOTE 3)	5	400-0245	A
O’RINGS (NOTE 4)			
Cover, Buna-N	2	204-0122	B
Neck, Buna-N	15	204-0113	B
Process connection, Buna-N	18	400-0235	B
TERMINAL HOLDING SCREW.			
Housing in Aluminum	11	304-0119	
Housing in 316 Stainless Steel	11	204-0119	
MAIN BOARD SCREW HOUSING IN ALUMINUM			
Units with indicator	3	304-0118	
Units without indicator	3	304-0117	
MAIN BOARD SCREW HOUSING IN 316 STAINLESS STEEL			
Units with indicator	3	204-0118	
Units without indicator	3	204-0117	
PROCESS CONECTION – INDUSTRIAL MODEL			
Flange 4” – 150# ANSI B-16.5, AISI 316	14	400-0237	
Flange 4” – 300# ANSI B-16.5, AISI 316	14	400-0238	
Flange 4” – 600# ANSI B-16.5, AISI 316	14	400-0239	
Flange DN 100, PN 25 / 40, din 2526 – Form D, AISI 316	14	400-0240	
Nylon Isolation Bush	17	400-0719	
Teflon Closing Junction	18	400-0720	

SPARE PARTS LIST			
DESCRIPTION OF PARTS	**POSITION**	**CODE**	**CATEGORY (NOTE 1)**
PROCESS CONNECTION - SANITARY MODEL			
Tank Adapter for Straight Model	21	400-0241	
Tri-Clamp de 4", AISI304	22	400-0242	
Tank Adapter for Curve Model	23	400-0721	
Silicon Closing Ring	24	400-0722	
Protection Flange	25	400-0723	
Tightening Flange	26	400-0724	
Tightening Flange Screw	27	400-0725	
PROBE			
Industrial Probe	16A or 16B	(NOTE 5)	B
Sanitary Probe	19A or 19B	(NOTE 5)	B

Table 4.2 - Spare Part List

NOTE:

1. For category A, it is recomended to keep, in stock, 25 parts installed for each set, and for category B, 50.
2. Includes Terminal Block, Bolts, caps and Identification plate without certification.
3. The main board of DT302 and probe are items.
4. 0-Rings are packaged in packs of 12 units.
5. To specify sensors, use the following tables.

400-0244	Sanitary Model Probe
CODE	**Range**
1	0.5 to 1.8 g/cm^3
2	1.0 to 2.5 g/cm^3
3	2.0 to 5.0 g/cm^3

CODE	Diaphragm (s) Material
H	Hastelloy C276
I	316L SST
T	Tantalum
Z	Others – Specify

CODE	Fill Fluid
D	DC 704 – Silicone Oil
S	DC 200/20 – Silicone Oil
G	Glycerin and water – Food Grade
N	Propylene Glicol – NEOBEE M20 – Food Grade
T	Syltherm 800
Z	Others – Specify

CODE	Mounting
1	Top
2	Side

400-0244	1	H	S	1

400-0243	Industrial Model Probe
CODE	**Range**
1	0.5 to 1.8 g/cm^3
2	1.0 to 2.5 g/cm^3
3	2.0 to 5.0 g/cm^3

CODE	Diaphragm (s) Material
H	Hastelloy C276
I	316L SST
T	Tantalum
Z	Others – Specify

CODE	Fill Fluid
D	DC 704 – Silicone Oil
S	DC 200/20 – Silicone Oil
G	Glycerin and water – Food Grade
N	Propylene Glicol – NEOBEE M20 – Food Grade
T	Syltherm 800
Z	Others – Specify

CODE	Mounting
1	Top
2	Side

400-0243	1	H	D	1

Section 5

Technical Characteristics

Filling Fluid
The filling fluid selection shall take into account 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 come in contact with the process fluid, should a leakage occur.

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

FILLING FLUID	VISCOSITY (cSt) at 25ºC	DENSITY (g/cm^3 at 25ºC)	THERMAL EXPANSION COEFICIENT (1/ºC)	APPLICATIONS
Silicone DC 200/20	20	0.95	0.00107	General purpose – Standard
Silicone DC 704	39	1.07	0.000799	General purpose – (high temperature and vacuum)
Sytherm 800	10	0.934	0.0009	General Purpose (extreme temperatures, positive and negative)
Propylene Glycol (Neobee M20) Food Grade	9.8	0.90	0.001	Food and beverage, and Pharmaceutical areas
Glycerin and Water Food Grade	12.5	1.13	0.00034	Food industries

Table 5.1 Properties of filling fluids

Functional Specifications

Input Signal Ranges
Range 1: 0.5 to 1.8 g/cm^3.
Range 2: 1.0 to 2.5 g/cm^3.
Range 3: 2.0 to 5.0 g/cm^3.

Temperature
Pt 100 - 40 to 300°C (- 40 to 572°F).

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

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

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

Hazardous Area Certifications
Explosion proof, weather proof and intrinsically safe (CENELEC and FM standards pending).

Temperature Limits

Ambient:	-40	to	85°C	(-40	to	185°F).	
Process:	-40	to	300°C	(-40	tp	572°F).	
Storage:	-40	to	100°C	(-40	to	212°F).	
Digital Display:	-10	to	60°C	(14	to	140°F)	normal operation.
	-40	to	85°C	(-40	to	185°F)	without damage.

Static Pressure Limit
1.7 Mpa (17 kgf/cm^2).

Turn-on Time
Approximately 10 seconds.

Update Time
Approximately 0.2 second.

Humidity Limits
0 to 100% RH.

Temperature Compensation
Automatic with Pt100.

Performance Specifications

Reference conditions: temperature 25°C (77°F), power supply of 24 Vdc, normal atmospheric pressure, silicone oil fill 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 ^{o}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
3	±0.0016 g/cm^3	0.041 kg/m^3	0.521 kg/m^3	0.007 kg/m^3

(1) Linearity, hysteresis and repeatability efects are inclued.
(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 IEC801 and European Standards EN50081 and EN50082.

Physical Specifications

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

Process Connection
Industrial model: 316 SST flange ANSI B16.5.
Sanitary model: 304 SST Tri-clamp.

Wetted Parts:
Isolating diaphragms: 316L SST or Hastelloy C276.
Probe material: 316L SST or Hastelloy C276 O-ring for
Sanitary model: Bruna N, Viton™ or PTFE.

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, DC704), Syltherm 800, Glycerin and Water or NEOBEE M2O.
Identification plate: 316 SST.

Mounting
Side or Top mounting.

Weight
Sanitary model: 8 kg - Industrial model: 14 kg.

Ordering Code

MODEL DT302I	INDUSTRIAL CONCENTRATION / DENSITY TRANSMITTER

CODE	Range
1	0,5 to 1,8 g/cm^3
2	1,0 to 2,5 g/cm^3
3	2,0 to 5,0 g/cm^3

CODE	Diaphragm Material
H	Hastelloy C276
I	316L SST
T	Tantalum
Z	Others – Specify

CODE	Fill Fluid
D	DC 704 Silicone Oil
S	DC 200/20 Silicone Oil
G	Glycerin and Water – Food Grade
N	Propylene Glycol – NEOBEE M20 – Food Grade
T	Syltherm 800
Z	Outers – Specify

CODE	Indicator Local
0	Without Indicator
1	With Digital Indicator

CODE	Electrical Connection
0	1/2 - 14NPT
A	M20 X 1.5
B	Pg 13.5 DIN
Z	Others – Specify

CODE	Mounting
1	Top
2	Side

CODE		Process Connection Size, Rating and Standard
4	1	4" 150# ANSI B – 16.5
4	2	4" 300# ANSI B – 16.5
4	3	4" 600# ANSI B – 16.5
9	C	DN 100 PN25/40 DIN 2526 – FORM D
Z	Z	Others – Specify

CODE	Optional Item (*)
H1	316 SST Housing
ZZ	Special Options – Specify

DT302I - 1 I S - 1 0 1 - 4 1 / *

(*) Leave it blank for no optional items.

MODEL	SANITARY CONCENTRATION / DENSITY TRANSMITTER
DT302S	

CODE	Range
1	0,5 to 1,8 g/cm^3
2	1,0 to 2,5 g/cm^3
3	2,0 to 5,0 g/cm^3

CODE	Diaphragm Material
H	Hastelloy C276
I	316L SST
T	Tantalum
Z	Others Specify

CODE	Fill Fluid
D	DC 704 Silicone Oil
S	DC 200/20 Silicone Oil
G	Glycerin and Water– Food Grade
N	Propylene Glicol – NEOBEE M20 – Food Grade
T	Syltherm 800
Z	Others – Specify

CODE	Local Indicator
0	Without Indicator
1	With Digital Indicator

CODE	Electrical Connection
0	1/2 - 14NPT
A	M20 X 1.5
B	Pg 13.5 DIN
Z	Others – Specify

CODE	Mounting
1	Top
2	Side

CODE	Process Connection
G	Tri-clamp – 4" 300#
Z	Others – Specify

CODE	Wetted Rings Material
B	Buna – N
V	Viton
T	Teflon
Z	Others – Specify

CODE	Tank Adapter
0	Without Tank Adapter (Supplied by Customer)
1	With Tank Adapter

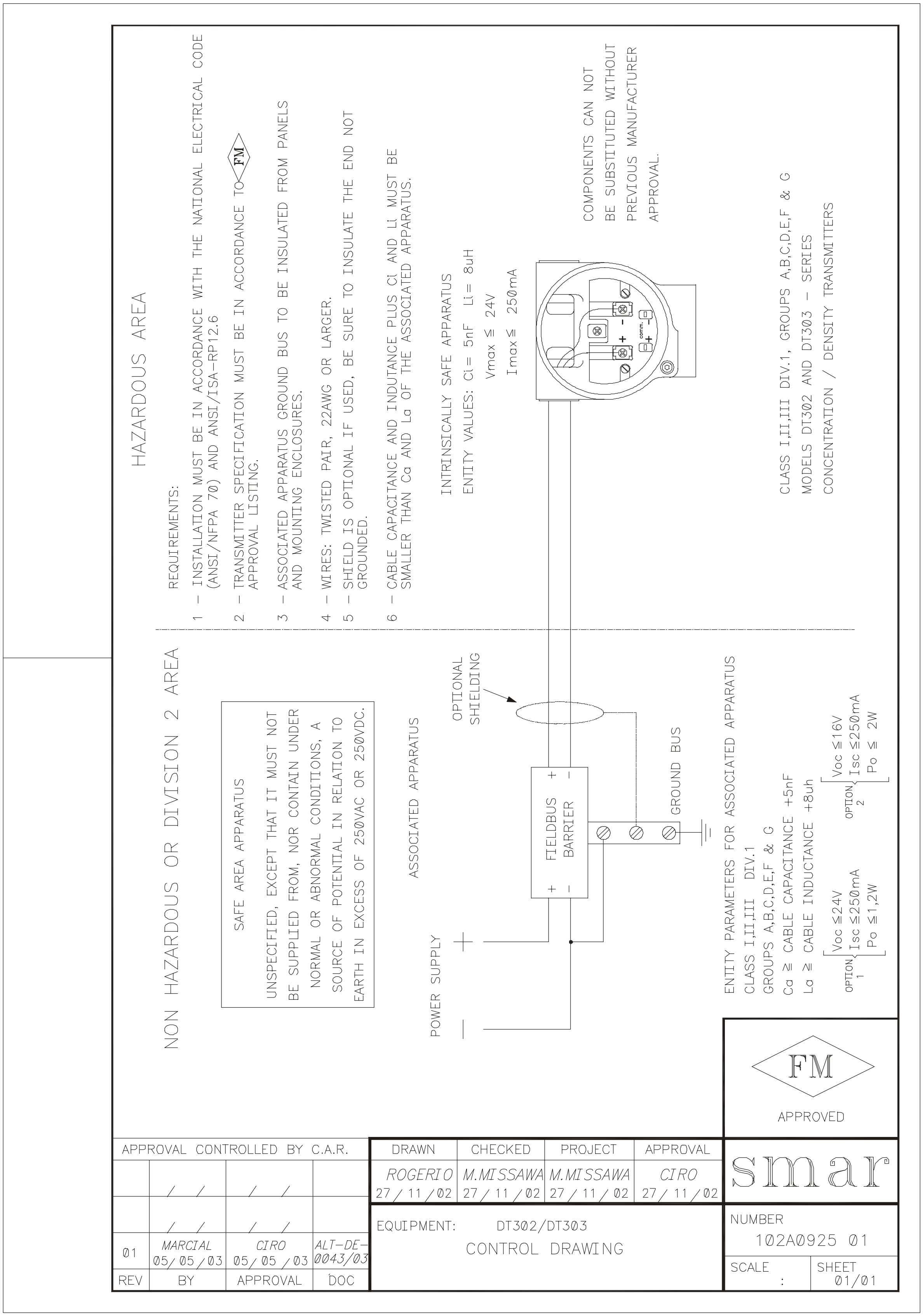
CODE	Tri – clamp
0	Without Tri-clamp
2	With Tank Adapter

COD.	Optional Item (*)
H1	316 SST Housing
ZZ	Special Options – Specify

DT302S - 1 I S - 1 0 1 - G B 0 0 / *

(*) Leave it blank for optional items.

Appendix


HAZARDOUS AREA
NON HAZARDOUS OR DIVISION 2 AREA
REQUIREMENTS:
1 - INSTALLATION MUST BE IN ACCORDANCE WITH THE NATIONAL ELECTRICAL CODE (ANSI/NFPA 70) AND ANSI/ISA-RP12.6
2 - TRANSMITTER SPECIFICATION MUST BE IN ACCORDANCE TO FM APPROVAL LISTING.
3 - ASSOCIATED APPARATUS GROUND BUS TO BE INSULATED FROM PANELS AND MOUNTING ENCLOSURES.
4 - WIRES: TWISTED PAIR, 22AWG OR LARGER.
5 - SHIELD IS OPTIONAL IF USED, BE SURE TO INSULATE THE END NOT GROUNDED.
6 - CABLE CAPACITANCE AND INDUTANCE PLUS Ci AND Li MUST BE SMALLER THAN Ca AND La OF THE ASSOCIATED APPARATUS.
INTRINSICALLY SAFE APPARATUS
ENTITY VALUES: Ci= 5nF Li= 8uH
Vmax ≤ 24V
Imax ≤ 250mA
COMPONENTS CAN NOT BE SUBSTITUTED WITHOUT PREVIOUS MANUFACTURER APPROVAL.
CLASS I,II,III DIV.1, GROUPS A,B,C,D,E,F & G
MODELS DT302 AND DT303 - SERIES
CONCENTRATION / DENSITY TRANSMITTERS
SAFE AREA APPARATUS
UNSPECIFIED, EXCEPT THAT IT MUST NOT BE SUPPLIED FROM, NOR CONTAIN UNDER NORMAL OR ABNORMAL CONDITIONS, A SOURCE OF POTENTIAL IN RELATION TO EARTH IN EXCESS OF 250VAC OR 250VDC.
ASSOCIATED APPARATUS
OPTIONAL SHIELDING
FIELDBUS BARRIER
GROUND BUS
POWER SUPPLY
ENTITY PARAMETERS FOR ASSOCIATED APPARATUS
CLASS I,II,III DIV.1
GROUPS A,B,C,D,E,F & G
Ca ≥ CABLE CAPACITANCE +5nF
La ≥ CABLE INDUCTANCE +8uh
OPTION 1: Voc ≤24V, Isc ≤250mA, Po ≤1,2W
OPTION 2: Voc ≤16V, Isc ≤250mA, Po ≤ 2W
FM APPROVED
APPROVAL CONTROLLED BY C.A.R.
01 MARCIAL 05/05/03 CIRO 05/05/03 ALT-DE-0043/03
REV BY APPROVAL DOC
DRAWN ROGERIO 27/11/02
CHECKED M.MISSAWA 27/11/02
PROJECT M.MISSAWA 27/11/02
APPROVAL CIRO 27/11/02
EQUIPMENT: DT302/DT303
CONTROL DRAWING
smar
NUMBER 102A0925 01
SCALE :
SHEET 01/01