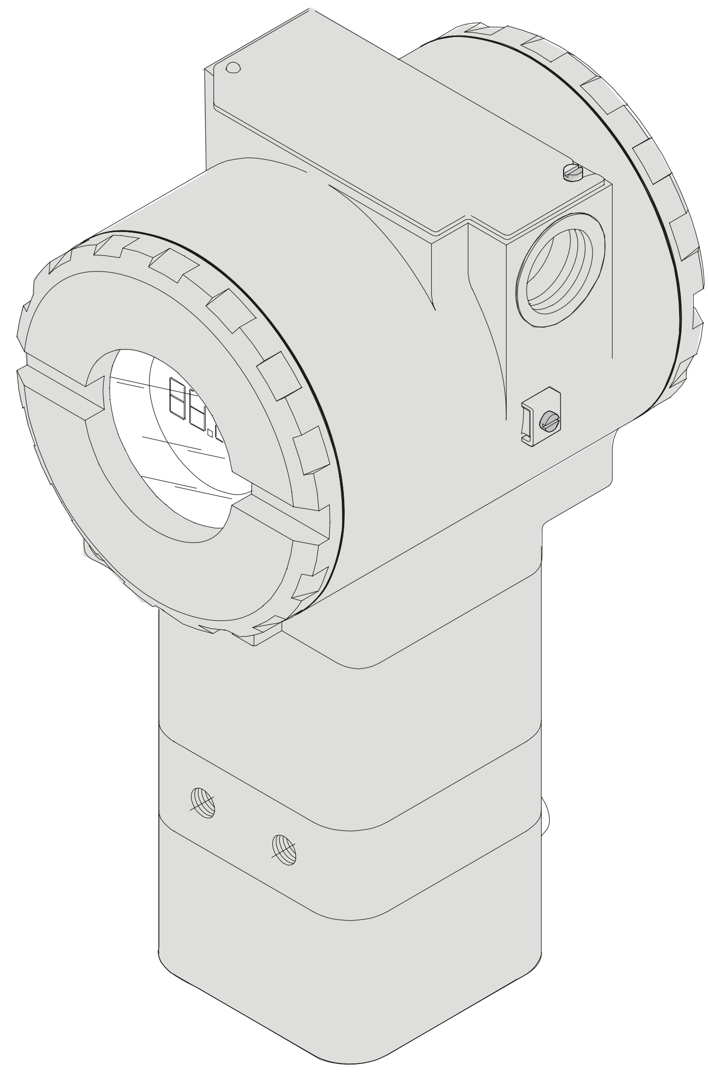
TP302

smar

FIRST IN FIELDBUS

OPERATION AND MAINTENANCE INSTRUCTION MANUAL

POSITION TRANSMITTER



JAN / 05

TP302

VERSION 3

FOUNDATION

TP302ME

smar

web: www.smar.com

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For the latest updates, please visit the SMAR website above.

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INTRODUCTION

The **TP302** is from the first generation of FIELDBUS devices. It is a transmitter for position measurements. It can measure displacement or movement of rotary or linear type. The **TP302** reads the positon and makes it available to Fieldbus system. The digital technology and communication provide an easy interface between the field and control room and several interesting features that considerably reduce the installation, operation and maintenance costs.

The **TP302** is part of SMAR's complete 302 line of Foundation Fieldbus devices.

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

Some 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.

Some of the disadvantages, in comparision to 4-20 mA technology, has also been seen: Communication speed too low for closed loop control, poor Inter-operability between devices of different type and manufacturer. Others: not possible to pass data direct from one device to another (peer-to-peer communication)

The main requirement for Fieldbus was to overcome these problems. Closed loop control with performance like a 4-20 mA system requires higher speed. Since higher speed means higher power consumption, this clashes with the need for intrinsic safety. Therefore a moderatly high communication speed was selected, and the system was designed to have minimum communication overhead. Using scheduling so as the system controls variable sampling, algorithm execution and communication to optimize the usage of the network, not loosing time. Thus achieving 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 (users of SMAR CD600 shoud be familiar with this, since it was implemented several years ago) The user may now easily build and overview complex control estrategies. Another advantage is adding flexibility, the control system may be edited without having to rewire or change the hardware.

The need for implementation of Fieldbus in small as well as large systems was considered when developing the entire 302 line of Fieldbus devices. They have the common features of being able to act as a master on the netwoork and be configured locally using a magnetic tool, eliminating the need for a configurator or console in many applicantions.

The **TP302**, like the rest of the 302 family, has several Fucntion Blocks built in, like PID controller, Input Selector and Splitter/Output selectior, eliminating the need for a separate device. This takes to reduced communication and thereby less dead-time and tighter control, not to mention the reduction in cost.

Get the best results of the TP302 by carefully reading these instructions.

NOTE

This Manual is compatible with version 3.XX, where 1 denotes software version and XX software release. The indication 3.XX means that this manual is compatible with any release of software version 3.

TABLE OF CONTENTS

INSTALLATION

The overall accuracy of measurement and control depends on several variables. Although the converter has an outstanding performance, proper installation is essential, in order to maximize its performance.

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

In warm environments, the transmitter should be installed to avoid, as much as possible, direct exposure to the sun. Installation close to lines and vessels subjected to high temperatures should also be avoided.

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

Humidity is fatal to electronic circuits. In areas subjected to high relative humidity, the O-rings for the electronics cover must be correctly placed. Removal of the electronics cover in the field should be reduced to the minimum necessary, since each time it is re-moved; the circuits are exposed to the humidity. The electronic circuit is protected by a humidity proof coating, but frequent exposures to humidity may affect the protection provided. It is also important to keep the covers tightened in place. Every time they are re-moved, the threads are exposed to corrosion, since painting cannot protect these parts. Code approved sealing methods on conduit entering the transmitter should be employed.

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

General

MOUNTING
The mounting of transmitter TP302 will depend on type movement, if it is linear or rotary. Two supports are required for mounting, one for the magnet and the other for the transmitter itself. Smar may supply then both since they are specified in the order code (See page 4.7)

Rotary Movement
Install the magnet on the valve stem using the magnet support (See Figure 1.2).

Install the transmitter support on the actuator. Should the actuator be in accordance with standard VDI/VDE 5845, all you have to do is tighten the four screws with the lock washers on the standard support.

For special supports, refer to specify instructions. After installing the support on the actuator, it is possible to mount transmitter TP302 on the support by means of the four screws with lock washers.

Make sure that the arrow engraved on the magnet coincides with the arrow engraved on the transmitter when the system is in mid travel.

Should the installation of the transmitter or magnet be altered, or should there be any other modification, the transmitter will require a recalibration.

Linear Movement

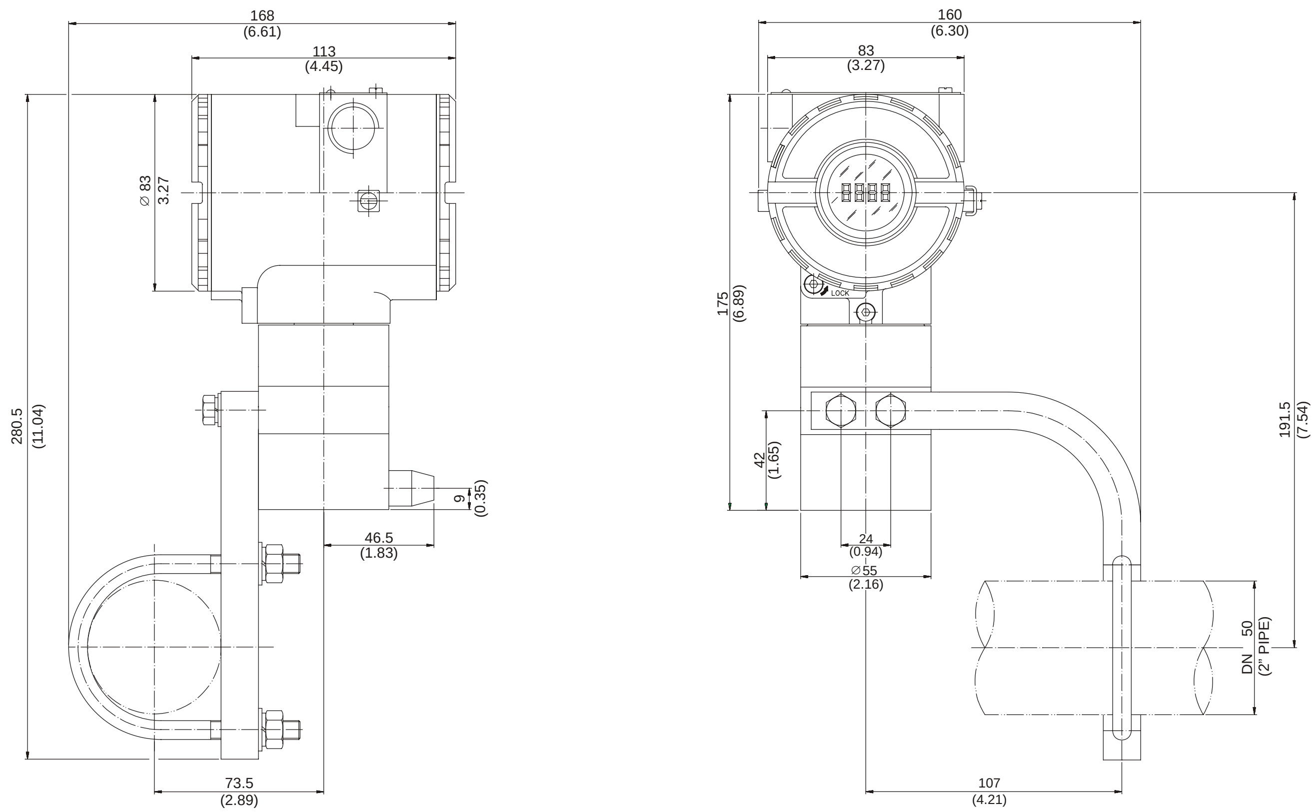
Install the magnet on the valve stem using the magnet support (See Figure 1.3).

Install the transmitter support on the actuator. The actuator support may be secured in place as per standard NAMUR/IEC 536-4 or in accordance with user specified boring. Install the transmitter on the support and tighten the four screws in the threaded bores located on the side opposite to the sensor (Figure 1.3). Use lock washers in order to prevent screw slackening.

Make sure that the support is not obstructing the exhaustion outlets.

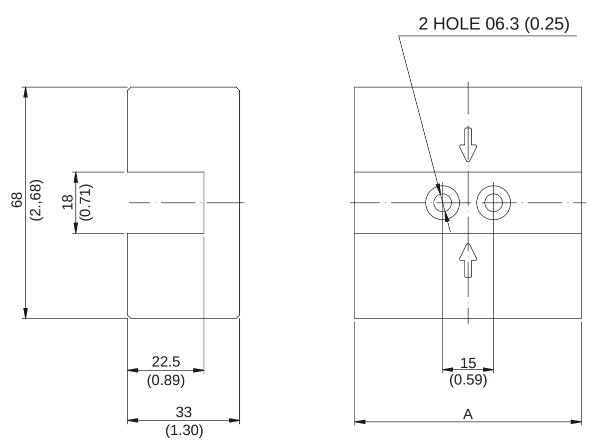
Make sure that arrow engraved on the magnet coincides with the arrow engraved on the transmitter when the system is in mid travel.

Should the installation of the transmitter or magnet be altered, or should there be any other modification, the transmitter will require a re-calibration.



Dimensions are mm (in)

LINEAR MAGNET



STROKE	DIMENSION A
UP TO 15mm (0.59)	44mm (1.73)
UP TO 50mm (1.97)	109mm (4.29)
UP TO 100mm (3.94)	185mm (7.28)

ROTARY MAGNET

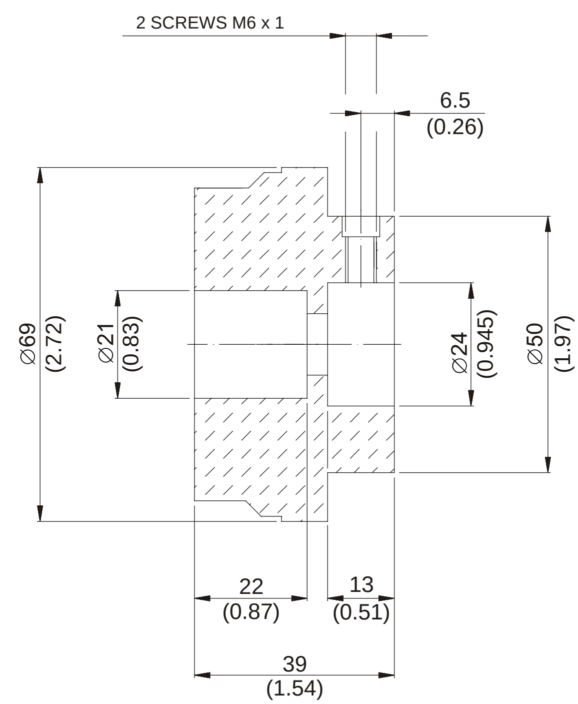


Fig. 1.1 – Dimensional Drawing of the TP302 and Magnet

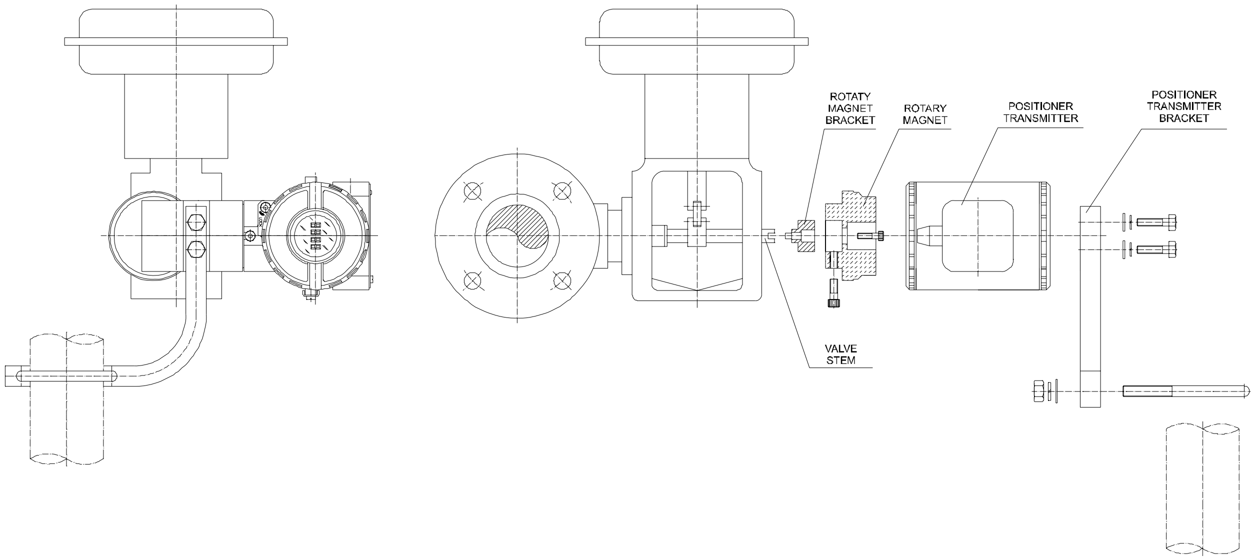
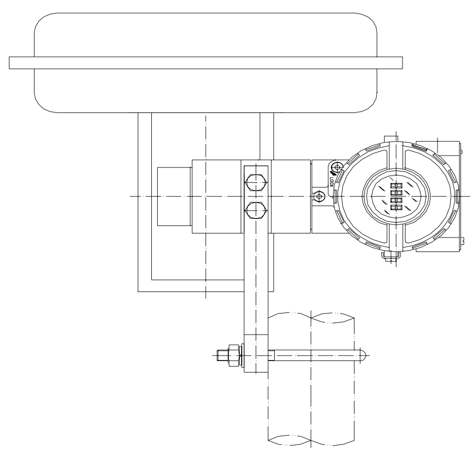


Fig. 1.2 – Transmitter on the Rotary Actuator



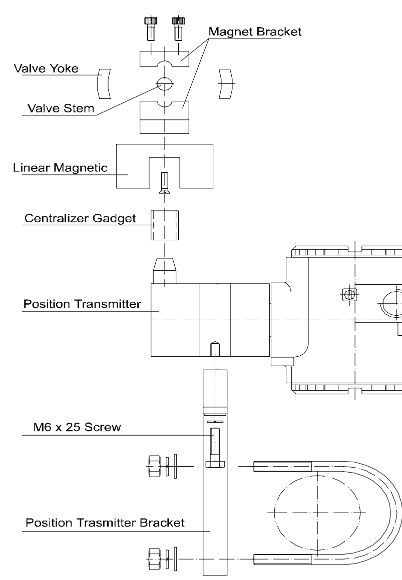


Fig. 1.3 – Transmitter on the Linear

HOUSING ROTATION

The electronic housing can be rotated in order to better position the digital display. To rotate it, uses the Housing Rotation Set Screw, see Figure 1.4.

The local indicator itself can also be rotated. See Section 5, Figure 5.2.

ELECTRIC WIRING

Access the wiring block by removing the Electrical Connection Cover (it sees fig 1.4). This cover can be locked closed by the cover locking screw. To release the cover, rotate the locking screw clockwise.

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

The wiring block has screws on which fork or ring-type terminals can be fastened. See Figure 1.5.

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

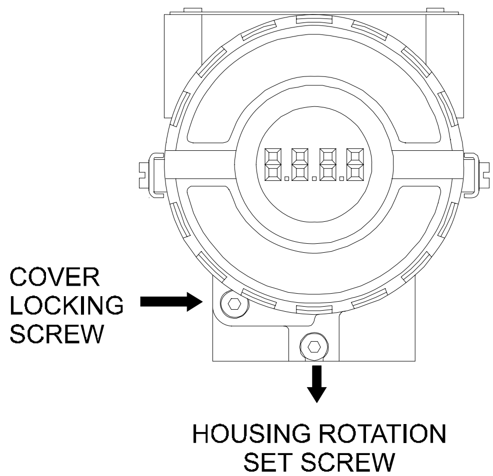


Fig. 1.4 – Cover Locking and Housing Rotation set screw

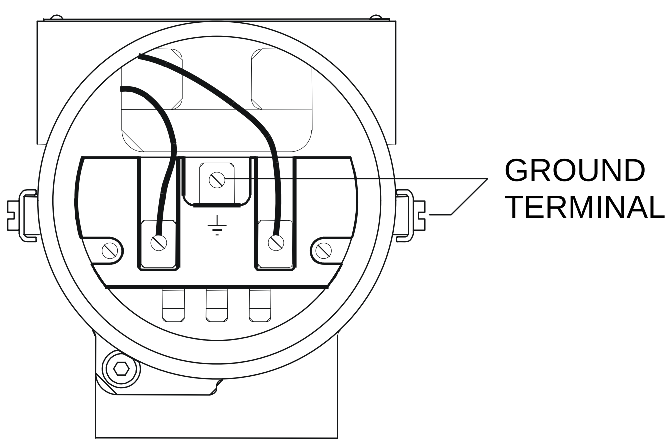


Fig. 1.5 – Wiring Block

The **TP302** 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 **TP302** is powered via the bus. The limit for such devices is 16 for one bus for non-intrinsically safe requirement.

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

The **TP302** is protected against reverse polarity, and can withstand ±35 VDC without damage.

NOTE

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

WARNING

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 incendive requirements, the circuit entity parameters and applicable installation procedures must be observed.

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

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

Bus Topology and Network Configuration

Bus and tree topology (See *Figure 1.6 - Bus Topology and* See *Figure 1.7 - 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.

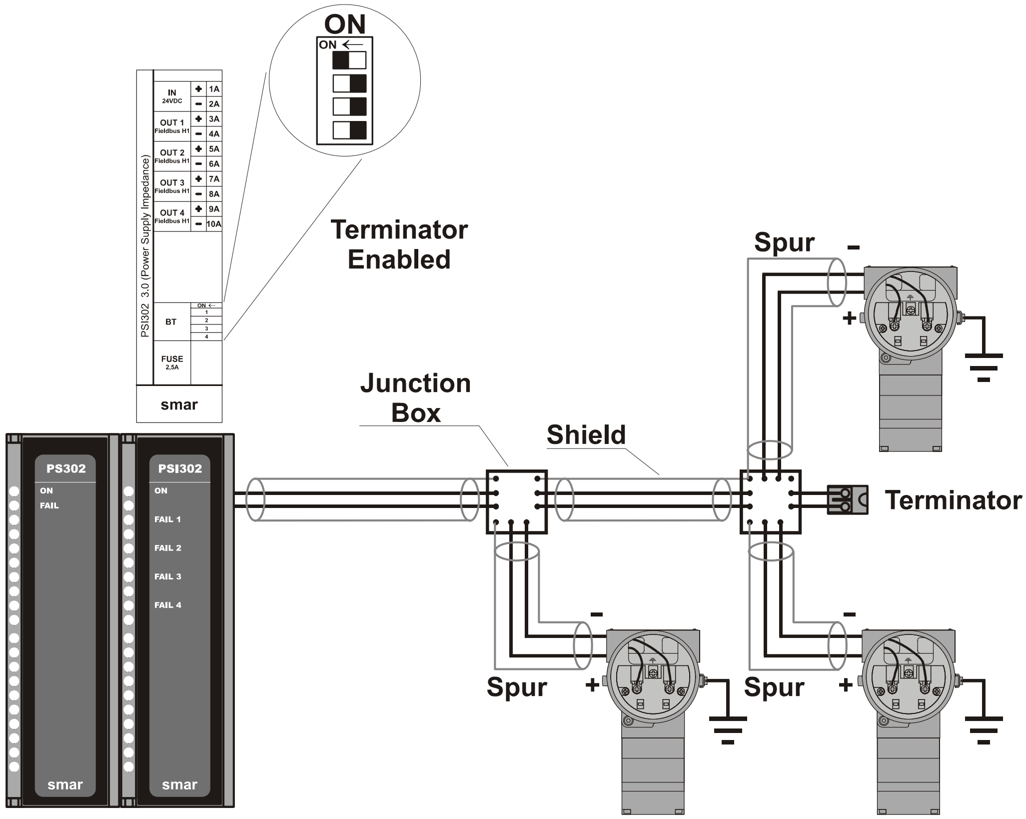


Figure 1.6 - Bus Topology

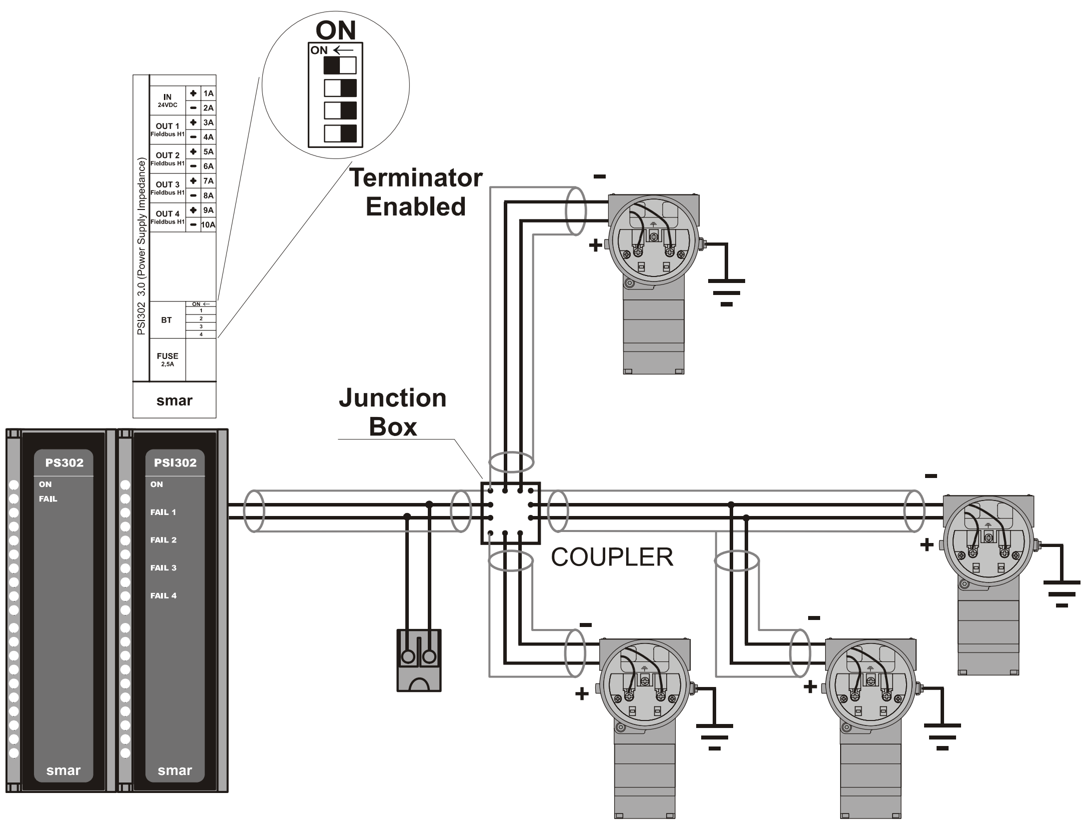


Figure 1.7 - Tree Topology

Jumper Configuration

In order to work properly, the jumpers J1 and W1 located in the **TP302** 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 **TP302** 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.

Remote Hall Sensor

The remote Hall magnetic sensor is recommended for applications where there are high temperatures and extreme vibrations applications. It prevents excessive wear of the equipment and, consequently, the reduction of its useful lifetime.

The electric signals on the remote sensor's connection cable are of low intensity. Therefore, it is recommended to install the cable inside a conduit (maximum length 20 meters) away from possible sources of induction and/or electromagnetic interferences. The cable supplied by Smar is shielded in order to protect it against electromagnetic interferences. Despite this protection, it is not recommended for the cable to share the same conduit with other cables.
The parts for the sensor's connection cable are:

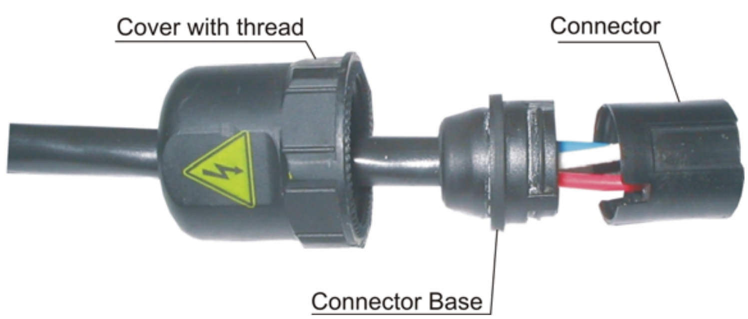


Fig. 1.13 –Hall Sensor cable and its accessories

Disassembly Procedure

Figures 1.11 to 1.14 show the correct disassembling order for the Hall sensor. The steps for disassembling are:

1. Unscrew the cover, by turning it on counter-clockwise direction (direction of the arrow) for the remote Hall side according to figure 1.11.
2. Pull the cable following the arrow as in figure 1.12,
3. Pull the cable connector base, to release it from the block connector, according to figures 1.13 and 1.14.

Fig. 1.14 – Disconnecting the cover of the Hall sensor cable

Fig. 1.15 – Disconnecting the Hall sensor cable

Fig. 1.16 –Unfastened connector

Fig. 1.17 – Connector with the cable's wires maintained in their orifices

Fig. 1.18 – Wires position in the connector

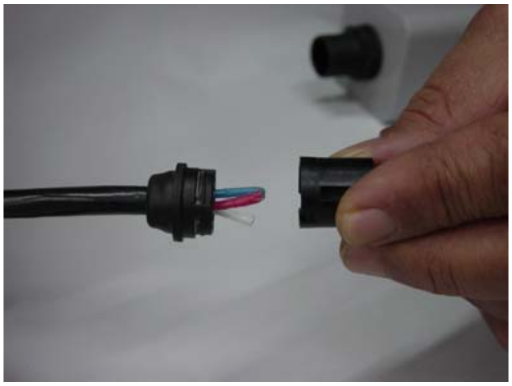


Fig. 1.19 – Release the cables' connector

Assembly Procedure

Mount the components following the sequence:

1. Pass the cable through the cover orifice (**Figure 1.17**);
2. Pass the cable through the base connector orifice (**Figure 1.18**);
3. The red, white, and black wires should be inserted in the base connector orifice marked by numbers beside them, look at **Figure 1.19** e **1.20.**

Fig. 1.20 – Assembling the cover

Fig. 1.21 – Assembling the wire bracket

Fig. 1.22 – Inserting the wires in the connector.

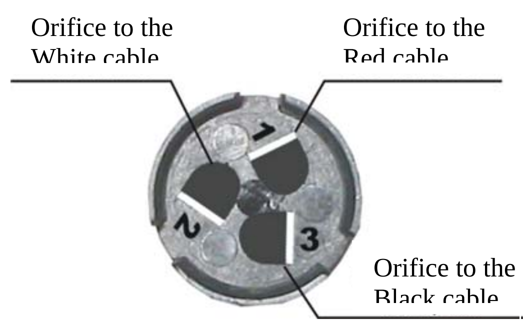


Fig. 1.23 – Orifice Cable's Connector with Numbers beside them.

Insert the cable connector in the remote Hall's block connector as figure 1.21. The block connector has internal saliencies that perfectly fit the groove, in order to prevent errors in the assembly. The cutting pins inside of the block connector will cut the wire insulators and press against them, thus establishing the electric contact between the cable and the hall sensor's circuit.
To finish, fasten the cover to the Hall sensor's connection (figure 1.22).

Fig. 1.24– Fasten the cover to the remote Hall.

Fig. 1.25 –Assembly finished.

Section 2

OPERATION

Functional Description – Hall Sensor

Sensor Hall supplies an output voltage proportional to the applied magnetic field. This magnetic sensor is ideal for use in system of sensor of linear or rotative position. The mechanical vibrations do not affect Sensor Hall.

Functional Description – Electronics

Refer to the block diagram Figure 2.1 - TP302 Block Diagram Hardware.
The function of each block is described below.

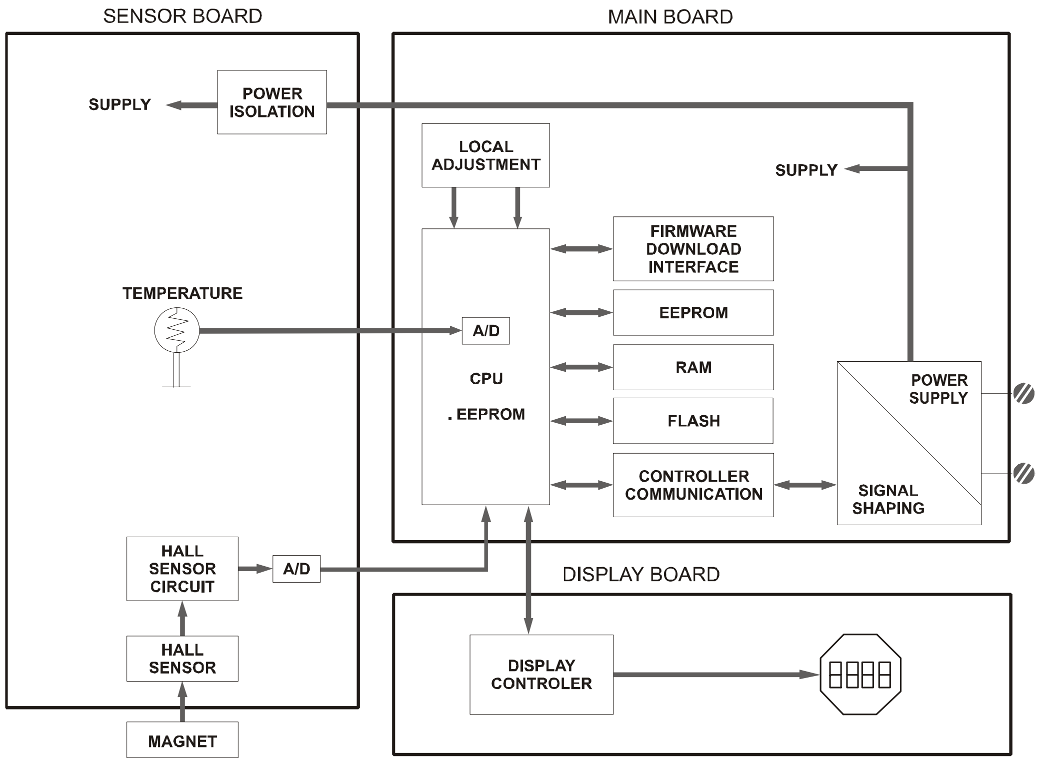


Figure 2.1 - TP302 Block Diagram Hardware

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.

Controller Communication
Monitors line activity, modulate and demodulate communication signals; inserts and deletes start and end delimiters, and check 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.

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

Hall Sensor Circuit

Measures the position actual to the CPU.

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. The magnetic tool without mechanical or electrical contact can activate them.

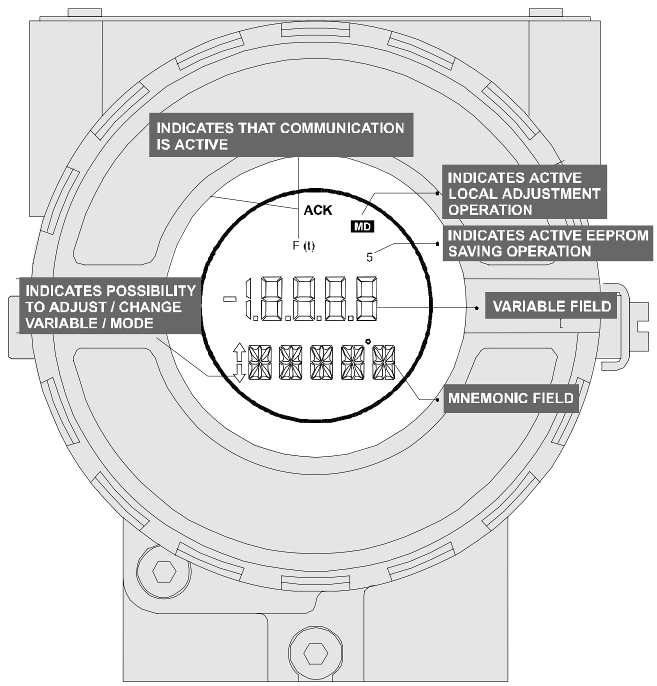


Figure 2.2 - LCD Indicator

Section 3

CONFIGURATION

One of the many advantages of Fieldbus is that device configuration is independent of the configurator. The **TP302** may be configured by a third party terminal or operator console.

The **TP302** contains one input transducer block, one resource block, one display block and function blocks.

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.

How to Configure the Transducer Block

Each time when you select a field device on SYSCON by instantiating on the Operation menu, automatically you instantiate one transducer block and it appears on screen.
The icon indicates that one transducer block has been created and by clicking twice on he icon, you can access it.

The tranducer block has an algorithm and a set of contained parameters.
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 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, linearisation 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 Syscon identifies each method associated to the parameters and enables the interface to it.

TP302 – Position Fieldbus Transducer

Description
The position fieldbus transducer makes the position input reading PRIMARY_VALUE available to the AI block. The engineering unit and the primary value range are selected from the XD_SCALE in the AI block. The only unit allowed is this case is %. The AI block connected to this transducer has the CHANNEL the same selection as TERMINAL_NUMBER. The supported mode is OOS and AUTO. As the transducer block runs together with AI block, the transducer block goes to AUTO only if the AI mode block is already in AUTO. The sensor module temperature may be read from the SECONDARY_VALUE parameter.
Warning messages may appear in Primary Value status or in the Block Error in certain condition as explain below.

Supported Modes
OOS and AUTO.

BLOCK_ERR
The BLOCK_ERR of the transducer block will reflect the following causes:
Input Failure – When mechanic module is disconnected from main electronic board.
Out of Service – When the block is in OOS mode.
Primary_Value Status
The PRIMARY_VALUE status of the transducer block will reflect the following causes:
Bad::SensorFailure:NotLimited – When mechanic module is disconnected from main electronic board.

Parameters

Idx	Parameter	Data Type	Valid Range	Initial/ Default Value	Units	Store	Description
1	ST_REV	Unsigned16		0	None	S	Indicates the level of static data.
2	TAG_DESC	VisibleString		Null	Na	S	Description of Transducer Block.
3	STRATEGY	Unsigned16		0	None	S	This parameter is not checked and processed by Transducer Block.
4	ALERT_KEY	Unsigned8	1-255	0	None	S	Number of identification in the plant.
5	**MODE_BLK**	**DS-69**	See Table	O/S	Na	Mix	**Indicates the operation mode of Transducer Block.**
6	**BLOCK_ERR**	**Bit String**				D	**Indicates the status associated with hardware or software in the Transducer.**
7	UPDATE_EVT	DS-73			Na	D	It is the alert for any static data.
8	BLOCK_ALM	DS-72			Na	D	It is used for configuration, hardware and others failures.
9	TRANSDUCER_DIRECTORY	Array of Unsigned16			None	N	It is used to select several Transducer Blocks.
10	TRANSDUCER_TYPE	Unsigned16	See Table	65535	E	N	Indicates the type of Transducer according to its class.
11	XD_ERROR	Unsigned8	See Table	0	None	D	It is used to indicate calibration status.
12	COLLECTION_DIRECTORY	Array of Unsigned 32			None	S	Specifies the number of transducer index into Transducer Block.
13	PRIMARY_VALUE_TYPE	Unsigned16	See Table	65535	None	S	Defines the calculation type for Transducer Block.
14	**PRIMARY_VALUE**	**DS-65**	± INF	0	PVR	D	**It is the value and status used by channel 1, 2 and 3.**
15	**PRIMARY_VALUE_RANGE**	**DS-68**	0-100%	100	PVR	S	**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.**
16	CAL_POINT_HI	Float	+INF	100	CU	S	The highest calibrated value.
17	CAL_POINT_LO	Float	-INF	0	CU	S	The lowest calibrated value.
18	CAL_MIN_SPAN	Float		5.0 %	CU	S	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.
19	CAL_UNIT	Unsigned16	See Table	%	E	S	The Device Description engineering units code index for the calibration values.
20	SENSOR_SN	Unsigned32	0 to 2^{32}	0		S	The sensor serial number.
21	SENSOR_CAL_METHOD	Unsigned8	See Table	Factory	None	S	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.

Idx	Parameter	Data Type	Valid Range	Initial/ Default Value	Units	Store	Description
22	SENSOR_CAL_LOC	VisibleString		NULL	None	S	The location of last sensor calibration. This describes the physical location at which the calibration was performed.
23	SENSOR_CAL_DATE	Time of Day		0	None	S	The date of the last sensor calibration.
24	SENSOR_CAL_WHO	VisibleString		NULL	None	S	The name of person who is in charge of last calibration.
25	**SECONDARY_VALUE**	**DS-65**	± INF	0	SUV	D	**The secondary value related to the temperature sensor.**
26	**SECONDARY_VALUE_UNIT**	**Unsigned16**	See Table	1001 (°C)	E	S	**The engineering units to be used with the secondary value related to the sensor.**
27	DIGITAL_HALL	Float	0-65536	0	Na	D	Digital Hall Value.
28	DIAGNOSTIC_STATUS	Unsigned16		Good		S	Show the device status (failures and warnings)
29	READ_HALL_CAL_POINT_HI	Float		43786.0		S	Digital Hall value for the highest calibration point.
30	READ_HALL_CAL_POINT_LOO	Float		24111.0		S	Digital Hall value for the lowest calibration point.
31	SENSOR_TEMPERATURE	DS-65		0	°C	D	The sensor temperature value
32	DIGITAL_TEMPERATURE	DS-65	± INF	0	None	D	The digital temperature value.
33	CAL_TEMPERATURE	Float	-40 a 85 °C	25	°C	S	The temperature value used to calibrate the temperature.
34	ACTION_TYPE	Unsigned8	Direct/Reverse	Direct	None	S	Defines if the action is direct or indirect.
35	BACKUP_RESTORE	Unsigned8	See Table	0	Na	S	This parameter is used to backup or to restore configuration data.
35	CAL_POINT_HI_BAKUP	Float	+INF	100	CU	S	Indicates the backup for high calibration point.
37	CAL_POINT_LO_BAKUP	Float	-INF	0	CU	S	Indicates the backup for low calibration point.
38	CAL_POINT_HI_FACTORY	Float	+INF	100	CU	S	Indicates the high factory calibration point.
39	CAL_POINT_LO_FACTORY	Float	-INF	0	CU	S	Indicates the low factory calibration point.
40	ORDERING_CODE	VisibleString		Null	Na	S	Indicates information about factory production.

Legend: E – Enumerated parameter; Na – Admensional parameter; RO – Read only; D – dynamic; N – non-volatile; S - static
CU: CAL_UNIT; PVR – PRIMARY_VALUE_RANGE; Sec: Seconds; SR: SENSOR_RANGE; SVU: SECONDARY_VALUE_RANGE

Gray Background Line: Default Parameters of Syscon

Calibration

There is a specific method to make the calibration operation. It is necessary to match the source of reference applied to or connected to the device with the wished value. At least four parameters should be used to configure this process: CAL_POINT_HI, CAL_POINT_LO, CAL_MIN_SPAN, and CAL_UNIT. Those parameters define the highest and lowest calibrated value for this device, the minimum allowed span value for calibration (if necessary) and the enginnering unit selected for calibration purpose.

Position Trim - TP302

The **TP302** provides the capability of making a trim in the input channels, if necessary.
A trim is necessary if the indicator reading of the transducer block output differs from the actual physical output. The reason may be:

The user's current meter differs from the factory standard.
The converter had its original characterization shifted by over-load or by long term drift.

The user can check the calibration of the transducer output by measuring the actual and compare it with the device's indication. If a mismatch is detected, a trim can be done.

There are at least two ways of doing the trim: using local adjustment or using **SYSCON** (the System Configurator from **SMAR**).
When doing the trim, make sure you are using an appropriate meter (with the necessary accuracy).

Via SYSCON

It is possible to calibrate the current inputs of the transmitter by means of parameters CAL_POINT_LO and CAL_POINT_HI.
Let's take the lower value as example.
Set the lower input position 0.0% and wait until the readout of parameter PRIMARY_VALUE stabilizes.
Write 0.0 or the lower value in parameter CAL_POINT_LO. For each value written a calibration is performed at the desired point.

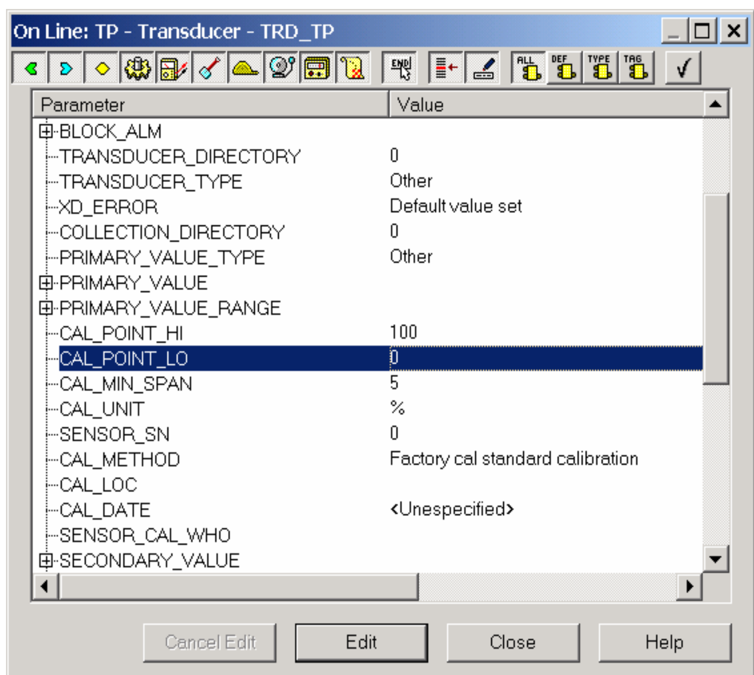


Figure 3.1 - Position Trim - TP302

Let's take the upper value as an example:
Set to the input position 100.0% and wait until the readout of parameter PRIMARY_VALUE stabilizes. Write 100.0 or the upper value in the parameter CAL_POINT_HI. For each value written a calibration is performed at the desired point.

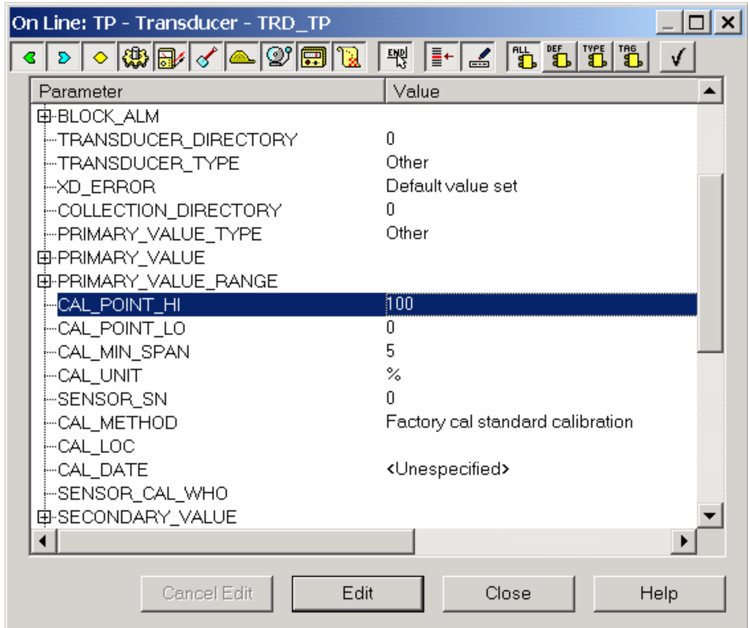


Figure 3.2 - Position Trim - TP302

WARNING

It is recommendable that a convenient engineering unit be chosen by means of parameter XD_SCALE of the Analog Input Block, considering that the range limits of the sensor must be respected, these being 100% and 0%.
It is also recommendable, for every new calibration, to save existing trim data in parameters CAL_POINT_LO_BACKUP and CAL_POINT_HI_BACKUP, by means of parameter BACKUP_RESTORE, using option LAST_TRIM_BACKUP.

Via Local Adjustment

In order to enter the local adjustment mode; place the magnetic tool in office “Z” until flag “MD” lights up in the display. Remove the 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”. Let’s take the upper value as an example:

Let’s take the upper value as an example:
Set to the input a position of 100.0%
Wait until the current of readout of parameter P_VAL (PRIMARY_VALUE) stabilizes and then actuates parameter UPPER until it reads 100.0%.
Let’s take the lower value as an example:
Set to the input a position of 0.0%.
Wait until the current of readout of parameter P_VAL (PRIMARY_VALUE) stabilizes and then actuates parameter LOWER until it reads 0.0%

Limit Conditions for Calibration

Upper:
-10.0%<= CAL_POINT_HI <= 110.0%
CAL_POINT_HI ≠ CAL_POINT_LO
CAL_MIN_SPAN = 1.0%.
Otherwise, Invalid calibration request.

Lower:
-10.0%<= CAL_POINT_HI <= 110.0%
CAL_POINT_HI ≠ CAL_POINT_LO
CAL_MIN_SPAN = 1.0%.
Otherwise, Invalid calibration request.

If all limit conditions are according to these rules, we will get successful in the performed operation.

NOTE
Trim 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.

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

Display Transducer Block

The local adjustment tree is completely configured by **SYSCON**. 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 between 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 shows significantly the resources on this transducer display. All Series 302 field devices from SMAR have 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 blocks and transducers defined according Foundation Fieldbus™ have a description of their features written on binary files, by the Device Description Language. This feature permits that third parties configurator 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 enable the local adjustment using the magnetic tool, it is necessary to previously prepare the parameters related with this operation via **SYSCON** (System Configurator). The Figure 3.7 - Parameters for Local Adjustment Configuration show all parameters and their respective values, which shall be configured in accordance with the necessity of being locally adjusted by means of the magnetic tool. All values shown on the display are default values.

There are seven groups of parameters, which may be pre-configured by the user in order to allow 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 parameter related (indexed) to the Tag 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 by opening the desired block.

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

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

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

Decimal_Point_Number
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. If option value is selected, the display will show 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.
If option mnemonic, the display will show the data in the numeric field and the mnemonic in the alphanumeric field.

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

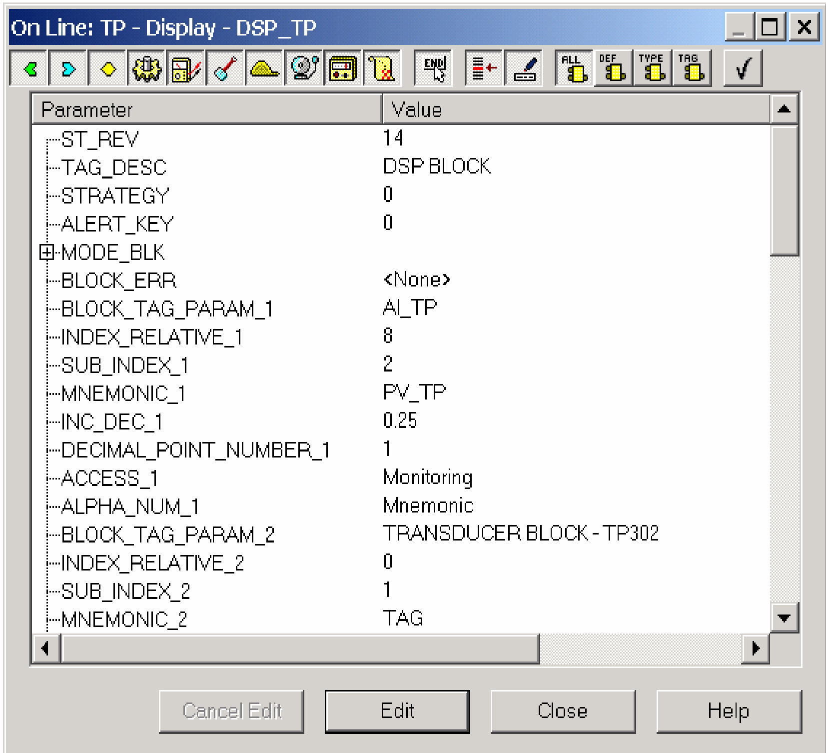


Figure 3.3 - Parameters for Local Adjustment Configuration

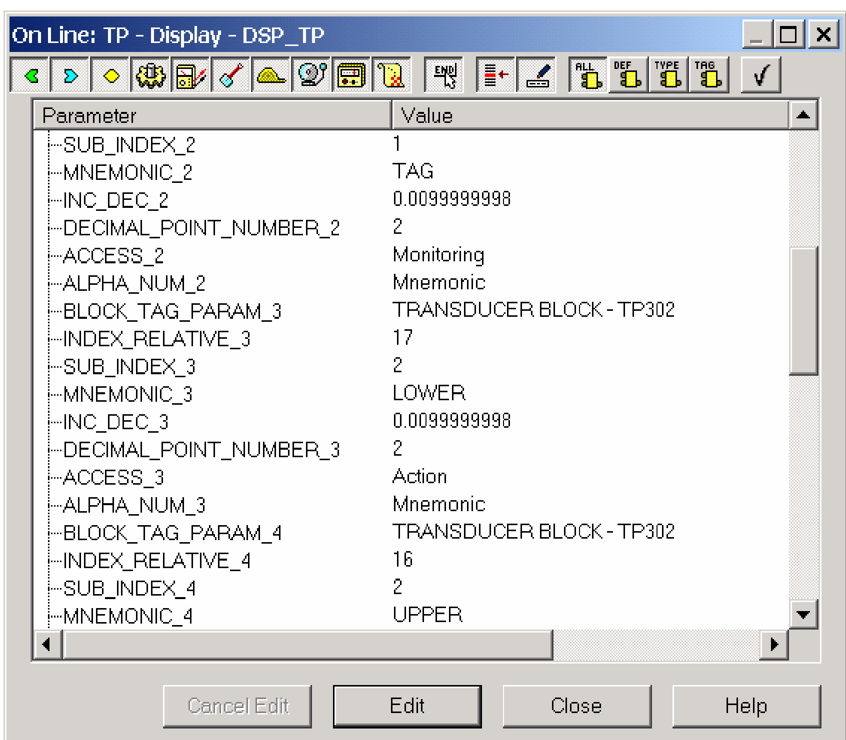


Figure 3.4 - Parameters for Local Adjustment Configuration

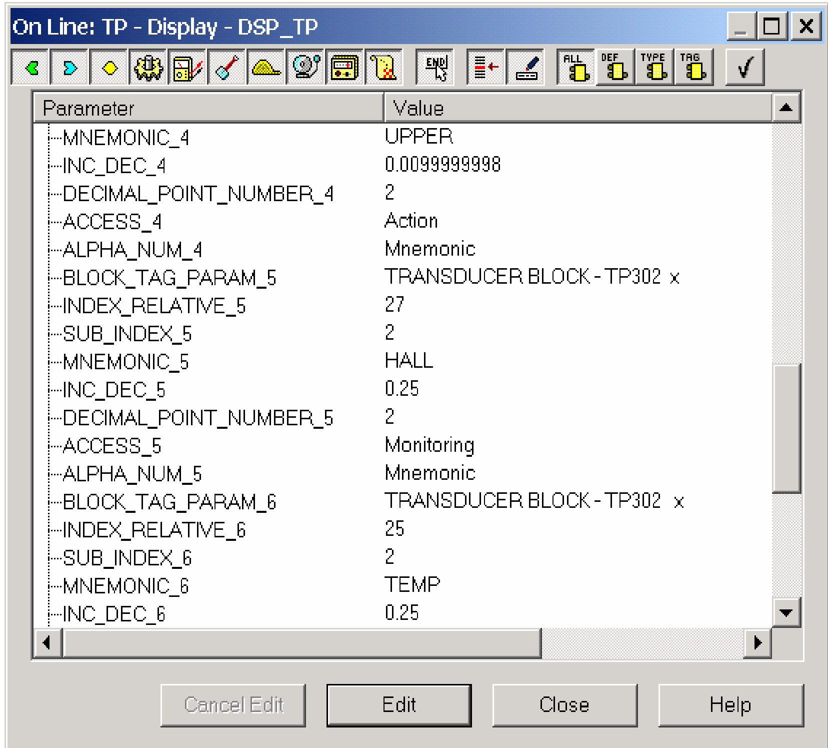


Figure 3.5 - Parameters for Local Adjustment Configuration

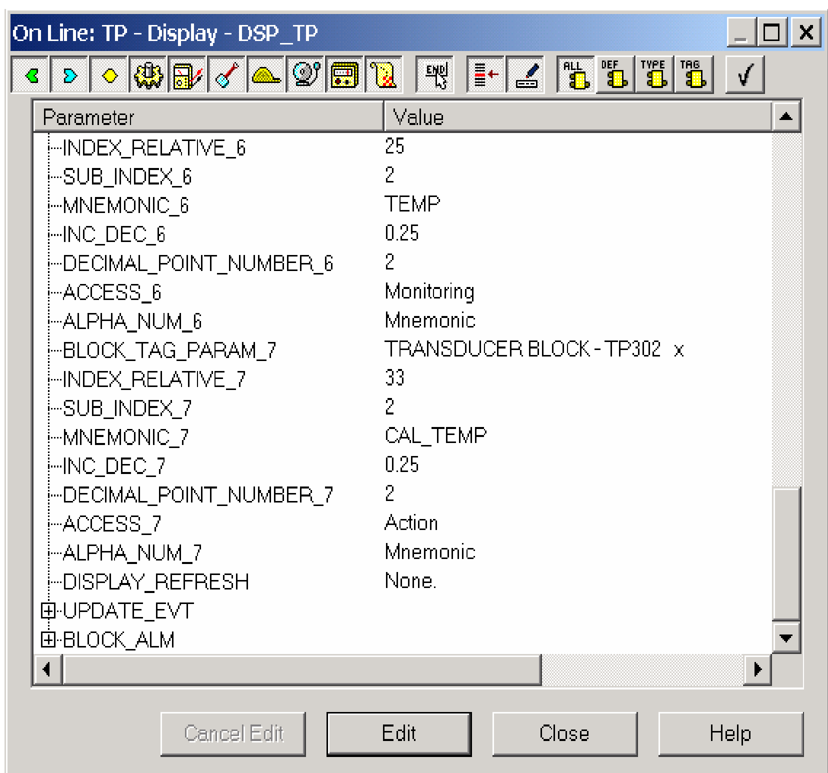


Figure 3.6 - Parameters for Local Adjustment Configuration

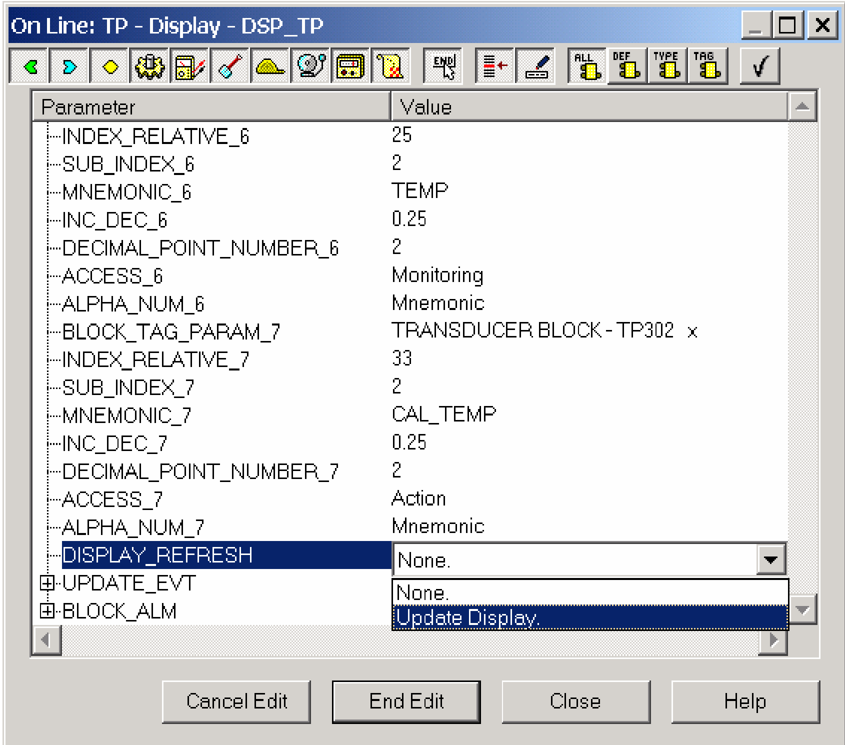


Figure 3.7 - Parameters for Local Adjustment Configuration

Programming Using Local Adjustment

The TP302 has two holes for magnetic switches activated by the magnetic tool 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 J1 on top of the main circuit board must be in place for this function to be enabled and the transmitter must be fitted with the digital display for access to the local adjustment. Without the display the local adjustment is not possible.

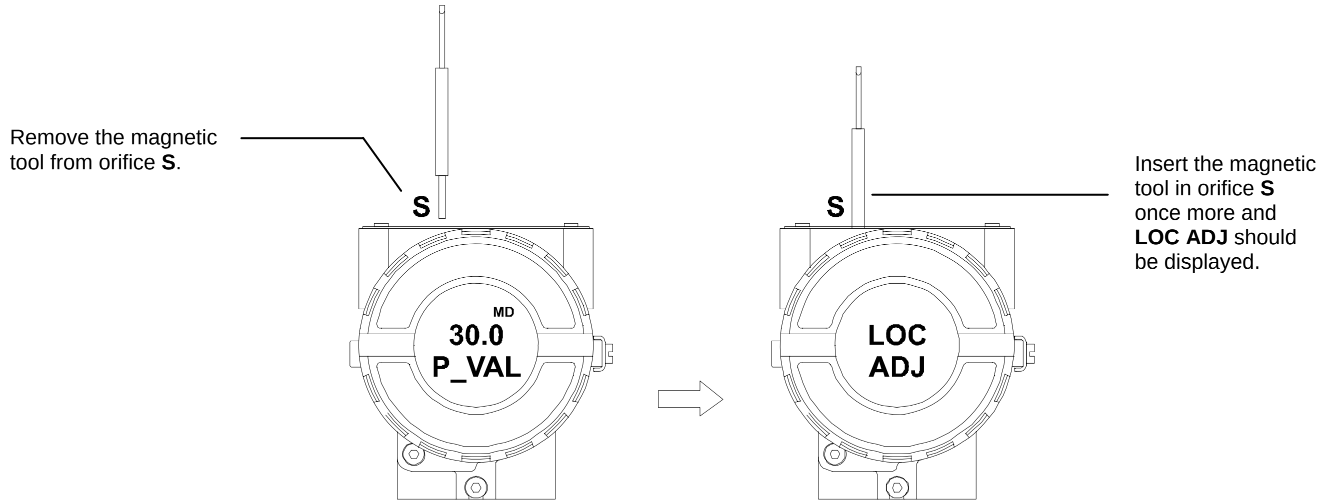


Figure 3.8 – Step 1 – TP302

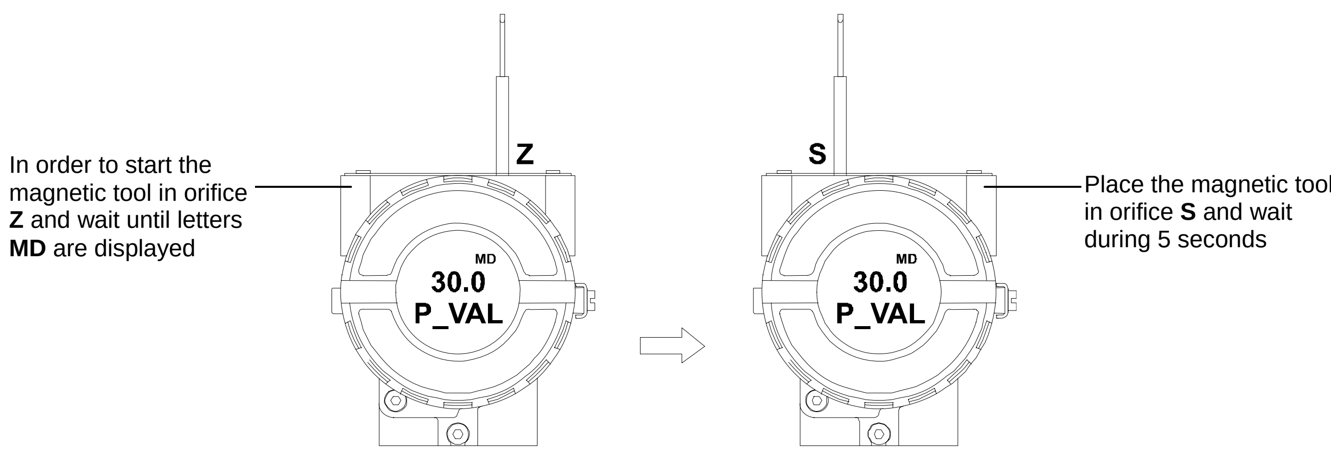


Figure 3.9 – Step 2 – TP302

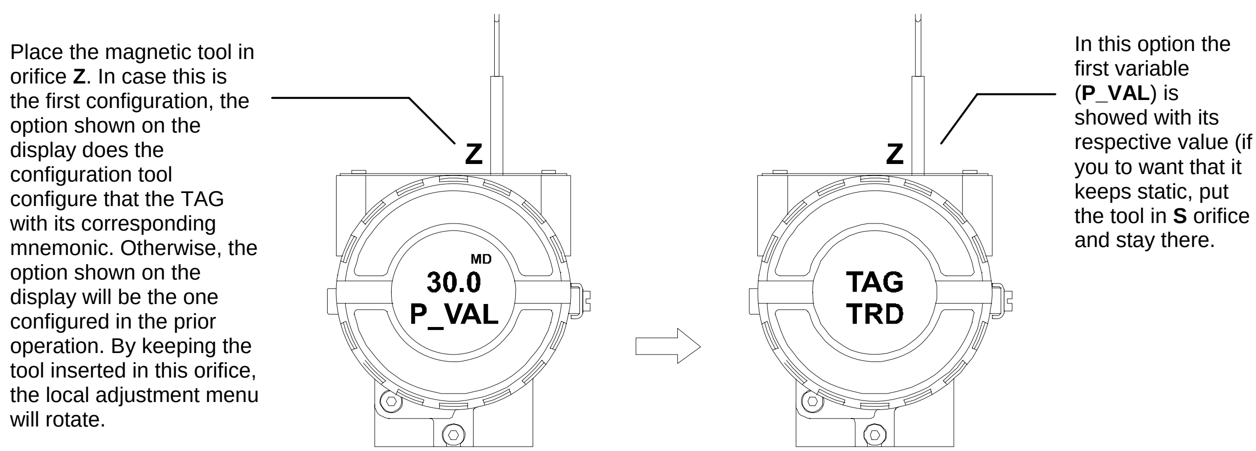
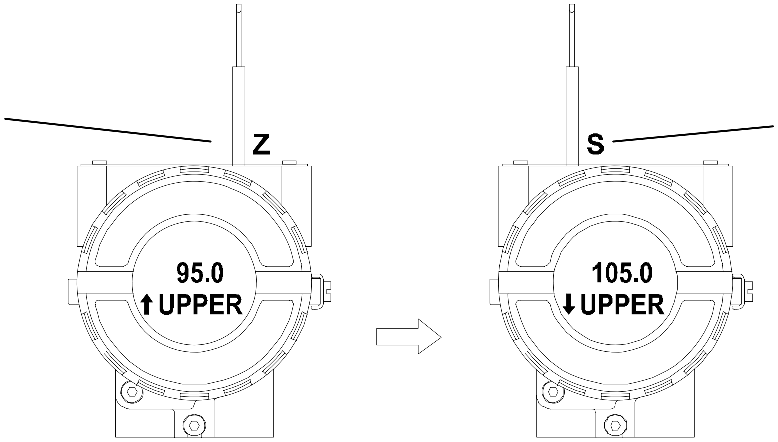


Figure 3.10 – Step 3 – TP302

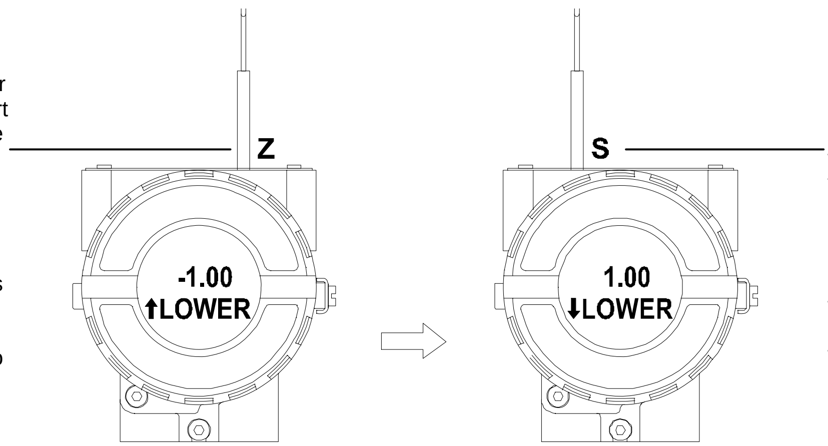
In order to range the upper value (lower); simply insert the magnetic tool in orifice **S** as soon as UPPER is shown on display. An arrow pointing upward (↑) increments the value and an arrow pointing downward (↓) decrements the value. In order to increment the value, keep the tool inserted in **S**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



In order to decrement the upper value, place the magnetic tool in orifice **Z** to shift the arrow to the downward position an then, by inserting and keeping the tool in orifice **S**, it is possible to decrement the upper value.

Figure 3.11 – Step 4 – TP302

In order to range the lower value (lower); simply insert the magnetic tool in orifice **S** as soon as LOWER is shown on 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** up to set the value desired.



In order to decrement the lower value, place the magnetic tool in orifice **Z** to shift the arrow to the downward position an then, by inserting and keeping the tool in orifice **S**, it is possible to decrement the lower value.

Figure 3.12 – Step 5 – TP302

NOTE

This Local adjustment configuration is a suggestion only. The user may choose his preferred configuration via SYSCON, simply configuring the display block (refer to paragraph Display Transducer Block).

Section 4

MAINTENANCE PROCEDURES

General

SMAR TP302 Position Transmitter are extensively tested and inspected before delivery to the end user. Nevertheless, during their design and development, consideration was given to the possibility of repairs being made by the end user, if necessary.

In general, it is recommended that end users do not try to repair printed circuit boards. Spare circuit boards may be ordered from **SMAR** whenever necessary. Refer to the item "Returning Materials" at the end of this Section.

The table 4.1 shows the messages of errors and potential 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 **TP302** terminals. Noise and ripple should be within the following limits: a) 16 mV peak to peak from 7.8 to 39 KHz. b) 2 V peak to peak from 47 to 63 Hz for non-intrinsic safety applications and 0.2 V for intrinsic safety applications. c) 1.6 V peak to peak from 3.9 MHz to 125 MHz.
	Network Connection Check network connections: devices, power supply and terminators.
	Network Impedance Check network impedance (power supply impedance and terminators).
	Converter Configuration Check configuration of communication parameters of converter.
	Network Configuration Make sure that device address is configured correctly.
	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 **TP302** 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 **TP302** has been configured to. Check if process is within the range of the sensor and the **TP302**.

Table 4.1 - Messages of Errors and Potential Cause

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

NOTE
The Factory Init should be tried as a last option to recover the equipment control when the equipment presents some problem related to the function blocks or the communication. **This operation must only be carried out by authorized technical personnel and with the process offline, since the equipment will be configured with standard and factory data.** This procedure resets all the configurations run on the equipment, after which a partial download should be performed. Two magnetic tools should be used to this 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 "5" symbol on the right upper corner of the display to unlit, thus indicating the end of the operation. This procedure makes effective all the factory configuration and will eliminate eventual problems with the function blocks or with the equipment communication.

Disassembly Procedure

WARNING
Refer to Fig. 4.3, **TP302** Exploded View. Make sure to disconnect power supply before disassembling the position transmitter.

Transducer

To remove the transducer 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 transducer, observing that the flat cable is not excessively twisted.

IMPORTANT:
The transmitters have a stopper that can be released to allow the transducer to rotate more than one turn. See Fig. 4.1

CAUTION:
Do not rotate the electronic housing more than 180º without disconnecting the electronic circuit from the power supply.

Electronic Circuit
To remove the circuit board (5) and indicator (4), first loose the cover locking (6) on the side not marked Field Terminals, then unscrew the cover (1).

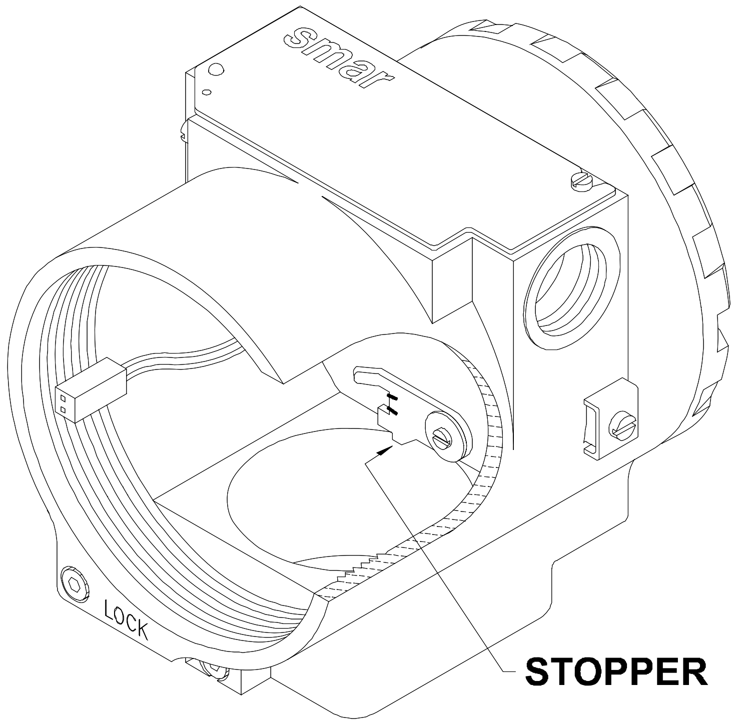


Figure 4.1 - Sensor Rotation Stopper

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.

Reassembly Procedure

WARNING
Do not assemble the main board with power on.

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.

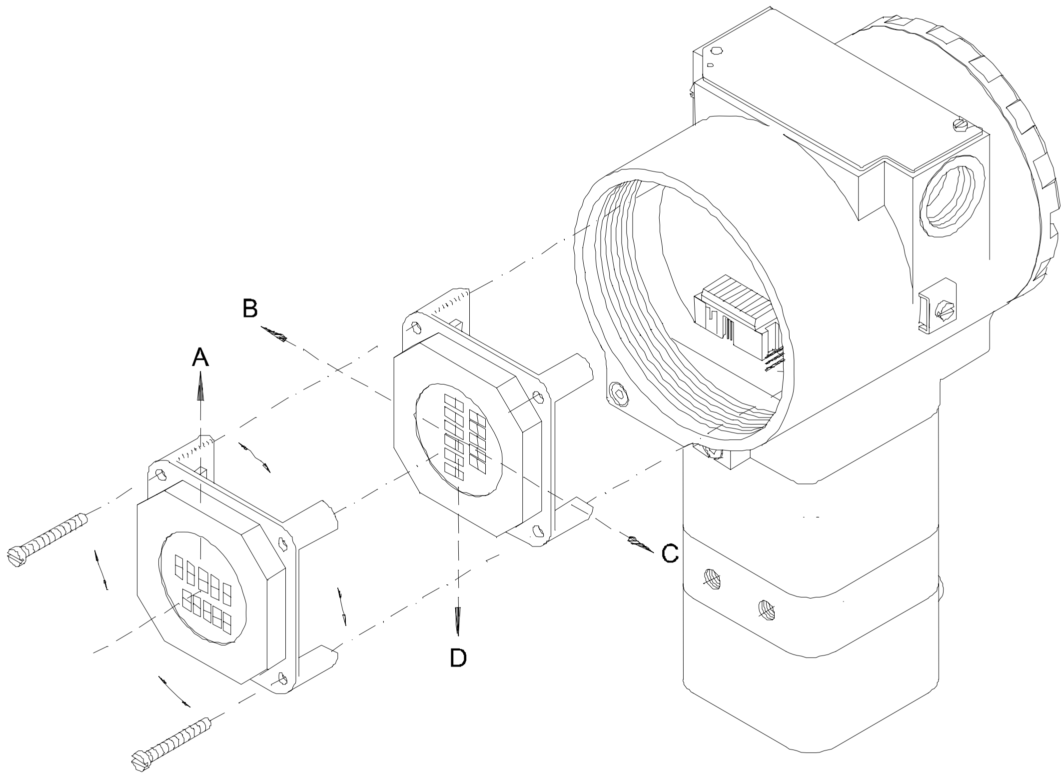


Figure 4.2 - Four Possible Positions of the Display

Upgrading TP301 to TP302

The sensor and casing of the TP301 is exactly the same as the **TP302**. By changing the circuit board of the TP301 it becomes a **TP302**. The display on TP301 version 1.XX, is the same as on **TP302** and can therefore be used with the **TP302** upgrade circuit board.
Upgrading the TP301 to a **TP302** 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 TP301 main board out of the housing and disconnect the power supply and the sensor connectors.

Put in the **TP302** main board reversing the procedure for removing the TP301 circuit.

Returning Materials

Should it become 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
BC302	Fieldbus/RS232 Interface
SYSCON	System Configurator
PS302	Power Supply
PSI302	Power Supply Impedance
BT302	Terminator
PCI	Process Control Interface

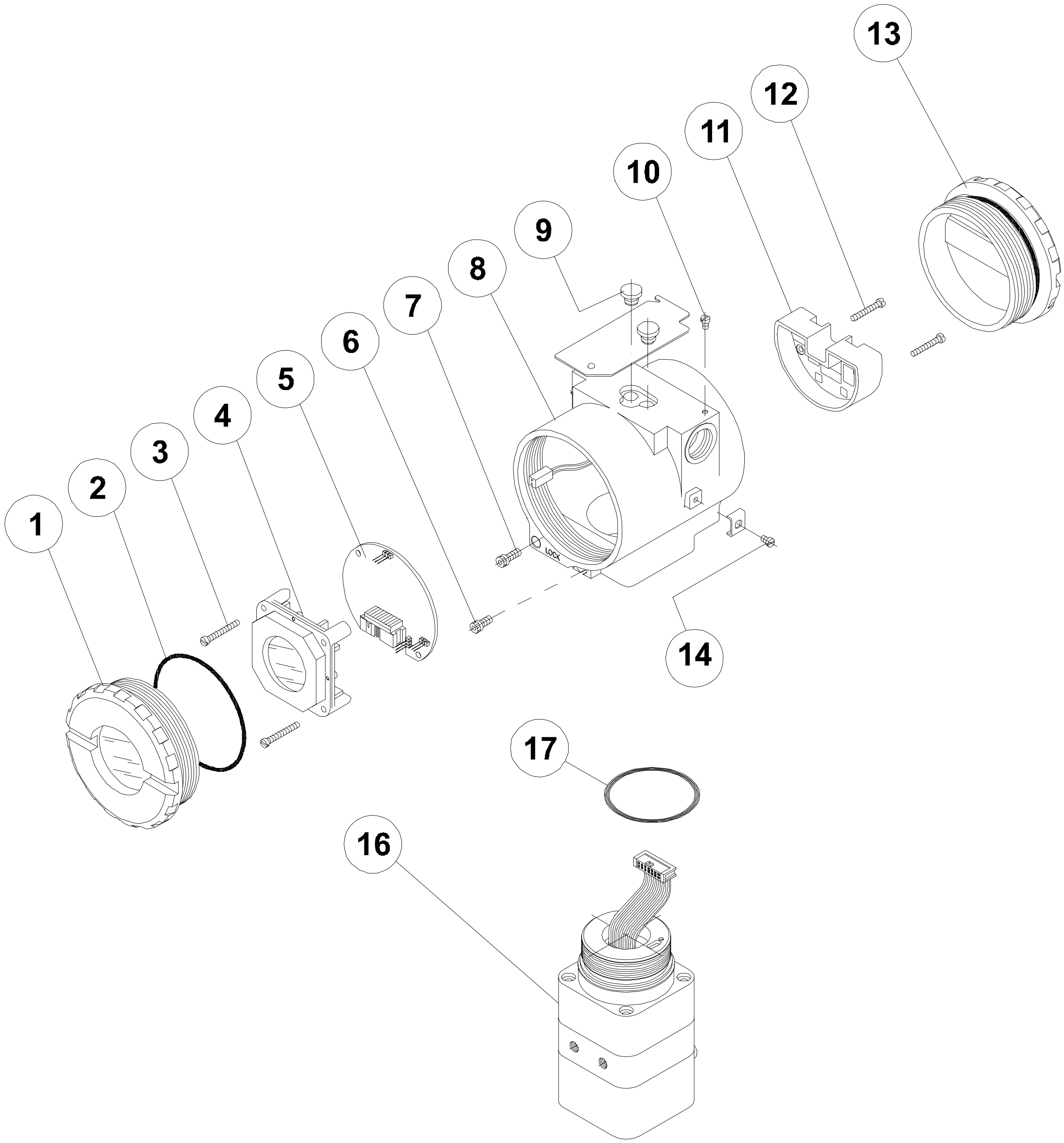


Fig. 4.3 – TP302 Exploded View

SPARE PARTS LIST		
DESCRIPTION OF PARTS	**POSITION**	**CODE**
HOUSING, Aluminum (NOTE 1)		
. ½ - 14 NPT	8	400-0574
. M20 x 1.5	8	400-0575
. PG 13.5 DIN	8	400-0576
HOUSING, 316 SS (NOTE 1)		
. ½ - 14 NPT	8	400-0577
. M20 x 1.5	8	400-0578
. PG 13.5 DIN	8	400-0579
COVER (INCLUDES O'RING)		
. Aluminum	1 and 13	204-0102
. 316 SS	1 and 13	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	14	204-0124
IDENTIFICATION PLATE FIXING SCREW	10	204-0116
DIGITAL INDICATOR	4	214-0108
TERMINAL INSULATOR	11	400-0059
MAIN ELECTRONIC CIRCUIT BOARD	5	400-0580
0-RINGS (NOTE 2)		
. Cover, Buna-N	2	204-0122
. Neck, Buna-N	17	204-0113
TERMINAL HOLDING SCREW		
- HOUSING IN ALUMINUM	12	304-0119
- HOUSING IN 316 STAINLESS STEEL	12	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
TRANSDUCER	16	400-0099
LOCAL ADJUSTMENT PROTECTIONS CAP	9	204-0114
LINEAR MAGNET UP TO 15 mm	-	400-0034
LINEAR MAGNET UP TO 50 mm	-	400-0035
LINEAR MAGNET UP TO 100 mm	-	400-0036
ROTARY MAGNET	-	400-0037

NOTE

1. For category A, it is recommended 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. 0-Rings and Backup Rings are packaged in packs of 12 units.
4. To specify sensors, use the following tables.
5. Including U-clamp, nuts, bolts and washers.

TECHNICAL CHARACTERISTICS

Functional Specifications

Travel
Linear Motion: 3 -100mm.
Rotary Motion: 30-120º-rotation angle.

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

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

Indicator
Optional 4½-digit numerical and 5-character alphanumerical LCD indicator.

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

Temperature Limits

Ambient:	-40 to 85 ºC	(-40 to 185ºF).
Process:	-40 to 100 ºC	(-40 to 212ºF).
Storage:	-40 to 100 ºC	(-40 to 212ºF).
Display:	-10 to 60 ºC	(14 to 140 ºF) operation.
	-40 to 85 ºC	(-40 to 185 ºF) without damage.

Turn-on Time
Performs within specifications of less than 5.0 seconds after power is applied to the transmitter.

Humidity Limits
0 to 100% RH.

Performance Specifications

Reference conditions: range starting at zero, temperature 25ºC (77ºF), power supply of 24 Vdc.

Accuracy
Linearity, hysteresis and repeatability effects are included.

Resolution
≤ 0.1% F.S.

Repeatability
≤ 0.5% F.S.

Hysteresis
≤ 0.2% F.S.

Stability
± 0.1% of F.S. for 12 months.

Temperature Effect
± 0.8%/20ºC of F.S.

Power Supply Effect
± 0.005% of calibrated F.S. per volt.

Electro-Magnetic Interface Effect
Designed to comply with IEC 801 and European Standards EN50081 and EN50082.

Physical Specifications

Hardware
Physical: according to IEC 61158-2 and conformity with the FISCO model.

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

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

Mounting Bracket
Plated carbon steel with polyester painting or 316 SST.

Identification Plate
316 SST.

Approximate Weights
Without display and mounting bracket: 0.80 kg.
Add for LCD display: 0.13 kg.
Add for mounting bracket: 0.60 kg.

Ordering Code

MODEL	POSITION TRANSMITTER
TP302	

	LOCAL INDICATOR
1	With Digital Indicator

	MOUNTING BRACKET
0	Without Bracket
1	With Bracket

CODE	ELECTRICAL CONNECTIONS
0	1/2 - 14 NPT
A	M20 X 1.5
B	PG 13.5 DIN

	TYPE OF MOTION
1	Rotary
3	Linear Stroke Up to 15 mm
5	Linear Stroke Up to 50 mm
7	Linear Stroke Up to 100 mm
Z	Others Specify

	OPTIONAL ITEMS*
H1	316 SST Housing
R1	Remote sensor - 5 m. Cable (**).
R2	Remote sensor - 10 m. Cable (**).
R3	Remote sensor - 15 m. Cable (**).
R4	Remote sensor - 20 m. Cable (**).
ZZ	With Special Features - Specify

TP302 - 1 0 - 0 1 / * **Typical Model**

* Leave it blank for no optional items.
** Consult SMAR for applications in classified areas.

NON HAZARDOUS OR DIVISION 2 AREA

SAFE AREA APPARATUS

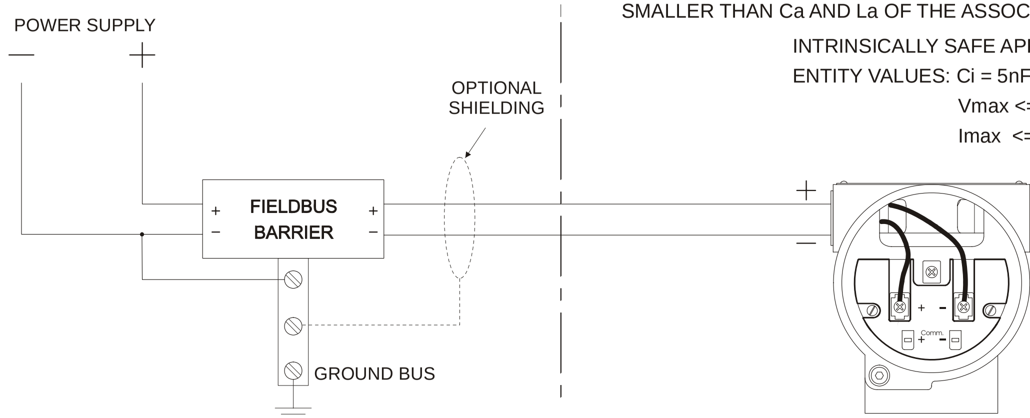
UNSPECIFIED, EXCEPT THAT IT MUST NOT BE SUPPLIED FROM, NOR CONTAIN UNDER NORMAL OR ABNORMAL CONDITIONS, A SOURCE OF POTENTIAL IN RELATION TO EARTH IN EXCESS OF 250VAC OR 250VDC.

HAZARDOUS AREA

REQUIREMENTS:

1 - INSTALLATION TO BE IN ACCORDANCE WITH ANSI/ISA RP12-6.
2 - CONVERTER 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=12uH
Vmax <= 24V
Imax <= 250mA



COMPONENTS CAN NOT BE SUBSTITUTED WITHOUT PREVIOUS MANUFACTURER APPROVAL.

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 + 12uH
FIELDBUS

OPTION 1: Voc <= 24V, Isc <= 250mA, Po <= 1,2W

OPTION 2: Voc <= 16V, Isc <= 250mA, Po <= 2W

CLASS I,II,III DIV.1, GROUPS A,B,C,D,E,F & G
MODEL TP302 & TP303 - SERIES
POSITIONER

FM APROVED

APPROVAL CONTROLLED BY C.A.R.			
	/ /	/ /	
	/ /	/ /	
01	MOACIR 04 / 05 / 03	CIRO 08 / 05 / 03	ALT - DE 0043/03
REV	BY	APPROVAL	DOC

DRAWN	CHECKED	PROJECT	APPROVAL
MOACIR 08 / 11 / 00	SINASTRE 08 / 11 / 00	BASÍLIO 08 / 11 / 00	MISSAWA 08 / 11 / 00

EQUIPMENT: TP302 / TP303
CONTROL DRAWING

smar

NUMBER	REV
102A0605	01
SCALE	SHEET 01 / 01