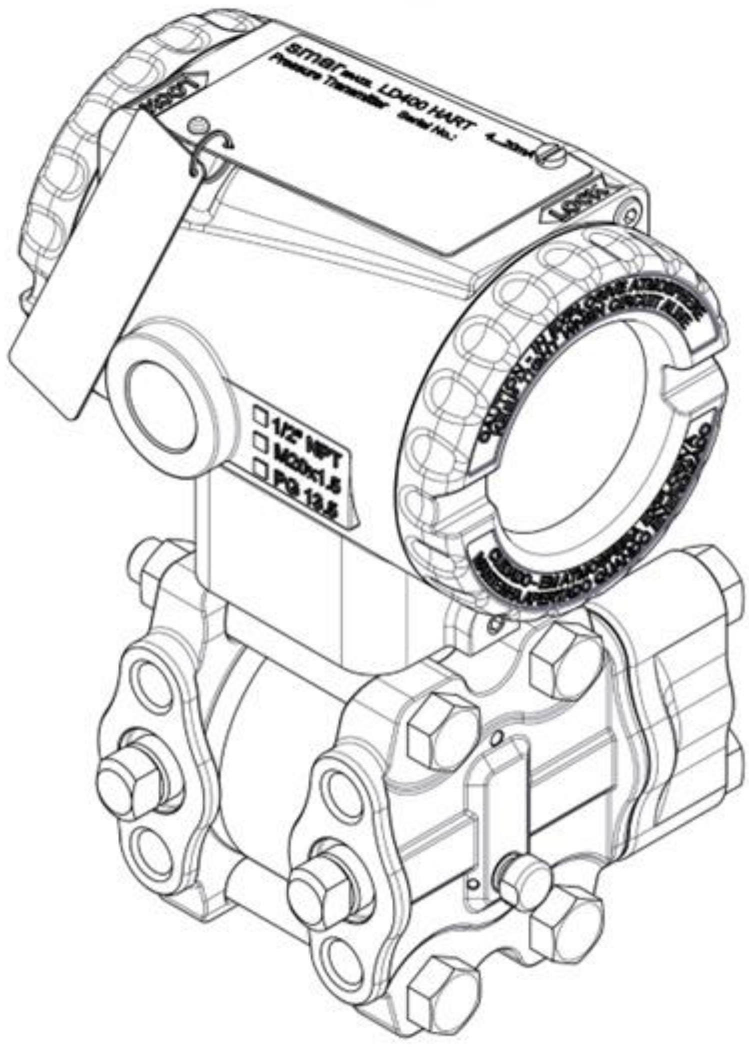
smar - LD400

OPERATION AND MAINTENANCE
INSTRUCTION / MANUAL

Smart Pressure Transmitter



MAY / 22
LD400
VERSION 2

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INTRODUCTION

LD400 HART® is a Smart Pressure Transmitter for differential, absolute, gauge, level and flow measurements.

✓ Differential Transmitter – **LD400D** and **LD400H**

This model measures the differential pressure applied in the sensor. Normally, both sides of the sensor are connected to the process and if the selected output function is linear, the measurement is the differential pressure. If the selected output function is a square root, the measurement is a fluid flow.

✓ Flow Transmitter – **LD400D** and **LD400H**

The differential pressure is generated by a flow primary element and the square root function supplies the measurement flow.

✓ Gauge Pressure Transmitter – **LD400M**

This model has the Lower Side Input connected to a blind flange and open to atmosphere. Therefore, this model measures the pressure relative to atmosphere and the output function can be linear or linearized by the linearization table.

✓ Absolut Pressure Transmitter - **LD400A**

This model has the Low Side Input connected to a blind flange and it is open to atmosphere. Therefore, this model measures the pressure relative to local pressure and the output function can be linear or linearized by the linearization table.

✓ Level Transmitter – **LD400L**

This model is available as a flange mounted unit with a flush diaphragm for direct installation on vessels. Extended diaphragms are also available.

✓ In-line Gauge Pressure Transmitter – **LD400G**

This model uses the Low-Cost Differential Capacitive Sensor with the Lower Side Input opened to atmosphere. Therefore, this model measures the pressure relative to atmosphere and the output function can be linear or linearized by the linearization table.

The **LD400** series use HART® technology. These instruments can be configured through Smar configuration software or other suppliers. The local adjustment is enabled for all the **LD400** series. With magnetic tools is possible to configure the zero and the span, to alter the measurement range, to alter the unit of measured pressure, to select the square root function, to operate the totaled value or to enable the control loop.

With the AssetView from Smar it is possible to do the diagnoses management field's instrument to aid in the reactive, preventive, predictive and proactive maintenance.

Waiver of responsibility

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

Warning

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

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

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

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

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

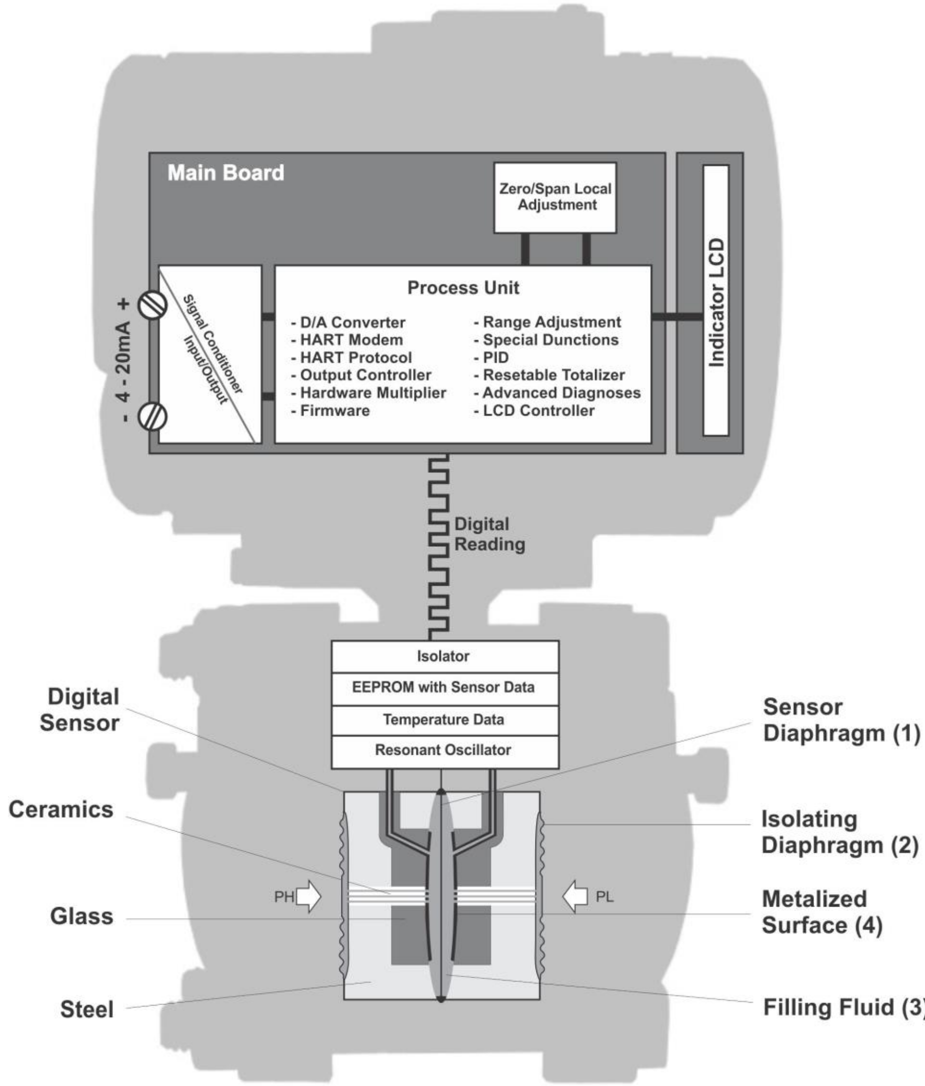
The user is responsible for the incorrect or inadequate handling of equipments run with pneumatic or hydraulic pressure or, still, subject to corrosive, aggressive or combustible products, since their utilization may cause severe bodily harm and/or material damages.

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

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

TRANSMITTER GENERAL VIEW

The **LD400 HART®** uses a highly proven technique for pressure measuring by capacitance reading. The block diagram of the **LD400 HART®** pressure transmitter is shown below.



In the cell center is the sensor diaphragm **(1)**. This diaphragm flexes in response to the different pressures applied on the LOW and HIGH sides of the cell (PL and PH). These pressures are directly applied on the isolator diaphragms **(2)**, whose function is to isolate the sensor process and supply high resistance against corrosion caused by process fluids. The pressure is transmitted directly to the sensor diaphragm through the filling fluid **(3)** and causes its deflection. The sensor diaphragm is a mobile electrode whose two metal surfaces **(4)** are stable electrodes. A deflection on the sensor diaphragm is read by the capacitance variation between both stable and mobile electrodes.

The resonance oscillator reads the capacitance variations between the mobile and the stable boards and generates a pressure output equivalent to the detected capacitance variation. This pressure value is informed in compliance with the transmitter communication protocol. As the conversion process does not involve an A/D converter, any errors or deviations are eliminated during the process. Temperature compensation is done by a sensor, which combined with a precision sensor, results in a high accuracy and small range measurement.

The process variable, as well as the diagnostic monitoring and information, are supplied by the digital communication protocol. The **LD400** is available with the HART® communication protocol.

Read carefully these instructions for better use of the **LD400 HART®**. Smar pressure transmitters are protected by American patents n. **6,433,791 and 6,621,443.**

Acronyms and Abbreviations

Acronym / Abbreviation	Designation	Description
HFT	Hardware Fault Tolerance	The hardware fault tolerance of the device. This is the capability of a functional unit to continue the execution of the demanded function in case of faults or deviations.
MTBF	Mean Time Between Failures	This is the mean time period between two failures.
MTTR	Mean Time To Repair	This is the mean time period between the occurrence of a failure in a device or system and its repair.
PFD	Probability of Failure on Demand	This is the likelihood of dangerous safety function failures occurring on demand.
PFDAVG	Average Probability of Failure	This is the average likelihood of dangerous safety function failures occurring on demand.
SIL	Safety Integrity Level	The International Standard IEC 61508 specifies four discrete safety integrity levels (SIL 1 to SIL 4). Each level corresponds to a specific probability range regarding the failure of a safety function. The higher the safety integrity level of the safety-related systems, the lower likelihood of non-execution of the demanded safety functions.
SFF	Safe Failure Fraction	The fraction of non-hazardous failures, e.g. the fraction of failures without the potential to set the safety-related system to a dangerous undetected state.
Low Demand Mode	Low Demand Mode of Operation	Measuring mode with low demand rate, in which the demand rate for the safety-related system is not more than once a year and is not greater than double the frequency of the periodic test.
DTM	Device Type Manager	The DTM is a software module which provides functions for accessing device parameters, configuring and operating the devices and diagnosing problems. By itself, a DTM is not executable software.
LRV	Device Configuration	Lower Range Value of the measurement range.
URV	Device Configuration	Upper Range Value of the measurement range.
Multidrop	Multidrop Mode	In multidrop mode, up to 15 field devices are connected in parallel to a single wire pair. The analog current signal serves just to energize the two-wire devices providing a fixed current of 4 mA.

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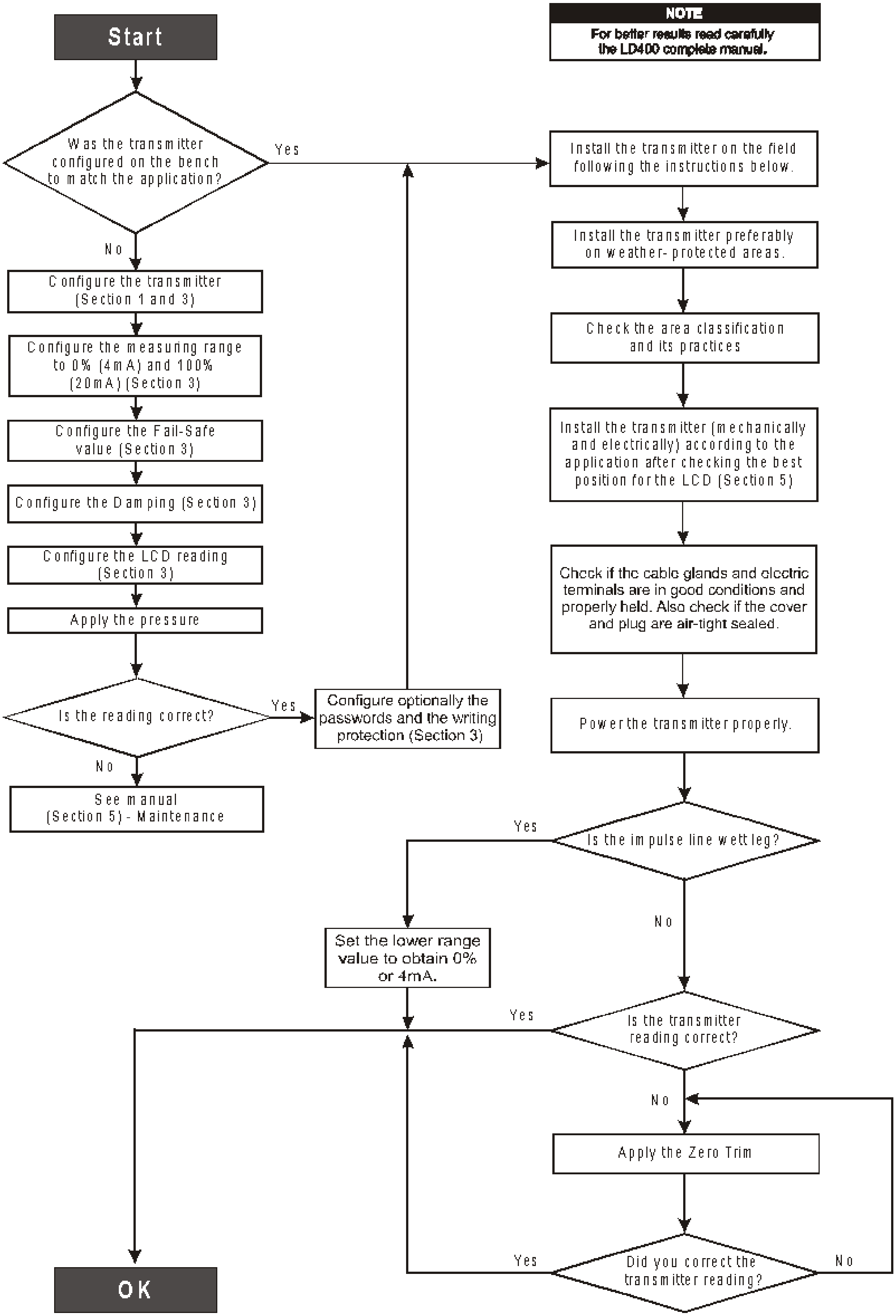
Installation Flowchart



INSTALLATION

General

NOTE
The installation carried out in hazardous areas should follow the recommendations of the IEC60079-14 standard.

The overall accuracy of a flow, level, or pressure measurement depends on several variables. Although the transmitter has an outstanding performance, proper installation is essential to maximize its efficiency. 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.

The **LD400 HART®** uses a capacitive sensor that is submitted to a temperature cycle, and the characteristics under different temperatures are recorded into sensor memory at the factory. At the field, this feature minimizes the temperature variation effect. The built-in temperature sensor available in the sensor board is only for temperature diagnoses.

Installing the transmitter in areas protected from extreme environmental changes can minimize temperature fluctuation effects. Installation close to lines and vessels subjected to high temperatures should also be avoided. Use longer sections of impulse piping between tap and transmitter whenever the process fluid is at high temperatures. In outdoor environments, the transmitter should be installed to avoid, as much as possible, direct exposure to the sun. 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 electronic housing covers must be correctly placed and the covers must be completely tightened by hand until you feel the O-rings being compressed. Do not use tools to close the covers. Removal of the electronics cover in the field should be reduced to the minimum necessary, since each time it is removed; the circuits are exposed to the humidity.

The electronic circuit is protected by a humidity proof coating, but frequent exposures to humidity may affect the protection provided. It is also important to keep the covers tightened in place. Every time they are removed, the threads are exposed to corrosion, since painting cannot protect these parts. Sealing methods should be employed on conduit entering the transmitter.

Although the transmitter is very resistant to vibration, installation close to pumps, turbines or other vibrating equipment should be avoided, due to induced resonance at the filling fluid of the capacitive sensors. If entirely inevitable, install the transmitter on a solid basis and use flexible vibration-proof hoses.

Proper winterization should be employed to prevent freezing within the measuring chamber (freeze protection), since this will result in an inoperative transmitter and could even damage the cell.

NOTE
When installing or storing the level transmitter, the diaphragm must be protected to avoid scratching denting or perforation of its surface.

NOTE
For a better performance, the installation should not present degradation problems of the sign 4 to 20 mA. For detection of this problem, the operator should always certify that the current emitted by the transmitter it is the same read by PLC.

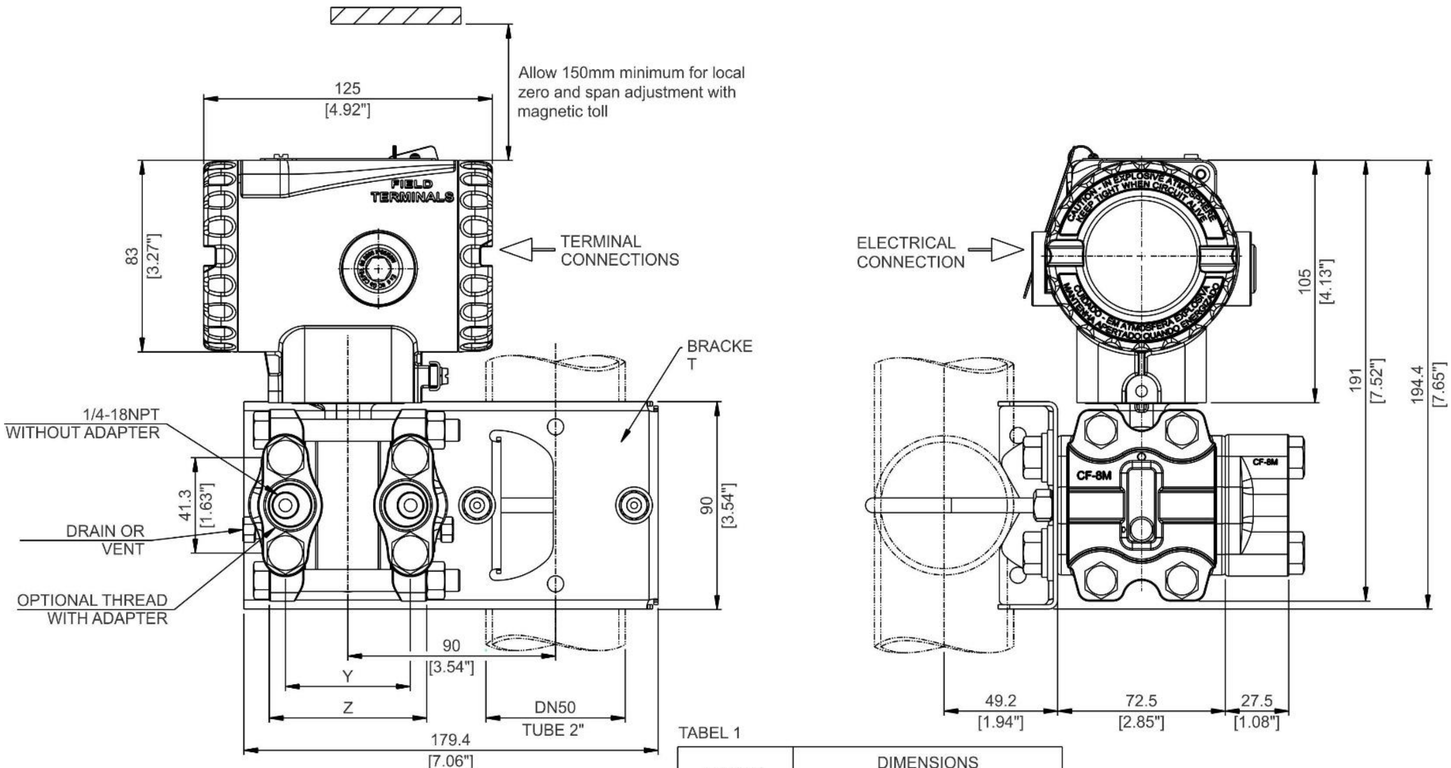
Mounting

The transmitter has been designed to be both rugged and lightweight at the same time. This makes its mounting easier. The mounting positions are shown in Figure 1.1 and 1.2. Existing standards for the manifolds have also been considered, and standard designs fits perfectly to the transmitter flanges

Should the process fluid contain solids in suspension, install valves or rod-out fittings regularly to clean out the pipes.

The pipes should be internally cleaned by using steam or compressed air, or by draining the line with the process fluid before such lines are connected to the transmitter (blow-down).

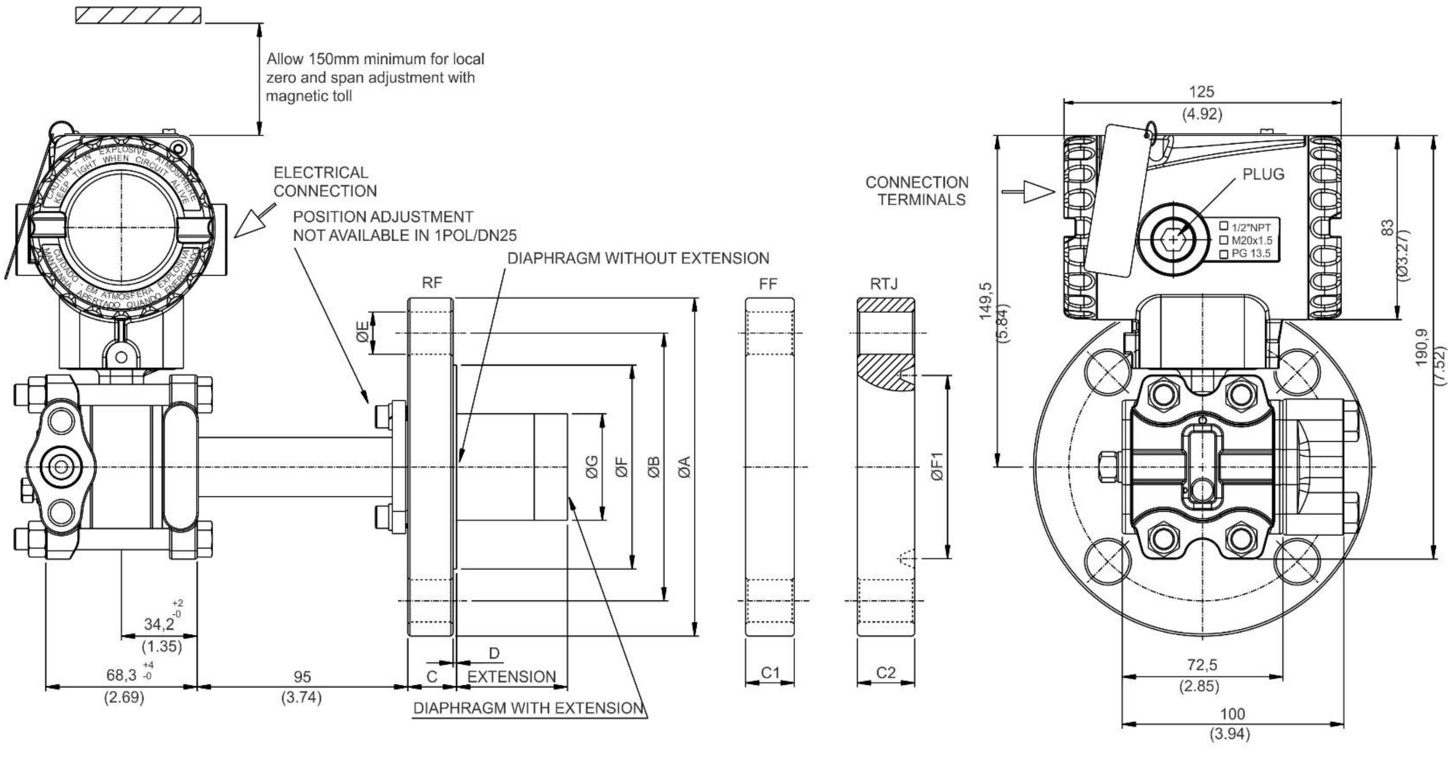
Shut the Drain/Vent valves tightly after each drain or discharge operation.



TABEL 1

RANGE	DIMENSIONS	
	Y	Z
0-1-2-3	54,0 (2.13)	69,6 (2.74)
4	56,0 (2.20)	71,6 (2.82)
5	58,3 (2.30)	73,9 (2.91)
6	58,7 (2.31)	74,3 (2.93)

Figure 1.1 (a) – Dimensional Drawing and Mounting Position for the LD400 HART® – Differential Pressure, Flow, Gage, Absolute and High Static Pressure Transmitter with Mounting Bracket



DIMENSIONS IN mm (inch)
EXTENSION LENGHTS: 0 , 50 , 100 , 150 or 200
EXTENSIONS AVAILABLE IN RF ONLY

ASME-B 16.5 - 2017 DIMENSIONS

DN	CLASS	A	B	C	C1 (FF)	C2 (RTJ)	D	E	F	F1 (RTJ)	RING	G	HOLES
1"	150	110 (4.33)	79,2 (3.12)	15 (0.59)	13 (0.59)	19 (0.75)	2 (0.06)	16 (0.63)	50,8 (2)	47,6 (1.87)	R15		4
	300	125 (4.92)	88,9 (3.50)	18 (0.71)	16 (0.63)	23,9 (0.94)	2 (0.06)	19 (0.75)	50,8 (2)	50,8 (2)	R16		4
	600	125 (4.92)	88,9 (3.50)	24,5 (0.96)		23,9 (0.94)	7 (0.25)	19 (0.75)	50,8 (2)	50,8 (2)	R16		4
1.1/2"	150	125 (4.92)	98,6 (3.88)	20 (0.78)	20 (0.79)	24,4 (0.96)	2 (0.06)	16 (0.63)	73,2 (2.88)	65,1 (2.56)	R19	40 (1.57)	4
	300	155 (6.10)	114,3 (4.5)	21 (0.83)	20 (0.79)	28,7 (1.13)	2 (0.06)	22 (0.87)	73,2 (2.88)	68,3 (2.68)	R20	40 (1.57)	4
	600	155 (6.10)	114,3 (4.5)	29,3 (1.15)		28,7 (1.13)	7 (0.25)	22 (0.87)	73,2 (2.88)	68,3 (2.68)	R20	40 (1.57)	4
2"	150	150 (5.90)	120,7 (4.75)	20 (0.79)	20 (0.79)	23,9 (0.94)	2 (0.06)	19 (0.75)	92 (3.62)	82,6 (3.25)	R22	48 (1.89)	4
	300	165 (6.50)	127 (5)	22,7 (0.89)	20,7 (0.81)	28,6 (1.13)	2 (0.06)	19 (0.75)	92 (3.62)	82,6 (3.25)	R23	48 (1.89)	8
	600	165 (6.50)	127 (5)	32,3 (1.27)		33,3 (1.31)	7 (0.25)	19 (0.75)	92 (3.62)	82,6 (3.25)	R23	48 (1.89)	8
3"	150	190 (7.48)	152,4 (6)	24,3 (0.96)	22,3 (0.88)	28,7 (1.13)	2 (0.06)	19 (0.75)	127 (5)	114,3 (4.5)	R29	73 (2.87)	4
	300	210 (8.27)	168,1 (6.62)	29 (1.14)	27 (1.06)	34,9 (1.37)	2 (0.06)	22 (0.87)	127 (5)	123,8 (4.87)	R31	73 (2.87)	8
	600	210 (8.27)	168,1 (6.62)	38,8 (1.53)		39,7 (1.56)	7 (0.25)	22 (0.87)	127 (5)	123,8 (4.87)	R31	73 (2.87)	8
4"	150	228,6 (9)	190,5 (7.5)	24,3 (0.96)	22,3 (0.88)	28,7 (1.13)	2 (0.06)	19 (0.75)	157 (6.19)	149,2 (5.87)	R36	89 (3.50)	8
	300	255 (10)	200 (7.87)	32,2 (1.27)	30,2 (1.19)	38,1 (1.50)	2 (0.06)	22 (0.87)	157 (6.19)	149,2 (5.87)	R37	89 (3.50)	8
	600	275 (10.83)	215,9 (8.5)	45,1 (1.77)		46 (1.81)	7 (0.25)	25 (1)	157 (6.19)	149,2 (5.87)	R37	89 (3.50)	8

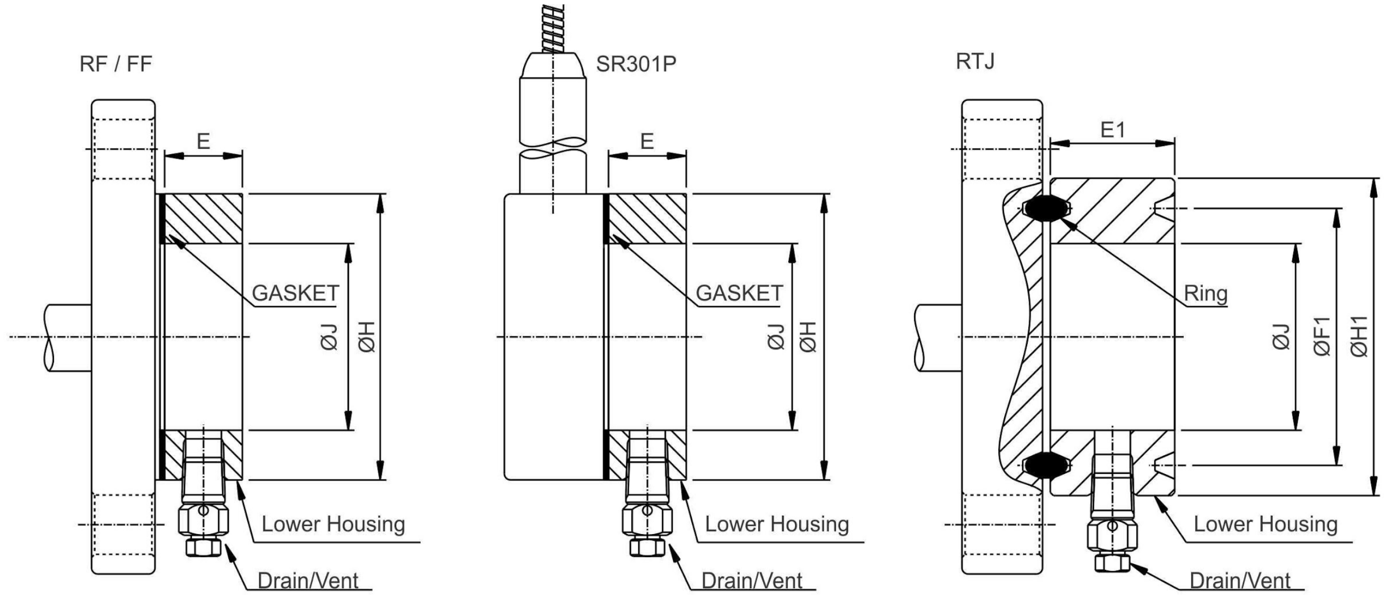
EN 1092-1-2008 DIMENSIONS

DN	PN	A	B	C	C1 (FF)		D	E	F		G	HOLES
25	10/40	115 (4.53)	85 (3.35)	18 (0.71)	18 (0.71)		2 (0.08)	14 (0.55)	68 (2.67)			4
40	10/40	150 (5.91)	110 (4.33)	20 (0.78)	20 (0.78)		3 (0.12)	18 (0.71)	88 (3.46)		40 (1.57)	4
50	10/40	165 (6.50)	125 (4.92)	20 (0.78)	20 (0.78)		3 (0.12)	18 (0.71)	102 (4.01)		48 (1.89)	4
80	10/40	200 (7.87)	160 (6.3)	24 (0.95)	24 (0.95)		3 (0.12)	18 (0.71)	138 (5.43)		73 (2.87)	8
100	10/16	220 (8.67)	180 (7.08)	20 (0.78)			3 (0.12)	18 (0.71)	158 (6.22)		89 (3.50)	8
	25/40	235 (9.25)	190 (7.5)	24 (0.95)			3 (0.12)	22 (0.87)	162 (6.38)		89 (3.50)	8

JIS B 2220 DIMENSIONS

DN	CLASS	A	B	C		D	E	F		G	HOLES
40A	20K	140 (5.5)	105 (4.13)	20 (0.78)		2 (0.08)	19 (0.75)	81 (3.2)		40 (1.57)	4
50A	10K	155 (6.1)	120 (4.72)	20 (0.78)		2 (0.08)	15 (0.59)	96 (3.78)		48 (1.89)	4
	20K	155 (6.1)	120 (4.72)	20 (0.78)		2 (0.08)	19 (0.75)	96 (3.78)		48 (1.89)	8
	40K	165 (6.5)	130 (5.12)	26 (1.02)		2 (0.08)	19 (0.75)	105 (4.13)		48 (1.89)	8
80A	10K	185 (7.28)	150 (5.9)	22 (0.87)		2 (0.08)	19 (0.75)	126 (4.96)		73 (2.87)	8
	20K	200 (7.87)	160 (6.3)	22 (0.87)		2 (0.08)	19 (0.75)	132 (5.2)		73 (2.87)	8
100A	10K	210 (8.27)	175 (6.89)	20 (0.78)		2 (0.08)	19 (0.75)	151 (5.95)		89 (3.50)	8

Figure 1.1 (b) – Dimensional Drawing and Mounting Position for the LD400 HART® – Flanged Pressure Transmitter (Integral Flange)



DIMENSIONS - RF / FF - mm (inch)

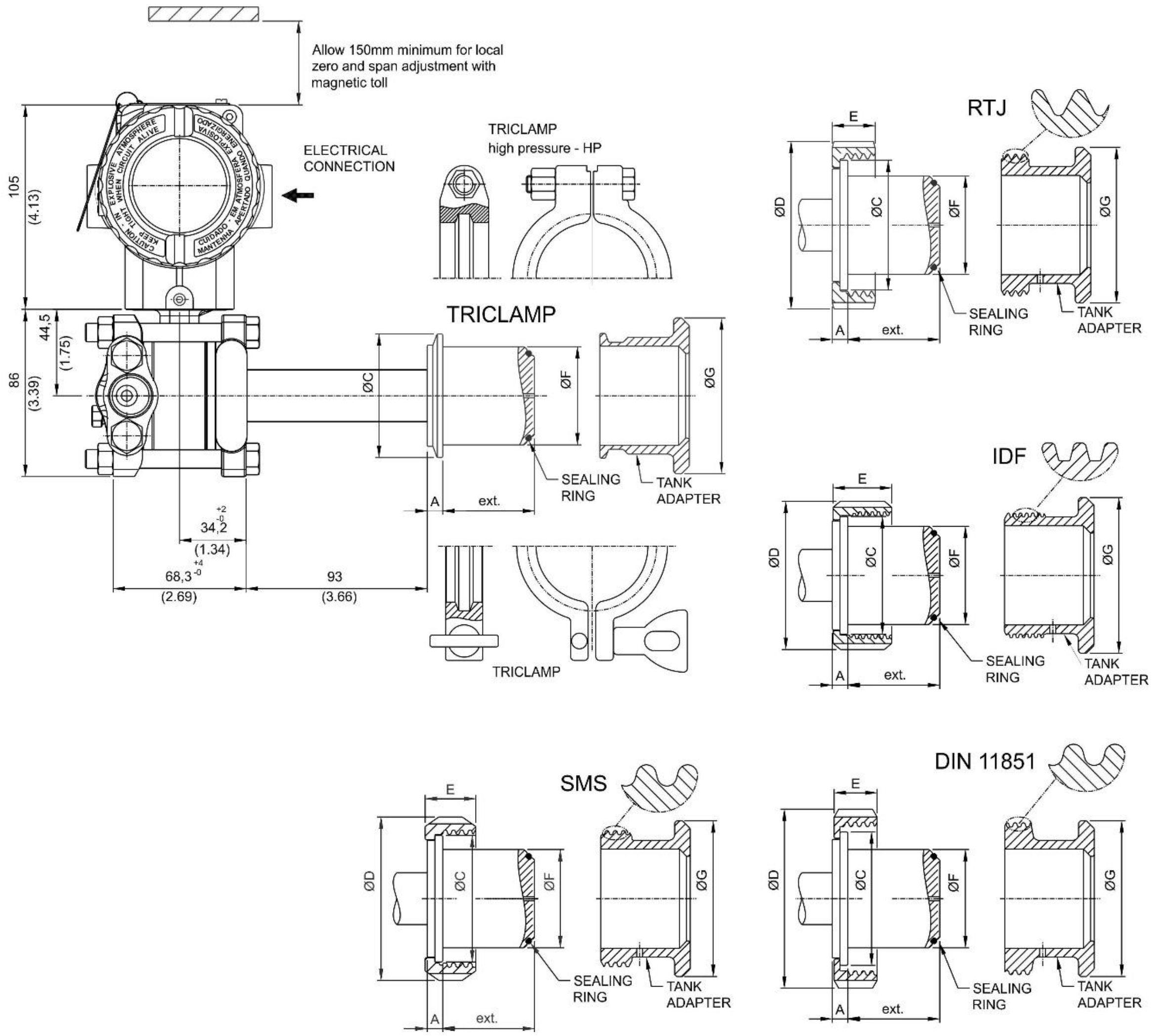
STANDARD	DN	CLASS	H	J	E	
					1/4"NPT	1/2"NPT
ASME B16.5	1"	ALL	50,8 (2,00)	35 (1,38)	25	
	1.1/2"		73,2 (2,88)	48 (1,89)	25	35
	2"		91,9 (3,62)	60 (2,36)	25	35
	3"		127 (5,00)	89 (3,50)	25	35
	4"		158 (6,22)	115 (4,53)	25	35
DIN EN 1092-1	25	ALL	68 (2,68)	35 (1,38)	25	35
	40		88 (3,46)	48 (1,89)	25	35
	50		102 (4,02)	60 (2,36)	25	35
	80		138 (5,43)	89 (3,50)	25	35
	100		158 (6,22)	115 (4,53)	25	35
JIS B 2220	40A	20K	81 (3,19)	48 (1,89)	25	35
	50A	10K	96 (3,78)	60 (1,36)	25	35
		40K	105 (4,13)	60 (1,36)	25	35
	80A	10K	126 (4,96)	89 (3,50)	25	35
		20K	132 (5,20)	89 (3,50)	25	35
	100A	10K	151 (5,94)	115 (4,53)	25	35

DIMENSIONS - RTJ - mm (inch) - ASME B16.5

DN	CLASS	F1	RING	H1	J	E1	
						1/4"NPT	1/2"NPT
1"	150	47,6 (1,87)	R15	63,5 (2,50)	35 (1,38)	40	45
	300	50,8 (2,00)	R16	70 (2,75)	35 (1,38)	40	45
	600	50,8 (2,00)	R16	70 (2,75)	35 (1,38)	40	45
	1500	50,8 (2,00)	R16	71,5 (2,81)	35 (1,38)	40	45
	2500	60,3 (2,37)	R18	73 (2,88)	35 (1,38)	40	45
1.1/2"	150	65,1 (2,56)	R19	82,5 (3,25)	48 (1,89)	40	45
	300	68,3 (2,69)	R20	90,5 (3,56)	48 (1,89)	40	45
	600	68,3 (2,69)	R20	90,5 (3,56)	48 (1,89)	40	45
	1500	68,3 (2,69)	R20	92 (3,62)	48 (1,89)	40	45
	2500	82,6 (3,25)	R23	114 (4,50)	48 (1,89)	40	45
2"	150	82,6 (3,25)	R22	102 (4,00)	60 (2,36)	40	45
	300	82,6 (3,25)	R23	108 (4,25)	60 (2,36)	40	45
	600	82,6 (3,25)	R23	108 (4,25)	60 (2,36)	40	45
	1500	95,3 (3,75)	R24	124 (4,88)	60 (2,36)	40	45
	2500	101,6 (4,00)	R26	133 (5,25)	60 (2,36)	40	45
3"	150	114,3 (4,50)	R29	133 (5,25)	89 (3,50)	40	45
	300	123,8 (4,87)	R31	146 (5,75)	89 (3,50)	40	45
	600	123,8 (4,87)	R31	146 (5,75)	89 (3,50)	40	45
4"	150	149,2 (5,87)	R36	171 (6,75)	115 (4,53)	40	45
	300	149,2 (5,87)	R37	175 (6,88)	115 (4,53)	40	45
	600	149,2 (5,87)	R37	175 (6,88)	115 (4,53)	40	45

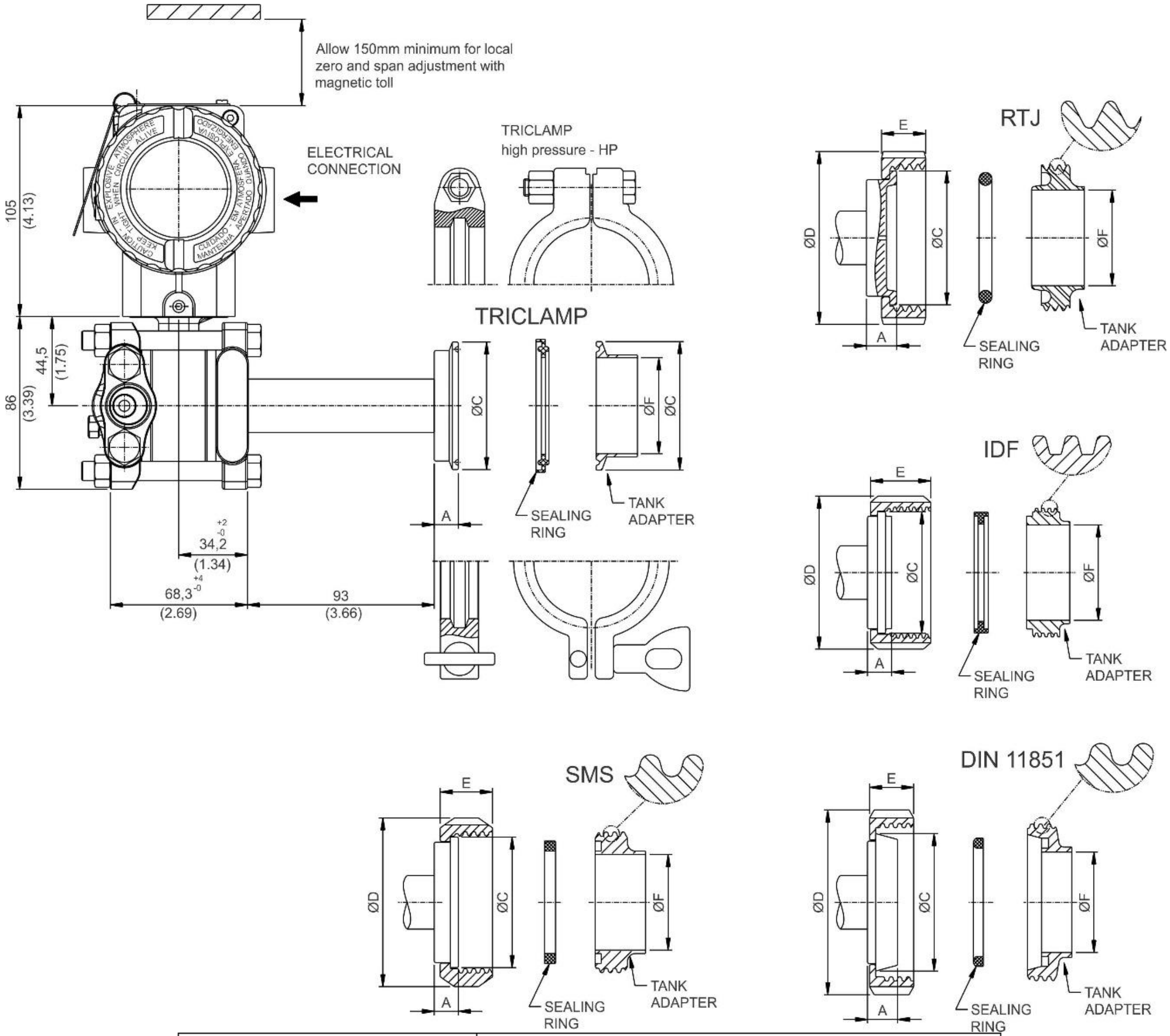
LOWER HOUSING 1/2NPT SUPPLIED WITH PLASTIC PROTECTION
NOT LOWER HOUSING 1/2 NPT FOR 1 INCH

Figure 1.1 (c) – – Dimensional Drawing Lower Housing



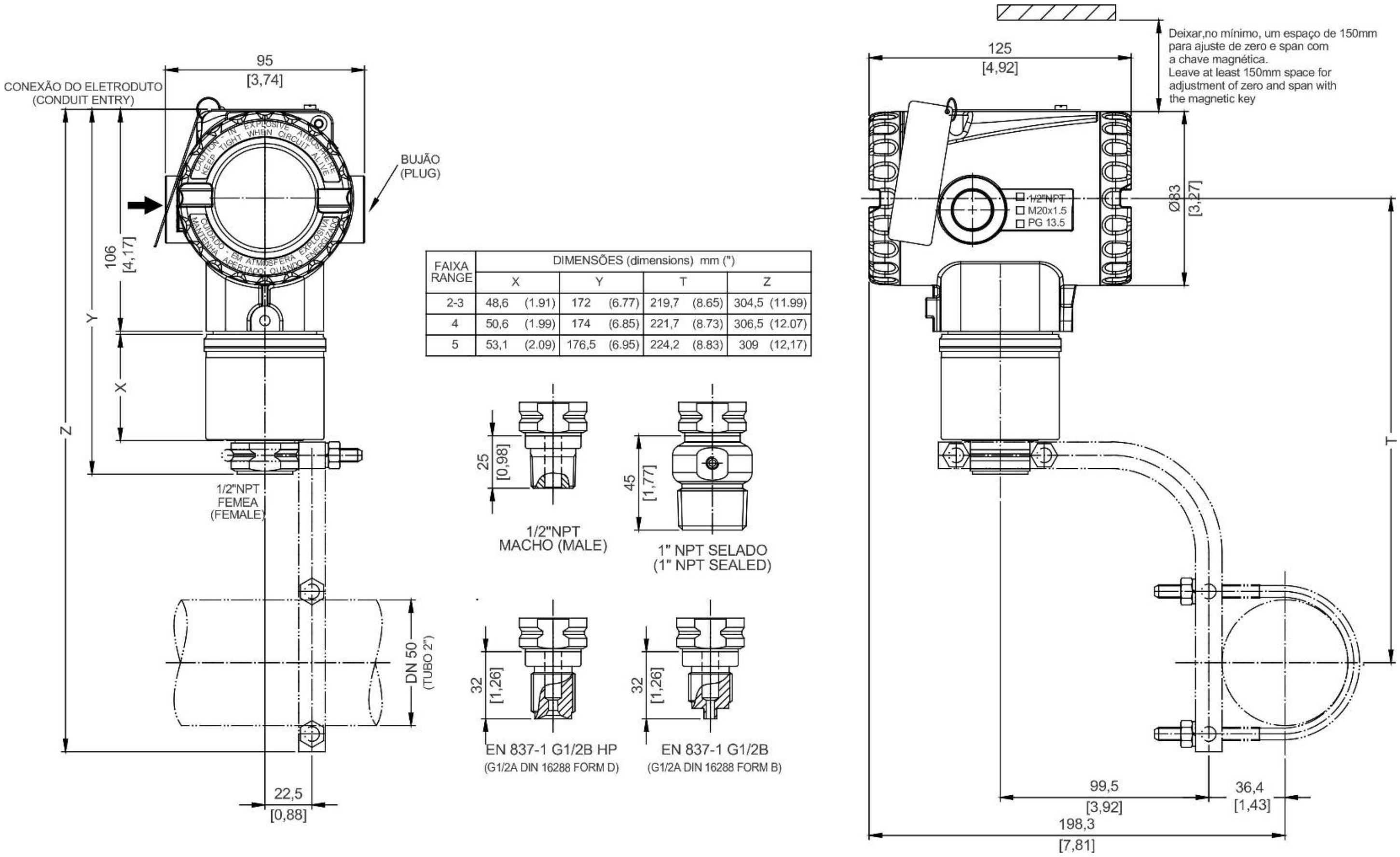
CONNECTIONS WITH EXTENSION	SR301S / LD30XS / LD400S						
	Dimensions in mm (inch)						
	A	ØC	ØD	E	ØF	ØG	EXT.
Tri-Clamp DN50 - with extension	8 (0.315)	64 (2.52)	---	---	50,5 (1.99)	80 (3.15)	48 (1.89)
Tri-Clamp DN50 HP - with extension	8 (0.315)	64 (2.52)	---	---	50,5 (1.99)	80 (3.15)	48 (1.89)
Tri-Clamp - 2" - with extension	8 (0.315)	64 (2.52)	---	---	50,5 (1.99)	80 (3.15)	48 (1.89)
Tri-Clamp - 2" HP -with extension	8 (0.315)	64 (2.52)	---	---	50,5 (1.99)	80 (3.15)	48 (1.89)
Tri-Clamp - 3" - with extension	8 (0.315)	91 (3.58)	---	---	72,5 (2.85)	100 (3.94)	50 (1.96)
Tri-Clamp - 3" HP - with extension	8 (0.315)	91 (3.58)	---	---	72,5 (2.85)	100 (3.94)	50 (1.96)
Thread DN25 - DIN 11851 - with extension	6 (0.24)	47,5 (1.87)	63 (2.48)	21 (0.83)	43,2 (1.7)	80 (3.15)	26,3 (1.03)
Thread DN40 - DIN 11851 - with extension	8 (0.315)	56 (2.2)	78 (3.07)	21 (0.83)	50,5 (1.99)	80 (3.15)	48 (1.89)
Thread DN50 - DIN 11851 - with extension	8 (0.315)	68,5 (2.7)	92 (3.62)	22 (0.86)	50,5 (1.99)	80 (3.15)	48 (1.89)
Thread DN80 - DIN 11851 - with extension	8 (0.315)	100 (3.94)	127 (5)	29 (1.14)	72,5 (2.85)	100 (3.94)	50 (1.96)
Thread SMS - 2" - with extension	8 (0.315)	65 (2.56)	84 (3.3)	26 (1.02)	50,5 (1.99)	80 (3.15)	48 (1.89)
Thread SMS - 3" - with extension	8 (0.315)	93 (3.66)	113 (4.45)	32 (1.26)	72,5 (2.85)	100 (3.94)	50 (1.96)
Thread RJT - 2" - with extension	8 (0.315)	66,7 (2.63)	86 (3.38)	22 (0.86)	50,5 (1.99)	80 (3.15)	48 (1.89)
Thread RJT - 3" - with extension	8 (0.315)	92 (3.62)	112 (4.41)	22,2 (0.87)	72,5 (2.85)	100 (3.94)	50 (1.96)
Thread IDF - 2" - with extension	8 (0.315)	60.5 (2.38)	76,2 (3)	30 (1.18)	50,5 (1.99)	80 (3.15)	48 (1.89)
Thread IDF - 3" - with extension	8 (0.315)	87,5 (3.44)	101,6 (4)	30 (1.18)	72,5 (2.85)	100 (3.94)	50 (1.96)

Figure 1.1 (d) – Dimensional Drawing and Mounting Position for the LD400 HART® – Sanitary Transmitter with Extension



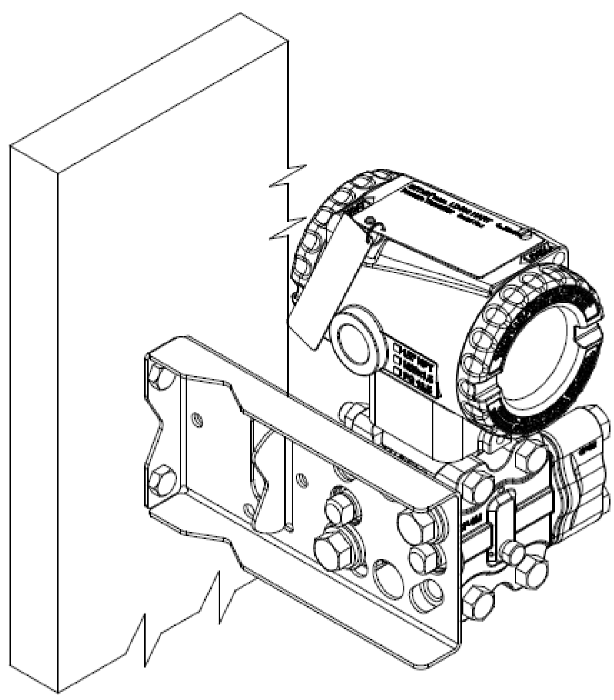
CONNECTIONS WITHOUT EXTENSION	Dimensions in mm (inch)						
	A	ØC	ØD	E	ØF	ØG	EXT.
Tri-Clamp - 1 1/2" - without extension	12 (0.47)	50 (1.96)	---	---	35 (1.38)	---	---
Tri-Clamp - 1 1/2" HP - without extension	12 (0.47)	50 (1.96)	---	---	35 (1.38)	---	---
Tri-Clamp - 2" - without extension	12 (0.47)	63,5 (2.5)	---	---	47,6 (1.87)	---	---
Tri-Clamp - 2" HP - without extension	12 (0.47)	63,5 (2.5)	---	---	47,6 (1.87)	---	---
Tri-Clamp - 3" - without extension	12 (0.47)	91 (3.58)	---	---	72 (2.83)	---	---
Tri-Clamp - 3" HP - without extension	12 (0.47)	91 (3.58)	---	---	72 (2.83)	---	---
Thread DN40 - DIN 11851 - without extension	13 (0.51)	56 (2.2)	78 (3.07)	21 (0.83)	38 (1.5)	---	---
Thread DN50 - DIN 11851 - without extension	15 (0.59)	68,5 (2.7)	92 (3.62)	22 (0.86)	50 (1.96)	---	---
Thread DN80 - DIN 11851 - without extension	16 (0.63)	100 (3.94)	127 (5)	29 (1.14)	81 (3.19)	---	---
Thread SMS - 1 1/2" - without extension	12 (0.47)	55 (2.16)	74 (2.91)	25 (0.98)	35 (1.38)	---	---
Thread SMS - 2" - without extension	12 (0.47)	65 (2.56)	84 (3.3)	26 (1.02)	48,6 (1.91)	---	---
Thread SMS - 3" - without extension	12 (0.47)	93 (3.66)	113 (4.45)	32 (1.26)	73 (2.87)	---	---
Thread RJT - 2" - without extension	15 (0.59)	66,7 (2.63)	86 (3.38)	22 (0.86)	47,6 (1.87)	---	---
Thread RJT - 3" - without extension	15 (0.59)	92 (3.62)	112 (4.41)	22,2 (0.87)	73 (2.87)	---	---
Thread IDF - 2" - without extension	12 (0.47)	60.5 (2.38)	76 (2.99)	30 (1.18)	47,6 (1.87)	---	---
Thread IDF - 3" - without extension	12 (0.47)	87,5 (3.44)	101,6 (4)	30 (1.18)	73 (2.87)	---	---

Figure 1.1 (e) – Dimensional Drawing and Mounting Position for the LD400 HART® – Sanitary Transmitter without Extension



FAIXA RANGE	DIMENSÕES (dimensions) mm (")			
	X	Y	T	Z
2-3	48,6 (1.91)	172 (6.77)	219,7 (8.65)	304,5 (11.99)
4	50,6 (1.99)	174 (6.85)	221,7 (8.73)	306,5 (12.07)
5	53,1 (2.09)	176,5 (6.95)	224,2 (8.83)	309 (12,17)

Figure 1.1 (f) – Dimensional Drawing and Mounting Position for the LD400 HART® – G Gage IN LINE



MOUNTING ON THE PANEL OR WALL
(See Section 6 –spare parts for mounting brackets available)

Figure 1.2 – Drawing of LD400 HART® Mounted on the Panel or Wall

Some examples of installation, illustrating the transmitter position in relation to the taps, are shown in Figure 1.3. The pressure taps location, and the relative positions of the transmitter are indicated in Table 1.1.

Process Fluid	Location of Taps	Location of LD400 HART® in Relation to the Taps
Gas	Top or Side	Above the taps.
Liquid	Side	Below the taps or at the piping centerline.
Steam	Side	Below the taps using Sealing (condensate) Pots.

Table 1.1 – Location of Pressure Taps

NOTE
For liquids, condensates, wet vapors, and gases the impulse lines must be bent on the ratio 1:10 to prevent bubbles from accumulating.

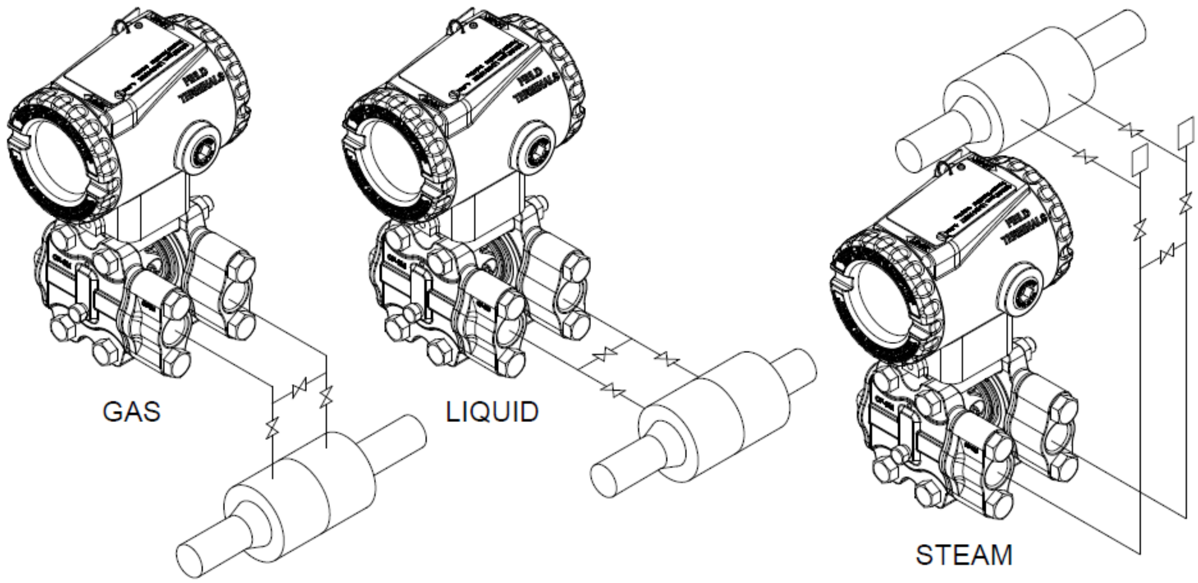


Figure 1.3 – Position of the Transmitter and Taps

For fiscal measuring and custody transference, use a safety seal on the front cover of the **LD400 HART®**, as shown below, Figure 1.4.

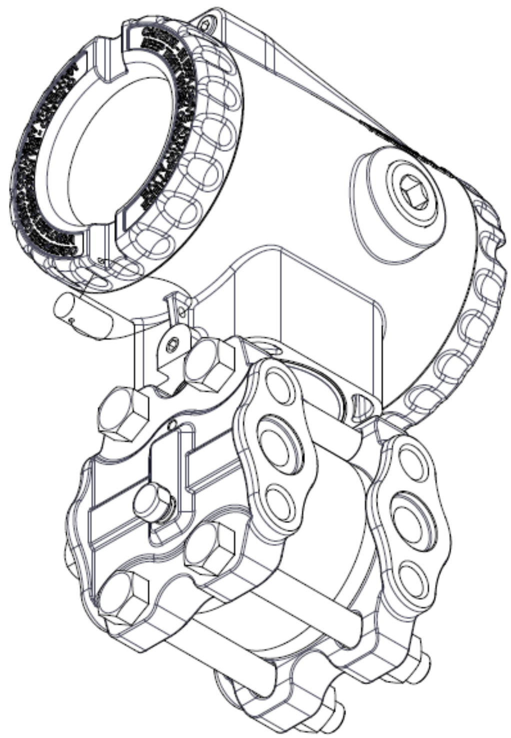


Figure 1.4 – Safety Seal and Custody Transference

When the sensor is in the horizontal position, the fluid weight pushes the diaphragm down and then the lower pressure trim must be applied. See Figure 1.5.

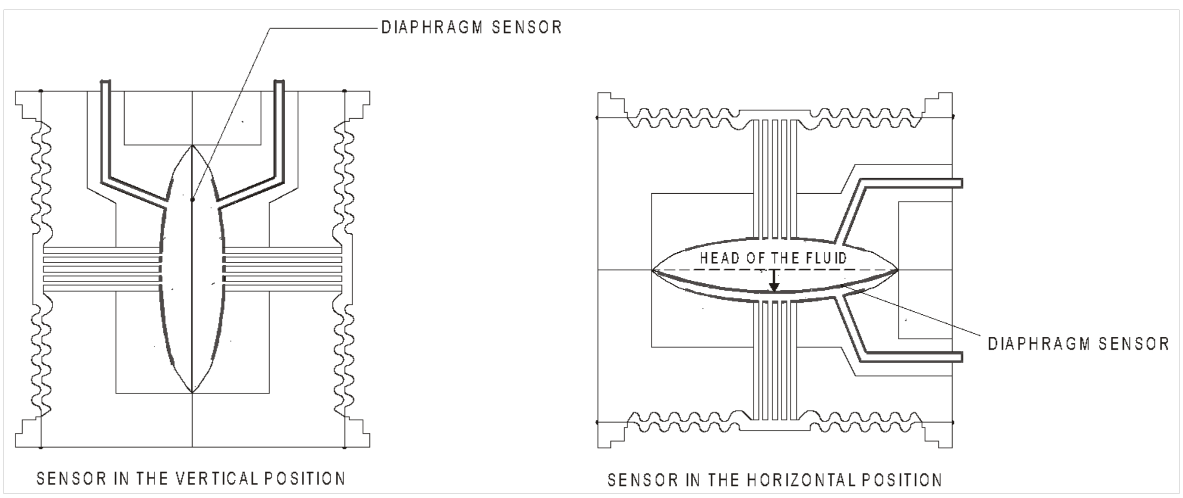


Figure 1.5 – Position of Sensor

NOTE
The transmitters are calibrated in the vertical position and a different mounting position displaces the zero point. Consequently, the indicator will indicate a different value from the applied pressure. In these conditions, it is recommended to do the zero pressure trim. The zero trim compensates the final assembly position and its performance, when the transmitter is in its final position. When the zero trim is executed, make sure the equalization valve is open and the wet leg levels are correct. For the absolute pressure transmitter, the assembly effects correction should be done using the Lower trim, due to the fact that the absolute zero is the unattainable reference for these transmitters, so there is no need for a zero value for the Lower trim.

Electronic Housing

The electronic housing can be rotated to adjust the digital display on a better position. To rotate it, loose the Housing Rotation Set Screw, see Figure 1.6.

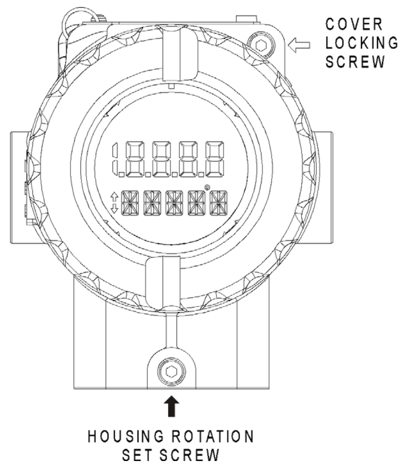


Figure 1.6 – Cover Locking and Housing Rotating Set Screw

NOTE
To prevent humidity entering, the electric housing and the sensor joint must have a minimum of 6 fully engaged threads. The provided joint allows 1 extra turn to adjust the position of the display window by rotating the housing clockwise. If the thread reaches the end before the desired position, then rotate the housing counterclockwise, but not more than one thread turn. Transmitters have a stopper that restricts housing rotation to one turn. See Section 6, Figure 6.2.

The display can also be rotated from 90º to 90º, for a better visualization. For more details on the several display positions, see Section 6 – Figure 6.4.

NOTE
The process flange on the level transmitter may be rotated ± 45º. Just loosen the two screws and rotate the flange. Do not remove the screw, according to a tag in the transmitter. See at Figure 1.1 (b), the Position Adjustment screws.

Wiring

To access the wiring block, loosen the rear cover locking screw to release the cover. See Figure 1.7.

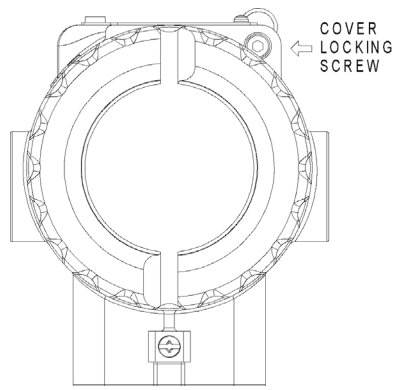


Figure 1.7 – Terminal Connection Side

The terminal block has screws that fit fork or eye type terminals. See Figure 1.8.

NOTE
The cover must be tightened with at least 8 turns to avoid the penetration of humidity or corrosive gases. The cover must be tightened **until you feel the O-rings being compressed**. Then, tighten more 1/3 turn (120°) to guarantee the sealing. Lock the covers using the locking screw. The signal cables passage to the terminal block may be done through one of the housing openings and may be connected to a conduit or cable clamp. The unused cable entries should be plugged and sealed accordingly to avoid humidity entering, which can cause the loss of the product's warranty. If the area is hazardous, use the required stopper. This manual has an order code for this type of stopper. See Maintenance section.

Test and Communication terminals allow, respectively, to measure the current in the 4 - 20 mA loop, without opening the circuit, and also to communicate with the transmitter. The "Test Terminals" must be used to measure the current. The "COMM" terminal must be used for HART® communication. The terminal block has screws where fork or ring-type terminals can be fastened. See Figure 1.8.

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

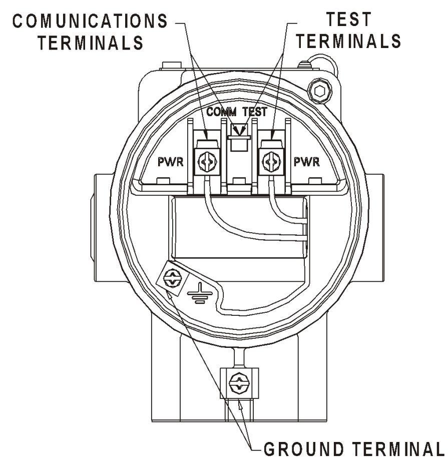


Figura 1.8 – LD400 HART® Terminal Block

NOTE
The external ground was designed to accept wiring up to 10 mm² section (S=12 mm²). Use a heavy-duty conductor, at least Ø 1,6mm²/15 AWG.

The **LD400 HART®** terminal block was developed to allow signal connections regardless their polarity.

Use of twisted pair (at least 22 AWG) cables are recommended. For sites with high electromagnetic levels (EMI above 10 V/m) shield conductors are recommended.

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

The duct threads must be sealed according to the hazardous area standards (see Installation in Hazardous Locations page 1.15).

The unused passage opening must be sealed with stopper and seal as per the area requirements to avoid humidity penetration. See Figure 1.9.

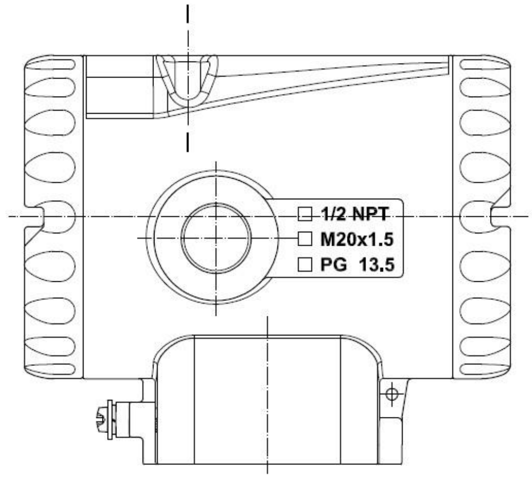


Figure 1.9 – Electric Conduit Thread Seal

Typical Installation for HART® Protocol

Figures 1.10 and 1.11 show **LD400 HART®** wiring diagrams to work as transmitter and controller, respectively.

Figure 1.12 shows the **LD400 HART®** wiring diagrams to work in the multidrop network. Note that a maximum of 15 transmitters can be connected on the same line and that they should be connected in parallel. Take care to the power supply as well, when many transmitters are connected on the same line. The current through the 250 Ω resistor will be high causing a high voltage drop. Therefore make sure that the power supply voltage is sufficient.

NOTE
For HART® transmitters to operate in multidrop mode each transmitter must be configured with a different identity Device ID. In addition, if the transmitter identification mode on the loop is done through the Command 0 address, the HART® address must also be different. If it is done through the Tag (Command 11), the Tags must be the same.

The Handheld Terminal can be connected to the communication terminals of the transmitter or at any point of the signal line by using the alligator clips. It is also recommended to ground the shield of shielded cables at only one end. The ungrounded end must be carefully isolated. On multidrop connections, the circuit loop integrity must be assured, with special care to prevent short-circuit between the circuit loop and the housing.

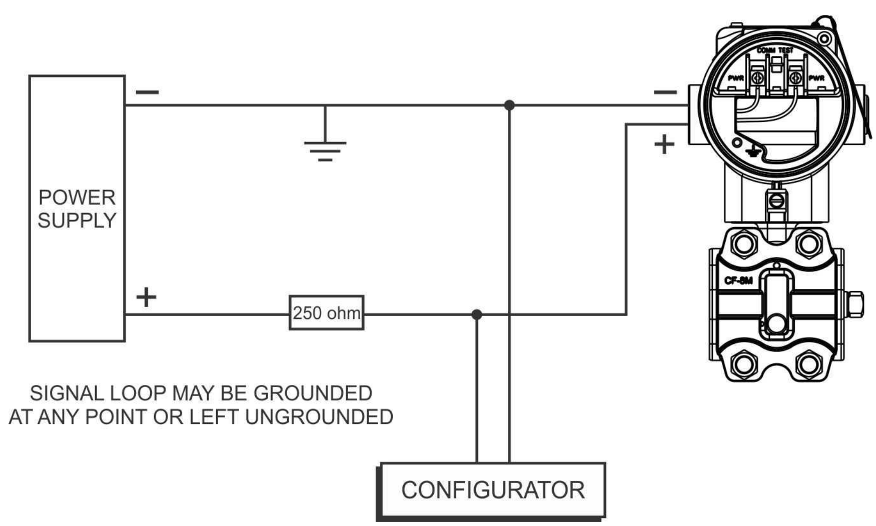


Figure 1.10 – Wiring Diagram for the LD400 HART® Working as a Transmitter

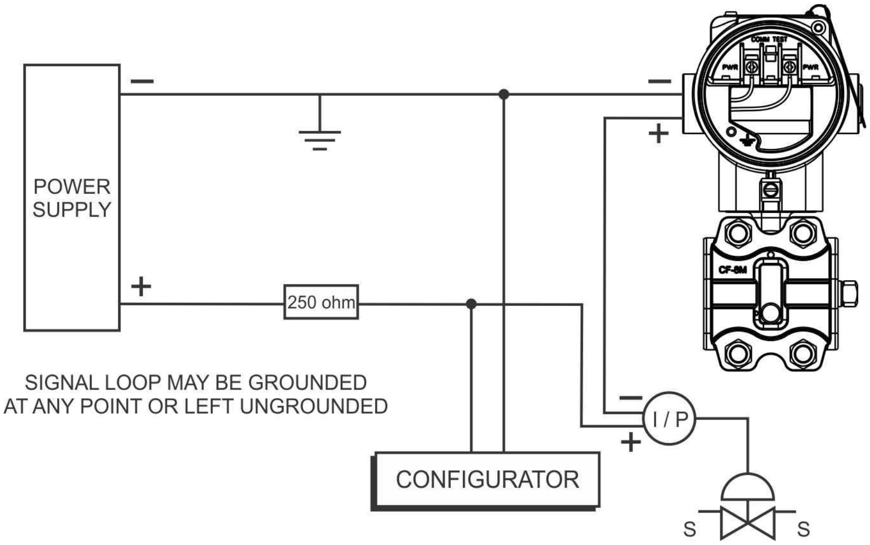


Figure 1.11 – Wiring Diagram for the LD400 HART® Working as a Controller

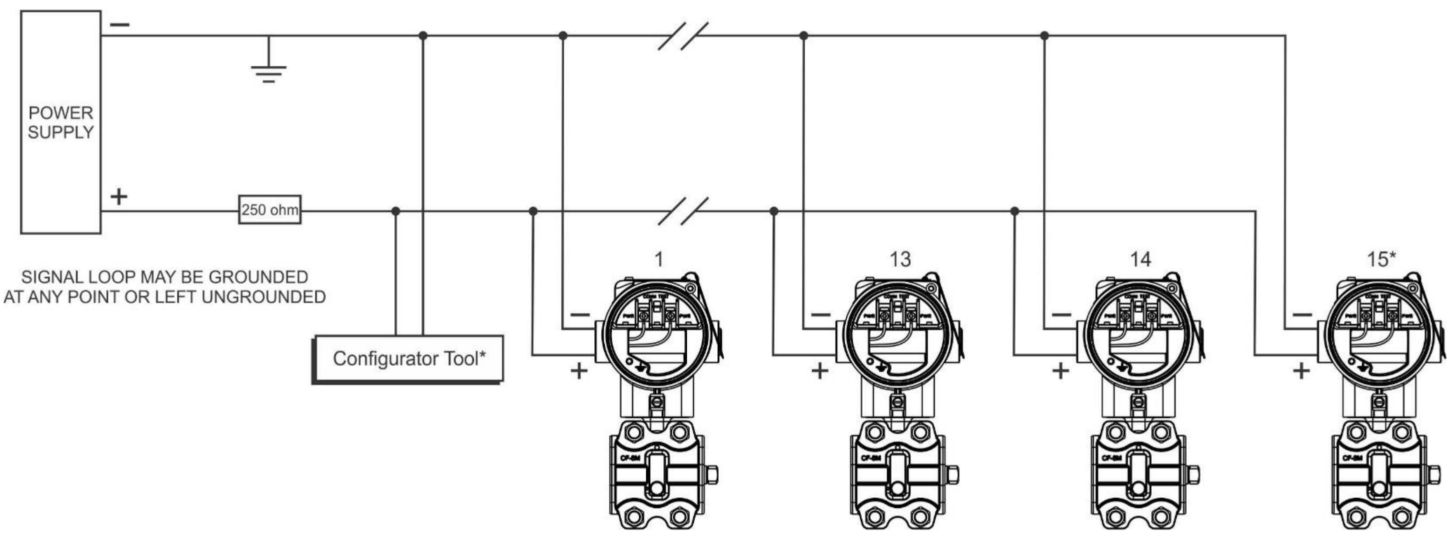


Figure 1.12 – Wiring Diagram for the LD400 HART® in Multidrop Configuration

NOTE
Make sure that the transmitter is operating within the operating area as shown on the load curve (Figure 1.13). Communication requires a minimum load of 250 Ohm.

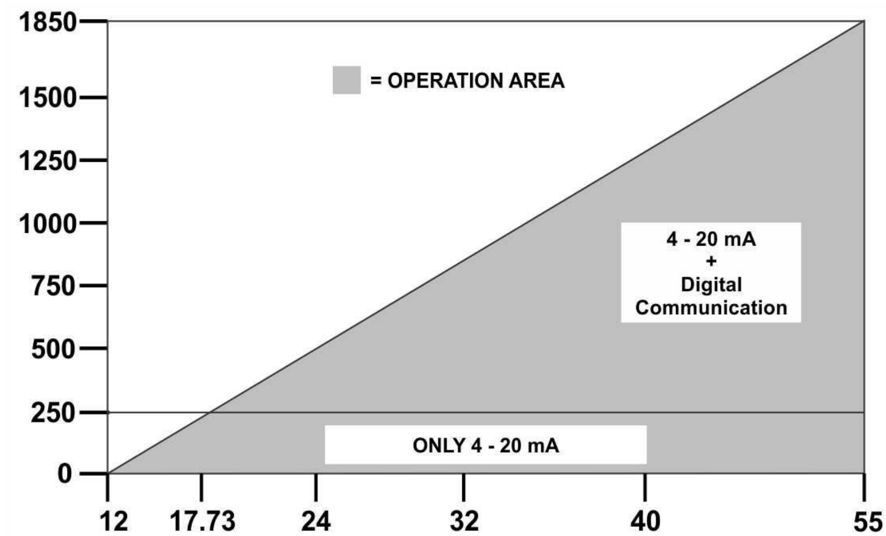


Figure 1.13 – Load Curve

Installation in Hazardous Locations

WARNING
Explosions could result in death or serious injury, besides financial damage. Installation of this transmitter in explosive areas must be carried out in accordance with the local standards and the protection type adopted. Before continuing the installation make sure the certificate parameters are in accordance with the classified area where the equipment will be installed. The instrument modification or parts replacement supplied by other than authorized representative of Smar is prohibited and will void the certification. The transmitters are marked with options of the protection type. The certification is valid only when the protection type is indicated by the user. Once a particular type of protection is selected, any other type of protection cannot be used. The electronic housing and the sensor installed in hazardous areas must have a minimum of 6 fully engaged threads. Lock the housing using the locking screw (Figure 1.6). The cover must be tightened with at least 8 turns to avoid the penetration of humidity or corrosive gases. The cover must be tightened until it touches the housing. Then, tighten more 1/3 turn (120°) to guarantee the sealing. Lock the covers using the locking screw (Figure 1.7). Consult the Appendix A for further information about certification.

Explosion/Flame Proof

WARNING
Only use Explosion Proof/Flameproof certified Plugs, Adapters and Cable glands. **In Explosion-Proof installations the cable entries must be connected or closed using metal cable gland and metal blanking plug, both with at least IP66 and Ex-d certification.** The standard plugs provided by Smar are certified according to CEPEL certificate. If the plug needs to be replaced, a certified plug must be used. The electrical connection with NPT thread must use waterproofing sealant. A non-hardening silicone sealant is recommended. For NEMKO ATEX certificate please to follow the installation guidelines in hazardous locations below: Group II Category 2G, Ex d, Group IIC, Temperature Class T6, EPL Gb U = 28VDC Ambient Temperature: -20 to 60ºC for T6 Environmental Protection: IP65/67 or IP65W/67W The electrical connection available are ½ - 14NPT and M20x1,5. **Cable entries must be connected or closed using metal cable gland and metal blanking plug, both with at least IP66 and Ex-d certification or any appropriate ATEX approved metal cable gland and metal blanking plug.** **Do not remove the transmitter covers when power is ON.**

Intrinsically Safe

WARNING
In hazardous zones with intrinsically safe or non-incendive requirements, the circuit entity parameters and applicable installation procedures must be observed. To protect the application, the transmitter must be connected to a barrier. Match the parameters between barrier and the equipment (Consider the cable parameters). Associated apparatus ground bus shall be insulated from panels and mounting enclosures. Shield is optional. If used, be sure to insulate the end not grounded. Cable capacitance and inductance plus C_i and L_i must be smaller than Co and Lo of the associated Apparatus. For free access to the HART bus in the explosive environment, ensure the instruments in the loop are installed in accordance with intrinsically safe or non-incendive field wiring practices. Use only Ex HART communicator approved according to the type of protection Ex-i (IS) or Ex-n (NI). It is not recommended to remove the transmitter cover when the power is ON.

FUNCTIONAL DESCRIPTION

Functional Description – Sensor

The **LD400 HART®** Smart Pressure Transmitters use capacitive sensor (capacitive cells) as pressure sensing elements, as shown in Figure 2.1

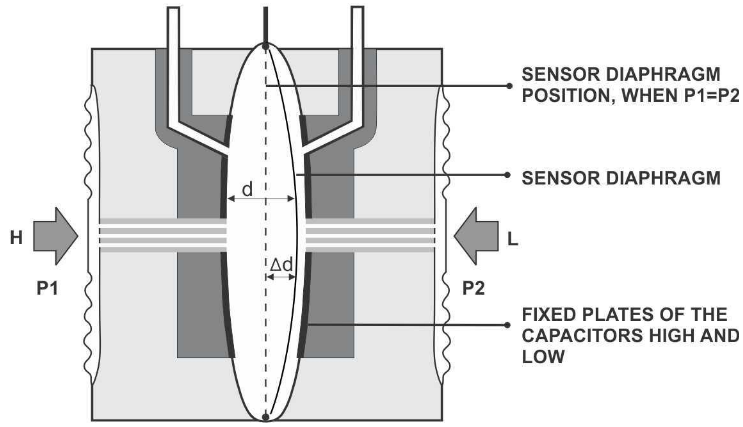


Figure 2.1 – Capacitive Cell

Where:

P_1 and **P_2** are the pressures in chambers H and L.
CH = capacitance between the fixed plate on P_1 side and the sensing diaphragm.
CL = capacitance between the fixed plate on P_2 side and the sensing diaphragm.
d = distance between CH and CL fixed plates.
Δ**d** = 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 as. See equation 1:

$$C = \frac{\varepsilon A}{d} \quad (1)$$

Where:

ε = dielectric constant of the fluid between the capacitor's plates.

Should *CH* and *CL* be considered as capacitances of flat and parallel plates with identical areas, when $P_1 > P_2$ then:

$$CH = \frac{\varepsilon . A}{(d/2) + \Delta d} \quad (2)$$

and

$$CL = \frac{\varepsilon \cdot A}{(d/2) - \Delta d} \quad (3)$$

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 proportional to Δd:

By developing the expression:

$$\frac{CL - CH}{CL + CH} \qquad \textbf{(4)}$$

It follows that:

$$\Delta P = \frac{CL - CH}{CL + CH} = \frac{2\Delta d}{d} \qquad \textbf{(5)}$$

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 capacitances vary according to the applied differential pressure.

Functional Description – Hardware

Refer to the block diagram Figure 2.2. The function of each block is described below.

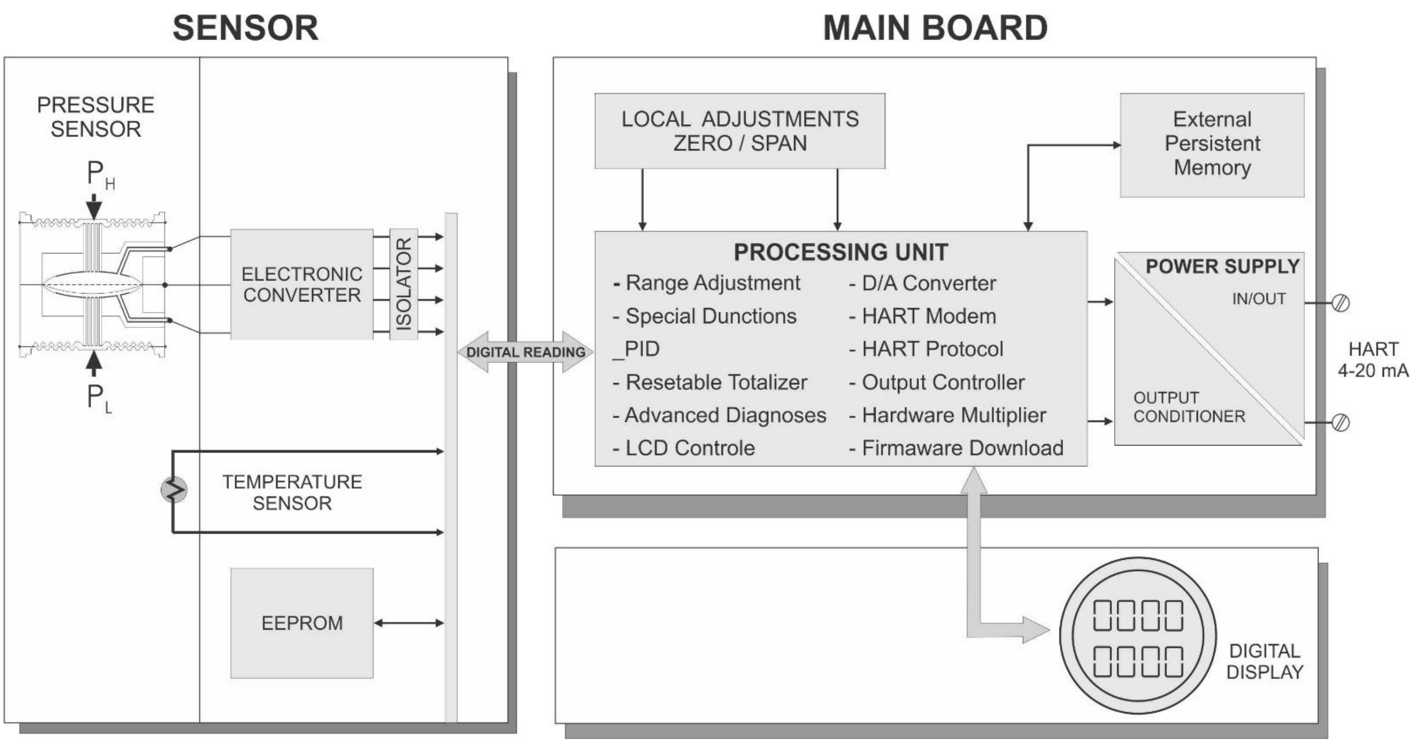


Figure 2.2 – LD400 HART® Hardware Block Diagram

Electronic Converter
This oscillator generates a frequency as a function of sensor capacitance.

Signal Isolator
The Control signals from the CPU are transferred through optical couplers, and the signal from the oscillator is transferred through a transformer.

EEPROM
An EEPROM memory 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.

Temperature Sensor
Sensor used to measure temperature of the sensor.

Processing Unit
The Processing Unit is the intelligent portion of the transmitter, being responsible for the management and operation of all other blocks, linearization, and communication. This unit consists of a Microcontroller (MCU) with many peripherals like Timers, Serial Communication Channels, A/D converter, Persistent Memory, like Flash, to store the Firmware and Volatile Memory RAM to store temporary data used by the MCU. For quick floating-point arithmetic processing an internal 32x32-bit Hardware Multiplier is used.

D/A Converter
It converts the digital data from the CPU to an analog signal with 16-bit resolution.

Output Controller
It controls the current in the supply line of the transmitter (2-wire transmitter). It acts as a variable resistive load whose value depends on the voltage from the D/A converter.

HART Modem
This peripheral provides the data exchanged with the serve-master digital communicators. This unit demodulates information from the power supply line, and after treating it adequately, modulates, over the line, the response to be sent. A "1" is represented by 1200 Hz and "0" by 2200 Hz. This analog signal is symmetrical and does not affect the DC-level of the 4-20 mA signals (analog signal without DC component).

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

External Persistent Memory
The specific transmitter datal such as calibration, configuration and identification data should be maintained intact when the power supply is switched off. An external persistent serial memory is used for this purpose.

Power Supply
Power must be supplied to the transmitter circuit using the signal line (2-wire system). The transmitter quiescent consumption is 3.55 mA; during operation, consumption may be as high as 21 mA, depending on the measurement and sensor status. The **LD400 HART®** in the transmitter mode shows failure indication at 3.6 mA when configured for low signal failure; at 21 mA, when configured for high signal failure; 3.8 mA in the case of low saturation; 20.5 mA in the case of high saturation and measurements proportional to the applied pressure in the range between 3.8 mA and 20.5 mA. 4 mA corresponds to 0% of the working range and 20 mA to 100% of the working range.

Local Adjustment
Two switches on the main board are magnetically activated by inserting the magnetic screwdriver. See Figure 2.3. This kind of actuation access the local adjust method externally, without any contact to electronic board, maintaining totally sealed the electronic chamber.

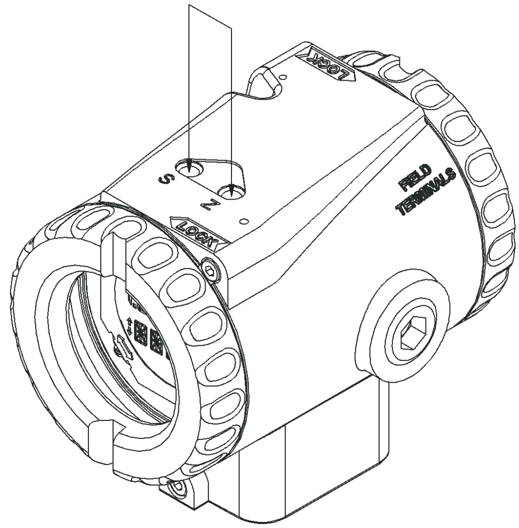


Figure 2.3 – Local Adjustment

Functional Description – LD400 HART® Software

The functional block diagram of the LD400 HART software is represented in the Figure 2.4. The function of each block is described below.

Factory Characterization
The actual pressure from the capacitance and temperature readouts obtained from the sensor can be calculated by using the factory characterization data stored in the sensor EEPROM.

Pressure Trim
The values obtained by Lower Pressure TRIM and Upper Pressure TRIM may correct the transmitter for long term drift or zero deviation or upper pressure reading due to installation or over pressure.

User Linearization
The characterization TRIM points P1 - P5 can be used to complement the transmitter original characterization.

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

This value (in seconds) may be freely configured by the user, from 0 to 128 seconds, zero value means no damping.

Engineering
The pressure normalized value is converted to the engineering unit, configured by the user.

Calibration
The pressure value is calculated in percentage taking in consideration the work range provided by the Lower Range Value (LRV) and the Upper Range Value (URV).

Function
Depending on the application, the transmitter output or controller PV may have the following characteristics according to the applied pressure: *Linear* (for pressure, differential pressure and level measurement); *Square-root* (for flow measurement with differential pressure producers) and *Square-root of the Third and Fifth power* (for flow measurements in open channels).

Block PID
The PID Block executes a control loop having the Setpoint (SP) and the Process Variable (PV) as input and the Manipulated Value (MV) as output.

Block PID: SP - Setpoint
It is the desired value in the process variable when the controller mode is activated.

Block PID: PID Algorithm
First, the error is calculated: PV-SP (DIRECT ACTION) or SP-PV (REVERSE ACTION), then the MV (manipulated value) is calculated, according to the algorithm of the PID. The PID output signal may follow a user-determined curve, in up to 16 configurable points. If the table is enabled, there will be a display indication with the F(X) icon.

Block PID: Auto/Manual
With the PID in Manual, the MV output can be bypassed by the user in the LOW LIMIT to HIGH LIMIT range. The POWER-ON option is used to determine in which mode the controller should be upon powering it on.

Block PID: Limits
This block makes sure that the MV does not go beyond its minimum and maximum limits as established by the HIGH-LIMIT and LOW-LIMIT. The Change Rate parameter limits the output signal variation to this selected percentage per second value.

Block PID: Bumpless A/M
On the Manual mode, the PID algorithm uses the output values as a compensation to its proportional action so that the Manual to Automatic transition do not occur abruptly. Therefore, even if the transition occurs in the presence of a percent ERROR, the proportional action is nullified, and the output is adjusted softly according to the integral action.

Block PID: Points Table PID
This block receives the Manipulated Variable output as the input of a look-up table of 2 to 16 points. The output of this block is calculated by the interpolation of these points. The points are given in the function "TABLE POINTS" in percent of the range (X_i) and in percent of the output (Y_i). Normally, this table is used for adaptative control.

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

Current Trim
The 4 mA TRIM and 20 mA TRIM adjustment is used to make the transmitter current comply with a current standard, when a deviation occurs.

User Unit
It converts 0 and 100% of the process variable to the desired engineering unit readout available for display and communication. It is used, e.g., to get a volume or flow indication from a level or differential pressure measurement, respectively. A unit for this variable can also be selected.

Totalization
Used for flow application to totalize the accumulated flow since the last reset, getting the volume or mass transferred. In the lack of power, the totalized value is saved and continues totalizing after its re-establishment.

Display
Until 3 variables can be configured to be showed alternately in the display.

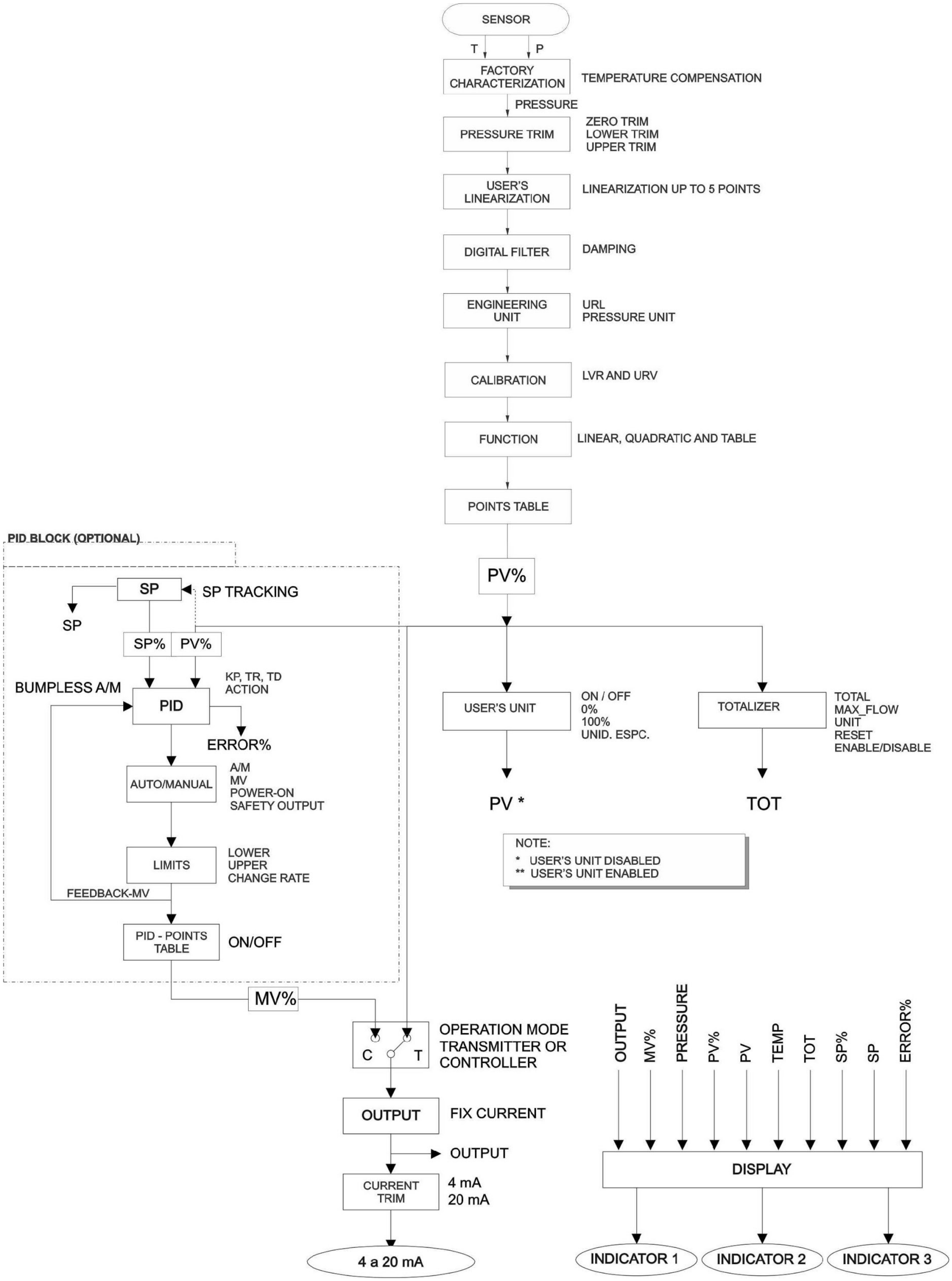


Figure 2.4 – LD400 HART® – Software Block Diagram

Functional Description - Display (LCD)

The local indicator is able to display three variables, which are user-selectable. When multiples variables are chosen, the display will alternate between both with an interval of 3 seconds.

The liquid crystal display includes a field with 4 ½ numeric digits, a field with 5 alphanumeric digits and an information field, as shown on Figure 2.5.

When the totalization is displayed, the most significant part appears in the unit and function field (upper) and the least significant part in the variable field (lower). See Total Value in Section 3.

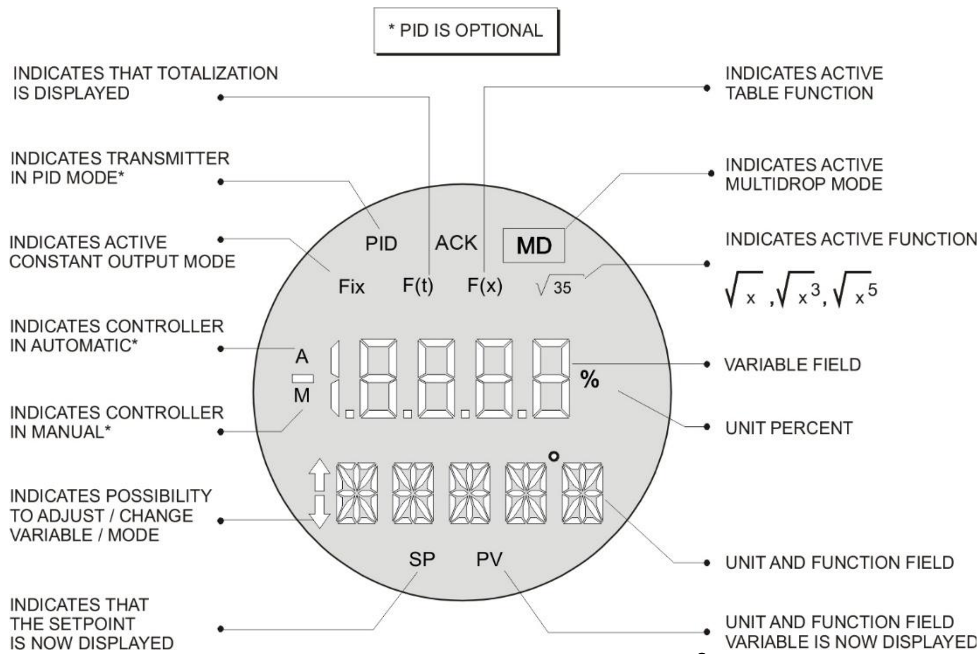


Figure 2.5 – Display for LD400 HART®

Monitoring

During normal operation, the **LD400 HART®** is in the monitoring mode. In this mode, indication alternates between the three variables (LCD_1, LCD_2, LCD_3) as configured by the user. See Figure 2.6.

The display indicates engineering units, values, and parameters simultaneously with most status indicators.

Figure 2.6 – Typical Monitoring Mode Display Showing PV, in this case 25.00 mmH₂0

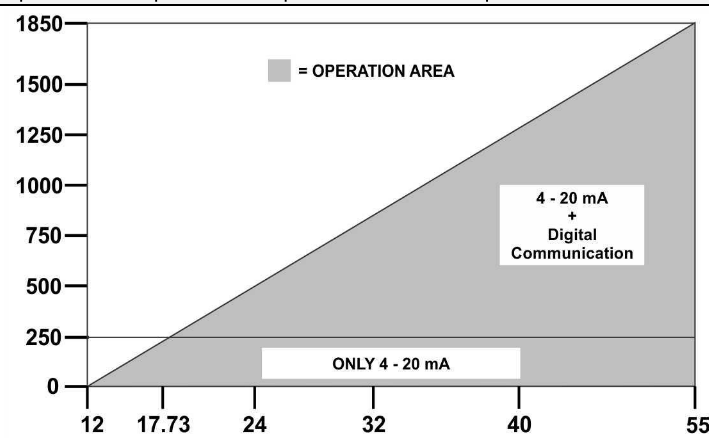
The monitoring mode is interrupted when the user applies the simple or complete local adjustment, going to the interactive actions defined to each selected local adjustment mode.

The **LD400 HART®** display may also exhibit messages and errors. A few examples of these messages are listed on Table 2.1. For a complete list, see Section 6 – Maintenance.

INDICATOR		DESCRIPTION
Numeric	**Alphanumeric**	
Version	LD400 HART and Version	The **LD400 HART®** is initialized after feeding.
Variable Value	SAT / Unit	Output current saturated on 3.8 or 20.5 mA. (see section 5 – Maintenance)
CH / CL alternating with current value	SAT / Unit	Failure on one sensor side or on both. The SAT is showed when the variable on the display is in percent value.
F-XX	YY-YY	Safety failure information in hexadecimal format. See Diagnostic via Transmitter, page 6.4, for more details.
FLSH	HH-HH	Flash CRC error: HH-HH = expected CRC value in hexadecimal format.
Icon Fix		This icon is showed when the output current is not more controlled according to the measurement. The output current is on the freeze state on user or safe state demands (safety current).

Table 2.1 – Messages Displayed

TECHNICAL CHARACTERISTICS

Functional Specifications	
Process Fluid	Liquid, gas, or steam.
Output and Communication Protocol	Two-wire, 4 - 20 mA controlled according to NAMUR NE43 specification, with superimposed digital communication (HART® Protocol).
Power Supply	12 - 55 Vdc. Input without polarization, with protection for transient suppressor and complemented by a lightning arrester. Insulation of housing larger than 10 GΩ. **Transient Suppressor** V_{max} = 65 Vp; Differential mode - bi-directional; Low current leak and capacitance; meets the standards: IEEE61000-4-4 and IEEE61000-4-5; Less than 5 ns response time. **Lightning Arrester** V = 1000 Vdc; Discharge current peak = 10 kA; Nominal current = 10 A/s; Common mode - low leak current and capacitance.
Indicator	4 1/2 -digit numerical and 5-character alphanumerical LCD indicator (optional). Function and status icon.
Hazardous Area Certifications	See Appendix A.
Zero and Span Adjustments	No interactive, via digital communication and local adjustment. Local adjustment jumper with three positions: simple, disable, and complete.
Load Limitation	
Failure Alarm (Diagnostics)	Detailed diagnostics via HART® communicator. Sensor failure and overpressure indication. Safe state failures detailed indication In case of sensor or circuit failure, the self-diagnostics drives the output to 3.6 or 21.0 mA, according to the user's configuration and NAMUR NE43 specification. Detailed diagnostic through HART® communication.
Temperature Limits	Ambient: -40 a 85 ºC (-40 a 185 °F) Process: -40 a 100 ºC (-40 a 212 °F) (Silicon Oil) -40 a 85 ºC (-40 a 185 °F) (Inert Halocarbon Oil) 0 a 85 ºC (32 a 185 °F) (Inert Fluorolube Oil) -20 a 85 ºC (-4 a 185 °F) (Inert Krytox and Fomblim Oil) -25 a 100 ºC (-13 a 212 °F) (Viton O´Ring) -40 a 150 ºC (-40 a 302 °F) (Level Model) Storage: -40 a 100 ºC (-40 a 212 °F) Digital Display: -20 a 80 ºC (-4 a 176 °F) -40 a 85 ºC (-40 a 185 °F) (Without damage)
Turn-on Time	Performs within specifications in less than 3 seconds after power is applied to the transmitter.
Configuration	By digital communication (HART® protocol) using the configuration software CONF401, DDCON 100 (for windows), or HPC401 (for Palms). It can also be configured using DD and FDT/DTM tools and can be partially configured through local adjustment. In order to keep the equipment configuration safe, the **LD400 HART®** has two kinds of write protection. One is via software and the other is a hardware mechanism selected by a jumper, with priority over the software.
Volumetric Displacement	Less than 0.15 cm^3 (0.01 in^3).

Overpressure and Static Pressure Limits (MWP – Maximum Working Pressure)

From 3.45 kPa abs. (0.5 psia) to:
- 0.5 MPa (72.52 psi) for range 0
- 8 MPa (1150 psi) for range 1
- 16 MPa (2300 psi) for ranges 2, 3 e 4
- 32 MPa (4600 psi) for models H e A5
- 40 MPa (5800 psi) for model M5
- 52 MPa (7500 psi) for models M6 e A6

Flange Test Pressure: 68.95 MPa (10000 psi)

Overpressures above will not damage the transmitter, but a new calibration may be necessary.

WARNING

It is described here only the maximum pressures of the materials referenced in each rule, it cannot be manufactured on request.

Temperatures above 150 ° C are not available in standard models.

PRESSURES TABLE FOR SEAL AND LEVEL FLANGES DIN EN 1092-1 2008 STANDARD

Material Group	Pressure Class	Maximum Temperature Allowed						
		RT	100	150	200	250	300	350
		Maximum Pressure Allowed (bar)						
10E0 AISI 304/304L	PN 16	16	13.7	12.3	11.2	10.4	9,6	9.2
	PN 25	25	21.5	19.2	17.5	16.3	15.1	14.4
	PN 40	40	34.4	30.8	28	26	24.1	23
	PN 63	63	63	57.3	53.1	50.1	46.8	45
	PN 100	100	86.1	77.1	70	65.2	60.4	57.6
	PN 160	160	137.9	123.4	112	104.3	96.7	92.1
	PN 250	250	215.4	192.8	175	163	151.1	144

Material Group	Pressure Class	Maximum Temperature Allowed						
		RT	100	150	200	250	300	350
		Maximum Pressure Allowed (bar)						
14E0 AISI 316/316L	PN 16	16	16	14.5	13.4	12.7	11.8	11.4
	PN 25	25	25	22.7	21	19.8	18.5	17.8
	PN 40	40	40	36.3	33.7	31.8	29.7	28.5
	PN 63	63	63	57.3	53.1	50.1	46.8	45
	PN 100	100	100	90.9	84.2	79.5	74.2	71.4
	PN 160	160	160	145.5	134.8	127.2	118.8	114.2
	PN 250	250	250	227.3	210.7	198.8	185.7	178.5

Material Group	Pressure Class	Maximum Temperature Allowed						
		RT	100	150	200	250	300	350
		Maximum Pressure Allowed (bar)						
16E0 1.4410 Super Duplex 1.4462 Duplex	PN 16	16	16	16	16	16	-	-
	PN 25	25	25	25	25	25	-	-
	PN 40	40	40	40	40	40	-	-
	PN 63	63	63	63	63	63	-	-
	PN 100	100	100	100	100	100	-	-
	PN 160	160	160	160	160	160	-	-
	PN 250	250	250	250	250	250	-	-

Overpressure and Static Pressure Limits (MWP – Maximum Working Pressure) (continuation)

PRESSURES TABLE FOR SEAL AND LEVEL FLANGES ASME B16.5 2009 STANDARD

Material Group	Pressure Class	Maximum Temperature Allowed								
		-29 to 38	50	100	150	200	250	300	325	350
		Maximum Pressure Allowed (bar)								
Hastelloy C276	150	20	19.5	17.7	15.8	13.8	12.1	10.2	9.3	8.4
	300	51.7	51.7	51.5	50.3	48.3	46.3	42.9	41.4	40.3
	400	68.9	68.9	68.7	66.8	64.5	61.7	57	55	53.6
	600	103.4	103.4	103	100.3	96.7	92.7	85.7	82.6	80.4
	900	155.1	155.1	154.6	150.6	145	139	128.6	124	120.7
	1500	258.6	258.6	257.6	250.8	241.7	231.8	214.4	206.6	201.1
	2500	430.9	430.9	429.4	418.2	402.8	386.2	357.1	344.3	335.3

Material Group	Pressure Class	Maximum Temperature Allowed								
		-29 to 38	50	100	150	200	250	300	325	350
		Maximum Pressure Allowed (bar)								
S31803 Duplex S32750 Super Duplex	150	20	19.5	17.7	15.8	13.8	12.1	10.2	9.3	8.4
	300	51.7	51.7	50.7	45.9	42.7	40.5	38.9	38.2	37.6
	400	68.9	68.9	67.5	61.2	56.9	53.9	51.8	50.9	50.2
	600	103.4	103.4	101.3	91.9	85.3	80.9	77.7	76.3	75.3
	900	155.1	155.1	152	137.8	128	121.4	116.6	114.5	112.9
	1500	258.6	258.6	253.3	229.6	213.3	202.3	194.3	190.8	188.2
	2500	430.9	430.9	422.2	382.7	355.4	337.2	323.8	318	313.7

Material Group	Pressure Class	Maximum Temperature Allowed								
		-29 to 38	50	100	150	200	250	300	325	350
		Maximum Pressure Allowed (bar)								
AISI316L	150	15.9	15.3	13.3	12	11.2	10.5	10	9.3	8.4
	300	41.4	40	34.8	31.4	29.2	27.5	26.1	25.5	25.1
	400	55.2	53.4	46.4	41.9	38.9	36.6	34.8	34	33.4
	600	82.7	80	69.6	62.8	58.3	54.9	52.1	51	50.1
	900	124.1	120.1	104.4	94.2	87.5	82.4	78.2	76.4	75.2
	1500	206.8	200.1	173.9	157	145.8	137.3	130.3	127.4	125.4
	2500	344.7	333.5	289.9	261.6	243	228.9	217.2	212.3	208.9

Material Group	Pressure Class	Maximum Temperature Allowed								
		-29 to 38	50	100	150	200	250	300	325	350
		Maximum Pressure Allowed (bar)								
AISI316	150	19	18.4	16.2	14.8	13.7	12.1	10.2	9.3	8.4
	300	49.6	48.1	42.2	38.5	35.7	33.4	31.6	30.9	30.3
	400	66.2	64.2	56.3	51.3	47.6	44.5	42.2	41.2	40.4
	600	99.3	96.2	84.4	77	71.3	66.8	63.2	61.8	60.7
	900	148.9	144.3	126.6	115.5	107	100.1	94.9	92.7	91
	1500	248.2	240.6	211	192.5	178.3	166.9	158.1	154.4	151.6
	2500	413.7	400.9	351.6	320.8	297.2	278.1	263.5	257.4	252.7

Material Group	Pressure Class	Maximum Temperature Allowed								
		-29 to 38	50	100	150	200	250	300	325	350
		Maximum Pressure Allowed (bar)								
AISI304	150	19	18,3	15,7	14,2	13,2	12,1	10,2	9,3	8,4
	300	49,6	47,8	40,9	37	34,5	32,5	30,9	30,2	29,6
	600	99,3	95,6	81,7	74	69	65	61,8	60,4	59,3
	1500	248,2	239,1	204,3	185	172,4	162,4	154,6	151,1	148,1
	2500	413,7	398,5	340,4	308,4	287,3	270,7	257,6	251,9	246,9

Humidity Limits	0 to 100% UR (Relative Humid).
Damping Adjustment	User configurable from 0 to 128 seconds (via digital communication).

Performance Specifications	
Reference Conditions	Span starting at zero, temperature of 25°C (77°F), atmospheric pressure, power supply of 24 Vcc, silicone oil fill fluid, isolating diaphragms in 316L SST and digital trim equal to lower and upper range values.
Accuracy	**Standard Class:** **For range 0 and gage or differential model:** *± (0.1) % of the span, for 0.16 URL ≤ span ≤ URL;* *± (0.0545 + 0.00728 * URL/span) % of the span, for 0.05 URL ≤ span ≤ 0.16 URL* **For range 1 and differential or gage model:** *± (0.06) % of the span, for 0.16 URL ≤ span ≤ URL;* *± (0.0364 + 0.003776 * URL/span) % of the span, for 0.025 URL ≤ span ≤ 0.16 URL* **For range 2, 3 or 4 and differential, high static pressure or gage models:** *± (0.06) % of the span, for 0.16 URL ≤ span ≤ URL;* *± (0.0364 + 0.003776 * URL/span) % of the span, for 0.025 URL ≤ span ≤ 0.16 URL;* *± (0.00024 + 0.00468 * URL/span) % of the span, for 0.005 URL ≤ span ≤ 0.025 URL* **For range 5 and gage or high static pressure or any sanitary model:** *± (0.065) % of the span, for 0.16 URL ≤ span ≤ URL* *± (0.0326 + 0.005184 * URL/span) % of the span, for 0.025 URL ≤ span ≤ 0.16 URL;* *± (0.00636 + 0.00584 * URL/span) % of the span, for 0.00833 URL ≤ span ≤ 0.025 URL* **For range 6 and gage model:** *± (0.08) % of the span, for 0.16 URL ≤ span ≤ URL* *± (0.0504 + 0.004736 * URL/span) % of the span, for 0.025 URL ≤ span ≤ 0.16 URL;* *± (0.00304 + 0.00592 * URL/span) % of the span, for 0.00833 URL ≤ span ≤ 0.025 URL* **For range 1 and absolute model:** ***± [0.0667 + 0.0333 URL/span] % span*** **For range 2 and absolute model:** *± (0.08) % of the span, for 0.16 URL ≤ span ≤ URL;* *± (0.0482 + 0.005088 * URL/span) % of the span, for 0.05 URL ≤ span ≤ 0.16 URL* **For range 3 or 4 and absolute model:** *± (0.065) % of the span, for 0.16 URL ≤ span ≤ URL;* *± (0.0326 + 0.005184 * URL/span) % of the span, for 0.025 URL ≤ span ≤ 0.16 URL;* *± (0.00636 + 0.00584 * URL/span) % of the span, for 0.00833 URL ≤ span ≤ 0.025 URL* **For range 5 and absolute model:** *± (0.075) % of the span, for 0.16 URL ≤ span ≤ URL;* *± (0.0443 + 0.004912 * URL/span) % of the span, for 0.025 URL ≤ span ≤ 0.16 URL* *± (0.00406 + 0.005918 * URL/span) % of the span, for 0.00833 URL ≤ span ≤ 0.025 URL* **For range 6 and absolute model or for range 2, 3, 4 or 5 and level model:** *± (0.08) % of the span, for 0.16 URL ≤ span ≤ URL;* *± (0.0504 + 0.004736 * URL/span) % of the span, for 0.025 URL ≤ span ≤ 0.16 URL;* *± (0.00616 + 0.005842 * URL/span) % of the span, for 0.00833 URL ≤ span ≤ 0.025 URL* **Performance High Class:** **For range 0 and gage or differential model:** *± (0.06) % of the span, for 0.16 URL ≤ span ≤ URL;* *± (0.0145 + 0.00728 * URL/span) % of the span, for 0.05 URL ≤ span ≤ 0.16 URL* **For range 1 and differential or gage model:** *± (0.05) % of the span, for 0.16 URL ≤ span ≤ URL;* *± (0.0264 + 0.003776 * URL/span) % of the span, for 0.025 URL ≤ span ≤ 0.16 URL*

Accuracy	**For range 2, 3 or 4 and differential, high static pressure or gage models:** *± (0.045) % of the span, for 0.16 URL ≤ span ≤ URL;* *± (0.021 + 0.00384 * URL/span) % of the span, for 0.025 URL ≤ span ≤ 0.16 URL;* *± (0.0002 + 0.00436 * URL/span) % of the span, for 0.005 URL ≤ span ≤ 0.025 URL* **For range 5 and gage or high static pressure:** *± (0.055) % of the span, for 0.16 URL ≤ span ≤ URL* *± (0.0257 + 0.004688 * URL/span) % of the span, for 0.025 URL ≤ span ≤ 0.16 URL;* *± (0.00466 + 0.005214 * URL/span) % of the span, for 0.00833 URL ≤ span ≤ 0.025 URL* **For range 6 and gage model:** *± (0.075) % of the span, for 0.16 URL ≤ span ≤ URL* *± (0.0454 + 0.004736 * URL/span) % of the span, for 0.025 URL ≤ span ≤ 0.16 URL;* *± (0.00316 + 0.005792 * URL/span) % of the span, for 0.00833 URL ≤ span ≤ 0.025 URL*
Stability	**For ranges 2, 3, 4, 5 or 6:** **Performance High Class:** ± 0.2% do URL per 12 years **Standard Class:** ± 0.15% URL per 7 years At 20 ºC temperature change and up to 7 MPa (1000 psi) of static pressure. **For range 1:** **Performance High Class:** ± 0.3% do URL per 12 years **Standard Class:** ± 0.3% do URL per 7 years At 20 ºC temperature change and up to 3.5 MPa (500 psi) of static pressure. **For range 0:** **Performance High Class:** ± 0.4% do URL per 12 years **Standard Class:** ± 0.4% do URL per 7 years At 20 ºC temperature change and up to 100 kPa (14.5 psi) of static pressure. **Note**: Installation complying with the best process practices and adequacy may be generated (hydrogen migration).
Temperature Effect	**For any model range 2, 3, 4, 5 or 6, except level or sanitary models:** ***± (0.0795 + 0.0205 * URL/span) % of the span, per 20 °C for 0.1 URL ≤ span ≤ URL;*** ***± (0.0345 + 0.025 * URL/span) % of the span, per 20 °C for span ≤ 0.1 URL*** **For any model range 1:** ***± (0.08 + 0.05 * URL/span) % of the span, per 20 °C for 0.1 URL ≤ span ≤ URL;*** ***± (0.06 + 0.052 * URL/span) % of the span, per 20 °C for span ≤ 0.1 UR*** **For any model range 0:** ***± (0.1 + 0.1 * URL/span) % of the span, per 20 °C for 0.1 URL ≤ span ≤ URL;*** ***± (0.05 + 0.105 * URL/span) % of the span, per 20 °C for span ≤ 0.1 URL*** **For any level or sanitary model:** 6 mmH_2O per 20 ºC for flange 4" and DN100 17 mmH_2O per 20 ºC for flange 3" and DN80 Consult for other flange dimensions and fill fluid.
Static Pressure Effect	**Zero Error:** **For ranges 5*:** ± 0.05% URL (± 0.1% for Tantalum diaphragm) per 7 MPa (1000 psi) **For ranges 2, 3 or 4*:** ±0.025% URL (± 0.1% for Tantalum diaphragm) per 7 MPa (1000 psi) **For range 1:** ± 0.05% URL per 1.7 MPa (250 psi) **For range 0:** ± 0.1% URL por 0.5 MPa (73 psi) **For any level or sanitary models:** ± 0.1% URL per 3.5 MPa (500 psi) The zero error is a systematic error that can be eliminated by calibrating at the operating static pressure. **Span Error:** **For ranges 2,3,4 ou 5*:** correctable to ± 0.1% of reading per 7MPa (1000 psi) **For range 1:** correctable to ± 0.1% of reading per 1.7 MPa (250 psi) **For range 0:** correctable to ± 0.2% of reading per 0.5 MPa (72 psi) **For level or sanitary models:** correctable to ± 0.1% of reading per 3.5 MPa (500 psi) * Except level or sanitary model.
Power Supply Effect	± 0.005% of calibrated span per volt.

Mounting Position Effect	Zero shift of up to 250 Pa (1 inH_2O) which can be calibrated out. No span effect.
Electromagnetic Interference Effect	Approved according to IEC61326-1:2006, IEC61326-2-3:2006, IEC61000-6-4:2006, IEC61000-6-2:2005.
Vibration Effect	All models: URL ±0.1% in plants with high vibration levels or piping with too much vibration, according to the following specification by IEC 60770-1: 10-60 Hz, 0.21 mm peak displacement standard / 60-2000 Hz, 29.4 m/s^2 acceleration.

NOTE
URL = Upper Range Limit LRL = Low Range Limit

Physical Specifications

Electrical Connection	½ - 14 NPT ¾ - 14 NPT (with 316 SST adapter for 1/2 - 14 NPT) ¾ - 14 BSP (with 316 SST adapter for 1/2 - 14 NPT)	½ - 14 BSP (with 316 SST adapter for 1/2 - 14 NPT) M20 X 1.5 PG 13.5 DIN
Process Connection	¼ - 18 NPT or ½ -14 NPT (with adapter). For level models or more information, see Ordering Code.	
Wetted Parts	**Sensor Isolating Diaphragms:** 316L SST, Hastelloy C276, Monel 400 or Tantalum **Drain/Vent Valves and Plugs 1/4NPT:** 316 SST, Hastelloy C276 or Monel 400 **Drain / Vent Valves and 1/4 NPT Plug:** 316L SST, Hastelloy C276, Monel 400 **Transmitter's Flanges (1/4 NPT) and 1/2 NPT Adapter:** Plated Carbon Steel, 316 SST (ASTM - A351-CF-8M), Hastelloy C276 ASTM – A494 CW-12MW) or Monel 400 **Wetted O-Rings (For Flanges and Adapters):** Nitrile, Viton™ PTFE or Ethylene-Propylene. **Level Flanges (LD400L – ASME / DIN / JIS)** 316L SST; 304L SST; Hastelloy C-276; Duplex UNS S31803 / S32205; Super Duplex UNS S32750 / S32760 **Flanges Isolating Diaphragms** 316L SST; 304L SST; Hastelloy C-276; Super Duplex UNS S32750 / S32760; 316L SST with Halar coating; 316L SST gold plated; Monel gold plated **Flange's Gaskets** PTFE; Grafoil **Sanitary connections** 316L SST (without extension) 316L SST; Hastelloy C-276 (extension end of connection) **Sanitary Diaphragms** 316L SST; Hastelloy C-276 **Sanitary connections - Sealing rings** Nitrile; PTFE; Viton	
Nonwetted Parts	**Electronic Housing:** aluminum or 316 SST with polyester or epoxy painting or 316 SST without painting housing. Complies with NEMA 4X/6P, IP66 or IP66W*, IP68 or IP68W*. **The IP68 sealing test (immersion) was performed at 10m for 24 hours.* *The W condition or 4X was tested for 200h and refer to saline atmosphere.* **Absolute/Gage Flange; reduced volume flange and Plug Flange**316 SST - CF8M (ASTM - A351) **Fill Fluid:** Silicone, Fluorolube, Krytox, Halocarbon 4.2 or Fomblim oils **O-Rings (cover/housing and sensor/housing)** Nitrile	

Nonwetted Parts	**Mounting Bracket:** Plated carbon steel or 316 SST Accessories (bolts, nuts, washers and U-clamps) in plated carbon steel or 316 SST **Transmitter Flange Bolts and Nuts:** Plated carbon steel, Grade 8 or 316 SST For NACE applications: carbon steel ASTM A193 B7M; SST 17-4PH; Hastelloy; Super duplex **Identification Plate:** 316 SST The **LD400** is available in NACE MR-01-75/ISO 15156 compliant materials.
Mounting	a) Flange mounted for Level models. b) Optional universal mounting bracket for surface or vertical/horizontal 2"- pipe (DN 50). c) Manifold Valve integrated to the transmitter. d) Directly on piping for closely coupled transmitter/orifice flange combinations.
Approximate Weights	3.15 kg (7 lb): all models, except L models.4,6 to 23,5 kg (10 lb to 52 lb): L models depending of diameter; class and material flanges and extension.
Control Functions Characteristics (Optional)	Control Block (PID) and Totalization (TOT). *NOTE: The PID block isn´t available for use in SIS Mode.*

Ordering Code

MODEL	DIFFERENTIAL PRESSURE, FLOW, GAGE, ABSOLUTE AND HIGH STATIC PRESSURE TRANSMITTER
LD400	Smart Pressure Transmitter

COD	Type	RANGE LIMITS						Turn Down
		Min.	Max.	Unit	Min.	Max.	Unit	Max.
D0	Differential **(23)**	-1	1	kPa	-10	10	mbar	20
D1	Differential and Flow	-5	5	kPa	-50	50	mbar	40
D2	Differential and Flow	-50	50	kPa	-500	500	mbar	200
D3	Differential and Flow	-250	250	kPa	-2500	2500	mbar	200
D4	Differential and Flow	-2500	2500	kPa	-25	25	bar	200
M0	Gage	-1	1	kPa	-10	10	mbar	20
M1	Gage	-5	5	kPa	-50	50	mbar	40
M2	Gage	-50	50	kPa	-500	500	mbar	200
M3	Gage	-100	250	kPa	-1000	2500	mbar	200
M4	Gage	-100	2500	kPa	-1	25	bar	200
M5	Gage	-0,1	25	MPa	-1	250	bar	120
M6	Gage	-0,1	40	MPa	-1	400	bar	120
A0	Absolute	0	1	kPa	0	7.5	mmHga	20
A1	Absolute	0	5	kPa	0	37	mmHga	4
A2	Absolute	0	50	kPa	0	500	mbar	20
A3	Absolute	0	250	kPa	0	2500	mbar	120
A4	Absolute	0	2500	kPa	0	25	bar	120
A5	Absolute	0	25	MPa	0	250	bar	120
A6	Absolute	0	40	MPa	0	400	bar	120
H2	Differential – High Static Pressure	-50	50	kPa	-500	500	mbar	120
H3	Differential – High Static Pressure	-250	250	kPa	-2500	2500	mbar	120
H4	Differential – High Static Pressure	-2500	2500	kPa	-25	25	bar	120
H5	Differential – High Static Pressure	-25	25	MPa	-250	-250	bar	120

NOTE: The range can be extended up to 0.75 LRL* and 1.2 URL* with small degradation of accuracy.

*LRL = Lower Range Limit.
*URL = Upper Range Limit

Due to differences in **mechanical** project, A1 range has turn-down lower than A0 range.

COD	Diaphragm Material and Fill Fluid		COD		
1	316L SST	Silicone Oil **(9)**	M	Monel 400 Gold Plated	Silicone Oil **(1) (3) (9)**
2	316L SST	Inert (Fluorolube Oil) **(2) (19)**	P	Monel 400 Gold Plated	Inert (Krytox Oil) **(1) (3) (19)**
3	Hastelloy C276	Silicone Oil **(1) (9)**	Q	316 L SST	Inert (Halocarbon 4.2 Oil) **(19)**
4	Hastelloy C276	Inert (Fluorolube Oil) **(1) (2) (19)**	R	Hastelloy C276	Inert (Halocarbon 4.2 Oil) **(19)**
5	Monel 400	Silicone Oil **(1)(3)(9)**	S	Tantalum	Inert (Halocarbon 4.2 Oil) **(3) (19)**
7	Tantalum	Silicone Oil **(3) (9)**	I	316L SST, L.I. Gold Plated	Silicone Oil **(3) (9) (18)**
8	Tantalum	Inert (Fluorolube Oil) **(2) (3) (19)**	J	316L SST, L.I. Gold Plated	Inert (Fluorolube Oil) **(3) (4) (18) (19)**
9	316L SST	Fomblim Oil (12)	L	316L SST, L.I. Gold Plated	Inert (Krytox Oil) **(3) (18) (19)**
A	Monel 400	Fomblim Oil **(1) (3)**	T	316L SST, L.I. Gold Plated	Inert (Halocarbon 4.2 Oil) **(3) (18) (19)**
D	316 L SST	Inert (Krytox Oil) **(12) (19)**	U	316L SST, L.I.	Silicone Oil **(3) (9) (18)**
E	Hastelloy C276	Inert (Krytox Oil) **(1) (12) (19)**	V	316L SST, L.I.	Inert (Fluorolube Oil) **(3) (4) (18) (19)**
G	Tantalum	Inert (Krytox Oil) **(3) (19)**	W	316L SST, L.I.	Inert (Krytox Oil) **(3) (18) (19)**
K	Monel 400	Inert (Krytox Oil) **(1) (3) (19)**	X	316L SST, L.I.	Inert (Halocarbon 4.2 Oil) **(3) (18) (19)**
				Note: L.I. = integral sheet	

COD	Performance Class
0	Default
1	High Performance **(14)**

COD	Communication Protocol
H	HART® and 4 to 20 mA

COD	Security Option
0	Default– For use in measurement and control
1	SIS - Safety Instrumented Systems **(24)**

COD	Flange(s), Adapter(s) and Drain/Vent Valves Material
0	Without Flanges, Adapters and Drain/Vent Valves
P	Carbon Steel with superficial treatment (Stainless Steel Purge) **(20)**
H	Hastelloy C276 (CW-12MW, ASTM - A494) **(1)**
I	316 SST - CF8M (ASTM A351)
F	Monel 400 - Laminated bar (for HF application) **(1)**
M	Monel 400 - Micro-casting **(1)**
1	316 SST - CF8M (ASTM A351) (Drain/Vent in Hastelloy C276) **(1)**
2	316 SST - CF8M (ASTM A351) Flange with PVDF (Kynar) Insert **(5) (7) (11)**
3	316 SST – CF8M (Drain/Vent and Plug in Monel) NACE Standard

COD	O´Ring Material	COD	
0	Without O´Ring	K	Kalrez **(3)**
B	Buna-N	T	Teflon
E	Etileno-Propileno	V	Viton

Note: O´Rings are not available on the side with Remote Seals.

COD	Drain/Vent Position
0	Without Drain/Vent
A	Drain/Vent (Opposite to Process Connection)
D	Bottom
U	Top

Note: For better drain/vent operation, vent valves are strongly recommended.
Drain/Vent valve are not available on the sides with remote seals.

COD	Process Connections
0	1/4 - 18 NPT (Without Adapter)
1	1/2- 14 NPT (With Adapter)
2	CF 16 (Without Adapter)
3	Remote Seal (With Plug) **(3) (8)**
5	1/2 - 14 NPT Axial (with PVDF Insert PVDF) **(5) (7) (16)**
9	Remote Seal (Low Volume Flange) **(3) (4) (8)**
B	High Side: 1/2 - 14 NPT Low Side: Remote Seal (With Plug) **(3) (10)**
D	High Side: Remote Seal (With Plug) and Low Side: 1/2 14 NPT **(3) (10)**
F	High Side: 1/2 - 14 NPT and Low Side: Low volume flange for remote seal **(3) (10)**
H	High Side: Low volume flange for remote seal and Low Side: 1/2 - 14 NPT **(3) (10)**
Q	8mm hole without thread. According to DIN 19213 **(13)**
T	1/2 - 14 BSP (With Adapter)
V	Manifold Valve Integrated to the Transmitter
Z	User's specification

COD	Special Applications
0	Without special cleaning
1	Degrease Cleaning (Oxygen or Chlorine Service) **(15)**

LD400	-	D2	1	0	-	H	0	-	I	B	D	1	1

CONTINUE IN THE NEXT PAGE

LD400-D210-H0-IBD11	DIFFERENTIAL PRESSURE, FLOW, GAGE, ABSOLUTE AND HIGH STATIC PRESSURE TRANSMITTER (CONTINUATION)

Flanges Bolts and Nuts Material

COD	Flanges Bolts and Nuts Material
P	Plated Carbon Steel (Default) **(20)**
I	316 SST
C	Carbon Steel (ASTM A193 B7M) (**1**) **(20)**
H	Hastelloy C276 **(1a)**
A	Super Duplex Stainless Steel NACE MR0175 / MR0103 Compliant **(1a)**

COD	Flange thread for fixing accessories (adapters, manifolds, mounting brackets, etc)
0	7/16 UNF
1	M10 X 1.5
2	M12 X 1.75

COD	Local Indication
0	Without Indicator
1	With Digital Indicator

COD	Electrical Connections
0	1/2 - 14 NPT **(22)**
1	3/4- 14 NPT (with 316 SST adapter for 1/2 - 14 NPT) **(22)**
2	3/4- 14 BSP (with 316 SST adapter for 1/2 - 14 NPT) **(6)**
3	1/2 - 14 BSP (with 316 SST adapter for 1/2 - 14 NPT) **(6)**
A	M20 X 1.5 **(22)**
B	PG 13.5 DIN **(22)**
Z	User's specification

COD	Blanket Plug
I	316 SST
C	Carbon Steel (Only available for ½" process connection) **(20)**

COD	Mounting Bracket for 2" Pipe or Surface Mounting
0	Without Bracket
1	Carbon steel bracket and accessories **(20)**
2	316 SST bracket and accessories
5	L type, carbon steel bracket and accessories (**20**)
6	L type, 316 SST bracket and accessories
7	Carbon steel bracket. Accessories: 316 SST (**20**)
9	L Type, carbon steel bracket. Accessories: 316 SST (**20**)
A	Flat, 304 SST bracket and 316 SST accessories
Z	User's specification

COD	Housing Material (25) (26)		
A	Aluminum (Default)	J	316 SST - saline atmospheres **(21)**
I	316 SST – CF8M (ASTM – A351)	B	Aluminum - saline atmospheres **(21)**

COD	Painting
0	Gray Munsell N 6.5 Polyester
8	Without Painting (17)
9	Safety Blue Epoxy – Electrostatic Painting
C	Safety Blue Polyesters – Electrostatic Painting
Z	Special Painting

COD	Certification Type for Hazardous Locations		
N	Without Certification	F	Non-incendive + Intrinsic Safety
I	Intrinsic Safety	G	Explosion Proof + Increased Safety
E	Increased Safety	H	Intrinsic Safety + Explosion Proof + Increased Safety
D	Explosion Proof	J	Non-incendive + Intrinsic Safety + Dust

COD	Identification Plate for Hazardous Locations		
0	Without Certification	5	CEPEL
1	FM (Pending)	7	EXAM
2	NEMKO (ATEX)		

COD	Tag Plate
0	With tag, when specified (Default)
1	Blank
2	User's specification

COD	HART® Configuration
**	

LD400-D210-H0-IBD11	-	P	0	1	-	0	I	1	-	A	0	N	0	0	/	**	TYPICAL MODEL NUMBER

**** Fill out with HART® Optional Configuration (see page 3.14)**

Notes:

(1) Meets NACE MR-0175 / ISO15156 standard.
(1a) Meets NACE MR-0103
(2) Not available for absolute models nor vacuum applications.
(3) Not applicable for ranges 0 and 1.
(4) Not applicable for vacuum service.
(5) Pressure maximum: 24 bar.
(6) Options not certified for use in hazardous locations.
(7) Drain/Vent not applicable.
(8) For Remote Seal only 316 SST CF8M (ASTM A351) flange is available (thread 7/16 UNF).
(9) Silicone Oil is not recommended for Oxygen (O2) or Chlorine service.
(10) Only available for differential pressure transmitter.
(11) O´Ring material must be of Viton or Kalrez.
(12) Not applicable for ranges 0.
(13) Only available for pressure transmitters D4 or H4 and 7/16 UNF or M10 x 1.5 flange thread for fixing accessories.
(14) Only available for **LD400D** and **LD400M**.
(15) Degrease cleaning not available for carbon steel flanges.
(16) Only available for Flange with PVDF (Kynar) Insert.
(17) Not available for aluminum housing.
(18) Effective for hydrogen migration processes.
(19) Inert Fluid: Oxygen Compatibility, safe for oxygen service.
(20) Not applicable for saline atmosphere.
(21) IPW/TYPEX was performed in a saturated solution of NaCl 5% w/w at 35◦C for a time of 200 h.
(22) Certificate for use in Explosion Proof (CEPEL).
(23) The D0 range should not be used for flow measurement.
(24) SIL 1 and SIL 2 (non-redundant) and SIL 3 (redundant) applications.
(25) IPX8 tested in 10 meters of water column for 24 hours.
(26) Ingress Protection:

Product	CEPEL	NEMKO / EXAM	FM
LD400	IP66/68W	IP65/67W	Type4X/6P

MODEL	FLANGED PRESSURE TRANSMITTER
LD400	Smart Pressure Transmitter

COD	TYPE	RANGE LIMIT Min	Max	Unit	Min	Max	Unit	Turn Down Max	
L2	Level	-50	50	kPa	-500	500	mbar	120	The range can be extended up to 0.75 LRL and 1.2 URL with small degradation of accuracy. The upper range value must be limited to the flange rating.
L3	Level	-250	250	kPa	-2500	2500	mbar	120	
L4	Level	-2500	2500	kPa	-25	25	bar	120	
L5	Level	-25	25	MPa	-250	250	bar	120	

COD.	Diaphragm material and Fill Fluid (Low Side)	
1	316L SST	Silicone Oil **(2)**
2	316L SST	Inert (Fluorolube Oil) **(3) (18)**
3	Hastelloy C276	Silicone Oil **(1) (2)**
4	Hastelloy C276	Inert (Fluorolube Oil) **(1) (3) (18)**
5	Monel 400	Silicone Oil **(1) (2)**
7	Tantalum	Silicone Oil **(2)**
8	Tantalum	Inert (Fluorolube Oil) **(3) (18)**
9	316L SST	Fomblim Oil
A	Monel 400	Fomblim Oil **(1)**
D	316 L SST	Inert (Krytox Oil) **(18)**
E	Hastelloy C276	Inert (Krytox Oil) **(1) (18)**
G	Tantalum	Inert (Krytox Oil) **(18)**
K	Monel 400	Inert (Krytox Oil) **(1) (18)**
M	Monel 400 Gold Plated	Silicone Oil **(1) (2)**
P	Monel 400 Gold Plated	Inert (Krytox Oil) **(1) (18)**
Q	316L SST	Inert (Halocarbon 4.2 Oil) **(18)**
R	Hastelloy C276	Inert (Halocarbon 4.2 Oil) **(1) (18)**
S	Tantalum	Inert (Halocarbon 4.2 Oil) **(18)**
I	316L SST, L.I. Gold Plated	Silicone Oil **(2) (17)**
J	316L SST, L.I. Gold Plated	Inert (Fluorolube Oil) **(3) (17) (18)**
L	316L SST, L.I. Gold Plated	Inert (Krytox Oil) (17) **(18)**
T	316L SST, L.I. Gold Plated	Inert (Halocarbon 4.2 Oil) **(17) (18)**
U	316L SST, L.I.	Silicone Oil **(2) (17)**
V	316L SST, L.I.	Inert (Fluorolube Oil) **(3) (17) (18)**
W	316L SST, L.I.	Inert (Krytox Oil) **(17) (18)**
X	316L SST, L.I.	Inert (Halocarbon 4.2 Oil) **(17) (18)**

Note: L.I = Integral Steel

COD.	Performance Class
0	Default

COD.	Communication Protocol
H	HART® and 4 to 20 mA

COD.	Security Option
0	Default- For use in measurement and control
1	SIS - Safety Instrumented Systems **(25)**

COD.	Flange, Adapter and Drain/Vent Valves material
A	304L SST
P	Plated CS (Drain/Vent in Stainless Steel) **(19)**
H	Hastelloy C276 (CW-12MW, ASTM - A494) **(1)**
I	316 SST - CF8M (ASTM A351)
F	Monel 400 - Laminated bar (Application in HF)
M	Monel 400 - Micro-casting **(1)**
1	316 SST - CF8M (ASTM A351) (Drain/Vent in Hastelloy C276) **(1)**
2	316 - CF8M (ASTM A351) Flange with PVDF (Kynar) Insert **(3) (4) (5)**

COD.	O'Ring Material
O	Without O´Ring
B	Buna-N
E	Ethylene - Propylene
K	Kalrez
T	Teflon
V	Viton

Note: O'rings are not available on the sides with remote seals.

COD.	Drain/Vent Position (Low Side)
0	Without Drain/Vent
A	Drain/Vent (Opposite to Process connection)
D	Bottom
U	Top

Note: For better Drain/Vent operation, vent valves are strongly recommended. Drain/Vent valve are not available on the sides with remote seals.

COD.	Process Connection (Low Side)
0	1/4 - 18 NPT (Without adapter)
1	1/2- 14 NPT (With adapter)
3	Remote Seal (With Plug) **(7)**
5	1/2- 14 NPT Axial with PVDF Insert **(3) (4) (6)**
9	Remote Seal (Low Volume Flange **(3) (7)**
T	1/2 - 14 BSP (With adapter)
Z	User´s specifications

COD.	Special Applications
0	Without Special Applications
1	Degrease Cleaning (Oxygen or Chlorine Service) **(11)**
2	For vacuum applications

COD.	Flanges Bolts and Nuts Material
P	Plated Carbon Steel (Default) **(19)**
I	316 SST
C	Carbon Steel (ASTM A193 B7M) **(1) (19)**
H	Hastelloy C276
A	Super Duplex Stainless Steel NACE MR0175 / MR0103 Compliant **(1a)**

COD.	Flange thread for fixing accessories (adapters, manifolds, mounting brackets, etc)
0	7/16UNF (Default)
1	M10 X 1.5
2	M12 X 1.75

LD400	-	L2	1	0	-	H	0	-	P	B	D	0	0	-	P	0

CONTINUE IN THE NEXT PAGE

LD400-L210-H0-PBD00-P0	FLANGED PRESSURE TRANSMITTER (CONTINUATION)

COD.	Process Connection (High Side)
U	1" 150 # (ASME B16.5) **(28)**
V	1" 300 # (ASME B16.5) **(28)**
W	1" 600 # (ASME B16.5) **(28)**
O	1 1/2" 150 # (ASME B16.5)
P	1 1/2" 300 # (ASME B16.5)
Q	1 1/2" 600 # (ASME B16.5)
9	2" 150 # (ASME B16.5)
A	2" 300 # (ASME B16.5)
B	2" 600 # (ASME B16.5)
1	3" 150 # (ASME B16.5)
2	3" 300 # (ASME B16.5)
C	3" 600 # (ASME B16.5)
3	4" 150 # (ASME B16.5)
4	4" 300 # (ASME B16.5)
D	4" 600 # (ASME B16.5)
5	DN 25 PN10/40 (DIN EN 1092-1) **(28)**
R	DN 40 PN10/40 (DIN EN 1092-1)
E	DN 50 PN 10/40 (DIN EN 1092-1)
6	DN 80 PN 10/40 (DIN EN 1092-1)
7	DN 100 PN 10/16 (DIN EN 1092-1)
8	DN 100 PN 25/40 (DIN EN 1092-1)
H	10K 100A (JIS 2202) **(22)**
F	10K 50A (JIS B 2220) **(22)**
G	10K 80A (JIS B 2220) **(22)**
S	20K 40A (JIS B 2220) **(22)**
L	20K 80A (JIS B 2220) **(22)**
T	40K 50A (JIS B 2220) **(22)**
Z	User´s specifications

COD.	Type and Flange Material (High Side)				
I	316L SST (Integral Flange)	J	304 SST (Slip-on Flange)	L	Carbon Steel (Slip-on Flange)
H	Hastelloy C276 (Integral Flange)	K	316 SST (Slip-on Flange)	Z	User's specification

COD.	Flange Facing Finish
0	Raised Face – RF (Default))
1	Flat Face – FF **(14)**
2	Ring Joint Face – RTJ (Only available for ASME standard flange) **(13)**

COD.	Extension Length	
0	0 mm (0")	Note: Extension Material 316L SST
1	50 mm (2")	
2	100 mm (4")	
3	150 mm (6")	
4	200 mm (8")	
Z	User´s specifications	

COD.	Diaphragm Material (Tap Level)
A	304L SST
L	316 L SST
H	Hastelloy C276
M	Monel 400
T	Tantalum **(10)**
X	Titanium **(10)**
1	316L SST with Teflon Lining (For 2"and 3")
2	316L SST Gold plated
3	Tantalum with Teflon Lining

COD.	Fill Fluid (Tap Level)
1	Silicone DC-200/20 Oil
2	Inert (Fluorolube MO-10 Oil) **(8) (18)**
3	Silicone DC704 Oil
4	Inert (Krytox Oil) **(18)**
N	Neobee M20 Propylene Glycol Oil
T	Syltherm 800 Oil
Z	User´s specifications

COD.	Local Indicator
0	Without indicator
1	With digital indicator

COD.	Electrical Connection
0	1/2 - 14 NPT **(21)**
1	3/4 – 14 NPT (with 316 SST adapter for ½ - 14 NPT) **(21)**
2	3/4 – 14 BSP (with 316 SST adapter for ½ - 14 NPT) **(9)**
3	1/2 – 14 BSP (with 316 SST adapter for ½ - 14 NPT) **(9)**
A	M20 X 1.5 **(21)**
B	PG 13.5 DIN **(21)**
Z	User´s specifications

COD	Blanket Plug
I	316 SST
C	Carbon Steel **(12) (19)**

LD400-L210-H0-PBD00-P0	1	-	I	0	1	-	L	1	1	0	I

CONTINUE IN THE NEXT PAGE

LD400-L210-H0-PBD00-P01-I01-L110I	FLANGED PRESSURE TRANSMITTER (CONTINUATION)		
COD.	**Housing Material (26) (27)**		
A	Aluminum	J	316 SST - saline atmosphere **(20)**
I	316 SST – CF8M (ASTM – A351)	B	Aluminum - saline atmosphere **(20)**

COD	Painting
0	Gray Munsell N6,5 Polyester
8	Without painting **(16)**
9	Safety Blue Epoxy – Electrostatic Painting
C	Safety Blue Polyesters – Electrostatic Painting
Z	Special Painting

COD	Certification Type for Hazardous Locations		
N	Without certification	F	Non-incendive + Intrinsic Safety
I	Intrinsic Safety	G	Explosion Proof + Increased Safety
E	Increased Safety	H	Intrinsic Safety + Explosion Proof + Increased Safety
D	Explosion Proof	J	Non-incendive + Intrinsic Safety + Dust

COD	Identification Plate for Hazardous Locations		
0	Without certification	5	CEPEL
1	FM (Pending)	7	EXAM
2	NEMKO (ATEX)		

COD.	Tag Plate
0	With TAG, when specified
1	Blanket
2	According to user's notes

COD.	Lower Housing Material		
0	Without Lower Housing **(24)**	3	Super Duplex (UNS 32750) **(23)**
1	Stainless Steel 316	4	Duplex (UNS 31803) **(23)**
2	Hastelloy C276	5	Stainless Steel 304L **(23)**

COD.	Gasket Material
0	Without gasket
T	Teflon (PTFE)
G	Grafoil (Flexible lead)
I	Stainless 316L

COD.	HART® Configuration

LD400-L210-H0-PBD00-P01-I01-L110I	-	A	0	N	0	0	2	T	**

TYPICAL MODEL NUMBER

**** Fill out with HART® Optional Configuration (see page 3.14)**

Notes:

(1) Meets NACE MR – 01 – 75/ISO 15156 recommendations.
(1a) MR103
(2) Silicone Oil is not recommended for Oxygen (O_2) or Chlorine service.
(3) Not applicable for vacuum service.
(4) Drain/Vent not applicable.
(5) O'Ring should be Viton or Kalrez.
(6) Maximum pressure 24 bar.
(7) For Remote Seal only 316SST CF8M (ASTM A351) flange is available (thread 7/16 UNF).
(8) Inert fill fluid (Fluorolube) is not available for Monel diaphragm.
(9) Options not certified for use in hazardous locations.
(10) Attention, check corrosion rate for the process, tantalum plate 0.1 mm, AISI 316L extension 3 to 6 mm.
(11) Degrease cleaning not available for carbon steel flanges.
(12) Only available for electrical connections 1/2".
(13) Only available for ASME B16.5 flange.
(14) Don´t available for JIS B 2220.
(15) For this option consult Smar.
(16) Don´t available for aluminum housing.
(17) Effective for hydrogen migration processes.
(18) Inert Fluid: Oxygen Compatibility, safe for oxygen service.
(19) Not applicable for saline atmosphere.
(20) IPW/TYPEX was performed in a saturated solution of NaCl 5% w/w at 35◦C for a time of 200 hours.
(21) Certificate for use in Explosion Proof (CEPEL).
(23) Item by inquiry.
(24) Supplied without Gasket.
(25) SIL 1 and SIL 2 (non-redundant) and SIL 3 (redundant) applications.
(26) IPX8 tested in 10 meters of water column for 24 hours.
(27) Ingress Protection:

Product	CEPEL	NEMKO / EXAM	FM
LD400	IP66/68W	IP66/68W	Type4X/6P

MODEL	SANITARY PRESSURE TRANSMITTER
LD400	Smart Pressure Transmitter

COD	TYPE	RANGE LIMIT Min	Max	Unit	Min	Max	Unit	Turn Down Max
S2	Sanitary	-50	50	kPa	-500	500	mbar	200
S3	Sanitary	-250	250	kPa	-2500	2500	mbar	200
S4	Sanitary	-2500	2500	kPa	-25	25	bar	200
S5	Sanitary	-25	25	MPa	-250	250	bar	120

Note: The range can be extended up to 0.75 LRL and 1.2 URL with small degradation of accuracy. The upper range value must be limited to the flange rating.

COD.	Diaphragm material and Fill Fluid (Low Side)	
1	316L SST	Silicone Oil **(2)**
2	316L SST	Inert (Fluorolube Oil) **(3) (16)**
3	Hastelloy C276	Silicone Oil **(1) (2)**
4	Hastelloy C276	Inert (Fluorolube Oil) **(1) (3) (16)**

COD.	Performance Class
0	Default

COD.	Communication Protocol
H	HART® and 4 to 20 mA

COD.	Security Option
0	Default – For use in measurement and control
1	SIS - Safety Instrumented Systems **(20)**

COD.	Flange, Adapter and Drain/Vent Valves material (Low Side)
H	Hastelloy C276 (CW-12MW, ASTM - A494)

COD.	O´Ring Material
O	Without O´Ring
B	Buna-N
E	Ethylene – Propylene
K	Kalrez
T	Teflon
V	Viton

Note: O'rings is not available on the sides with remote seals.

COD.	Drain/Vent Position (Low Side)
0	Without drain/vent
A	Drain/Vent (Opposite to Process Connection)
D	Bottom
U	Top

Note: For better Drain/Vent operation, vent valves are strongly recommended.
Drain/Vent valve are not available on the sides with remote seals.

COD.	Process Connection (Low Side)
0	1/4 - 18 NPT (Without adapter)
1	1/2 - 14 NPT (With adapter)
3	Remote Seal (With Plug) **(7)**
9	Remote Seal (Low Volume Flange) **(3) (7)**
T	1/2 – 14 BSP (With adapter)
Z	User´s specifications

COD.	Special Applications
0	Without special cleaning
1	Degrease Cleaning (Oxygen or Chlorine Service) **(11)**
2	For application in vacuum

COD.	Flanges Bolts and Nuts Material
P	Plated Carbon Steel (Default) **(19)**
I	316 SST
C	Carbon Steel (ASTM A193 B7M) **(1) (19)**
H	Hastelloy C276
A	Super Duplex Stainless Steel NACE MR0175 / MR0103 Compliant **(1a)**

COD.	Flange thread for fixing accessories (adapters, manifolds, mounting brackets, etc)
0	7/16UNF
1	M10 X 1.5
2	M12 X 1.75

LD400	-	S2	1	0	-	H	0	-	H	B	D	U	0	-	P	0

CONTINUE IN THE NEXT PAGE

LD400-S210-H0-HBDU0-P0 | **SANITARY PRESSURE TRANSMITTER (CONTINUATION)**

COD.	Process Connection (High Side)
8	THREAD DN25 DIN 11851 – WITH EXTENSION/316 SST
9	THREAD DN40 DIN 11851 - WITH EXTENSION/316 SST
H	THREAD DN40 DIN 11851 – WITH EXTENSION/316 SST
V	THREAD DN50 DIN 11851 - WITH EXTENSION/316 SST
U	THREAD DN50 DIN 11851 - WITHOUT EXTENSION/316 SST
X	THREAD DN80 DIN 11851 - WITH EXTENSION/316 SST
W	THREAD DN80 DIN 11851 - WITHOUT EXTENSION/316 SST
4	THREAD IDF 2" - WITH EXTENSION/316 SST
B	THREAD IDF 2" - WITH EXTENSION/316 SST
K	THREAD IDF 3" - WITH EXTENSION/316 SST
3	THREAD IDF 3" - WITHOUT EXTENSION/316 SST
5	THREAD RJT 2" - - WITH EXTENSION/316 SST
C	THREAD RJT 2" - WITH EXTENSION/316 SST
L	THREAD RJT 3" - WITH EXTENSION/316 SST
2	THREAD RJT 3" - WITHOUT EXTENSION/316 SST
S	THREAD SMS 1 1/2" - WITH EXTENSION/316 SST
7	THREAD SMS 2" - - WITH EXTENSION/316 SST
E	THREAD SMS 2" - WITH EXTENSION/316 SST
M	THREAD SMS 3" - - WITH EXTENSION/316 SST
1	THREAD SMS 3" - - WITHOUT EXTENSION/316 SST
F	TRI CLAMP 1 1/2" - WITH EXTENSION/316 SST
Q	TRI CLAMP 1 1/2" HP (High Pressure) - 316 SST
6	TRI CLAMP 2" - - WITH EXTENSION/316 SST
D	TRI CLAMP 2" - WITH EXTENSION/316 SST
N	TRI CLAMP 2" HP (High Pressure) - - WITH EXTENSION/316 SST
P	TRI CLAMP 2" HP (High Pressure) - 316 SST
I	TRI CLAMP 3" - - WITH EXTENSION/316 SST
G	TRI CLAMP 3" - WITH EXTENSION/316 SST
J	TRI CLAMP 3" HP (High Pressure) - - WITH EXTENSION/316 SST
R	TRI CLAMP 3" HP (High Pressure) - WITH EXTENSION/316 SST
A	TRI CLAMP DN50 - - WITH EXTENSION/316 SST
O	TRI CLAMP DN50 HP (High Pressure) - - WITH EXTENSION/316 SST
T	TRI-CLAMP DN50 - WITH EXTENSION/316 SST
Z	User´s specifications

COD.	O´Ring Material (High Side)
0	Without O´Ring ((Client supplied)
B	Buna-N
K	Kalrez
T	Teflon
V	Viton
Z	User´s specifications

COD.	Tank Adapter
0	Without adapter (Client supplied)
1	With tank, 316 SST adapter
Z	User´s specifications

COD.	Clamp TRI-CLAMP
0	Without TRI-CLAMP clamp (Client supplied)
2	With Stainless Steel TRI-CLAMP clamp **(13)**
Z	User´s specifications

COD.	Diaphragm material (High Side)
I	316 L SST
H	Hastelloy C276

COD.	Fill Fluid (High Side)
1	DC – 200/20 Silicone Oil
2	Inert (Fluorolube MO-10 Oil) **(3)**
3	Silicone Oil DC704
4	Inert (Krytox Oil)
N	Neobee M20 Propylene Glycol Oil
T	Syltherm 800 Oil
Z	User´s specifications

COD.	Local Indicator
0	Without indicator
1	With digital indicator

COD.	Electrical Connection
0	1/2 - 14 NPT **(19)**
1	3/4 – 14 NPT (with 316 SST adapter for ½ - 14 NPT) **(19)**
2	3/4 – 14 BSP ((with 316 SST adapter for ½ - 14 NPT) **(9)**
3	1/2 – 14 BSP ((with 316 SST adapter for ½ - 14 NPT) **(9)**
A	M20 X 1.5 **(19)**
B	PG 13.5 DIN **(19)**
Z	User´s specifications

COD.	Blanket Plug
I	316 SST
C	Carbon Steel **(12) (17)**

LD400-S210-H0-HBDU0-P0	4	-	B	1	0	-	I	1	1	0	I

CONTINUE IN THE NEXT PAGE

LD400-S210-H0-HBDU0-P04-B10-I110I	SANITARY PRESSURE TRANSMITTER (CONTINUATION)		
COD	**Housing Material (22) (23)**		
A	Aluminum (IP/TYPE)	J	316 SST - saline atmospheres (IPW/TYPEX) **(18)**
I	316 SST – CF8M (ASTM – A351) (IP/TYPE)	B	Aluminum - saline atmospheres (IPW/TYPEX) **(18)**

COD	Painting
0	Gray Munsell N6,5 Polyester
8	Without painting **(14)**
9	Blue Safety Epoxy – Electrostatic Painting
C	Blue Safety Polyester - Electrostatic Painting
Z	Special Painting

COD	Certification Type for Hazardous Locations		
N	Without Certification	F	Non-incendive + Intrinsic Safety
I	Intrinsic Safety	G	Explosion Proof + Increased Safety
E	Increased Safety	H	Intrinsic Safety + Explosion Proof + Increased Safety
D	Explosion Proof	J	Non-incendive + Intrinsic Safety + Dust

COD	Identification Plate for Hazardous Locations		
0	Without certification	5	CEPEL
1	FM (Pending)	7	EXAM
2	NEMKO (ATEX)		

COD	TAG Plate
0	With TAG, when specified
1	Blanket
2	According to user notes

COD	HART Configuration
**	

LD400-S210-H0-HBDU0-P04-B10-I110I	-	A	0	N	0	0	/	**	**TYPICAL MODEL NUMBER**

**** Fill out with HART® Optional Configuration (see page 3.14)**

Notes:

(1) Meets NACE MR – 01 – 75/ISO 15156 recommendations.
(1a) MR103
(2) Silicone Oil is not recommended for Oxygen (O_2) or Chlorine service.
(3) Not applicable for vacuum service.
(4) Drain/Vent not applicable.
(5) O'Ring should be Viton or Kalrez.
(7) For Remote Seal only 316 SST CF8M (ASTM A351) flange is available (thread 7/16 UNF).
(9) Options not certified for use in hazardous locations.
(10) Not recommended with extension.
(11) Degreaser's cleaning is not available for carbon steel flanges.
(12) Only available for connection process 1/2".
(13) Only available for TRI-CLAMP connections.
(14) Don´t available for housing aluminum.
(15) Effective for hydrogen migration.
(16) Inert Fluid: Oxygen Compatibility, safe for oxygen service.
(17) Not applicable for saline atmosphere.
(18) IPW/TYPEX was performed in a saturated solution of NaCl 5% w/w at 35◦C for a time of 200 h.
(19) Certificate for use in Explosion Proof (CEPEL).
(20) SIL 1 and SIL 2 (non-redundant) and SIL 3 (redundant) applications.
(22) IPX8 tested in 10 meters of water column for 24 hours.
(23) Ingress Protection:

Product	CEPEL	NEMKO / EXAM	FM
LD400	IP66/68W	IP66/68W	Type4X/6P

**HART OPTIONAL CONFIGURATION (1)

LD400-D210-H0-IBD11-P01-0I1-A060
LD400-L210-H0-PBD00-P01-I01-L110I-A060
LD400-S210-H0-HBDU0-P04-B10-I110I-A060 / **MAIN CODE OF HART TRANSMITTER (CONTINUATION)**

COD.	Burn-out
BD	Start Scale (According NAMUR NE43 specifications) (Default)
BU	End Scale (According NAMUR NE43 specifications)

COD.	LCD1 Indication
Y0	LCD1: Percentage (Default)
Y1	LCD1: Current - I (mA)
Y2	LCD1: Pressure (Engineering Unit)
Y3	LCD1: Temperature (Engineering Unit)
YU	LCD1: User´s specifications **(2)**

COD.	LCD2 Indication
Y0	LCD2: Percentage (Default)
Y1	LCD2: Current - I (mA)
Y2	LCD2: Pressure (Engineering Unit)
Y3	LCD2: Temperature (Engineering Unit)
YU	LCD2: User´s specifications **(2)**

COD.	LCD 3 Indication
Y0	LCD3: Percentage (Default)
Y1	LCD3: Current - I (mA)
Y2	LCD3: Pressure (Engineering Unit)
Y3	LCD3: Temperature (Engineering Unit)
YU	LCD3: User´s specifications **(2)**

COD.	PID availability
P0	PID don´t available
P1	Available and disable (Default)
P2	Available and enable

COD.	Transfer Function for Flow Measurement
F0	**Linear** (Default)
F1	**SQRT -** Square Root. Considering the pressure input **X** varying between 0 and 100%, the output will be $10\sqrt{x}$. This function is used in flow measurement with, e.g., orifice or Venturi tube etc**. (3)**
F2	**SQRT**3 -** Square Root of the Third Power; The output will be $0,1\sqrt{X^3}$. This function is used in open channel Flow measurement with weirs or flumes. **(3)**
F3	**SQRT**5** –Square Root of the Fifth Power. The output will be $0,001\sqrt{X^5}$. This function is used in open channel Flow measurement with V-notch weirs. **(3)**
F4	**TABLE** - The output is a curve formed by **16** points. These points may be edited directly on the **XY** Table of **LD400**. For example, it may be used as a camber table for tanks in applications where the tank volume is not linear in relation to the measured pressure. **(3)**
F5	**SQRT & TABLE** - Square root and Table. Same application as square roots, but also allows additional compensation of, e.g., varying Reynolds number. **(3)**
F6	**SQRT**3 & TABLE** - Square Root of the Third Power AND TABLE. **(3)**
F7	**SQRT**5 & TABLE** - Square Root of the Fifth Power AND TABLE. **(3)**
F8	**TABLE & SQRT –** This function provides bidirectional flow measurement (piping flow measurement in both ways). This function is available for version 6.05 or above firmware. **(3)**

COD.	Special Characteristics
M0	Without special characteristics (Default)
M4	Calibration with reading on the top and bottom (Hysteresis)
M5	Calibration with 10 points
M6	Special method of Acquisition disables

COD.	Insulator Kit
K0	Without insulator Kit
K1	With insulator kit **(4)**

COD.	Special Characteristics
ZZ	User´s specifications

LD400-D210-H0-IBD11-P01-0I1-A060	/	BU	Y2	Y3		P2	F1			
LD400-L210-H0-PBD00-P01-I01-L110I-A060	/	BD	Y2	Y3		P2				
LD400-S210-H0-HBDU0-P04-B10-I110I-A060	/	BD	Y2	Y3		P2				

TYPICAL MODEL NUMBER

Notes:
(1) Fill out with optional codes only if different from default.
(2) Limited values to 4 ½ digits; limited units to 12 characters.
(3) Only available for differential, gage, absolute and high static pressure differential models.
(4) Only available for level models.

CONFIGURATION

General

The **LD400 HART®** Intelligent Pressure Transmitter is a digital instrument with the most up-to-date features a measurement device can possibly have. Its digital communication protocol (HART) enables the instrument to be connected to a computer in order to be configured in a very simple and complete way. Such computers connected to the transmitters are called HOST computers. They can either be primary or Secondary Masters. Therefore, even the HART being a master-slave type of protocol, it is possible to work with up to two masters in a bus. The Primary HOST plays the supervisory role and the Secondary HOST plays the Configuration tool role.

The transmitters may be connected in a point-to-point or multidrop type network. In a point-to-point connection, the equipment must be with "0" address so that the output current may be modulated in 4 to 20 mA, as per the measurement. In a multidrop network, if the devices are recognized by their addresses, the transmitters shall be configured with a network address between "1" and "15. In this case, the transmitter output current is kept constant, with a consumption of 4 mA each. If the acknowledgement mechanism is via Tag, the transmitter addresses may be "0" while their output current is still being controlled, even in a multidrop configuration.

In the case of the **LD400 HART®**, which can be configured both as Transmitter and as a Controller; the HART addressing is used as follows:

TRANSMITTER MODE - The "0" address causes the **LD400 HART®** to control its output current and addresses "1" through "15" place the **LD400 HART®** in the multidrop mode, according to the text above.

CONTROLLER MODE - The **LD400 HART®** always controls the output current, in accordance with the value calculated for the Controlled Variable, regardless of its network address.

WARNING
The controller mode is not available for use in SIS mode.

NOTE

In the case of multidrop network configuration for classified areas, the entity parameters allowed for the area shall be strictly observed. Therefore, the following shall be checked:

$$Ca \geq \sum Ci_j + Cc \qquad La \geq \sum Li_j + Lc$$

$$Voc \leq \min\left\lfloor V\max_j \right\rfloor \qquad Isc \leq \min\left\lfloor I\max_j \right\rfloor$$

Where:
Ca, La - Barrier Allowable Capacitance and Inductance;
Ci_j, Li_j - Non protected internal Capacitance/Inductance of transmitter *j (j = up to 15);*
Cc, Lc - Cable capacitance and Inductance;
V_{oc} - Barrier open circuit voltage;
I_{sc} - Barrier short circuit current;
$Vmax_j$ - Maximum allowable voltage to be applied to the instrument *j;*
$Imax_j$ - Maximum allowable current to be applied to the instrument *j.*

The **LD400 HART®** Intelligent Pressure Transmitter includes a very encompassing set of HART Command functions that make it possible to access the functionality of what has been implemented. Such commands comply with the HART protocol specifications, and are grouped as Overall Commands, Common Practice Controls Commands and Specific Commands. A detailed description of such commands may be found in the manual entitled HART® Command Specification – LD400 Intelligent Pressure Transmitter.

Smar has developed the **DEVCOMDROID** (Android DDL Interpreter) software, used with HART interfaces, such as the **HI331** (Bluetooth Interface), in addition to **AssetView** (based on DTM**)** to configure the HART® equipment.

However, the old **PALM** with **HPC301** or **CONF401**, which are obsolete, remains operable even with the latest updates in HART transmitters.

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

It is also compatible to use configurators that support DDL (Device Description Language) or DTM (Device Type Manager).

Configuration Features

By means of the HART configuration tool, the **LD400 HART®** firmware allows the following configuration features to be accessed:

- Transmitter Identification and Manufacturing Data;
- Primary Variable Trim – Pressure;
- Primary Variable Trim – Current;
- Temperature Trim;
- Transmitter Adjustment to the Working Range;
- Engineering Unit Selection;
- Transference Function for Flow rates Measurement;
- Linearization Table;
- Totalizer Configuration;
- PID Controller Configuration and MV% Characterization Table;
- Device Configuration;
- Equipment Maintenance.

The operations, which take place between the configuration tool and the transmitter do not interrupt the Pressure measurement, and do not disturb the output signal. The configuration tool can be connected on the same pair of wires as the 4-20 mA signal, up to 2 km away from the transmitter.

Manufacturing Data and Identification

The following information about the **LD400 HART®** manufacturing and identification data is available:

- **TAG** – 8-byte ASCII character for transmitter identification, coded in 6-byte HART Packed ASCII format;

- **DESCRIPTOR** - 16-byte ASCII character for additional transmitter identification, coded in 12-byte HART Packed ASCII format. May be used to identify service or location.

- **DATE** - The date may be used to identify a relevant date as the last calibration, the next calibration or the installation. The date is presented in the form of bytes where DD = [1,..31], MM = [1..12], AA = [0..255], where the effective year is calculated by [Year = 1900 + AA].

- **MESSAGE** - 32- byte ASCII character for any other information, coded in 24-byte HART Packed ASCII format, such as the name of the person who made the last calibration, some special care to be taken, or if a ladder is needed for accessing.

- **FLANGE TYPE** - Conventional, Coplanar, Remote Seal, Level 3 in # 150, Level 4 in # 150, Level 3 in # 300, Level 4 in # 300, Level DN80 PN10/16, Level DN80 PN25/40, Level DN100 PN10/16, Level DN100 PN25/40, Level 2 in # 150, Level 2 in # 300, Level DN50 PN10/16, Level DN50 PN25/40, None, Unknown and Special.

- **FLANGE MATERIAL** - Carbon Steel, 316 SST, Hastelloy C, Monel, Unknown and Special.

- **O-RING MATERIAL** - PTFE, Viton, Buna-N, Ethyl-prop, None, Unknown and Special.

- **INTEGRAL METER** - Installed, None and Unknown.

- **DRAIN/VENT MATERIAL** - Carbon Steel, 316 SST, Hastelloy C, Monel, None, Unknown and Special.

- **REMOTE SEAL TYPE** - Chemical Tee, Flanged Extended, Pancake, Flanged, Threaded, Sanitary, Sanitary Tank Spud, None, Unknown and Special.

- **REMOTE SEAL FLUID** - Silicone, Syltherm 800, Inert, Glycerin/H20, Prop gly/H20, Neobee-M20, None, Unknown and Special.
- **REMOTE SEAL DIAPHRAGM** - 316L SST, Hastelloy C, Monel, Tantalum, Titanium, None, Unknown and Special.
- **REMOTE SEAL QUANTITY** - One, Two, None, Unknown and Special.
- **SENSOR FLUID*** - Silicone, Inert, Special, Unknown and None.
- **SENSOR ISOLATING DIAPHRAGM*** - 316 SST, Hastelloy C, Monel, Tantalum and Special.
- **SENSOR TYPE*** - It shows the sensor type.
- **SENSOR RANGE*** - It shows the sensor range in user-chosen engineering units. See Configuration Unit.

*These marked items cannot be changed. They come directly from the sensor memory.

Primary Variable Trim – Pressure

Pressure, defined as a Primary Variable, is determined from the sensor readout by means of a conversion method. Such a method uses parameters obtained during the fabrication process. They depend on the electric and mechanical characteristics of the sensor, and on the temperature change to which the sensor is submitted. These parameters are recorded in the sensor's EEPROM memory. When the sensor is connected to the transmitter, such information is made available to the transmitter microprocessor, which sets a relationship between the sensor signal and the measured pressure.

Sometimes, the pressure shown on the transmitter display is different from the applied pressure. This may be due to several reasons, among which the following:

- The transmitter mounting position;
- The user pressure standard differs from the factory standard;
- Sensor original characteristics shifted by overpressure, over temperature or by long-term drift.

NOTE
Some users prefer to use this feature for zero elevation or suppression when the measurement refers to a certain point of the tank or tap (wet leg). Such practice, however, is not recommended when frequent laboratory calibrations are required, because the equipment adjustment refers to a relative measurement, and not to an absolute one, as per a specific pressure standard.

The Pressure Trim, as described on this document, is the method used in order to adjust the measurement both in relation to the applied pressure and the user's pressure standard. The most common discrepancy found in transmitters is usually due to Zero displacement. This may be corrected by means of the zero trim or the lower trim.

There are four types of pressure trim available:

- **LOWER TRIM:** Is used to trim the reading at the lower range. The user informs the transmitter the correct reading for the applied pressure via HART configuration tool.

NOTE
Check on section 1, the note on the influence of the mounting position on the indicator. For better accuracy, the trim adjustment should be made in the lower and upper values of the operation range values.

NOTE
For Absolute Pressure Transmitter is recommended to do Lower Trim, writing the value of pressure, instead of doing the Zero Trim.

- **UPPER TRIM:** Is used to trim the reading at the upper range. The user informs the transmitter the correct reading for the applied pressure via HART configuration tool.

WARNING
The upper pressure trim shall always be applied after the zero trim.

- **ZERO TRIM:** is similar to the LOWER TRIM, but is assumed that the applied pressure is zero. The reading equal to zero must be active when the pressures of differential transmitter cameras are equalized or when a gage transmitter opens to atmosphere. Therefore, the user does not need to enter with any value.

NOTE
The pressure taps on the transmitter must be equalized when zero trim is applied.

- **CHARACTERIZATION:** this is used to correct any possible intrinsic non-linearity to the conversion process. Characterization is done by means of a linearization table, with up to five points. The user shall apply pressure and use the HART configuration tools to inform the pressure value applied to each point of the table. In most cases, characterization is not required, due to the efficiency of the production process. The **LD400 HART®** is fitted with an internal feature to enable or disable the use of the Characterization Table.

WARNING
The characterization trim changes the transmitter characteristics. Read the instructions carefully and make sure that you are working with a pressure standard with 0.03% accuracy or better, otherwise the transmitter accuracy will be seriously affected.

Primary Variable Current Trim

When the microprocessor generates a 0% signal, the Digital to Analog converter and associated electronics are supposed to deliver a 4 mA output. If the signal is 100%, the output should be 20 mA.

There might be differences between the Smar current standards and your current plant Standard. In this case, the Current Trim adjustment shall be done with a precision ammeter as measurement reference.

Two Current Trim types are available:

- **4 mA TRIM:** this is used to adjust the output current value corresponding to 0% of the measurement;

- **20 mA TRIM:** this is used to adjust the output current value corresponding to 100% of the measurement;

The Current Trim shall be carried out as per the following procedure:

- Connect the transmitter to the precision ammeter;
- Select one of the Trim types;
- Wait a while for the current to stabilize and inform the transmitter the current readout of the precision ammeter.

NOTE
The transmitter presents a resolution that makes it possible to control currents as low as microamperes. Therefore, when informing the current readout to the transmitter, it is recommended that data input consider values up to tenths of microamperes.

Temperature Trim

The **LD400 HART®** transmitter monitors the temperature to be measured with the capacitive sensor located near the process plug board. Normally, this temperature is adjusted to the ambient temperature, during manufacturing. Is any deviation on the measuring is recorded; the Temperature Trim is done to correct it. Through a single calibration method, the **LD400 HART®** may adjust temperature Zero as well as Span. Whenever the Temperature Trim is applied at temperature over 20 ºC in relation to the last measuring; the **LD400 HART®** adjusts these two parameters simultaneously.

Transmitter Adjustment to the Working Range

This function directly affects the transmitter 4-20 mA output. It is used to define the transmitter working range; in this document it is referred to as the transmitter calibration. The **LD400 HART®** transmitter includes two calibration features:

- **CALIBRATION WITH REFERENCE:** this is used to adjust the transmitter working range, using a pressure standard as reference;
- **CALIBRATION WITHOUT REFERENCE:** this is used to adjust the transmitter working range, simply by having user-informed limit values.

Both calibration methods define the Working Range Upper and Lower values, in reference to some applied pressure or simply informed by entered values. CALIBRATION WITH REFERENCE differs from the Pressure Trim, since CALIBRATION WITH REFERENCE establishes a relationship between the applied pressure and the 4 to 20 mA signal, and the Pressure Trim is used to correct the measurement.

In the transmitter mode, the Lower Value always corresponds to 4 mA and the Upper Value to 20 mA. In the controller mode, the Lower Value corresponds to PV=0% and the Upper Value to PV=100%.

The calibration process calculates the LOWER and the UPPER values in a completely independent way. The adjustment of values does not affect one another. The following rules shall, however, be observed:

- The Lower and Upper values shall be within the range limited by the Minimum and Maximum Ranges supported by the transmitter. As a tolerance, values exceeding such limits by up to 25% are accepted, although with some accuracy degradation;
- The Working Range Span, determined by the difference between the Upper and Lower Values, shall be greater than the minimum span, defined by [Transmitter Range / (120) for models: D, M, H, A4, A5, and Transmitter Range / (2.5), (25), or (50) for A1, A2, and A3, respectively]. Values up to 0.75 of the minimum span are acceptable with slight accuracy degradation.

NOTE
Should the transmitter operate with a very small span, it will be extremely sensitive to pressure variations. Keep in mind that the gain will be very high and that any pressure change, no matter how small, will be amplified.

If it is necessary to perform a reverse calibration, that is, to work with an UPPER VALUE smaller than the LOWER VALUE, proceed as follows:

- Place the Lower Limit in a value as far as possible from the present Upper Value and from the new adjusted Upper value, observing the minimum span allowed. Adjust the Upper Value at the desired point, and then, adjust the Lower Value.

This type of calibration is intended to prevent the calibration from reaching, at any moment, values not compatible with the range. For example: lower value equals to upper value or separated by a value smaller than the minimum span.

This calibration procedure is also recommended for zero suppression or elevation in those cases where the instrument installation results in a residual measurement in relation to a certain reference. This is the specific case of the wetted tap.

NOTE
In most applications with wetted taps, indication is usually expressed as a percentage. Should readout in engineering units with zero suppression be required, it is recommended to use the User Unit feature for such conversion.

Engineering Unit Selection

Transmitter **LD400 HART®** includes a selection of engineering units to be used in measurement indication.

For pressure measurements, the **LD400 HART®** includes an option list with the most common units.

The internal reference unit is inH_2O @ 20 ºC; should the desired unit be other than this one, it will be automatically converted using conversion factors included in Table 4.1.

As the **LD400 HART®** uses a 4 ½ digit display, the largest indication will be 19999. Therefore, when selecting a unit, make sure that it will not require readouts greater than this limit. For User reference, Table 4.1 presents a list of recommended sensor ranges for each available unit.

CONVERSION FACTOR	ENGINEERING UNITS	RECOMMEND RANGE
1.00000	inH_2O @20 ºC	1, 2, 3 and 4
0.0734241	inHg @ 0 ºC	all
0.0833333	ftH_2O @ 20 ºC	all
25.4000	mmH_2O @ 20 ºC	1 and 2
1.86497	mmHg @ 0 ºC	1, 2, 3 and 4
0.0360625	psi	2, 3, 4, 5 and 6
0.00248642	bar	3, 4, 5 and 6
2.48642	mbar	1, 2, 3 and 4
2.53545	gf/cm^2	1, 2, 3 and 4
0.00253545	kg/cm^2	3, 4, 5 and 6
248.642	Pa	1
0.248642	kPa	1, 2, 3 and 4
1.86947	Torr @ 0 ºC	1, 2, 3 and 4
0.00245391	atm	3, 4, 5 and 6
0.000248642	MPa	4, 5 and 6
0.998205	inH_2O @ 4 ºC	1, 2, 3 and 4
25.3545	mmH_2O @ 4 ºC	1 and 2
0.0254	mH_2O @ 20 ºC	1, 2, 3 and 4
0.0253545	mH_2O @ 4 ºC	1, 2, 3 and 4

Table 4.1 – Available Pressure Units

In applications where the **LD400 HART®** will be used to measure variables other than pressure or in the cases where a relative adjustment has been selected, the new unit may be displayed by means of the User Unit feature. This is the case of measurements such as level, volume, and flow rate or mass flow obtained indirectly from pressure measurements.

The User Unit is calculated adopting the working range limits as a reference, which is, defining a value corresponding to 0% and another corresponding to 100% of the measurement:

- 0% - Desired readout when the pressure is equal to the Lower Value (PV% = 0%, or transmitter mode output equal to 4 mA);
- 100% - Desired readout when the pressure is equal to the Upper Value (PV% = 100%, or transmitter mode output equal to 20 mA).

The user unit may be selected from a list of options included in the **LD400 HART®**. Table 4.2 makes it possible to associate the new measurement to the new unit so that all supervisory systems fitted the HART® protocol can access the special unit included in this table. The user will be responsible for the consistency of such information. The **LD400 HART®** does not verify if the values corresponding to the 0% and 100% inserted by the user are compatible with the selected unit.

VARIABLE	UNIT
Pressure	inH_2O, inHg, ftH_2O, mmH_2O, mmHg, psi, bar, mbar, gf/cm^2, kgf/cm^2, Pascal, Torricelli, atm, Mpa, inH_2O @ 4 ºC, mmH_2O @ 4 ºC, mH_2O @ 4 ºC, mH_2O @ 20 ºC.
Volumetric Flow	ft^3/min, gal/min, Gal/min, m^3/h, gal/s, l/s, Ml/d, ft^3/d, m^3/s, m/d, Ga/h, Ga/d, ft^3/ h, m^3/min, bbl/s, bbl/min, bbl/d, gal/s, l/h, gal/d.
Velocity	ft/s, m/s, m/h.
Volume	gal, litro, Gal, m^3, bbl, bush, Yd^3, $Pé^3$, In^3, hl.
Level	ft, m, in, cm, mm.
Mass	grama, kg, Ton, lb, Sh ton, Lton.
Mass Flow	g/s, g/min, g/h, kg/s, kg/min, kg/h, kg/d, Ton/min, Ton/h, Ton/d, lb/s, lb/min, lb/h, lb/d
Density	SGU, g/m^3, kg/m^3, g/ml, kg/l, Twad, Brix, Baum L, API, % Solw, % Solv, Ball.
Others	CSo, cPo, mA, %.
Special	12 characters. (See section 6)

Table 4.2 – Available User Units

Should a special unit other than those presented on Table 4.2 be required, the **LD400 HART®** allows the user to create a new unit by entering up to 5 alphanumeric digits. The **LD400 HART®** includes an internal feature to enable and disable the User Unit.

Example: transmitter **LD400 HART®** is connected to a horizontal cylindrical tank (6 meters long and 2 meters in diameter), linearized for volume measurement using camber table data in its linearization table. Measurement is done at the high-pressure tap and the transmitter is located 250 mm below the support base. The fluid to be measured is water at 20 °C. Tank volume is: [(π.d2)/4].l = [(π.22)/4]π.6 = 18.85 m^3. The wet tap shall be subtracted from the measured pressure in order to obtain the tank level. Therefore, a calibration without reference shall be carried out, as follows:

In Calibration:
Lower = 250mmH_2O
Superior = 2250 mmH_2O
Pressure unit = mmH_2O

In User Unit:
User Unit 0% = 0
User Unit 100% = 18.85 m^3
User Unit = m^3

When activating the User's Unit, **LD400 HART®** it will start to indicate the new measurement.

Transfer Function for Flow Measurement

The function can be used to convert the measured pressure for others measure unit as flow or volume. The following functions are available:

NOTE
● Use the lowest required damping to prevent measurement delays; ● If the square root extraction for flow measurement is carried out externally by other loop element, do not enable this function on the transmitter.

SQRT - Square Root. Considering the pressure input X varying between 0 and 100%, the output will be $10\ x$. This function is used in flow measurement with, e.g., orifice or Venturi tube etc.

The Square Root has an adjustable cutoff point. Below this point the output is linear, if the cutoff mode is bumpless with the differential pressure as indicated by the Figure 4.4. If the cutoff mode is hard the output will be 0% below the cutoff point. The default value for Cutoff is 6% of ranged pressure input. The maximum value for cutoff is 100%. Cutoff is used to limit the high gain, which results from square root extraction on small values. This gives a more stable reading at low flows.

In order to find the square root, the **LD400 HART®** configurable parameters are: cutoff point defined at a certain pressure expressed as % and the cutoff mode, hard or bumpless.

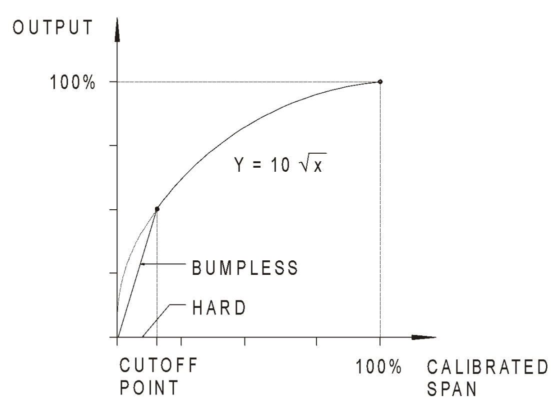


Figure 4.4 – Square Root curve with Cutoff point

NOTE
In bumpless cutoff mode the gain below the cutoff point is given by the equation: $$G = \frac{10}{\sqrt{Cutoff}}$$ For example, at 1% the gain is 10, i.e., a 0.1% error in differential pressure, gives a 1% error in Flow reading. The lower the cutoff, the higher is the gain.

SQRT3 -** Square Root of the Third Power; The output will be $0.1\ x^3$. This function is used in open channel Flow measurement with weirs or flumes.

SQRT5 -** Square Root of the Fifth Power. The output will be $0.001\ x^5$. This function is used in open channel Flow measurement with V-notch weirs. It is possible to combine the previous functions with a table. The flow can be corrected according to the table to compensate, for example, the variation of Reynolds number at the flow measurement.

TABLE - The output is a curve formed by 16 points. These points may be edited directly on the XY Table of the **LD400 HART®**. For example, it may be used as a camber table for tanks in applications here the tank volume is not linear in relation to the measured pressure;

SQRT & TABLE - Square root and Table. Same application as square roots, but also allows additional compensation of, e.g., varying Reynolds number.

SQRT3 & TABLE -** Square Root of the Third Power AND TABLE;

SQRT5 & TABLE -** Square Root of the Fifth Power AND TABLE;

TABLE & SQRT – This function provides bidirectional flow measurement (piping flow measurement in both ways).

The measurement of the bidirectional flow is useful when it is needed to measure the flow in the pipe in both directions. For example, in tank maneuvering there are several pipes where the direction of the fluid may vary. In this case, **LD400 HART®** has the bidirectional flow measurement function. This function treats the flow, no matter what its direction is, as if it were positive. Thus, it is possible to extract the square root and measure the bidirectional flow.

Table Points

If the option TABLE is selected, the output will follow a curve given in the option TABLE POINTS. If the user wants to have your 4-20 mA proportional to the fluid volume or mass inside a tank, he must transform the pressure measurement "X" into volume (or mass) "Y" using the tank strapping table, as the example shown in Table 4.3.

POINTS	LEVEL (PRESSURE)	X	VOLUME	Y
1	-	-10%	-	-0.62%
2	250 mmH_2O	0%	0 m^3	0%
3	450 mmH_2O	10%	0.98 m^3	5.22%
4	750 mmH_2O	25%	2.90 m^3	15.38%
5	957.2 mmH_2O	35.36%	4.71 m^3	25%
6	1050 mmH_2O	40%	7.04 m^3	37.36%
7	1150 mmH_2O	45%	8.23 m^3	43.65%
8	1250 mmH_2O	50%	9.42 m^3	50%
:	:	:	:	:
15	2250 mmH_2O	100%	18.85 m^3	100%
16	-	110%	-	106%

Table 4.3 – Tank Strapping Table

As shown on the previous example, the points may be freely distributed for any desired value of X. In order to achieve a better linearization, the distribution should be concentrated in the less linear parts of the measurement.

The **LD400 HART®** includes an internal feature to enable and disable the Linearization Table.

Totalization Configuration

When the **LD400 HART®** works in flow applications it is often desirable to totalize the flow in order to know the accumulated volume or mass that has flown through the pipe/channel.

The totalizer integrates PV% over time:

The totalizer integrates the PV% along time, working with a time scheduling based on seconds, as per the following:

$$TOT = \int \frac{Maximum\_Flowrate}{Totalization\_Increment} \times PV\%dt$$

The method uses such totalization and, through three parameters (MAXIMUM FLOWRATE, TOTAL INCREMENT and TOTAL UNIT), converts it to the user-defined totalizing unit:

- **MAXIMUM FLOW RATE -** this is the maximum flow rate expressed in volume or mass units per second, corresponding to the measurement (PV%=100%). For example: m3/s, bbl/s, kg/s, lb/s;
- **TOTALIZATION INCREMENT -** this is used to convert the flow rate base unit into a multiple unit of mass or volume. For example, a flow rate totalized in gallons/s may be converted to a volume in m3; a mass flow rate of g/s may be converted to kilos, etc.
- **TOTALIZATION UNIT -** this is the engineering unit. It shall be associated to the totalized value. It may be a standard unit or a special unit with up to five characters.

WARNING
To configure any these parameters, the totalizer should be disable.

The largest totalized value is 9.999.999 totalizing units, in integer format, without decimal digits. When the totalization is displayed, the most significant part is shown on the numeric field, and the less significant part is shown on the alphanumeric field. Figure 4.5 shows a typical display indication.

NOTE
F(t) indication is activated every time the totalized value is shown on the digital display.

Figure 4.5 – Typical Monitoring Mode Display Showing the Total, in this case 9.670.823

The following services are associated with the Totalizer:

- **INITIALIZATION -** Totalization is reinitialized from value "0";
- **ENABLING/DISABLING -** this allows the totalization function to be enabled or disabled.

WARNING
The total value is not lost with power drop.

Example: A differential pressure of 0 - 20 inH_2O represents a flow of 0 - 6800 dm^3/minute.
In CONF set Lower = 0 inH_2O and Upper = 20 inH_2O.

In order to adjust the MAX._FLOW, the maximum flow must be converted to cubic decimeters per second: 6800 / 60 = 113.3 dm^3 /s.

The selection of the totalization unit (U_TOTAL) is made in function of the maximum flow and the minimum time allowable for the counter overrun, i.e., the time required for the totalization to reach 99.999.999.

In the example, if U_TOTAL = 1, the totalization increment is 1 dm^3. The time required for the overrun with maximum flow is 245 hours, 10 minutes and 12.5 seconds.

On the other hand, in case a TOTALIZATION INCREMENT equal to 10 is used, the totalized unit will be deciliter (dal) and the totalizer will receive one increment at every 10 dm^3. Considering the maximum flow rate (113.3 dm^3/s), the totalizer will reach its maximum value and return to zero in10 days, 5 hours, 10 minutes e 12.5 seconds.

PID Controller Configuration

The **LD400 HART®** may be factory -configured to work as Transmitter only or as Transmitter / Controller. In case the **LD400 HART®** is configured as a Transmitter / Controller, the end user may change its operation mode at any time simply by configuring an internal status variable.

The LD400 HART SIS does not support PID Controller configuration.

As a PID Controller, the **LD400 HART®** may run a PID type control algorithm, where its 4 to 20 mA will represent the status of the Manipulated variable (MV). In such a mode, output is 4 mA when the MV = 0% and 20 mA when MV = 100%.

The PID implementation algorithm is:

$$MV = Kp\,(e + 1/Tr \int e\,dt + Td\,dPV/dt)$$

Where:
e(t) = PV-SP (direct) SP-PV (reverse)
SP = Setpoint
PV = Process Variable (Pressure, Level, Flow, etc.)
Kp = Proportional Gain
Tr = Integration Time
Td = Derivative Time
MV = Manipulated Variable (output)

The three configuration groups below are pertinent to the PID controller:

SAFETY LIMITS - this group enables the configuration of: Safety Output, Output Rate and Output Lower and Upper Limits.

The **Safety Output** defines the value of the output in the case of equipment failure.

Output Rate is the maximum variation Rate allowed for the output, expressed in %/s.

The **Lower** and **Upper Limits** define the output range.

TUNING - this group enables the PID tuning to be performed. The following parameters may be adjusted: Kp, Tr and Td.

Parameter Kp is the proportional gain (not the proportional band) that controls the PID proportional action. It may be adjusted from 0 to 100.

Parameter Tr is the integral time that controls the PID integral action. It may be adjusted from 0 to 999 minutes per repetition.

Parameter Td is the derivative time controlling the PID derivative action. It may be adjusted from 0 to 999 seconds.

NOTE
All these parameters accept zero as input. Such value simply nullifies the corresponding PID control actions.

OPERATION MODES - this group enables the configuration of: Control Action, Setpoint Tracking and Power On.
The Control Action Mode enables the selection of the desired output action: direct or reverse. In direct action, a PV increase causes an output increase; in reverse action, a PV increase causes an output

decrease.

When the Setpoint Tracking mode is enabled, it is possible for the Setpoint to follow the PV while in Manual Control. Thus, when control passes to Auto, the Setpoint value will be that of the last PV prior to the switching.

When the PID is enabled, the Power On mode allows the adjustment of the mode in which the PID controls shall return after a power failure: Manual mode, Automatic mode or the last mode prior to the power failure.

TABLE – If the table option is selected, the MV output will follow a curve according to the values typed in the **LD400 HART®** characterization table. The points can freely be configured as percentage values. For a better linearization, it is recommendable that the points are the closest possible, in the less linear regions of the curve. The **LD400 HART®** has an internal variable to enable and disable the characterization table of the MV output of the PID.

Equipment Configuration

The **LD400 HART®** enables the configuration not only of its operational services, but of the instrument itself. This group includes services related to: Input Filter, Burnout, Addressing, Display Indication and Passwords.

- **INPUT FILTER** - The Input Filter, also referenced to as damping, is a first order digital filter implemented by the firmware. User configurable from any value higher than zero seconds in addition to intrinsic sensor response time (0.2 s) (via digital communication). The transmitter mechanical damping is 0.2 seconds.

- **BURN OUT** - The output current may be programmed to go to the maximum limit of 21 mA (Full Scale) or to the minimum limit of 3.6 mA in case of transmitter failure. Configuring the BURNOUT parameter for Upper or Lower may do this. The BURNOUT configuration is only valid in the transmitter mode. When a failure occurs in the PID mode, the output is driven to a safety Output value, between 3.8 and 20.5 mA.

- **ADDRESSING** - The **LD400 HART®** includes a variable to define the equipment address in a HART network. Addresses may go from value "0" to "15"; addresses from "1" to "15" are specific addresses for multidrop connections. This means that, in a multidrop configuration, the **LD400 HART®** will display the MD icon for addresses "1" to "15".

NOTE
The output current will be fixed to 4 mA as the **LD400 HART®** address, in the Transmitter mode, is altered to another value than "0" (this does not happen when the **LD400 HART®** is configured in the Controller mode).

The **LD400 HART®** is factory-configured with address "0".

- **DISPLAY INDICATION** - the **LD400 HART®** digital display is comprised of three distinct fields: an information field with icons indicating the active configuration status, a 4 ½ digit numeric field for value indication and a 5-digit alphanumeric field for units and status information.

The **LD400 HART®** may work with up to three display configurations to be alternately displayed at 2 second intervals. Parameters that may be selected for visualization are those listed on Table 4.4, below.

PARAMETER	DESCRIPTION
CURRENT	Current in milliamperes.
OUT% = (MV% (*))	Output in percentage.
PV	Process Variable in engineering units.
PV%	Process Variable in percentage.
TEMP	Ambient temperature.
TOTAL	Total accumulated by the totalizer.
SP% (*)	Setpoint in percentage.
SP (*)	Setpoint in engineering units.
ER% (*)	Error in percentage (PV% - SP %).
NONE	Used to cancel the second or third indication.

Table 4.4– Variables for Display Indication

NOTE
Items marked with an asterisk can only be selected in the PID mode. Total can only be selected if enabled.

- **PASSWORDS** - this service enables the user to modify the operation passwords used in the **LD400 HART®**. Each password defines the access for a priority level (1 to 3); such configuration is stored in the **LD400 HART®** EEPROM. Password Level 3 is hierarchically superior to password level 2, which is superior to level 1.

Equipment Maintenance

Here are grouped maintenance services related with the collection of information required for equipment maintenance. The following services are available: Order Code, Serial Number, Operation Counter and Backup/Restore.

- **ORDER CODE** - The Order Code is the one used for purchasing the equipment, in accordance with the User specification. There are 22 characters available in the **LD400 HART®** to define this code and the last one is a bar that must be placed at the end of the main code; the sequential characters are optional *. The optional items may select or not, according to user needs. Example:

1		2	3	4		5	6		7	8	9	10	11		12	13	14		15	16	17		18	19	20	21	22		23	24	25	26	27
LD400	-	D2	1	0	-	H	1	-	I	B	U	0	0	-	P	0	1	-	0	I	1	-	A	0	N	0	0	/	BU	Y2	Y5	P2	F1

Nº	OPTION	DESCRIPTION
1	LD400	Differential, Flow, and Level Transmitter
2	D2	Differential, Range: -50 a 50 kPa.
3	1	Stainless Steel 316L Diaphragm and Fill Fluid with Silicone Oil
4	0	Class of Standard performance
5	H	HART® Transmitter 4-20 mA
6	1	SIS: Safety Instrumented System
7	I	Flanges, Adapters, and 316 Stainless steel Drain/Vent valves
8	B	Buna-N O-Rings
9	U	Drain in up position
10	0	Process Connection: 1/4 - 18 NPT (Without Adapter)
11	0	Without Special Cleaning
12	P	Flanges, nuts, and bolts Material: Plated Carbon Steel
13	0	Flange Threaded for accessories fixing (adapters, manifolds, etc): 7/16" UNF.
14	1	With Digital Indicator
15	0	Electrical connection 1/2 NPT
16	I	316 Blank conduit Plug
17	1	316 Stainless Steel Blank Conduit Plug. Mounting Bracket for 2" Pipe or surface mounting: Bracket and Accessories in Carbon Steel
18	A	Electronic Housing: Aluminum
19	0	Painting: N6, 5 Munsell Gray Polyester
20	N	Without identification
21	0	None
22	0	TAG plate: with tag, when specified
23	BU	Burn-out: full Scale
24	Y2	LCD1 Indication: Pressure (Engineering Units)
25	Y5	LCD2 Indication: Temperature (Engineering Units)
26	P2	Available and enable PID
27	F1	Transfer Function for flow measure: Square Root

Table 4.5– Differential Pressure Transmitter Ordering Code

- **SERIAL NUMBER** - Three serial numbers are stored:

Circuit Number - This number is unique to each main circuit board and cannot be changed.

Sensor Number - The serial number of the sensor connected to the **LD400 HART®** and cannot be changed. This number is read from the sensor every time a new sensor is inserted in the main board.

Transmitter Number - The number that is written at the identification plate in each transmitter.

NOTE
The transmitter number must be changed whenever there is the main plate change to avoid communication problems.

- **OP_COUNT** - Every time a change is made, there is an increment in the respective change counter for each monitored function, according to the table 4.6. The counter is cyclic, from 0 to 255. The monitored items are:

VARIABLE	DESCRIPTION
Lower Value/Upper Value	When any type of calibration is done.
Function	When any change in the transference function is done, e.g., linear, square root, const, table.
Trim_4mA	When the current trim is done at 4mA.
Trim_20mA	When the current trim is done at 20mA.
Trim_Zero/Lower	When pressure trim is done at Zero or Lower Pressure.
Trim Upper Pressure	When the trim is done at Upper Pressure.
Characterization	When any change is made in any point of the pressure characterization table in trim mode.
Temperature Trim	When the temperature is done.
TRM/PID	When any change is made in the operation mode, i.e., from PID to TRM or vice versa.
Totalization	When any change is made in the totalization, configuration or in the reset.
Table	When the contents on the transference function table is altered.
Multidrop	When any change is made in the communication mode, for example, multidrop or single transmitter.
Password	When any change is made in the password

Table 4.6 – Functions Monitored by the Operation Counter

- **BACKUP -** This option allows copying the data saved in the main board to the sensor memory.

- **RESTORE -** This option allows copying the data saved in the sensor memory to the main board memory. It also allows restoring to the main board the data stored in the sensor.

Section 5

PROGRAMMING USING LOCAL ADJUSTMENT

The Magnetic Tool

With the Magnetic Tool it is possible to configure locally the **LD400 HART®** and eliminate the need for additional configurators in many basic applications.

There are two ways to adjust the **LD400 HART®** locally according to the jumper configuration (see Table 5.1):

- ✓ Simple Local Adjustment
- ✓ Complete Local Adjustment

For the configuration with the magnetic tool to be possible:

- ✓ The display must be connected;
- ✓ The writing protection jumper must be disabled;
- ✓ The local adjustment jumper must be enabled on simple mode or complete mode.

See on Figure 5.1 the jumper positions for Local Adjustment and Writing Protection on the main board. If the option chosen is Complete Adjustment, with a disabled writing protection and without the display connected, the transmitter will redirect automatically the local adjustment for Simple mode. This happens because the Complete Local Adjustment needs an interaction with the display, and Simple Local Adjustment does not.

The Simple Local Adjustment is used for Zero and Span Calibration.

On the other hand, the Complete Local Adjustment makes possible to use the transmitter for several operations, both for control and for configuration.

Figure 5.1 – Main Board

To configure the Local Adjustment, set the main board jumpers as shown on Table 5.1.

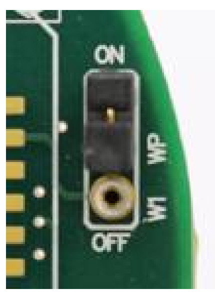
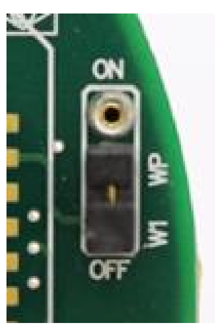
Local Adjustment	
	**Simple Mode Enable**
	**Disable**
	**Complete Mode Enable**
Writing Protection	
	**Enable Writing**
	**Disable Writing**

Table 5.1– Local Adjustment Selection

Notes:
1 - If the writing protection (WP ON) is selected, the writing in EEPROM will be protected.
2 - The standard configuration for the tools is the local adjustment selected for simple, and the writing protection is disabled.

Local Adjustment

Under the identification plate, the transmitter has two orifices where the magnetic tool is inserted to set the Local Adjustment. See Figure 5.2.

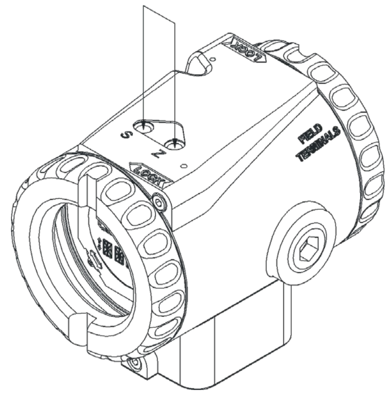


Figure 5.2 – Zero and Span Local Adjustment

The holes are marked with **Z** (Zero) and **S** (Span) and from now on will be simply described as (**Z**) and (**S**), respectively. Table 5.2 shows the action performed by the magnetic tool while inserted in (**Z**) and (**S**) in accordance with the selected adjustment type.

Browsing the functions and their branches works as follows:

- ✓ Inserting the handle of the magnetic tool in (**Z**), the transmitter passes from the normal measurement state to the transmitter configuration state. The transmitter software automatically starts to display the available functions in a cyclic routine. The group of functions displayed depends on the mode selected for the **LD400 HART®**, either Transmitter (BPCS or SIS) or Controller.
- ✓ In order to reach the desired option, browse the options, wait until they are displayed and move the magnetic tool from (**Z**) to (**S**). Refer to Figure 5.3 – Local Adjustment Programming Tree, in order to know the position of the desired option. By placing the magnetic tool once again in (**Z**), it is possible to browse other options within this new branch.
- ✓ The procedure to reach the desired option is similar to the one described on the previous item, for the whole hierarchical level of the programming tree.

ACTION	SIMPLE LOCAL ADJUSTMENT		COMPLETE LOCAL ADJUSTMENT	
	TRANSMITTER MODE	CONTROLLER MODE	TRANSMITTER MODE	CONTROLLER MODE
Z	Selects the Lower Range Value		Moves among the Complete Local Adjustment options	Moves among all the options
S	Selects the Upper Range Value		Activates the selected Functions	Activates the selected Functions

Table 5.2- Local Adjustment Description

Simple Local Adjustment

The Simple Local Adjustment executes the following functions:

- ✓ **Zero Calibration:** when inserting the magnetic tool in the (**Z**) hole, the measured pressure will be equivalent to the 4 mA current pressure;

- ✓ **Span Calibration:** when inserting the magnetic tool in the (**S**) hole, the measured pressure will be equivalent to the 20 mA current pressure.

NOTE
For adequate calibration, notice the minimum span for each measuring range and types as defined on the Technical Specification (Section 3).

Zero calibration with reference shall be done as follows:

- Apply the Lower Value pressure;
- Wait for the pressure to stabilize;
- Insert the magnetic tool in the ZERO adjustment hole. (See Figure 5.2);
- Wait 2 seconds with the magnetic tool into the hole and the transmitter should be generating 4 mA. During this time the display will show CALIB and ZERO in sequence;
- Remove the tool.

Zero calibration with reference does not affect the span. In order to change the span, the following procedure shall be observed:

- Apply the Upper Value pressure;
- Wait for the pressure to stabilize;
- Insert the magnetic tool in the SPAN adjustment hole (**S**);
- Wait 2 seconds with the magnetic tool into the hole and the transmitter should be generating 20 mA. During this time the display will show CALIB and SPAN in sequence
- Remove the tool.

Zero adjustment causes a new upper value (URV), calculated in accordance with the effective span. In case the resulting URV is higher than the Upper Limit Value (URL), the URV will be limited to the URL value, and the span will be automatically adjusted.

Complete Local Adjustment

The following functions are available for local adjustment: Simulation, Range, Trim, Configuration, Operation and Quit.

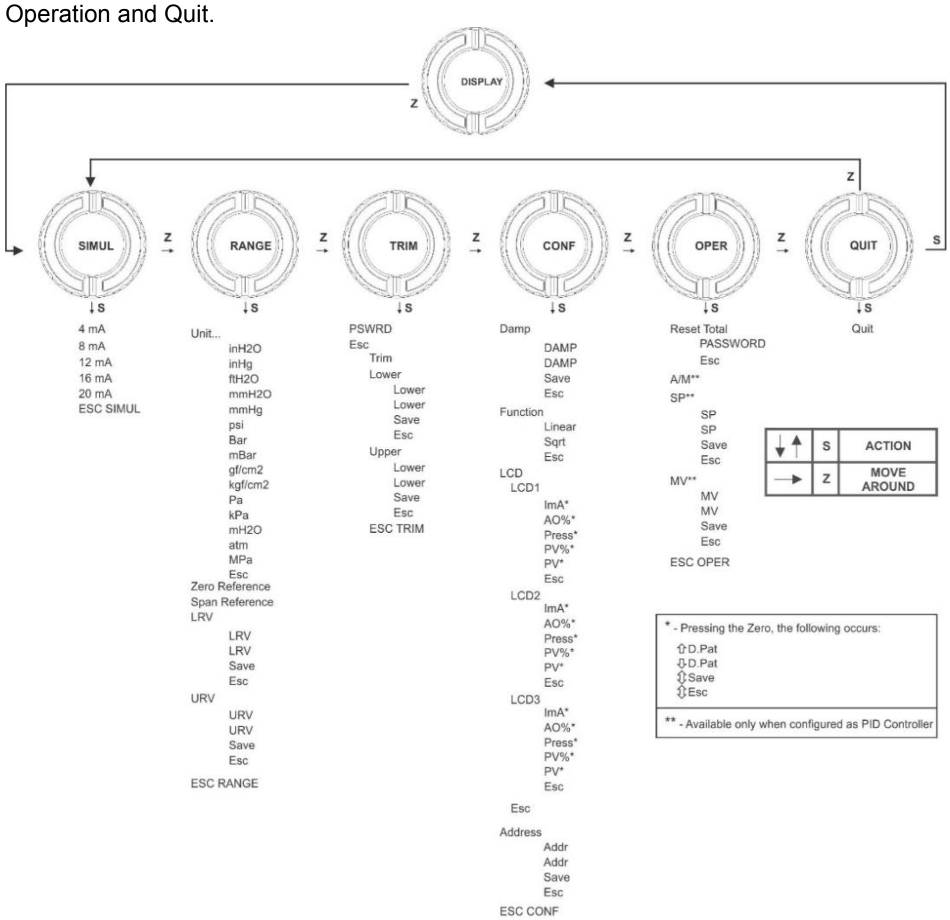


Figure 5.3 – Complete Local Adjustment Programming Tree – Main Menu

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

The Main branch starts at the "SIMUL" option.

SIMULATION (SIMUL) – Simulation loop test current. Options: 4 mA, 8 mA, 12 mA, 16 mA or 20 mA.

RANGE (RANGE) – This option allows change the measurement unit and the operation range like as zero, span, lower and upper range values calibrations.

TRIM (TRIM) – It is the option used to trim the transmitter with the following options: Zero, Lower and Upper Trim.

CONFIGURATION (CONF) – Is the option where the output and display related parameters are configured: damping, function, display and address.

OPERATION (OPER) – Is the option where the operation related parameters of the transmitter or controller: Reset Totalization, Auto/Manual, Setpoint and Manual output.

QUIT - Is the option used to go back to normal monitoring mode.

Simulation [SIMUL]

This operation simulates the output current for the Loop test. Optional values to be simulated are 4 mA, 8 mA, 12 mA, 16 mA or 20 mA.

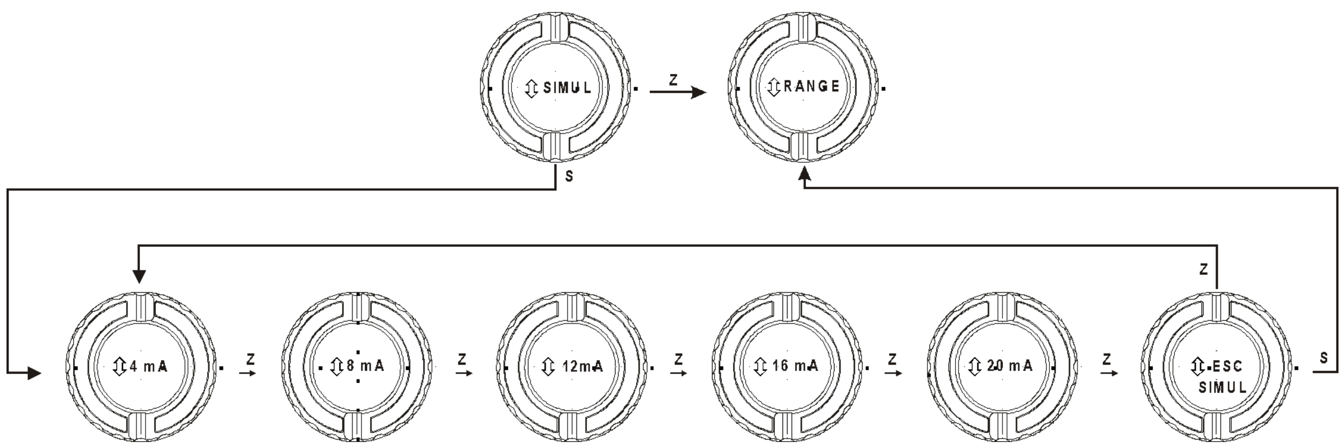
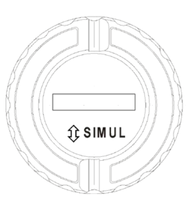


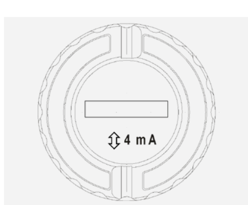
Figure 5.4 – Simulation branch of the Complete Local Adjustment Tree

SIMULATION BRANCH (SIMUL)



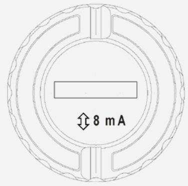
Z: Moves between the Main branch options of the Complete Local Adjustment tree.

S: Enters in the Simulation branch.



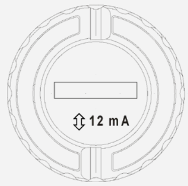
Z: Moves between the Simulation branch options.

S: Selects 4 mA value for simulation.



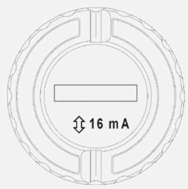
Z: Moves between the Simulation branch options.

S: Selects 8 mA value for simulation.



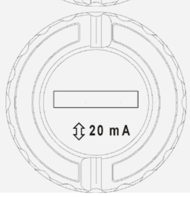
Z: Moves between the Simulation branch options.

S: Selects 12 mA value for simulation.



Z: Moves between the Simulation branch options.

S: Selects 16 mA value for simulation.



Z: Moves between the Simulation branch options.

S: Selects 20 mA value for simulation.

Z: Moves between the Main branch options of the Complete Local Adjustment tree.

S: Escapes from the Simulation branch and returns to the Main branch.

NOTE
After entering a simulation current value, the **LD400 HART®** automatically quits the simulation mode in around 2 minutes if the ESC option is not selected. Other configuration branches are also abandoned in fairly less time, around 8 seconds.

Range [RANGE]

This option makes zero and span calibration, also called calibration with reference, or define lower and upper operation range values, while performing calibration without reference. The unit associated to pressure measuring may also be modified in this branch.

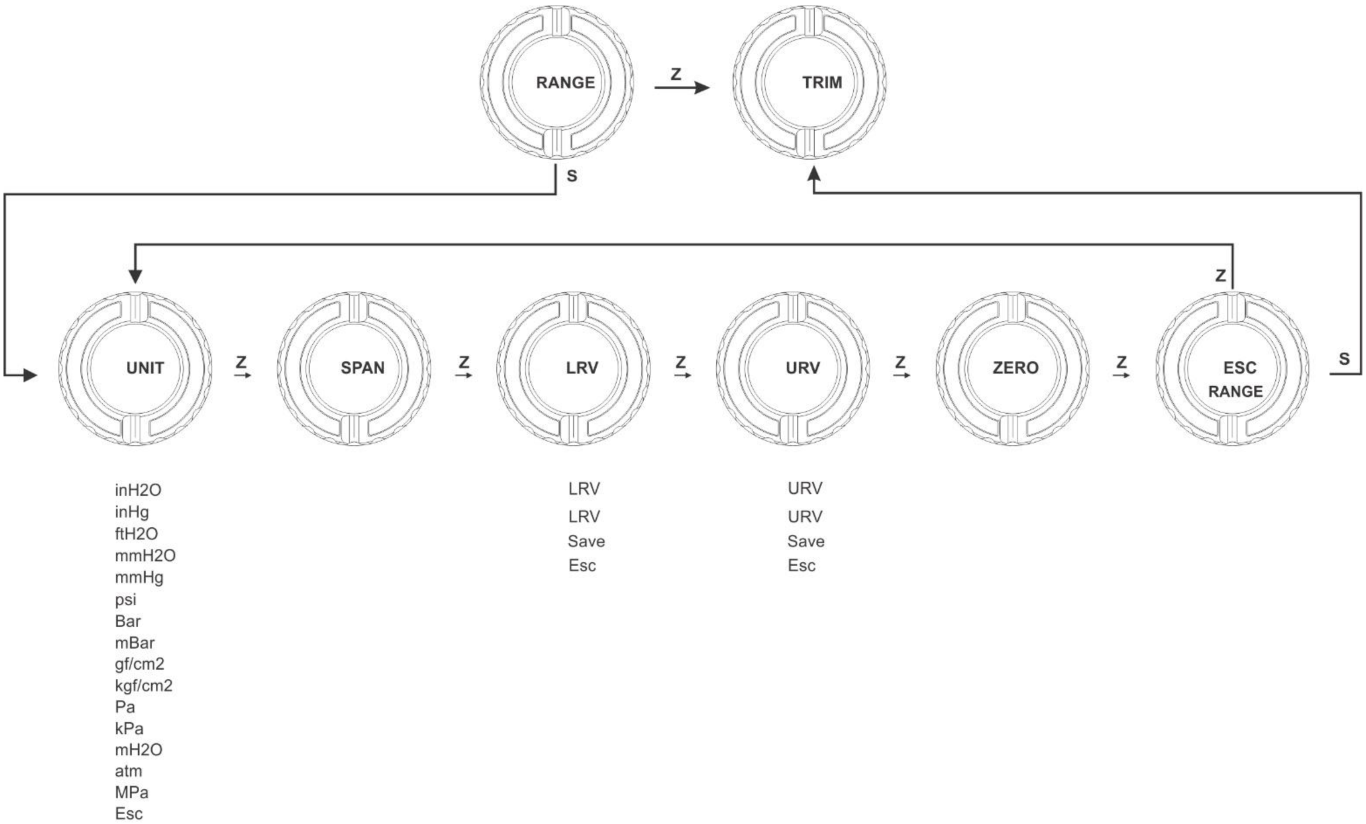
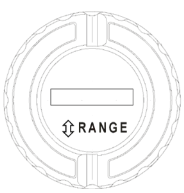


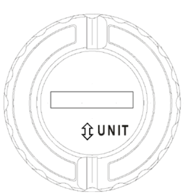
Figure 5.5 – Range branch of the Complete Local Adjustment Tree

RANGE BRANCH [RANGE]



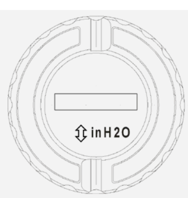
Z: Moves between the Main branch options of the Complete Local Adjustment tree.

S: Enters in the RANGE branch.



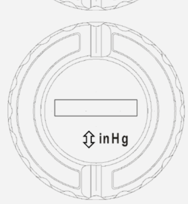
Z: Moves between the Range branch options.

S: Enters in the Engineering Units branch.



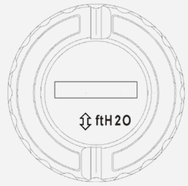
Z: Moves between the Engineering Units branch options.

S: Selects **inH$_2$O** and returns to the Engineering Units branch to circulate in the RANGE branch options.



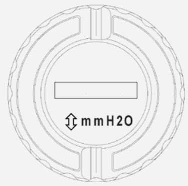
Z: Moves between the Engineering Units branch options.

S: Selects **inHg** and returns to the Engineering Units branch to circulate in the RANGE branch options.



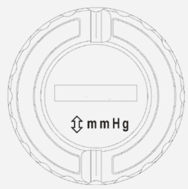
Z: Moves between the Engineering Units branch options.

S: Selects **ftH$_2$O** and returns to the Engineering Units branch to circulate in the RANGE branch options.



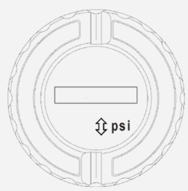
Z: Moves between the Engineering Units branch options.

S: Selects **mmH$_2$O** and returns to the Engineering Units branch to circulate in the RANGE branch options.



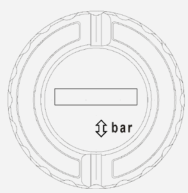
Z: Moves between the Engineering Units branch options.

S: Selects **mmHg** and returns to the Engineering Units branch to circulate in the RANGE branch options.



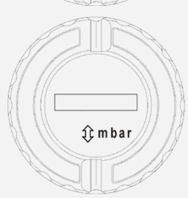
Z: Moves between the Engineering Units branch options.

S: Selects **psi** and returns to the Engineering Units branch to circulate in the RANGE branch options.



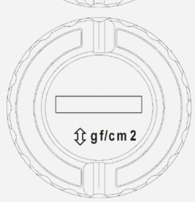
Z: Moves between the Engineering Units branch options.

S: Selects **bar** and returns to the Engineering Units branch to circulate in the RANGE branch options.



Z: Moves between the Engineering Units branch options.

S: Selects **mbar** and returns to the Engineering Units branch to circulate in the RANGE branch options.

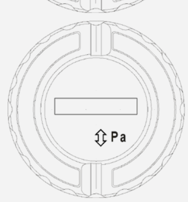


Z: Moves between the Engineering Units branch options.

S: Selects **gf/cm^2** and returns to the Engineering Units branch to circulate in the RANGE branch options.

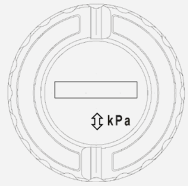
Z: Moves between the Engineering Units branch options.

S: Selects **kgf/cm^2** and returns to the Engineering Units branch to circulate in the RANGE branch options.



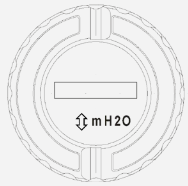
Z: Moves between the Engineering Units branch options.

S: Selects **Pa** and returns to the Engineering Units branch to circulate in the RANGE branch options.



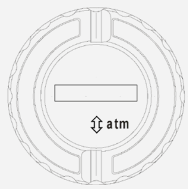
Z: Moves between the Engineering Units branch options.

S: Selects **kPa** and returns to the Engineering Units branch to circulate in the RANGE branch options.



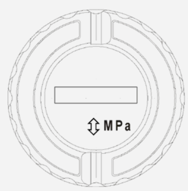
Z: Moves between the Engineering Units branch options.

S: Selects **mH_2O** and returns to the Engineering Units branch to circulate in the RANGE branch options.



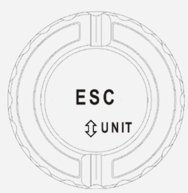
Z: Moves between the Engineering Units branch options.

S: Selects **atm** and returns to the Engineering Units branch to circulate in the RANGE branch options.



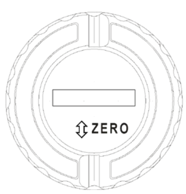
Z: Moves between the Engineering Units branch options.

S: Selects **MPa** and returns to the Engineering Units branch to circulate in the RANGE branch options.



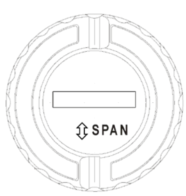
Z: Moves between the Engineering Units branch options.

S: Escapes from the Engineering Unit branch and returns to the Range branch options.



Z: Moves between the Range branch options.

S: Performs Zero Calibration.

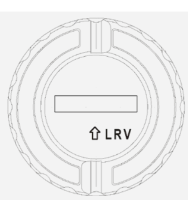


Z: Moves between the Range branch options.

S: Performs Span Calibration.

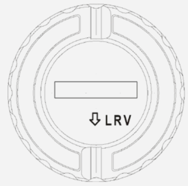
Z: Moves between the Range branch options.

S: Enters in the Lower Range Value branch.



Z: Moves between the Lower Range Value branch options.

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



Z: Moves between the Lower Range Value branch options.

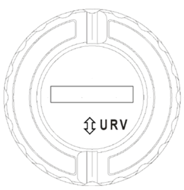
S: Decreases the Lower Range Value until the magnetic tool is removed or the minimum Lower Range Value is reached.

Z: Moves between the Lower Range Value branch options.

S: Saves the Lower Range Value.

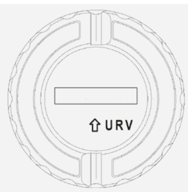
Z: Moves between the Lower Range Value branch options.

S: Escapes from the Lower Range Value branch and returns to the Range branch.



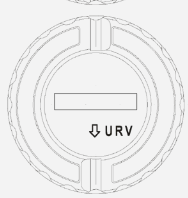
Z: Moves between the Range branch options.

S: Enters in the Upper Range Value branch.



Z: Moves between the Upper Range Value branch options.

S: Increases Upper Range Value.



Z: Moves between the Upper Range Value branch options.

S: Decreases Upper Range Value.

Z: Moves between the Upper Range Value branch options.

S: Saves the Upper Range Value.

Z: Moves between the Upper Range Value branch options.

S: Escapes from the Upper Range Value branch and returns to the Range branch.

Z: Moves between the Range branch options.

S: Escapes from the Range branch and returns to the Main branch of the Complete Local Adjustment tree.

Pressure Trim [TRIM]

This field of the tree is used to adjust the digital reading according to the applied pressure. The pressure TRIM differs from RANGING WITH REFERENCE, since the TRIM is used to correct the measure and RANGING WITH REFERENCE reach only the applied pressure with the output signal of 4-20 mA.

Figure 5.6 shows the options available to run the pressure TRIM.

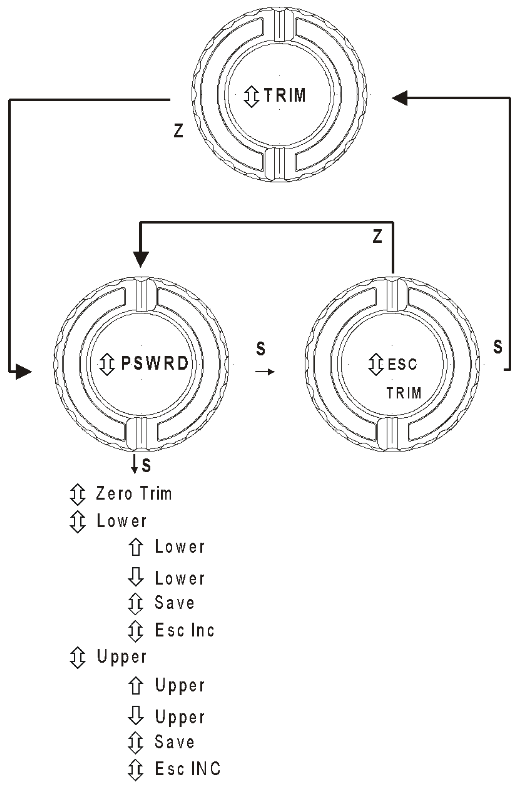
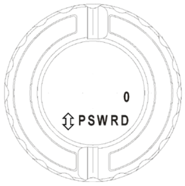


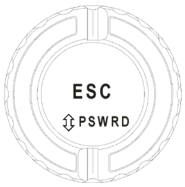
Figure 5.6 – Trim branch of the Complete Local Adjustment Tree

PRESSURE TRIM BRANCH [TRIM]



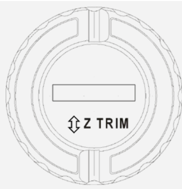
Z: Moves between 0 PSWRD and ESC PSWRD options.

S: This function is protected by a "password," when prompted 0 PSWD, enter the password. The password code is entered by inserting and removing the magnetic tool twice in (**S**). The password value is changed from 0 to 1. After entering the "password," you can move around the Trim branch options using (**Z**). To select the desired option, uses (**S**).



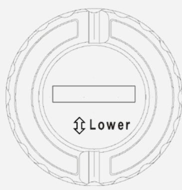
Z: Moves between 0 PSWRD and ESC PSWRD options.

S: Escapes from the PSWRD branch and returns to the Main branch of the Complete Local Adjustment tree.



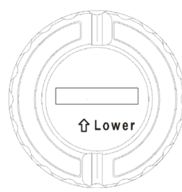
Z: Moves between the TRIM branch options.

S: Zero Trim: Trims the transmitter internal reference to read 0 at the applied pressure.



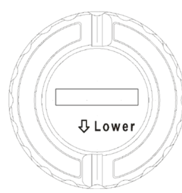
Z: Moves between the TRIM branch options.

S: Enters in the Lower Trim branch.



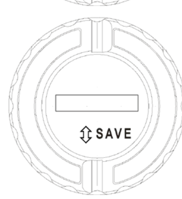
Z: Moves between the Lower Trim branch options.

S: Sets the transmitter internal reference, increasing the displayed value that will be interpreted as the LOWER Pressure value corresponding to the applied pressure.



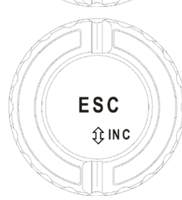
Z: Moves between the Lower Trim branch options.

S: Sets the transmitter internal reference, decreasing the displayed value that will be interpreted as the LOWER Pressure value corresponding to the applied pressure.



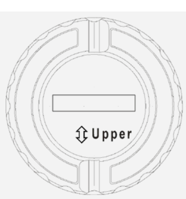
Z: Moves between the Lower Trim branch options.

S: Save the Lower Pressure Trim adjustment.



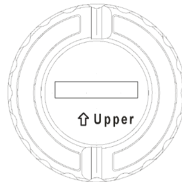
Z: Moves between the Lower Trim branch options.

S: Escapes from the Lower Trim adjustment branch and returns to the Trim branch.



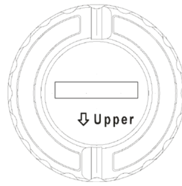
Z: Moves between the TRIM branch options.

S: Enters in the Upper Pressure Trim branch.



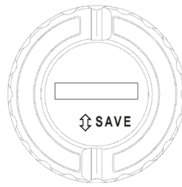
Z: Moves between the Upper Trim branch options.

S: Sets the transmitter internal reference, increasing the displayed value that will be interpreted as the UPPER Pressure value corresponding to the applied pressure.



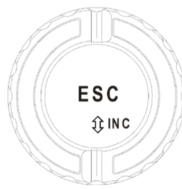
Z: Moves between the Upper Trim branch options.

S: Sets the transmitter internal reference, decreasing the displayed value that will be interpreted as the UPPER Pressure value corresponding to the applied pressure.



Z: Moves between the Upper Trim branch options.

S: Saves the Upper Pressure Trim adjustment.



Z: Moves between the Upper Trim branch options.

S: Escapes from the Upper Trim branch and returns to the Trim branch.

Z: Moves between the TRIM branch options.

S: Escapes from the Trim branch and returns to the Main branch of the Complete Local Adjustment tree.

Configuration [CONF]

Configuration functions affect directly the 4-20 mA output current and the display indication. The configuration options implemented in this branch are the following:

- Digital filter damping time configuration of the readout signal input;
- Selection of the transfer function to be applied to the measured variable;
- Selection of the variable to be shown on Display 1, Display 2 and Display 3;

Figure 5.7 shows the CONF branch with the available options.

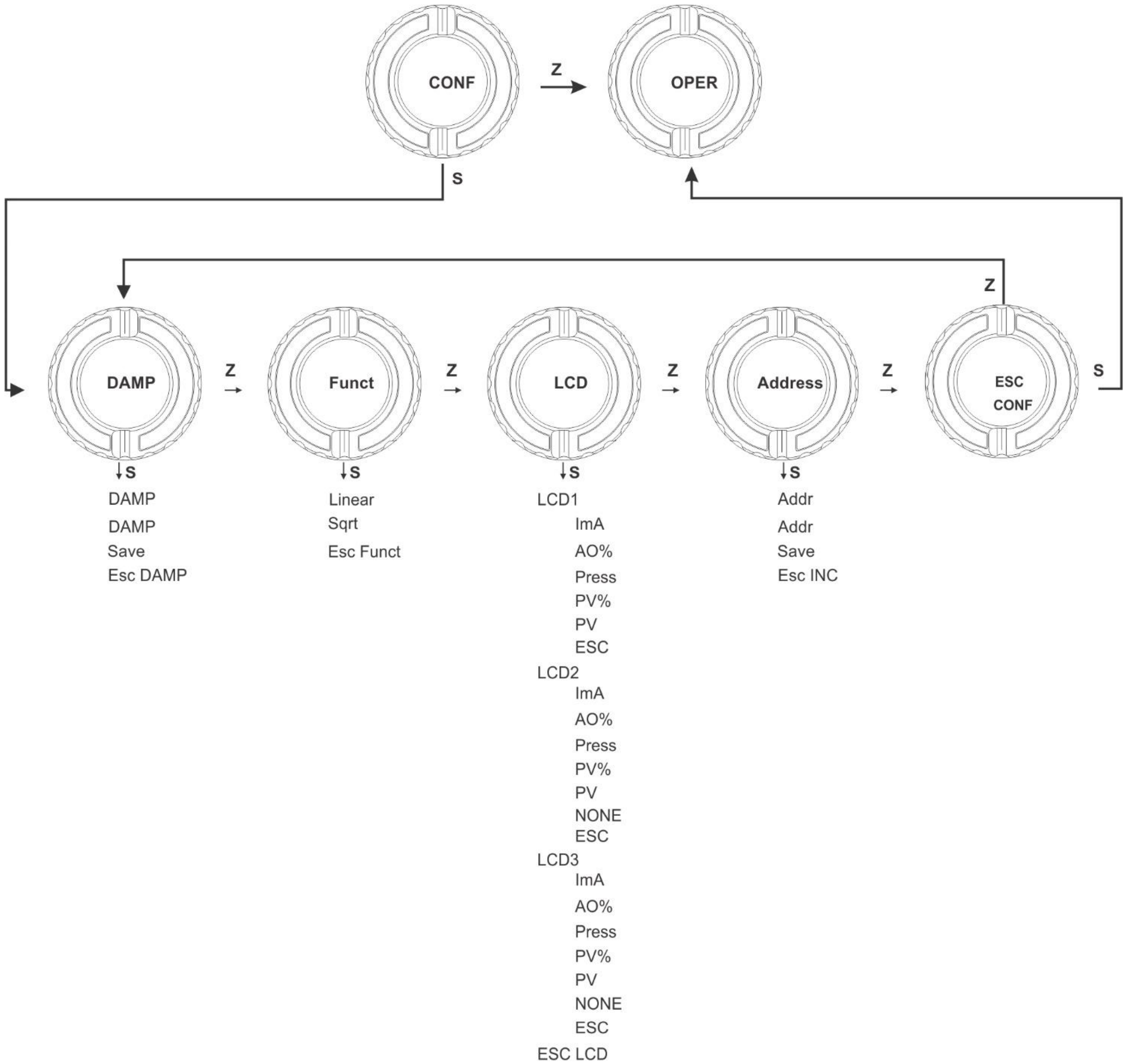
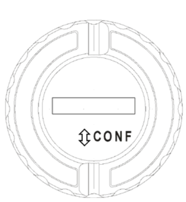


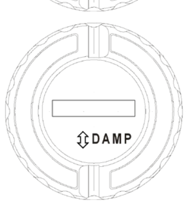
Figure 5.7 – Configuration branch of the Complete Local Adjustment Tree

CONFIGURATION BRANCH [CONF]



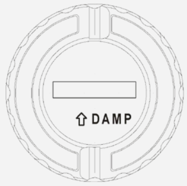
Z: Moves between the Main branch options of the Complete Local Adjustment tree.

S: Enters in the CONFIGURATION branch.



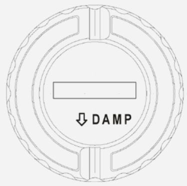
Z: Moves between the Configuration branch options.

S: Enters in the Damping Time branch.



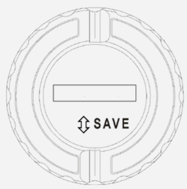
Z: Moves enter Damping Time branch options.

S: Increases the damping time constant until the magnetic tool is removed or 128 seconds are reached.



Z: Moves between Damping Time branch options.

S: Decreases the Damping Time constant until the magnetic tool is removed or 0 seconds is reached.

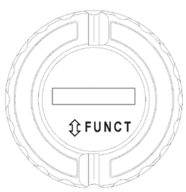


Z: Moves between the Damping Time branch options.

S: Save the Damp Time value.

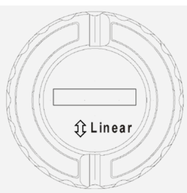
Z: Moves between the Damping Time branch options.

S: Escapes from the Damping Time branch and returns to the Configuration branch.



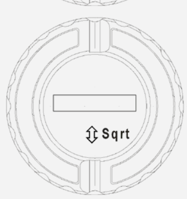
Z: Moves between the Configuration branch options.

S: Enters the Transfer Function branch.



Z: Moves between the Transfer Function options.

S: Selected of input function and returns to the Configuration branch.

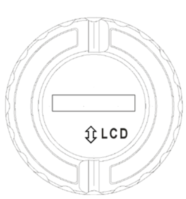


Z: Moves between the Transfer Function options.

S: Selected of Square Root function and returns to the Configuration branch.

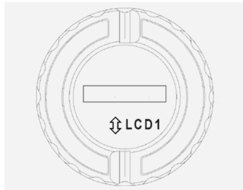
Z: Moves between the Transfer Function options.

S: Escapes from the Transfer Function branch and returns to the Configuration branch.



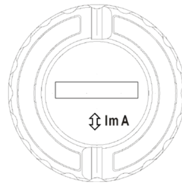
Z: Moves between the Configuration branch options.

S: Enters in the Display branch.



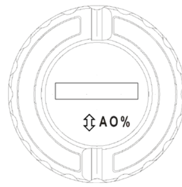
Z: Moves between the LCD1, LCD2, LCD3 and ESC LCD options.

S: Enters in the Display 1 branch.



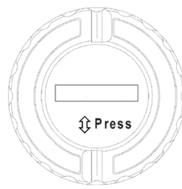
Z: Moves between the variables to be indicated as primary display.

S: Selects current in mA and enter in the Decimal Point branch showed at the end of Configuration branch.



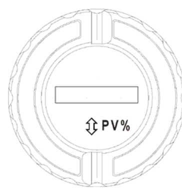
Z: Moves between the variables to be indicated as primary display.

S: Selects the analog output in percentage and enter in the Decimal Point branch showed at the end of Configuration branch.



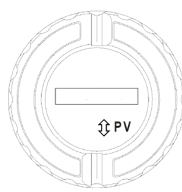
Z: Moves between the variables to be indicated as primary display.

S: Selects the Pressure (Engineering Unit) and enter in the Decimal Point branch showed at the end of Configuration branch.



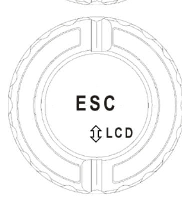
Z: Moves between the variables to be indicated as primary display.

S: Selects Process Variable in Percentage and enter in the Decimal Point branch showed at the end of Configuration branch.



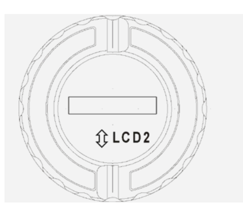
Z: Moves between the variables to be indicated as primary display.

S: Selects Process Variable and enter in the Decimal Point branch showed at the end of Configuration branch.



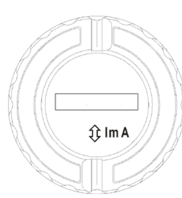
Z: Moves between the variables to be indicated as primary display.

S: Escapes from the Display 1 branch.



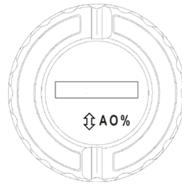
Z: Moves between the LCD1, LCD2, LCD3 and ESC LCD options.

S: Enters in the Display 2 branch.



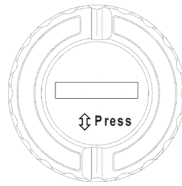
Z: Moves between the variables to be indicated on the Display 2.

S: Selects the current in mA and enter in the Decimal Point branch showed at the end of Configuration branch.



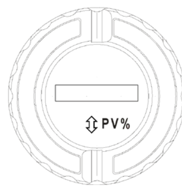
Z: Moves between the variables to be indicated on the Display 2.

S: Selects the analog output in percentage and enter in the Decimal Point branch showed at the end of Configuration branch.



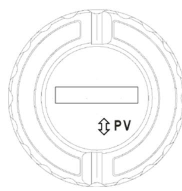
Z: Moves between the variables to be indicated on the Display 2.

S: Selects the Pressure (Engineering Unit) and enter in the Decimal Point branch showed at the end of Configuration branch.



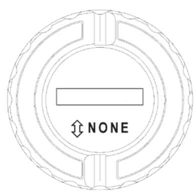
Z: Moves between the variables to be indicated on the Display 2.

S: Selects the Process Variable in Percentage and enter in the Decimal Point branch showed at the end of Configuration branch.



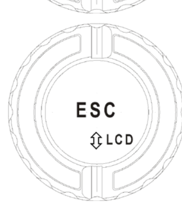
Z: Moves between the variables to be indicated on the Display 2.

S: Selects the Process Variable and enter in the Decimal Point branch showed at the end of Configuration branch.



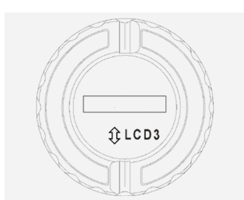
Z: Moves between the variables to be indicated on the Display 2.

S: Selects the option for not showing the readout on Display 2.



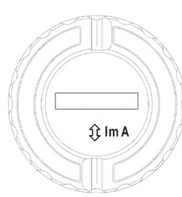
Z: Moves between the variables to be indicated on the Display 2.

S: Escapes from the choose Display 2 variable branch.



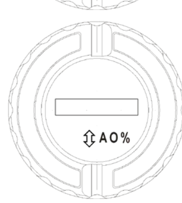
Z: Moves between the LCD1, LCD2, LCD3 and ESC LCD options.

S: Enters in the Display 3 branch.



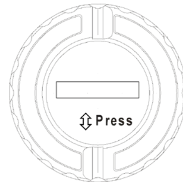
Z: Moves between the variable to be indicated in the Display 3.

S: Selects the output in mA and enter in the Decimal Point branch showed at the end of Configuration branch.



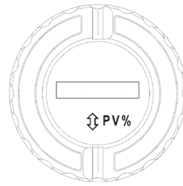
Z: Moves between the variable to be indicated in the Display 3.

S: Selects analog output in percentage and enter in the Decimal Point branch showed at the end of Configuration branch.



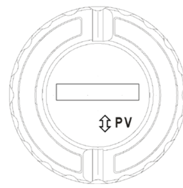
Z: Moves between the variable to be indicated in the Display 3.

S: Selects the Pressure (Engineering Unit) and enter in the Decimal Point branch showed at the end of Configuration branch.



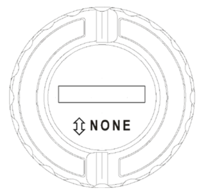
Z: Moves between the variable to be indicated in the Display 3.

S: Selects the Process Variable in Percentage and enter in the Decimal Point branch showed at the end of Configuration branch.



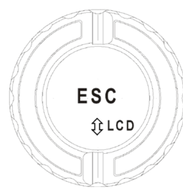
Z: Moves between the variable to be indicated in the Display 3.

S: Selects Process Variable and enter in the Decimal Point branch showed at the end of Configuration branch.



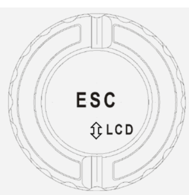
Z: Moves between the variable to be indicated in the Display 3.

S: Selects the option for not showing the indication on Display 3.



Z: Moves between the variable to be indicated in the Display 3.

S: Escapes from the Display 3 branch.

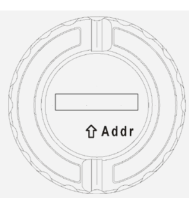


Z: Moves between the LCD1, LCD2, LCD3 and ESC LCD options.

S: Escapes from LCD branch and returns to Configuration branch.

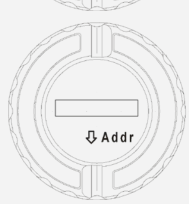
Z: Moves between the Configuration branch options.

S: Enters in the Address branch.



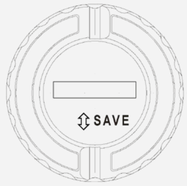
Z: Moves between the available options to address adjustment.

S: Increases the value on the address shown on the display.



Z: Moves between the available options to address adjustment.

S: Decreases the value on the address shown on the display.



Z: Moves between the available options to address adjustment.

S: Saves the address adjusted.

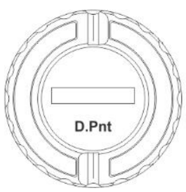
Z: Moves between the available options to address adjustment.

S: Escapes from the equipment address adjustment branch.

Z: Moves between the Configuration branch options.

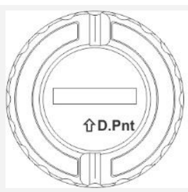
S: Escapes from the Configuration branch and returns to the Main branch of the Complete Local Adjustment tree.

DECIMAL POINT BRANCH [D.Pnt]



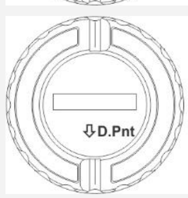
Z: Moves between the LCDi branch options.

S: Enters in the DPoint branch.



Z: Moves between the available options to DPoint adjustment.

S: Increases the value of decimal points shown on the display.



Z: Moves between the available options to DPoint adjustment.

S: Decreases the value of decimal points shown on the display.

Z: Moves between the available options to address adjustment.

S: Saves the decimal points adjusted.

Z: Moves between the available options to DPoint adjustment.

S: Escapes from the DPoint branch.

Operation [OPER]

This adjustment option is applicable to the **LD400 HART®** configured to Transmitter, SIS or Controller mode. It allows to Reset the Totalization Value to Zero and the control state to be changed from Automatic to Manual and vice versa, and also to adjust the Setpoint and Manipulated Variable values. Figure 5.8 shows branch OPER with the available options.

If the equipment is configured to Transmitter or SIS mode, only the total Reset will be available.

Equipment Configured to Transmitter or SIS Mode

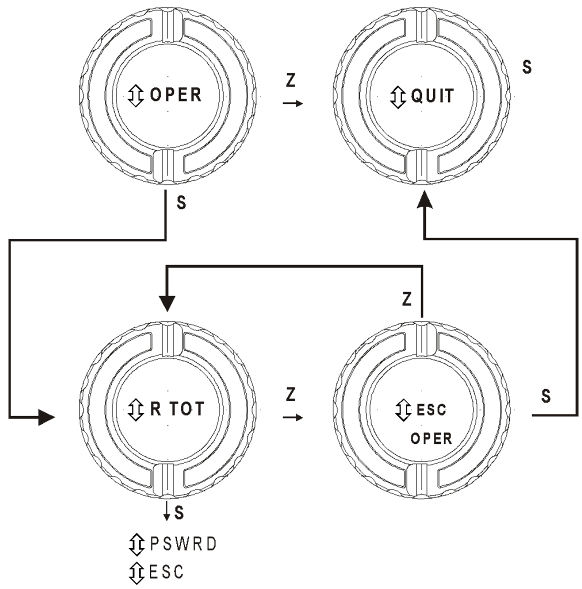
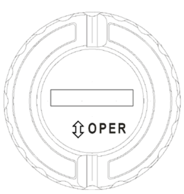


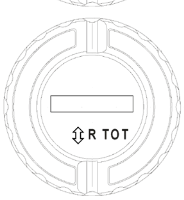
Figure 5.8 - Operation branch of the Complete Local Adjustment Tree - Transmitter and SIS Mode

OPERATION BRANCH (OPER) – TRANSMITTER and SIS MODE



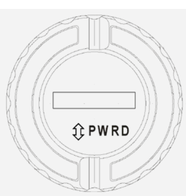
Z: Moves between the Main branch options of the Complete Local Adjustment tree.

S: Enters in the OPERATION branch.



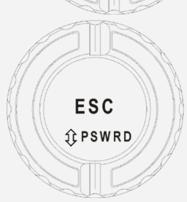
Z: Moves between the Operation branch options.

S: Asks for password.



Z: Moves between the 0 PSWRD and ESC PSWRD options.

S: This function is protected by a "password," when prompted 0 PSWD, enter the password. The password code is entered by inserting and removing the magnetic tool twice in (S). The password value is changed from 0 to 1. After entering the "password," the Totalization value is zeroed.



Z: Moves between the 0 PSWRD and ESC PSWRD options.

S: Escapes from the PSWRD branch and returns to the Operation branch.

Z: Moves between the Operation branch options.

S: Escapes from Operation branch.

Equipment Configured to Controller Mode

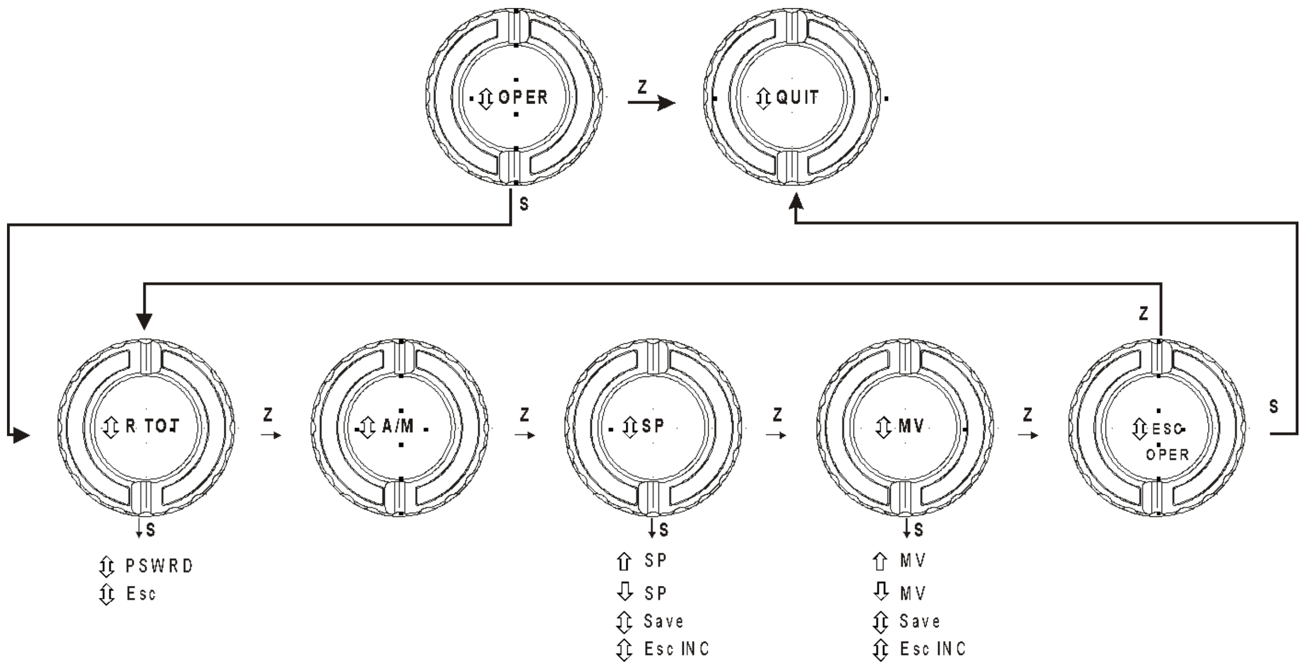
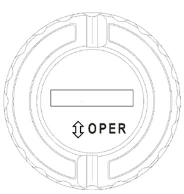


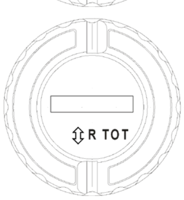
Figure 5.9 - Operation branch of the Complete Local Adjustment Tree – Controller Mode

OPERATION BRANCH (OPER) – CONTROLLER MODE



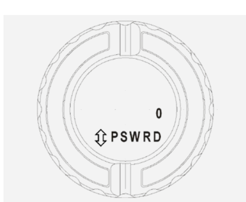
Z: Moves between the main branch options of complete local adjustment tree.

S: Enters in the Operation branch.



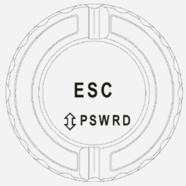
Z: Moves between the Operation branch options.

S: Asks for password.



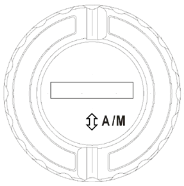
Z: Moves between the 0 PSWRD and ESC PSWRD.

S: This function is protected by a "password," when prompted 0 PSWD, enter the password. The password code is entered by inserting and removing the magnetic tool twice in (S). The password value is changed from 0 to 1. After entering the "password," the Totalization Value is zeroed.



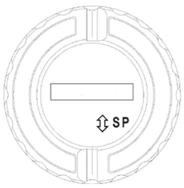
Z: Moves between the 0 PSWRD and ESC PSWRD.

S: Escapes from PSWRD branch and returns to the Operation branch.



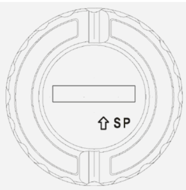
Z: Moves between the Operation branch options.

S: Toggles controller status, Automatic to Manual or Manual to Automatic. A and M indicate status.



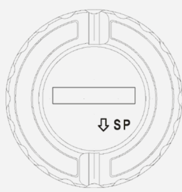
Z: Moves between the Operation branch options.

S: Enters in the Setpoint adjustment branch.



Z: Moves between the increase or decrease Setpoint value, save or escape.

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



Z: Moves between the increase or decrease Setpoint value, save or escape.

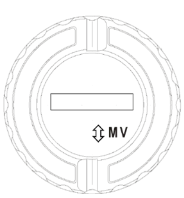
S: Decreases the Setpoint until the magnetic tool is removed or 0% is reached.

Z: Moves between the increase or decrease Setpoint value, save or escape.

S: Save adjusted Setpoint Value.

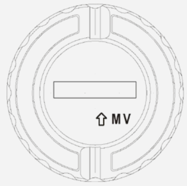
Z: Moves between the increase or decrease Setpoint value, save or escape.

S: Escapes from Setpoint Adjustment branch.



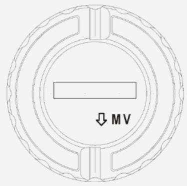
Z: Moves between the Operation branch options.

S: Enters in the Manipulated Variable adjustment branch.



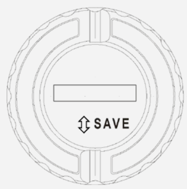
Z: Moves between the increase or decrease Setpoint value, save or escape.

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



Z: Moves between the increase or decrease Setpoint value, save or escape.

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



Z: Moves between the increase or decrease Setpoint value, save or escape.

S: Saves the Set Point and Manipulated Variable.

Z: Moves between the increase or decrease Setpoint value, save or escape.

S: Escapes from Manipulated Variable adjustment branch.

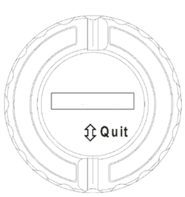
Z: Moves between the Operation branch options.

S: Escapes from Operation branch.

Quit [QUIT]

This branch of the main tree is used to leave the Complete Local Adjustment mode, placing the Transmitter or Controller in the monitoring mode**.**

QUIT BRANCH [QUIT]



Z: Moves between the main branch options of complete local adjustment tree.

S: Escapes from the Complete Local Adjustment tree and returns to the monitoring mode.

Section 6

MAINTENANCE

General

NOTE
Equipment installed in hazardous atmospheres must be inspected in compliance with the IEC60079-17 standard.

Below, there are some important maintenance procedures that should be followed in order to have safer plant and easy maintenance.

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 sensor has been designed to operate for many years without malfunctions. Should the process application require periodic cleaning of the transmitter, the flanges may be easily removed and reinstalled.

Should the sensor eventually require maintenance, it may not be changed on the field. In this case, the possibly damaged sensor should be returned to SMAR for evaluation and, if necessary, repair. Refer to the "Returning Materials" item at the end of this Section.

Diagnostic using Configuration Tool

Should any problem be noticed regarding the transmitter output, the configurator can be used to verify what is the problem (see Table 6.1).

The configurator should be connected to the transmitter according to the wiring diagram shown on Section 1, Figures 1.7, 1.8 and 1.9.

Error Messages

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

Table 6.1 presents a list of error messages with details for corrective actions that may be necessary.

ERROR MESSAGES	POTENTIAL SOURCE OF PROBLEM
UART RECEIVER FAILURE: • PARITY ERROR • OVERRUN ERROR • ERROR CHECK SUM • FRAMING ERROR	● The line resistance is not according to load curve; ● Excessive noise or ripple in the line; ● Low level signal; ● Interface damaged; ● Power supply with inadequate voltage.
CONFIGURATOR RECEIVES NO ANSWER FROM TRANSMITTER	● Transmitter line resistance is not according to load curve. ● Transmitter not powered. ● Interface not connected or damaged ● Repeated bus address. ● Power supply with inadequate voltage.
CMD NOT IMPLEMENTED	● Software version not compatible between configurator and transmitter. ● Configurator is trying to carry out a **LD400 HART®** specific command in a transmitter with different Specific revision or, from another manufacturer.
TRANSMITTER BUSY	● Transmitter carrying out an important task, e.g., local adjustment.
XMTR MALFUNCTION	● Sensor disconnected; ● Sensor failure.
COLD START	● Start-up or Reset due to power supplies failure.
OUTPUT FIXED	● Output in Constant Mode; ● Transmitter in Multidrop mode; ● Transmitter in safe current mode.

OUTPUT SATURATED	● Pressure out of calibrated Span or in fail-safe state (Output current in 3.8 or 20.5 mA).
SV OUT OF LIMITS	● Temperature out of operating limits. ● Temperature sensor damaged.
PV OUT OF LIMITS	● Pressure out of operation limits; ● Sensor damaged or sensor module not connected; ● Transmitter with false configuration.
LOWER RANGE VALUE TOO HIGH	● Lower value exceeds 24% of the Upper Range Limit.
LOWER RANGE VALUE TOO LOW	● Lower value exceeds 24% of the Lower Range Limit.
UPPER RANGE VALUE TOO HIGH	● Upper value exceeds 24% of the Upper Range Limit.
UPPER RANGE VALUE TOO LOW	● Upper value exceeds 24% of the Lower Range Limit.
UPPER & LOWER RANGE VALUES OUT OF LIMITS	● Lower and Upper Values are out of the sensor range limits.
SPAN TOO SMALL	● The difference, between the Lower and Upper values is less than the 0.75 x (minimum span).
APPLIED PRESSURE TOO HIGH	● The pressure applied was above the 24% upper range limit.
APPLIED PRESSURE TOO LOW	● The pressure applied was below the 24% lower range limit.
EXCESS CORRECTION	● The trim value entered exceeded the factory-characterized value by more than 10%.
PASSED PARAMETER TOO LARGE	● Parameter above operating limits.
PASSED PARAMETER TOO SMALL	● Parameter below operating limits.

Table 6.1 – Error Messages and Potential Source

Diagnostic via Transmitter

Symptom: NO LINE CURRENT

Probable Source of Trouble:

Transmitter Connections
- Check wiring polarity and continuity.
- Check for shorts or ground loops.
- Check if the power supply connector is connected to main board.

Power Supply
- Check power supply output. The voltage must be between 12 and 50 Vdc at transmitter terminals.

Electronic Circuit Failure
- Check the main board for defect by using a spare one.

Symptom: NO COMMUNICATION

Probable Source of Trouble:

Terminal Connections

- Check the terminal interface connection of the configurator.
- Check if the interface is connected to the wires leading to the transmitter or to the terminals [+] and [-].

Check if the interface is compatible with HART® Protocol

- Transmitter connections.
- Check if connections are according to wiring diagram.
- Check if there is resistance in the 250 Ω line.

✓ **Power Supply**

- Check output of power supply. The voltage at the **LD400 HART®** terminals must be between 12 and 50 Vdc, and ripple less than 500 mV.

✓ **Electronic Circuit Failure**

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

✓ **Transmitter Address**

- Check if the transmitter address is compatible with the one expected by the configurator.

Symptom: CURRENT OF 21.0 mA OR 3.6 mA

Probable Source of Trouble:

✓ **Pressure Tap (Piping)**

- Verify if blocking valves are fully open.
- Check for gas in liquid lines or for liquid in dry lines.
- Check the specific gravity of process fluid.
- Check process flanges for sediments.
- Check the pressure connection.
- Check if bypass valves are closed.
- Check if pressure applied is not above upper limit of the transmitter range.

✓ **Sensor to Main Circuit Connection**

- Sensor connection to the Main Board.
- Check connection (male and female connectors).

✓ **Electronic Circuit Failure**

- Check the sensor circuit for damage by replacing it with a spare one.
- Replace sensor.

Symptom: INCORRECT OUTPUT

Probable Source of Trouble:

✓ **Transmitter Connections**

- Check power supply voltage.
- Check for intermittent short circuits, open circuits and grounding problems.

✓ **Noise Measurement Fluid**

- Adjust damping

✓ **Pressure Tap**

- Check for gas in liquid lines and for liquid in steam or gases lines.
- Check the integrity of the circuit by replacing it with a spare one.

✓ **Calibration**

- Check calibration of the transmitter.

NOTE
A 21.0 or 3.6 mA current indicates that the transmitter is in Burnout (TRM) or safety output (PID). Use the configurator to investigate the source of the problem.

Symptom: DISPLAY INDICATES "F-XX YY-ZZ"

When the diagnoses of the LD400 HART Transmitter detect any kind of the failure that result in safe state current, the display shows the failure in hexadecimal format, where each bit set corresponds to the failure listed below. The XX represents the first diagnosis byte, the YY, the second and ZZ, the third.

Probable Source of Trouble:

XX- First diagnosis byte contents:

BIT #	DESCRIPTION	TRANSMITTER DETECTION
7	Memory Leak	Stack violation detected
6	FRAM memory failure	FRAM failure detected during writing operation
5	Sensor EEPROM memory failure	EEPROM failure detected during writing operation
4	ROM check failure	Invalid ROM CRC
3	RAM memory check failure	Invalid RAM Mirror CRC
2	Floating Point Unit Failure	FPU failure detected
1	No temperature update	Acquisition process stops the execution
0	No pressure update	Acquisition process stops the execution

YY- Second diagnosis byte contents:

BIT #	DESCRIPTION	TRANSMITTER DETECTION
7	Microprocessor Unit Failure	CPU register Failure is detected
6	Sensor module not initialized	Invalid sensor serial number detected on device power-on
5	Sensor Module not connected	No sensor connected during power-on
4	Incompatible sensor connected	Invalid Smar Sensor Type
3	Sensor Chamber High shorted	Without sensor capacitance signal
2	Sensor Chamber High opened	Invalid capacitance signal: stray capacitance
1	Sensor Chamber Low shorted	Without sensor capacitance signal
0	Sensor Chamber Low opened	Invalid capacitance signal: stray capacitance

ZZ- Third diagnosis byte contents:

BIT #	DESCRIPTION	TRANSMITTER DETECTION
7	Sensor Degraded	Excessive Zero Drift
6	System Clock Failure	Excessive System Clock drift
5	Lost Output Control	Excessive difference between Output Current and Feedback Current
4	Sequence Failure	Execution sequencing failure
3	RAM Static Failure	Failure on RAM cells - Galpat method
2	Program Code Failure	Failure on Flash Memory cells
1	Capacitance Switching failure	Failure on sensor board
0	Incompatible Output Current value	Output current and feedback doesn't match

Symptom: DISPLAY INDICATES "FLSH XX-XX"

Probable Source of Trouble:

- **Wrong Sensor Connected**
  - Check if the sensor is proper to the LD400 HART transmitter: Smar Sensor Type = 7, 8, 9 or 10 type. These sensor types are manufactured with validation CRC code and if the sensor CRC does not match, this message shows what valid CRC is expected for this connected sensor.

Information about Hazardous Locations

WARNING
Only use Explosion Proof/Flameproof certified Plugs, Adapters and Cable glands. **In Explosion-Proof installations the cable entries must be connected or closed using metal cable gland and metal blanking plug, both with at least IP66 and Ex-d certification.** The standard plugs provided by Smar are certified according to CEPEL certificate. If the plug needs to be replaced, a certified plug must be used. The electrical connection with NPT thread must use waterproofing sealant. A non-hardening silicone sealant is recommended. For NEMKO ATEX certificate please to follow the installation guidelines in hazardous locations below: Group II Category 2G, Ex d, Group IIC, Temperature Class T6, EPL Gb U = 28VDC Ambient Temperature: -20 to 60ºC for T6 Environmental Protection: IP65/67 or IP65W/67W The electrical connection available are ½ - 14NPT and M20x1,5. **Cable entries must be connected or closed using metal cable gland and metal blanking plug, both with at least IP66 and Ex-d certification or any appropriate ATEX approved metal cable gland and metal blanking plug.** **Do not remove the transmitter covers when power is ON.**

Disassembly Procedure

WARNING
Do not disassemble with power on.

Figure 6.1 shows a transmitter exploded view and will help you to visualize the following.

Sensor

In order to have access to the sensor for cleaning purposes, the transmitter should be removed from its process connections. The transmitter should be isolated from the process by means of manifolds or valves; then, the drain must be opened to vent any remaining pressure.

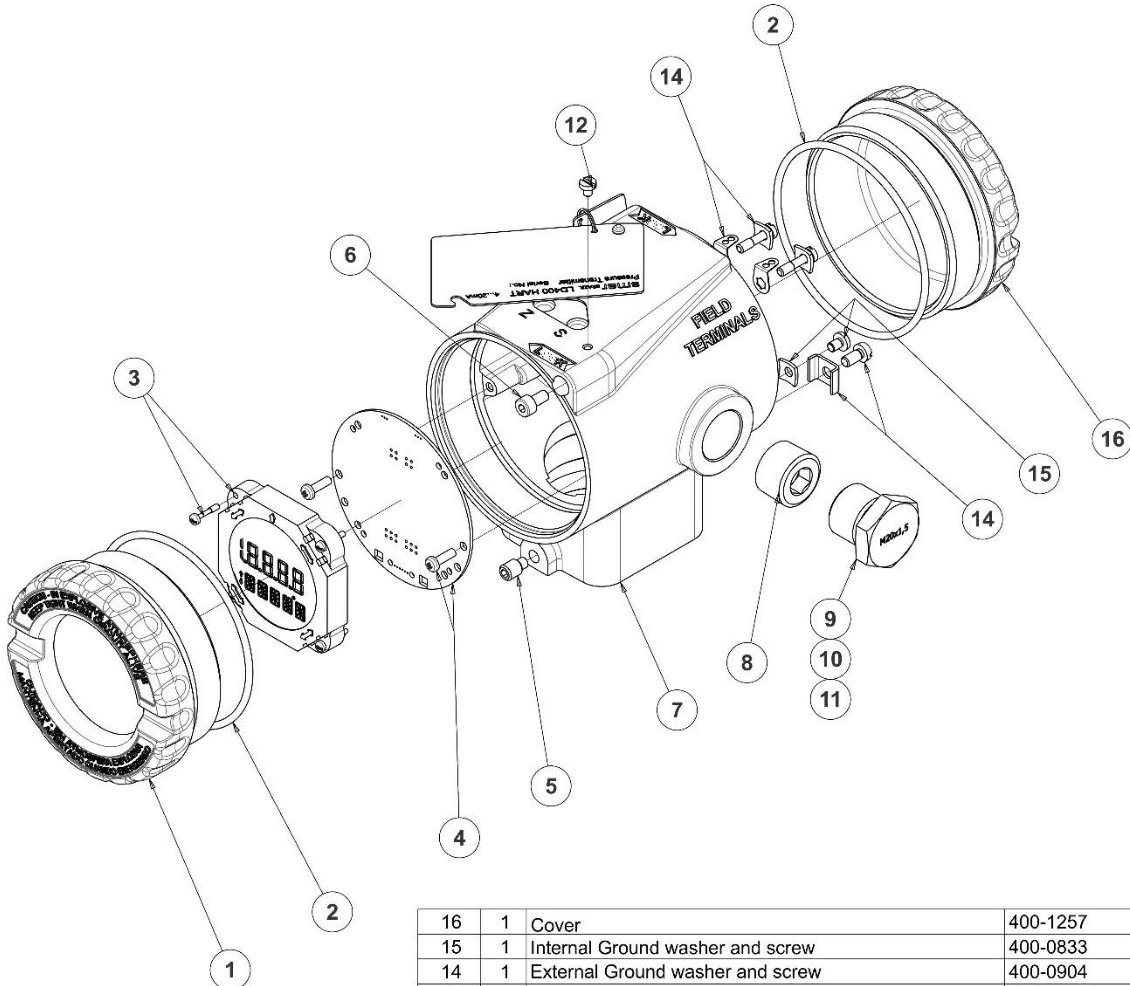
After this, the transmitter may be removed from the standpipe. The flange bolts may now be loosened counterclockwise, one at a time. After removing bolts and flanges, the isolating diaphragms will be easily accessible for cleaning.

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

The oscillator circuit is part of the sensor. If the former is replaced, the latter should also be replaced. The oscillating circuit is a part of the sensor and the replacement of one implies replacing the other. 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 and carefully unscrew the electronic housing from the sensor, observing if the flat cable is not excessively twisted.

WARNING
To avoid damage do not rotate the electronic housing more than 270º without disconnecting the electronic circuit from the sensor and from the power supply. See Figure 6.2.

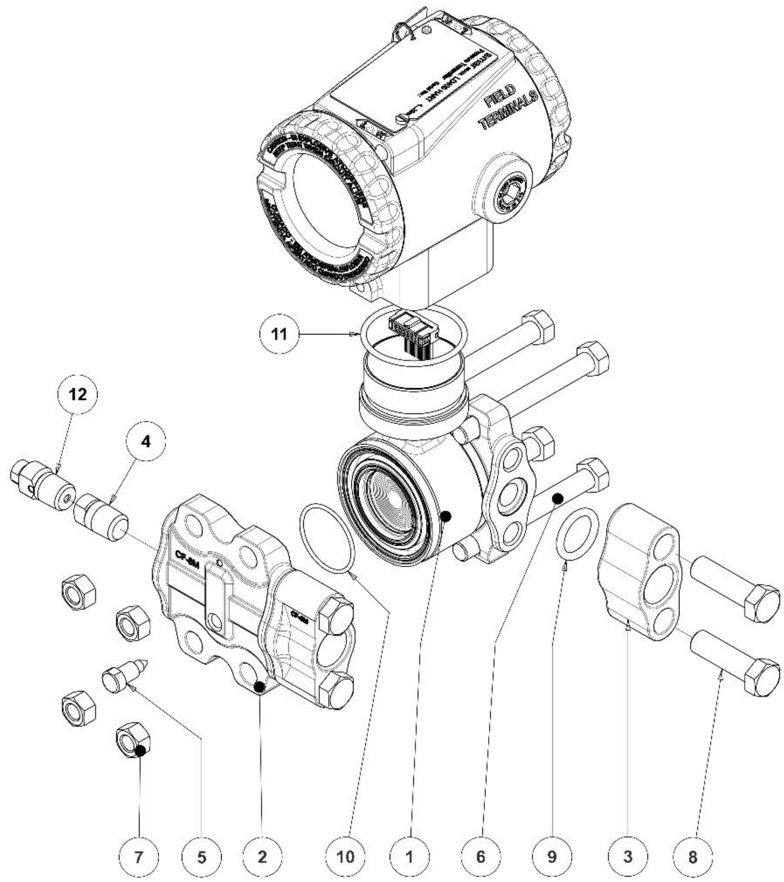


ITEM	QTY	DESCRIPTION	PART NUMBER
16	1	Cover	400-1257
15	1	Internal Ground washer and screw	400-0833
14	1	External Ground washer and screw	400-0904
13	1	Serrated terminal with screw and lock washer	400-0827
12	1	Identitification plate screw	204-0116
11	1	3/4NPT AISI316 adapter Exd	400-0812
10	1	Plug PG13.5 316 Exd	400-0811
9	1	Plug M20 316 Exd	400-0810
8	1	Plug 1/2NPT 316 Exd	400-0809
7	1	Electronic Housing 400	400-1368-xxxxx
6	2	Cover lock screw	204-0120
5	1	Sensor lock screw	400-1121
4	1	Main board screw	400-0832
4	1	Main Board GLL1475 (with display / assembly kit) LD400 HART	400-1461 *
4	1	Main Board GLL1475 (with display / assembly kit) LD400 HART SIS	400-1459 **
3	1	Display LD400 (include assembly kit)	400-1467 ***
2	1	Cover oring	204-0122
1	1	Cover with window	400-0822-xx

* Previous main board 400-0829 and 400-0831 have been discontinued, if revision is needed it should be replaced by the current one (GLL1475)

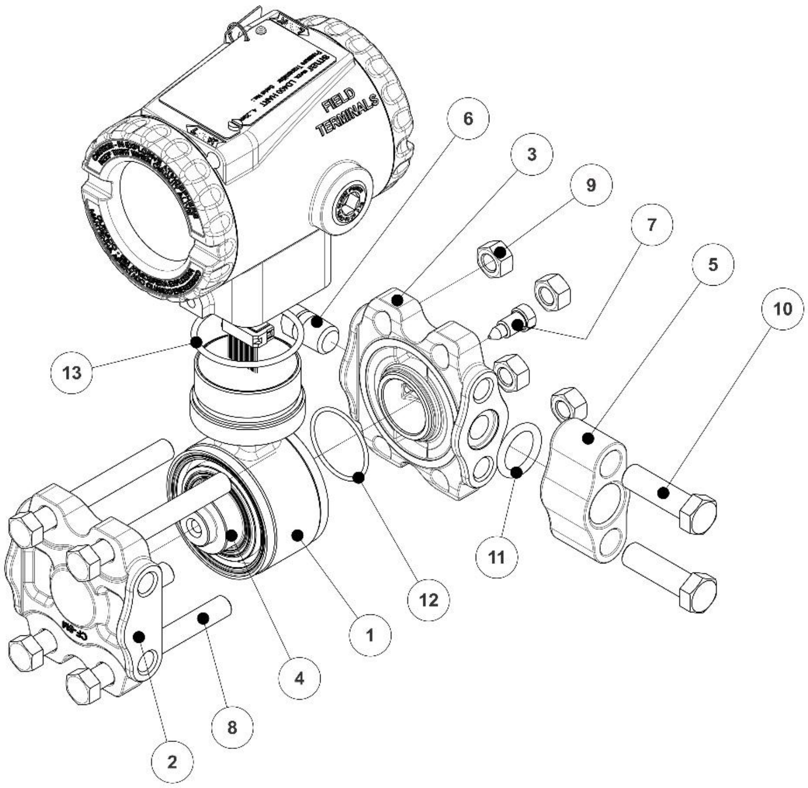
** When a revision is needed in the SIS transmitter, the sensor and board must be replaced by a new one (GLL1475)

*** New display 400-1467 does not work with previous boards (GLL1306 and GLL1353), if a new display is needed, the board must also be replaced (GLL1475)



The letters x after codes see complete code in manual
the parbak rings 203-0710 are use only flanges with sealing 45°,
This new version use radial sealing, not use parbak rings.
A drain valve can be used with flanges without drain, in place of 1/4NPT plug.

12	1	drain valve monel	400-0794
12	1	drain valve hastelloy	400-0793
12	2	drain valve SS 316	400-0792
11	1	oring sensor / housing buna N	204-0113
10	2	oring sensor etileno	203-0404
10	2	oring sensor teflon	203-0403
10	2	oring sensor viton	203-0402
10	2	oring sensor buna N	203-0401
9	1	oring adapter etileno	203-0704
9	2	oring adapter teflon	203-0703
9	2	oring adapter viton	203-0702
9	2	oring adapter buna N	203-0701
8	4	Adapter's screw SS316	203-0351
8	4	Adapter's screw carbon steel bicromatized	203-0350
7	4	Flange's Nut SS316	203-0312
7	4	Flange's Nut carb bicromatized	203-0302
6	4	Flange's screw SS316	203-0310
6	4	Flange's screw carbon steel bicromatized	203-0300
5	2	Drain Screw Monel	203-1403
5	2	Drain Screw Hastelloy	203-1402
5	4	Drain Screw SS 316	203-1401
4	2	Plug 1-4NPT monel	203-0554
4	2	Plug 1-4NPT hastelloy	203-0553
4	2	Plug 1-4NPT SS 316	203-0552
3	2	Adapter 1/2NPT monel 400 bar	203-0604
3	2	Adapter 1/2NPT HS CW-12MW (hast)	203-0603
3	2	Adapter 1/2NPT SS CF-8M (316)	203-0602
3	2	Adapter 1/2NPT carbon steel	203-0601
2	2	differential Flange Standard	400-1330-xxx
1	1	Sensor	204-0301-Dxxxxx
ITEM	QTY	DESCRIPTION	PART NUMBER



the campanula ID 4 only used in absolute model, welded on the sensor.
the letter "x" in codes, see complete code in manual.
The part numbers of electronic housing are in other figure

ITEM	QTD	DESCRIÇÃO	CÓDIGO
13	1	oring sensor / housing buna N	204-0113
12	1	oring sensor etileno	203-0404
12	1	oring sensor teflon	203-0403
12	1	oring sensor viton	203-0402
12	1	oring sensor buna N	203-0401
11	1	oring adapter etileno	203-0704
11	1	oring adapter teflon	203-0703
11	1	oring adapter viton	203-0702
11	1	oring adapter buna N	203-0701
10	2	Adapter's screw SS316	203-0351
10	2	Adapter's screw carbon steel bicromatized	203-0350
9	4	Flange's Nut SS316	203-0312
9	4	Flange's Nut carb bicromatized	203-0302
8	4	Flange's screw SS316	203-0310
8	4	Flange's screw carbon steel bicromatized	203-0300
7	1	Drain Screw Monel	203-1403
7	1	Drain Screw Hastelloy	203-1402
7	1	Drain Screw SS 316	203-1401
6	1	Plug 1-4NPT monel	203-0554
6	1	Plug 1-4NPT hastelloy	203-0553
6	1	Plug 1-4NPT SS 316	203-0552
5	1	Adapter 1/2NPT monel 400 bar	203-0604
5	1	Adapter 1/2NPT HS CW-12MW (hast)	203-0603
5	1	Adapter 1/2NPT SS CF-8M (316)	203-0602
5	1	Adapter 1/2NPT carbon steel	203-0601
4	1	Absolute Campanula	
3	1	Differential Flange	400-1330-xxx
2	1	Absolute/Gage Flange SS	204-1102
1	1	Gage Sensor (without campanula)	204-0301-M-xxx
1	1	Absolute Sensor	204-0301-A-xxx

Figure 6.1 – Exploded View

Figure 6.2– Sensor Rotation Stopper

Electronic Circuit

To remove the circuit board **(6)**, loosen the two screws **(5)**.

WARNING
The board has CMOS components, which may be damaged by electrostatic discharges. Make sure that these components will be handled by trained people that know the right handling procedures. The operator and the bench must be grounded during the entire process. Also, the circuit boards should be stored in electric-charge proof packages.

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

Reassembly Procedure

WARNING
Do not assemble with power on.

Sensor

When mounting the sensor **(29)**, make use of a new set of gaskets **(20 and 21)** compatible with the process fluid. The bolts, nuts, flanges and other parts should be inspected for corrosion or other eventual damage. Damaged parts should be replaced.

The O-rings should be lightly lubricated with silicon oil before they are fitted into place. Use halogen grease on applications having inert filling fluid. The flanges must be positioned on a flat surface. Insert the gaskets and Backup **(19)** (only for high pressure) in the flange according to figure 6.1. Set the four bolts **(17)** and tighten the nuts **(30)** initially by hand while keeping the flanges parallel through the whole mounting and finalize with an adequate tool.

O-RINGS AND BACKUP RINGS FOR HIGH PRESSURE
Except for special cases, the new standard flanges no longer use parbak. For specials that still use it, proceed as follows: Do not bend the parback ring and check that it has no biting, etc. Mount it carefully. The flat side must press the o-ring in the mounting.

Procedure for tightening the flange screws

- ✓ Tighten one nut till the flange seats;
- ✓ Tighten the nut diagonally across with a torque of 2.5 to 3 Kgfm;
- ✓ Tighten the first nut with the same torque;
- ✓ Verify the flanges alignment;
- ✓ Check torque on the four bolts.

Should the adapters **(27)** be removed, it is recommended to replace gaskets **(26)** and to connect the adapters to the process flanges before coupling them to the sensor. Optimum torque is 2.5 to 3 Kgfm.

The fitting of the sensor must be done with the main board out of the electronic housing. Mount the sensor to the housing turning it clockwise until it stops. Then turn it counterclockwise until the cover **(1)** is parallel to the process flange **(18)**. Tighten the screw **(7)** to lock the body to the sensor.

Electronic Circuit

Plug sensor connector and power supply connector to main board. If there is a display, attach it to the main board by means of 4 screws **(3)**. The display can be installed in any of the 4 possible positions (See Figure 6.4). The '▲' mark indicates up position.

Pass the screws **(5)** through the main board holes **(6)** and the spacers **(7)** as shown on Figure 6.4 and tighten them to the body.

After tightening the protective cover **(1)**, mounting procedure is complete. The transmitter is ready to be energized and tested. It is recommended that adjustment be done on the ZERO TRIM and on the UPPER PRESSURE TRIM.

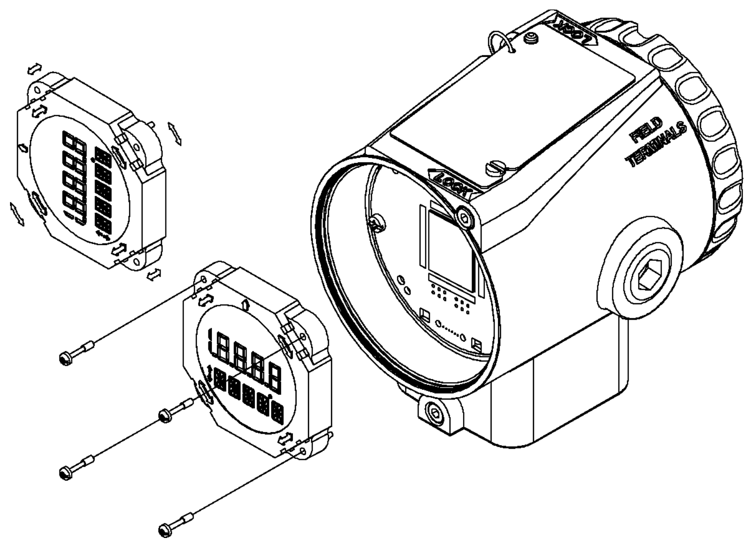


Figure 6.4 - Four Possible Positions of the Display

Interchangeability

In order to obtain an accurate and better temperature compensated response, each sensor is submitted to a characterization process and the specific data is stored in an EEPROM located in the sensor body.

The main board, in this operation, reads the sensor serial number and compares it with the number stored in the main board. In case they do not match, the circuit considers that the sensor has been changed and will probe the memory of the new sensor for the following information:

- Temperature compensation coefficients.
- Sensor trim data, including 5-point characterization curve.
- Sensor characteristics: type, range, diaphragm material and fill fluid.

Information not transferred during sensor replacement will remain unchanged in the main board memory. Thus, information such as Upper Value, Lower Value, Damping, Pressure Unit and replaceable transmitter parts (Flange, O-ring, etc.) shall be updated, depending on whether the correct information is that of the sensor or the main board. In the case of a new sensor, the main board will have the most updated information; in the opposite case, the sensor will have the correct information. Depending on the situation, the updating shall be from one or the other.

Data transference from the main board to the sensor or vice versa can also be forced by function MAINT/BACKUP/READ FROM SENSOR.

Returning Materials

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

If it becomes necessary to return the transmitter and/or configurator to Smar, simply contact our office, informing the defective instrument's serial number, and return it to our factory. In order to speed up analysis and solution of the problem, the defective item should be returned with the Service Request Form (SRF – Appendix B) properly filled with a description of the failure observed and with as much details as possible. Other information concerning to the instrument operation, such as service and process conditions, is also helpful.

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

Lifetime Transmitter

The **LD400 HART®** Smart Pressure Transmitter has a life span of 50 years. The reliability data listed in the FMEDA report are only valid for this period. After this time the transmitter may present failures.

Spare Parts List

SPARE PARTS LIST FOR TRANSMITTER				
DESCRIPTION OF PARTS		**POSITION**	**CODE**	**CATEGORY (NOTE 1)**
MOUNTING BRACKET FOR 2" PIPE MOUNTING **(NOTE 5)**	. CS		203 0801	
	. 316 SST		203 0802	
	. CS with bolts, nuts, washers and U-clamp in 316 SST		203 0803	
SENSOR		*29*	**(NOTE 4)**	B
DRAIN/VENT VALVE	. 316 SST	*30*	400-0792	

NOTES

(1) For category **A**, it is recommended to keep, in stock, 25 parts installed for each set, and **20** for category **B**.

(2) Includes Terminal Block, Screws, caps and Identification plate without certification.

(3) O-rings and Backup Rings are packaged in packs of 12 units, except for spring loaded.

(4) To specify sensors, use the following tables.

(5) Including U-Clamp, nuts, bolts and washers.

(6) For this type, O-ring pack has 1 piece.

Spare Sensor Ordering Code

MODEL	DIFFERENTIAL, FLOW, GAGE, ABSOLUTE AND HIGH STATIC PRESSURE SENSOR
400-0837	Sensor Module

COD	Type	Range LIMITS						Turn Down
		Min	Max	Unit	Min	Max	Unit3	Max
D0	Differential **(10)**	-1	1	kPa	-10	10	mbar	20
D1	Differential and Flow	-5	5	kPa	-50	50	mbar	40
D2	Differential and Flow	-50	50	kPa	-500	500	mbar	200
D3	Differential and Flow	-250	250	kPa	-2500	2500	mbar	200
D4	Differential and Flow	-2500	2500	kPa	-25	25	bar	200
M0	Gage	-1	1	kPa	-10	10	mbar	20
M1	Gage	-5	5	kPa	-50	50	mbar	40
M2	Gage	-50	50	kPa	-500	500	mbar	200
M3	Gage	-100	250	kPa	-1000	2500	mbar	200
M4	Gage	-100	2500	kPa	-1	25	bar	200
M5	Gage	-0.1	25	MPa	-1	250	bar	120
M6	Gage	-0.1	40	MPa	-1	400	bar	120
A0	Absolute	0	1	kPa	0	7.5	mmHg	20
A1	Absolute	0	5	kPa	0	37	mmHga	4
A2	Absolute	0	50	kPa	0	500	mbar	20
A3	Absolute	0	250	kPa	0	2500	mbar	120
A4	Absolute	0	2500	kPa	0	25	bar	120
A5	Absolute	0	25	MPa	0	250	bar	120
A6	Absolute	0	40	MPa	0	400	bar	120
H2	Differential – High Static Pressure	-50	50	kPa	-500	500	mbar	120
H3	Differential – High Static Pressure	-250	250	kPa	-2500	2500	mbar	120
H4	Differential – High Static Pressure	-2500	2500	kPa	-25	25	bar	120
H5	Differential – High Static Pressure	-25	25	MPa	-250	-250	bar	120

NOTE: The range can be extended up to 0.75 LRL* and 1.2 URL* with small degradation of accuracy.

*LRL = Lower Range Limit.
*URL = Upper Range Limit.

Due to differences in mechanical project, A1 range has turn-down lower than A0 range.

COD	Diaphragm Material and Fill Fluid		COD		
1	316L SST	Silicone Oil **(5)**	M	Monel 400 Gold Plated	Silicone Oil **(1) (3) (5)**
2	316L SST	Inert (Fluorolube Oil) **(2) (9)**	P	Monel 400 Gold Plated	Inert (Krytox Oil) **(1) (3) (9)**
3	Hastelloy C276	Silicone Oil **(1) (5)**	Q	316 L SST	Inert (Halocarbon 4.2 Oil) **(9)**
4	Hastelloy C276	Inert (Fluorolube Oil) **(1) (2) (9)**	R	Hastelloy C276	Inert (Halocarbon 4.2 Oil) **(9)**
5	Monel 400	Silicone Oil **(1)(3)(5)**	S	Tantalum	Inert (Halocarbon 4.2 Oil) **(3) (9)**
7	Tantalum	Silicone Oil **(3) (5)**	I	316L SST, L.I. Gold Plated	Silicone Oil **(3) (5) (8)**
8	Tantalum	Inert (Fluorolube Oil) **(2) (3) (9)**	J	316L SST, L.I. Gold Plated	Inert (Fluorolube Oil) **(3) (4) (8) (9)**
9	316L SST	Fomblim Oil **(6)**	L	316L SST, L.I. Gold Plated	Inert (Krytox Oil) **(3) (8)**
A	Monel 400	Fomblim Oil **(1) (3)**	T	316L SST, L.I. Gold Plated	Inert (Halocarbon 4.2 Oil) **(3) (8) (9)**
D	316 L SST	Inert (Krytox Oil) **(6) (9)**	U	316L SST, L.I.	Silicone Oil **(3) (5) (8)**
E	Hastelloy C276	Inert (Krytox Oil) **(1) (6) (9)**	V	316L SST, L.I.	Inert (Fluorolube Oil) **(3) (4) (8) (9)**
G	Tantalum	Inert (Krytox Oil) **(3) (9)**	W	316L SST, L.I.	Inert (Krytox Oil) **(3) (8)**
K	Monel 400	Inert (Krytox Oil) **(1) (3) (9)**	X	316L SST, L.I.	Inert (Halocarbon 4.2 Oil) **(3) (8) (9)**
				Note: L.I = Integral Steel	

COD	Performance Class		
0	Default	1	High Performance **(7)**

COD	Safety Instrumented		
0	Default – For use in measurement and control	1	SIS - Safety Instrumented Systems **(11)**

400-0837	D2	1	1	0

NOTES

(1) Meets NACE MR – 01 – 75/ISO 15156 recommendations.
(2) Not available for absolute models nor for vacuum applications.
(3) Not available for ranges 0 and 1.
(4) Not recommended for vacuum applications.
(5) Silicone Oil is not recommended for oxygen (O_2) or Chlorine service.
(6) Not available for range 0.
(7) Only available for differential pressure and gage transmitters.
(8) Effective for hydrogen migration processes.
(9) Inert Fluid: Oxygen Compatibility, safe for oxygen service.
(10) The D0 range should not be used for flow measurement.
(11) SIL 1 and SIL 2 (non-redundant) and SIL 3 (redundant) applications.

MODEL	LEVEL SENSOR
400-0837	Smart Pressure Transmitter

COD	TYPE	RANGE LIMITS Min	Max	Unit	Min	Max	Unit	Turn Down Max
L2	Level	-50	50	kPa	-500	500	mbar	120
L3	Level	-250	250	kPa	-2500	2500	mbar	120
L4	Level	-2500	2500	kPa	-25	25	bar	120
L5	Level	-25	25	MPa	-250	250	bar	120

Note: The range can be extended up to 0.75 LRL and 1.2 URL with small degradation of accuracy. The upper range value must be limited to the flange rating.

COD	Diaphragm material and Fill Fluid		COD		
1	316L SST	Silicone Oil **(2)**	M	Monel 400 Gold Plated	Silicone Oil **(1) (2)**
2	316L SST	Inert (Fluorolube Oil) **(3) (16)**	P	Monel 400 Gold Plated	Inert (Krytox Oil) **(1) (16)**
3	Hastelloy C276	Silicone Oil **(1) (2)**	Q	316 L SST	Inert (Halocarbon 4.2 Oil) **(16)**
4	Hastelloy C276	Inert (Fluorolube Oil) **(1) (3) (16)**	R	Hastelloy C276	Inert (Halocarbon 4.2 Oil) **(1) (16)**
5	Monel 400	Silicone Oil **(1) (2)**	S	Tantalum	Inert (Halocarbon 4.2 Oil) **(16)**
7	Tantalum	Silicone Oil **(2)**	I	316L SST, L.I. Gold Plated	Silicone Oil (**2**) (**15**)
8	Tantalum	Inert (Fluorolube Oil) **(3) (16)**	J	316L SST, L.I. Gold Plated	Inert (Fluorolube Oil) (**3**) (**15**) **(16)**
9	316L SST	Fomblim Oil	L	316L SST, L.I. Gold Plated	Inert (Krytox Oil) (**15**) **(16)**
A	Monel 400	Fomblim Oil **(1)**	T	316L SST, L.I. Gold Plated	Inert (Halocarbon 4.2 Oil) (**15**) **(16)**
D	316 L SST	Inert (Krytox Oil) **(16)**	U	316L SST, L.I.	Silicone Oil (**2**) (**15**)
E	Hastelloy C276	Inert (Krytox Oil) **(1) (16)**	V	316L SST, L.I.	Inert (Fluorolube Oil) (**3**) (**15**) **(16)**
G	Tantalum	Inert (Krytox Oil) **(16)**	W	316L SST, L.I.	Inert (Krytox Oil) (15) **(16)**
K	Monel 400	Inert (Krytox Oil) **(1) (16)**	X	316L SST, L.I.	Inert (Halocarbon 4.2 Oil) (**15**) **(16)**

Note: L.I. = Integral Steel

COD.	Performance Class
0	Default

COD.	Safety Instrumented
0	Default – For use in measurement and control
1	SIS - Safety Instrumented Systems **(19)**

COD.	Flange, Adapter and Drain/Vent Valves Material
A	304L SST
P	Plated CS (Drain/Vent in Stainless Steel) **(17)**
H	Hastelloy C276 (CW-12MW, ASTM - A494) **(1)**
I	316 SST - CF8M (ASTM A351)
F	Monel 400 - Laminated bar (HF applications) **(1)**
M	Monel 400 - Micro-cast **(1)**
1	316 SST - CF8M (ASTM A351) (Drain/vent in Hastelloy C276) **(1)**
2	316 SST - CF8M (ASTM A351) Flange with PVDF (Kynar) insert **(3) (4) (5)**

COD.	O'Ring Material
0	Without O-ring
B	Buna-N
E	Ethylene – Propylene
K	Kalrez
T	Teflon
V	Viton

Note: O-rings are not available on the sides with remote seals.

COD.	Drain/Vent Position (Low Side)
0	Without drain/vent
A	Drain/Vent (Opposite to Process Connection)
D	Bottom
U	Top

Note: For better Drain/Vent operation, vent valves are strongly recommended. Drain/Vent valve not available on the sides with remote seals.

COD.	Process Connection (Low Side)
0	1/4 - 18 NPT (Without adapter)
1	1/2- 14 NPT (With adapter) **(9)**
3	Remote Seal (With Plug) **(7)**
5	1/2- 14 NPT Axial with PVDF Insert **(3) (4) (6)**
9	Remote Seal (Low Volume Flange) **(3) (7)**
T	1/2 - 14 BSP (With adapter) **(9)**
U	Reduced Volume Level Flange, Welded
Z	User´s specifications

COD.	Special Applications
0	Without special cleaning
1	Degrease Cleaning (Oxygen or Chlorine Service) **(11)**
2	Applicable for vacuum service

COD.	Flanges Bolts and Nuts Material
P	Plated CS **(17)**
I	316 SST
C	Carbon Steel (ASTM A193 B7M) **(1) (17)**
H	Hastelloy C276

COD.	Flange, Adapter and Drain/Vent Valves Material (Low Side)
0	7/16" UNF (Default)
1	M10 X 1.5
2	M12 X 1.75

COD.	Process Connection (High Side)		
O	1 1/2" 150 # (ANSI B16.5)	R	DN 40 PN10/40 (DIN EN 1092-1)
P	1 1/2" 300 # (ANSI B16.5)	E	DN 50 PN 10/40 (DIN EN 1092-1)
Q	1 1/2" 600 # (ANSI B16.5)	6	DN 80 PN 10/40 (DIN EN 1092-1)
9	2" 150 # (ANSI B16.5)	7	DN 100 PN 10/16 (DIN EN 1092-1)
A	2" 300 # (ANSI B16.5)	8	DN 100 PN 25/40 (DIN EN 1092-1)
B	2" 600 # (ANSI B16.5)	H	10K 100A (JIS B 2220) **(18)**
1	3" 150 # (ANSI B16.5)	F	10K 50A (JIS B 2220) **(18)**
2	3" 300 # (ANSI B16.5)	G	20K 100A (JIS B 2220) **(18)**
C	3" 600 # (ANSI B16.5)	S	20K 50A (JIS B 2220) **(18)**
3	4" 150 # (ANSI B16.5)	L	20K 80A (JIS B 2220) **(18)**
4	4" 300 # (ANSI B16.5)	T	40K 50A (JIS B 2220) **(18)**
D	4" 600 # (ANSI B16.5)	Z	User´s specifications

400-0837	L2	1	0	0	I	B	A	0	1	P	0	1

CONTINUE IN THE NEXT PAGE

400-0837	L2	1	0	0	I	B	A	0	1	P	0	1	Continued from Sensor Main Code

COD	Type and Flange Material (High Side)		
I	316L SST (Integral Flange)	Z	User's specification
H	Hastelloy C276 (Integral Flange)		

COD	Flange Facing Finish
0	Raised Face – RF (Default)
1	Flat Face – FF
2	Ring Joint Face – RTJ (Only available for ANSI standard flange) **(12)**

COD	Extension Length	
0	0 mm (0")	Note: Extension Material 316L SST.
1	50 mm (2")	
2	100 mm (4")	
3	150 mm (6")	
4	200 mm (8")	
Z	User´s specifications	

COD	Diaphragm Material
A	304 L SST
L	316 L SST
H	Hastelloy C276
M	Monel 400
T	Tantalum **(10)**
X	Titanium **(10)**
1	316L SST with Teflon Lining (For 2"and 3")
2	316L SST Gold plated
3	Tantalum with Teflon Lining

COD	Fill Fluid
1	Silicone DC-200/20 Oil
2	Fluorolube MO-10 Oil **(8)**
3	Silicone DC704 Oil
4	Krytox Oil
N	Neobee M20 Propylene Glycol Oil
T	Syltherm 800 Oil
Z	User´s specifications

400-0837	L2	1	0	0	I	B	A	0	1	P	0	1	I	0	1	L	1

TYPICAL MODEL NUMBER

Notes:

(1) Meets NACE MR – 01 – 75/ISO 15156 recommendations.
(1a) MR103
(2) Silicone Oil is not recommended for Oxygen (O2) or Chlorine service.
(3) Not applicable for vacuum service.
(4) Drain/Vent not applicable.
(5) O'Ring should be Viton or Kalrez.
(6) Maximum pressure 24 bar.
(7) For Remote Seal only 316 SST CF8M (ASTM A351) flange is available (thread 7/16 UNF).
(8) Inert fill fluid (Fluorolube) is not available for Monel diaphragm.
(9) Explosion proof approvals do not apply to adapter, only to transmitter.
(10) Attention, check corrosion rate for the process, tantalum plate 0.1 mm, AISI 316L extension 3 to 6mm.
(11) Degrease cleaning not available for carbon steel flanges.
(12) Only enable for flange ASME B16.5.
(13) For this option consult Smar.
(14) Effective for hydrogen migration processes
(15) Inert Fluid: Oxygen Compatibility, safe for oxygen service.
(16) Not applicable for saline atmosphere.
(17) SIL 1 and SIL 2 (non-redundant) and SIL 3 (redundant) applications.

MODEL	SENSOR FOR SANITARY PRESSURE TRANSMITTER
400-0837	Sensor Module

COD.	TYPE	Range Limits Min	Max	Unit	Min	Max	Unit	Turn Down Max
S2	Sanitary	-50	50	kPa	-500	500	mbar	120
S3	Sanitary	-250	250	kPa	-2500	2500	mbar	120
S4	Sanitary	-2500	2500	kPa	-25	25	bar	120
S5	Sanitary	-25	25	MPa	-250	250	bar	120

Note: The range can be extended up to 0.75 LRL and 1.2 URL with small degradation of accuracy. The upper range value must be limited to the flange rating.

COD.	Diaphragm material and Fill Fluid (Low Side)		COD.		
1	316L SST	Silicone Oil **(2)**	3	Hastelloy C276	Silicone Oil **(1) (2)**
2	316L SST	Inert Fluorolube Oil **(3) (12)**	4	Hastelloy C276	Inert Fluorolube Oil **(1) (3) (12)**

COD.	Performance Class3
0	Default

COD.	Safety Instrumented
0	Default – For use in measurement and control
1	SIS - Safety Instrumented Systems **(15)**

COD.	Flange, Adapter and Drain/Vent Valves material
H	Hastelloy C276 (CW-12MW, ASTM - A494)

COD	O'Ring Material
O	Without O-ring
B	Buna-N
E	Ethylene – Propylene
K	Kalrez
T	Teflon (Approved 3A) **(14)**
V	Viton (Approved 3A) **(14)**

Note: O-rings are not available on the sides with remote seals.

COD	Drain/Vent Position
0	Without drain/vent
A	Drain/Vent (Opposite to Process Connection)
D	Bottoms
U	Top

Note: For better Drain/Vent operation, vent valves are strongly recommended. Drain/Vent valve are not available on the sides with remote seals.

COD.	Process Connection (Low Side)
0	1/4 - 18 NPT (Without Adapter)
1	1/2 - 14 NPT (Without Adapter) **(9)**
3	Remote Seal (With Plug) **(7)**
9	Remote Seal (Low Volume Flange)
T	1/2 – 14 BSP (With adapter) **(9)**
U	Level Flange with Welded Plug
Z	User´s specifications

COD.	Specials Applications
0	Without special cleaning
1	Degrease Cleaning (Oxygen or Chlorine Service) **(10)**
2	Applicable for vacuum service.

COD.	Flanges Bolts and Nuts Material
P	Plated CS **(13)**
I	316 SST
C	Carbon Steel (ASTM A193 B7M) **(1) (13)**
H	Hastelloy C276

COD.	Flange thread for fixing accessories (adapters, manifolds, mounting brackets, etc)
0	7/16" UNF
1	M10 X 1.5
2	M12 X 1.75

400-0837	S2	1	0	0	H	B	D	0	0	P	0

CONTINUE IN THE NEXT PAGE

400-0837	S2	1	0-	0	H	B	D	0	0	P	0	Continued from sanitary sensor main code

COD.	Process Connections
8	DN25 DIN 11851 – WITH EXTENSION/316 SST
9	DN40 DIN 11851 - WITH EXTENSION/316 SST
H	DN40 DIN 11851 – 316 SST
V	THREAD DN50 DIN 11851 - WITH EXTENSION/316 SST
U	THREAD DN50 DIN 11851 - WITHOUT EXTENSION/316 SST
X	THREAD DN80 DIN 11851 - WITH EXTENSION/316 SST
W	THREAD DN80 DIN 11851 - WITHOUT EXTENSION/316 SST
4	THREAD IDF 2" - WITH EXTENSION/316 SST
B	THREAD IDF 2" - 316 SST
K	THREAD IDF 3" - WITH EXTENSION/316 SST
3	THREAD IDF 3" - WITHOUT EXTENSION/316 SST
5	THREAD RJT 2" - - WITH EXTENSION/316 SST
C	THREAD RJT 2" - 316 SST
L	THREAD RJT 3" - WITH EXTENSION/316 SST
2	THREAD RJT 3" - WITHOUT EXTENSION/316 SST
S	THREAD SMS 1 1/2" - 316 SST
7	THREAD SMS 2" - - WITH EXTENSION/316 SST
E	THREAD SMS 2" - 316 SST
M	THREAD SMS 3" - - WITH EXTENSION/316 SST
1	THREAD SMS 3" - - WITHOUT EXTENSION/316 SST
F	TRI CLAMP 1 1/2" - 316 SST
Q	TRI CLAMP 1 1/2" HP (High Pressure) - 316 SST
6	TRI CLAMP 2" - - WITH EXTENSION/316 SST
D	TRI CLAMP 2" - 316 SST
N	TRI CLAMP 2" HP (High Pressure) - - WITH EXTENSION/316 SST
P	TRI CLAMP 2" HP (High Pressure) - 316 SST
I	TRI CLAMP 3" - - WITH EXTENSION/316 SST
G	TRI CLAMP 3" - 316 SST
J	TRI CLAMP 3" HP (High Pressure) - - WITH EXTENSION/316 SST
R	TRI CLAMP 3" HP (High Pressure) - 316 SST
A	TRI CLAMP DN50 - - WITH EXTENSION/316 SST
O	TRI CLAMP DN50 HP (High Pressure) - - WITH EXTENSION/316 SST
T	TRI-CLAMP DN50 - 316 SST
Z	User´s specifications

COD.	O-Rings Materials (High Side)
0	Without O-ring (Supplied by Client)
B	Buna N
K	Kalrez
T	Teflon (Approved 3A) **(14)**
V	Viton (Approved 3A) **(14)**
Z	User´s specifications

COD.	Diaphragm Material (High Side)
L	316L SST
H	Hastelloy C276

COD.	Fill Fluid (High Side)
1	Silicone DC-200/20 Oil
2	Fluorolube MO-10 Oil (3)
3	Silicone Oil DC704
4	Krytox Oil
N	Neobee M20 Propylene Glycol Oil (Approved 3A)
T	Syltherm 800 Oil
Z	User´s specifications

400-0837	S2	1	0	0	H	B	D	0	0	P	0	4	B	L	1	TYPICAL MODEL NUMBER

Notes:

(1) Meets NACE MR – 01 – 75/ISO 15156 recommendations.
(2) Silicone Oil is not recommended for Oxygen or Chlorine service.
(3) Not applicable for vacuum service.
(4) Drain/Vent not applicable.
(5) O'Ring should be Viton or Kalrez.
(6) For Remote Seal only 316 SST CF8M (ASTM A351) flange is available (thread 7/16 UNF).
(7) Explosion proof approvals do not apply to adapter, only to transmitter.
(8) Degrease cleaning not available for carbon steel flanges.
(9) Effective for hydrogen migration processes.
(10) Inert Fluid: safe for oxygen service.
(11) Not applicable for saline atmosphere.
(12) SIL 1 and SIL 2 (non-redundant) and SIL 3 (redundant) applications.

HART® Special Units

VARIABLE	CODE	UNIT	DESCRIPTION
Pressure	1	inH_2O (68ºF)	inches of water at 68 degrees F
	2	inHg (0ºC)	inches of mercury at 0 degrees C
	3	ftH_2O (68ºF)	feet of water at 68 degrees F
	4	mmH_2O (68ºF)	millimeters of water at 68 degrees F
	5	mmHg (0ºC)	millimeters of mercury at 0 degrees C
	6	lb/in^2	pounds per square inch
	7	bar	bars
	8	mbar	millibars
	9	gf/cm^2	Gram force per square centimeter
	10	kgf/cm^2	Kilogram force per square centimeter
	11	Pa	pascals
	12	kPa	kilopascals
	13	torr	torr
	14	atm	atmospheres
	145	inH^2O (60ºF)	inches of water at 60 degrees F
	237	MPa	megapascals
	238	inH^2O (4ºC)	inches of water at 4 degrees C
	239	mmH^2O (4ºC)	millimeters of water at 4 degrees C
VOLUMETRIC FLOW	15	CFM	cubic feet per minute
	16	GPM	gallons per minute
	17	l/min	liters per minute
	18	ImpGal/min	imperial gallons per minute
	19	m^3/h	cubic meters per hour
	22	gal/s	gallons per second
	23	Mgal/d	million gallons per day
	24	l/s	liters per second
	25	Ml/d	million liters per day
	26	ft^3/s	cubic feet per second
	27	ft^3/d	cubic feet per day
	28	m^3/s	cubic meters per second
	29	m^3/d	cubic meters per day
	30	ImpGal/h	imperial gallons per hour
	31	ImpGal/d	imperial gallons per day
	121	Nm^3/h	normal cubic meters per hour
	122	Nl/h	normal liters per hour
	123	ft^3/min	standard cubic feet per minute
	130	CFH	cubic feet per hour
	131	m^3/h	cubic meters per hour
	132	bbl/s	barrels per second
	133	bbl/min	barrels per minute
	134	bbl/h	barrels per hour
	135	bbl/d	barrels per day
	136	gal/h	gallons per hour
	137	ImpGal/s	imperial gallons per second
	138	l/h	liters per hour
	235	gal/d	gallons per day

VARIABLE	CODE	UNIT	DESCRIPTION
VELOCITY	20	ft/s	feet per second
	21	m/s	meters per second
	114	in/s	inches per second
	115	in/min	inches per minute
	116	ft/min	feet per minute
	120	m/h	meters per hour
TEMPERATURE	32	ºC	degrees Celsius
	33	ºF	degrees Fahrenheit
	34	ºR	degrees Rankine
	35	K	degrees Kelvin
ELECTROMAGNETIC FORCE	36	mV	millivolts
	58	V	volts
ELECTRIC RESISTANCE	37	ohm	ohms
	163	kohm	kilo ohms
ELECTRIC CURRENT	39	mA	milliamperes
VOLUME	40	gal	gallons
	41	l	liters
	42	ImpGal	imperial gallons
	43	m^3	cubic meters
	46	bbl	barrels
	110	bushel	bushels
	111	yd^3	cubic yards
	112	ft^3	cubic feet
	113	in^3	cubic inches
	124	bbl(liq)	liquid barrels
	166	Nm^3	normal cubic meter
	167	Nl	normal liter
	168	SCF	standard cubic feet
	236	hl	hectoliters
LENGTH	44	ft	feet
	45	m	meters
	47	in	inches
	48	cm	centimeters
	49	mm	millimeters
	151	$ftin^{16}$	feet in sixteenths
TIME	50	min	minutes
	51	s	seconds
	52	h	hours
	53	d	days
MASS	60	g	grams
	61	kg	kilograms
	62	t	metric tons
	63	lb	pounds
	64	Shton	short tons (2000 pounds)
	65	Lton	long tons (2240 pounds)
	125	oz	ounce

VARIABLE	CODE	UNIT	DESCRIPTION
VISCOSITY	54	cSt	centistokes
	55	cP	centipoises
ENERGY (INCLUDES WORK)	69	N-m	newton meter
	89	decatherm	deka therm
	126	ft-lb	foot pound force
	128	KWH	kilo watt hour
	162	Mcal	mega calorie
	164	MJ	mega joule
	165	Btu	british thermal unit
MASS FLOW	70	g/s	grams per second
	71	g/min	grams per minute
	72	g/h	grams per hour
	73	kg/s	kilograms per second
	74	kg/min	kilograms per minute
	75	kg/h	kilograms per hour
	76	kg/d	kilograms per day
	77	t/min	metric tons per minute
	78	t/h	metric tons per hour
	79	t/d	metric tons per day
	80	lb/s	pounds per second
	81	lb/min	pounds per minute
	82	lb/h	pounds per hour
	83	lb/d	pounds per day
	84	Shton/min	short tons per minute
	85	Shton/h	short tons per hour
	86	Lton/d	short tons per day
	87	Lton/h	long tons per hour
	88	Lton/d	long tons per day
MASS PER VOLUME	90	SGU	specific gravity units
	91	g/cm^3	grams per cubic centimeter
	92	kg/m^3	kilograms per cubic meter
	93	lb/gal	pounds per gallon
	94	lb/ft^3	pounds per cubic foot
	95	g/ml	grams per milliliter
	96	kg/l	kilograms per liter
	97	g/l	grams per liter
	98	lb/in^3	pounds per cubic inch
	99	ton/yd^3	short tons per cubic yard
	100	degTwad	degrees twaddell
	102	degBaum hv	degrees Baume heavy
	103	degBaum lt	degrees Baume light
	104	deg API	degrees API
	146	µg/l	micrograms per liter
	147	$µg/m^3$	micrograms per cubic meter
	148	%Cs	percent consistency

VARIABLE	CODE	UNIT	DESCRIPTION
ANGULAR VELOCITY	117	°/s	degrees per second
	118	rev/s	revolutions per second
	119	RPM	revolutions per minute
POWER	127	kW	kilo watt
	129	hp	horsepower
	140	Mcal/h	mega calorie per hour
	141	MJ/h	mega joule per hour
	142	Btu/h	British thermal unit per hour
MISCELLANEOUS	38	Hz	hertz
	56	μS	micro siemens
	57	%	percent
	59	pH	pH
	66	mS/cm	milli siemens per centimeter
	67	μS/cm	micro siemens per centimeter
	68	N	Newton
	101	degbrix	degrees brix
	105	%sol/wt	percent solids per weight
	106	%sol/vol	percent solids per volume
	107	degBall	degrees balling
	108	proof/vol	proof per volume
	109	proof/mass	proof per mass
	139	ppm	parts per million
	143	°	degrees
	144	rad	radian
	149	%vol	volume percent
	150	%stm qual	percent steam quality
	152	ft^3/lb	cubic feet per pound
	153	pF	picofarads
	154	ml/l	milliliters per liter
	155	μl/l	microliters per liter
	160	% plato	percent plato
	161	LEL	percent lower explosion level
	169	ppb	parts per billion
GENERIC	240 to 249	-	May be used for manufacturer specific definitions
	250	-	Not Used
	251	-	None
	252	-	Unknown
	253	-	Special

Section 7

SAFETY INSTRUMENTED SYSTEMS

Introduction

WARNING
LD400 HART ® SIS has the housing cover in red to distinguish them from the standard model.

LD400 HART® SIS is an intelligent pressure transmitter used for differential, absolute, gauge, level and flow measurements in safety applications. **LD400 HART® SIS** outputs a 4 to 20 mA DC signal corresponding to the pressure applied. This information is transmitted to a safety PLC and can be shown on the LCD display or remotely monitored via HART communication. **LD400 HART® SIS** is certified by TÜV for safety applications.

WARNING
The SIS project must be carried by a professional duly qualified for this type of work.

Safety Standard

LD400 HART® SIS satisfies the requirements of the standards shown in the Table 7.1.

Standard	Description
IEC 61508: 2010	Functional safety of E/E/PE safety-related systems.
IEC 61326-1:2012	Electrical equipment for measurement, control and laboratory use - EMC requirements – Part 1 General Requirements.
IEC 61000-6-7:2014	Electromagnetic compatibility (EMC) – Part 6-7: Generic standards – Immunity requirements for equipment intended to perform functions in a safety-related system (functional safety) in industrial locations.
IEC 61298:2008	Process measurement and control devices - General Methods and procedures for evaluating performance.
IEC 60770:2010	Transmitters for use in industrial-process control systems - Methods for performance evaluation and for inspection and routine testing.
IEC 61010:2017	Safety requirements for electrical equipment for measurement, control and laboratory use.
ANSI/NEMA-250:2018	Enclosures for Electrical Equipment and IEC 60529:2013 Degrees of protection provided by enclosures (IP Code).

Table 7.1 – Safety Standards

Application Standards

Standard	Description
IEC 61511:2018	Functional safety - Safety instrumented systems for the process industry sector.
ANSI/ISA 61511:2018	Functional safety - Safety instrumented systems for the process industry sector.
IEC 60079-0:2017	Explosive atmospheres – Part 0: Equipment – General requirements
IEC 60079-1:2017	Explosive atmospheres – Part 1: Equipment protection by flameproof enclosures “d”
IEC 60079-7:2017	Explosive atmospheres – Part 7: Equipment protection by increased safety “e”
IEC 60079-11:2017	Explosive atmospheres – Part 11: Equipment protection by intrinsic safety “i”
FMRC-3600:2018	Electrical Equipment for use in Hazardous (Classified) Locations - General Requirements.
FMRC-3610:2018	Intrinsically Safe Apparatus and Associated Apparatus for use in Class I, II and III, Division 1 Hazardous Location.
FMRC-3611:2018	Electrical Equipment for use in Class I, Division 2; Class II, Division 2; and Class III, Division 1 and 2 Hazardous Location.
FMRC-3615:2018	Explosionproof Electrical Equipment General Requirements.
FMRC-3810:2018	Electrical Equipment for Measuring, Control and Laboratory Use.

Table 7.2 – Application Standards

Safety Function

The **LD400 HART® SIS** transmitter measures the pressure within the safety accuracy and converts it in a 4-20 mA analog output using the selected output transfer function and the output current is treated according to NAMUR NE-43 specification. In case of sensor or circuit failure, the implemented self-diagnoses (software or hardware) drive the output to below 3.6 or above 21 mA that are the device safe states defined to this equipment.

In the normal circumstance it takes about 280 msecs to read the pressure within the specified resolution (response time) and about 80 msecs for pressure with high change rates.

In order to judge the failure behavior of the **LD400 HART® SIS**, the following definitions for the product were considered:

Failure	Description
Safe State	It is considered the state when the output current is out of the valid range, therefore lower than 3.8 mA or higher than 20.5 mA;
Safe Failure	Failure that leads the system to a safe state, without a process demand;
Dangerous Failure	Failure that leads the system to a dangerous condition, in other words, the transmitter will output a current out of the safety specification;
Undetected Failure	Failure that cannot be detected by the online diagnostics;
Detected Failure	Failure that can be detected by the online diagnostics.

Table 7.3 – Failure Modes

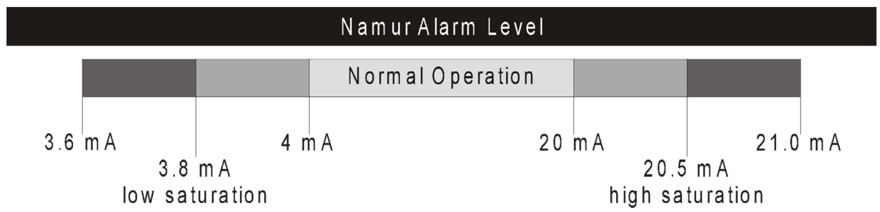


Figure 7.1 – Alarm Levels

Functional Safety Properties

The Table 7.4 shows the Functional Safety Values obtained for **LD400 HART® SIS**.

OPERATION MODE	LOW DEMAND
TYPE	B
SFF	96.51%
LAMBDA SD (FITS)	19.63
LAMBDA SU (FITS)	269.21
LAMBDA DD (FITS)	233.85
LAMBDA DU (FITS)	18.90
PFD AVG FOR 20 YEARS PROOF TEST INTERVAL	1.7 E-03
TRANSMITTER LIFETIME	20 YEARS
SAFETY INTEGRITY LEVEL (SIL)	SIL 2 (HFT=0) SIL 3 (HFT=1)

Table 7.4 – Functional Safety Values

Environmental Properties

Refer to the Section 3 Technical Characteristics for the proper environmental instructions.

Installation

Refer to the Section 1 Installation for the proper installation instructions.

Modes of Operation

The **LD400 HART® SIS** Transmitter has two modes of operation:

- **Configuration Mode**

This is the mode used for the configuration of the transmitter. In this mode the transmitter will accept HART write commands and local adjust. To enter in this mode, the user must follow the Configuration Mode Enabling Procedure that is explained in this SAFETY MANUAL.

WARNING
It is highly recommended that the user does not use the transmitter for SIS applications while it is in the Configuration Mode.

- **SIS Mode**

In the SIS Mode the **LD400 HART® SIS** is enabled to work only as measurement equipment. In this mode no changes on configuration are allowed. Not even the hardware jumpers can be able to change transmitter parameters and only the Hart read commands are permitted in SIS Mode the following applies:

- HART Protocol: only the READ commands are available;
- Multidrop Mode: is available, but will not stay with fixed current;
- PID: not available for the **LD400 HART® SIS** Transmitter;
- Hardware Jumpers: no action in SIS mode;
- DAMPING: User-selected damping will affect the transmitters ability to respond to changes in the applied process. The damping value + response time should not exceed the loop requirements.

WARNING
The SIS mode is recognized either by reading the transmitter settings or by looking the icon on the display (⇔). In the configuration mode this icon will be blinking and in safety mode this icon will be stopped.

WARNING
The Safety Function of the transmitter does not depend on the value in the display. This value is for information purposes only.

Configuration Mode Enabling Procedure

To change the transmitter to the configuration mode:

- Set the Write Protection jumper in the OFF position;
- Choose the appropriate Local Adjustment Mode (COMPLETE or SIMPLE);
- Reset the transmitter if it is turned on or turn it on if it is not powered.

To return the transmitter to the SIS Mode:

- Set the Write Protection jumper in the ON position;
- Choose the appropriate Local Adjustment Mode in OFF
- Reset the transmitter if it is turned on or turn it on if it is not powered.

Refer to the Table 5.1 - Section 5 Programming Using Local Adjustment for the proper main board jumpers' instructions.

LD400 HART® SIS Technical Characteristics

The **LD400 HART® SIS** must be operated according to functional and performance specifications described in this manual - Section 3, with the following exceptions:

Functional Specifications

Turn Down Limits

MODEL	TURN DOWN
D0	10:1
D1	10:1
D2	20:1
D3	20:1
D4	20:1
H2	20:1
H3	20:1
H4	20:1
H5	20:1
M0	10:1
M1	10:1
M2	20:1
M3	20:1
M4	20:1
M5	20:1
M6	20:1
G2	20:1

MODEL	TURN DOWN
G3	20:1
G4	20:1
G5	20:1
A1	4:1
A2	10:1
A3	20:1
A4	20:1
A5	20:1
L2	10:1
L3	20:1
L4	20:1
L5	20:1
S2	20:1
S3	20:1
S4	20:1
S5	20:1

Performance Specifications

Reference Accuracy

OBS.:

a) Reference accuracy includes the linearity effects, hysteresis and repeatability of the hardware and sensor;

b) Reference Conditions: Span starting at 0 of pressure, with digital trim at the lower and upper range values of measure; temperature of 25 ºC; atmospheric pressure; power supply voltage of 24 Vdc; and silicone oil fill fluid and isolating diaphragms in 316 L SST.

- Accuracy for ranges D2, D3, D4, M2, M3 or M4 (10:1):

  ± [0.06] % of the span, for 0.2 URL ≤ span ≤ URL

  ± [0.04 + 0.004 URL/span] % of the span, for 0.1 URL ≤ span ≤ 0.2 URL

- Accuracy for ranges D1 or M1 (5:1): ± [0.065] % of the span

- Accuracy for range M5 (10:1):

  ± [0.065] % of the span, for 0.2 URL ≤ span ≤ URL

  ± [0.044 + 0.0042 URL/span] % of the span, for 0.1 URL ≤ span ≤ 0.2 URL

- Accuracy for range M6 (10:1):

  ± [0.075] % of the span, for 0.2 URL ≤span ≤ URL

  ± [0.054 + 0.0042 URL/span] % of the span, for 0.1 URL ≤ span ≤ 0.2 URL

- Accuracy for range A1 (5:1): ± [0.075 + 0.0015URL/span] % of the span

- Accuracy for range A2 (10:1):

  ± [0.08] % of the span, for 0.2 URL ≤span ≤ URL

  ± [0.056 + 0.0048 URL/span] % of the span, for 0.1 URL ≤ span ≤ 0.2 URL

- Accuracy for ranges A3 or A4 (10:1):

  ± [0.075] % of the span, for 0.2 URL ≤span ≤ URL

  ± [0.052 + 0.0046 URL/span] % of the span, for 0.1 URL ≤ span ≤ 0.2 URL

- Accuracy for range A5 (10:1):

  ± [0.08] % of the span, for 0.2 URL ≤span ≤ URL

  ± [0.057 + 0.0046 URL/span] % of the span, for 0.1 URL ≤ span ≤ 0.2 URL

- Accuracy for range A6 (10:1):

  ± [0.08] % of the span, for 0.2 URL ≤span ≤ URL

  ± [0.0565 + 0.0047 URL/span] % of the span, for 0.1 URL ≤ span ≤ 0.2 URL

<table>
<tr><td></td><td>

Accuracy for ranges H2, H3 or H4 (10:1):
± [0.07] % of the span, for 0.2 URL ≤span ≤ URL
± [0.047 + 0.0046 URL/span] % of the span, for 0.1 URL ≤ span ≤ 0.2 URL
Accuracy for range H5 (10:1):
± [0.075] % of the span, for 0.2 URL ≤span ≤ URL
± [0.0515 + 0.0047 URL/span] % of the span, for 0.1 URL ≤ span ≤ 0.2 URL
Accuracy for ranges L2, L3, L4 or L5 (10:1):
± [0.08] % of the span, for 0.2 URL ≤span ≤ URL
± [0.0565 + 0.0047 URL/span] % of the span, for 0.1 URL ≤ span ≤ 0.2 URL
The accuracy for special assembling of the transmitter, different of the above stated condition, must be specified in detail in the product manual.

</td></tr>
<tr><td>Reference Temperature Effect</td><td>
For standard flange models:
OBS.: Reference Condition: Span starting at 0 of pressure, with digital trim at the lower and upper range values of measure done at temperature of 20 ºC; atmospheric pressure; power supply voltage of 24 Vdc; silicone oil fill fluid and isolating diaphragms in 316 L SST.
For the calculation of the deviation in temperature, never consider step lower than 20 ºC. The temperature cycle recommended is: 20 ºC (reference); 40 ºC; 60 ºC; 20 ºC; 0 ºC; -20 ºC; e 20 ºC.

Temperature effect for ranges 2, 3, 4, 5 or 6, except level or sanitary models:
± (0.0795 + 0.0205 * URL/span) % of the span, for 20 °C for 0.1 URL ≤ span ≤ URL;
± (0.0345 + 0.025 * URL/span) % of the span, for 20 °C for 0.05 URL ≤ span ≤ 0.1 URL
Temperature effect for range 1:
± (0.08 + 0.05 * URL/span) % of the span, for 20°C
Temperature effect for range 0:
± (0.1 + 0.1 * URL/span) % of the span, for 20°C
The temperature effect for special assembling of the transmitter, different of the above stated condition, must be specified in detail in the product manual.

For In-Line gauge models:

Temperature effect for ranges 2, 3, 4 and 5:
± (0.0795 + 0.0205 * URL/span) % of the span, for 20 °C for 0.1 URL ≤ span ≤ URL;
± (0.0345 + 0.025 * URL/span) % of the span, for 20 °C for 0.05 URL ≤ span ≤ 0.1 URL

For flush diaphragm models:

With flange of 4” and DN100: 6 mmH2O for 20 °C
With flange of 3” and DN80: 17 mmH2O for 20 °C

</td></tr>
<tr><td>Stabilization time after the power up</td><td>

Less than 5 seconds for hot start up.
Less than 30 seconds for cold start up;

</td></tr>
</table>

Maintenance

The maintenance of **LD400 HART® SIS** must be done according to the specifications described in the Section 6.

All maintenance services must be done by qualified personnel. Parts replacements must be supplied by Smar.

WARNING
The firmware download should not be made in the field.

Appendix A

CERTIFICATIONS INFORMATION

European Directive Information

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

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

ATEX Directive 2014/34//EU - "Equipment for explosive atmospheres"
The EC-Type Examination Certificate is released by DNV Product Assurance AS (CE2460) and DEKRA EXAM GmbH (CE0158).
Designated certification body that monitors manufacturing and released QAN (Quality Assurance Notification) and QAR (Quality Assessment Report) is Nemko AS (CE0470).

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

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

ROHS Directive 2011/65/EU - "Restriction of the use of certain hazardous substances in electrical and electronic equipment"
For the evaluation of the products the following standards were consulted: EN 50581

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

Immunity test requirements:
IEC 61000-4-2 Electrostatic discharge immunity test
IEC 61000-4-3 Radiated, radiofrequency, electromagnetic field immunity test
IEC 61000-4-4 Electrical fast transient/burst immunity test
IEC 61000-4-5 Surge immunity test
IEC 61000-4-6 Immunity to conducted disturbances, induced by radio-frequency fields
IEC 61000-4-8 Power frequency
IEC 61000-4-11 Voltage dips short interruptions and voltage variations immunity tests

Emission test requirements:
IEC 61000-3-2 Limits for harmonic current emissions (equipment input current ≤ 16 A per phase)
IEC 61000-3-3 Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current ≤ 16 A per phase and not subject to conditional connection
CISPR11 Industrial, scientific, and medical equipment - Radio-frequency disturbance characteristics - Limits and methods of measurement.

Hazardous locations general information

Ex Standards:
IEC 60079-0 General Requirements
IEC 60079-1 Flameproof Enclosures “d”
IEC 60079-7 Increased Safe “e”
IEC 60079-11 Intrinsic Safety “i”
IEC 60079-18 Encapsulation “m”
IEC 60079-26 Equipment with equipment protection level (EPL) Ga
IEC 60079-31 Equipment dust ignition protection by enclosure "t"
IEC 60529 Classification of degrees of protection provided by enclosures (IP Code)
IEC 60079-10 Classification of Hazardous Areas
IEC 60079-14 Electrical installation design, selection and erection
IEC 60079-17 Electrical Installations, Inspections and Maintenance
IEC 60079-19 Equipment repair, overhaul and reclamation
ISO/IEC80079-34 Application of quality systems for equipment manufacture

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

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

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

Instrinsic Safety / Non Incendive application
In hazardous areas with intrinsic safety or or non-incendive requirements, the circuit entity parameters and applicable installation procedures must be observed.
The instrument must be connected to a proper intrinsic safefy barrier. Check the intrinsically safe parameters involving the barrier and equipment including the cable and connections. Associated apparatus ground bus shall be insulated from panels and mounting enclosures. Shield is optional, when using shielded cable, be sure to insulate the end not grounded.
Cable capacitance and inductance plus Ci and Li must be smaller than Co and Lo of the Associated Apparatus. It is recommended do not remove the housing covers when powered on.

Explosionproof / Flameproof application
Only use Explosionproof/Flameproof certified Plugs, Adapters and Cable glands.
The electrical connections entries must be connected using a conduit with sealed unit or closed using metal cable gland or metal blanking plug with at least IP66. Do not remove the housing covers when powered on.

Enclosure
The electronic housing and sensor threads installed in hazardous areas must have a minimum of 6 fully engaged threads.
The covers must be tightening with at least 8 turns, to avoid the penetration of humidity or corrosive gases, and until it touches the housing. Then, tighten more 1/3 turn (120º) to guarantee the sealing.
Lock the housing and covers using the locking screw.
The enclosure contains aluminum and is considered to present a potential risk of ignition by impact or friction.
Care must be taken during installation and use to prevent impact or friction.

Degree of Protection of enclosure (IP)
IPx8: Second numeral meaning continuous immersion in water under special condition defined as 10m for a period of 24 hours (Ref: IEC60529).
IPW/ TypeX: Supplementary letter W or X meaning special condition defined as saline environment tested in saturated solution of NaCl 5% w/w at 35ºC for a period of 200 hours (Ref: NEMA 250/ IEC60529).
For enclosure with IP/IPW/TypeX applications, all NPT threads must apply a proper water-proof sealant (a non-hardening silicone group sealant is recommended).

Safety Approval

TUV SUD
LD400 HART SIS
Safety components
Smar Pressure transmitters

Certificate No. Z10 070430 0003

Parameters:	Pressure range:	Up to 40 MPa
	Mode of operation:	Low demand
	Output:	4-20mA
	Hardware Fault Tolerance	0 - SIL 2
	Hardware Fault Tolerance	1 - SIL 3

Tested According to: IEC 61508 part 1 to 7; IEC 61511; IEC 61010-1; IEC 61326-1; IEC 61326-3-2
Test report no.: SS82601T

Hazardous Locations Approvals

DNV Product Assurance AS
Explosion Proof (DNV 22 ATEX 34311X)

II - / 2G Ex db IIC T6 Gb
Voltage = 28 VDC, Current = 157 mA
Ambient Temperature: -20 ºC to 60 ºC

Special Condition for Safe Use “X”:
Repairs of the flameproof joints must be made in compliance with the structural specifications provided by the manufacturer. Repairs must not be made on the basis of values specified in tables 3 of EN/IEC 60079-1.
For cover and sensor thread form and quality of fit, contact the manufacturer for proper details.

For maintaining the explosion protection, the manual that accompany the products shall be considered.
Type Designation: LD400-***-X1*-*****-***-X2**-X3X4D2*/*
X1 = Communication Protocol (H - HART® & 4 to 20 mA)
X2 = Electrical connection (0 = ½ - 14NPT; A = M20x1,5)
X3 = Housing material (A and B = Aluminum, I and J = 316 SST)
X4 = Painting (0 = Gray Munsell N 6,5 Polyester, 8 = Without Painting, 9 = Safety Blue Epoxy - Electrostatic Painting, C = Safety Blue Polyester – Electrostatic)

The marking used indicates that the equipment is Flameproof enclosure, able to work into an environment other than mines (II), operated in both non-hazardous area (–) and where explosive atmospheres are likely to occur (2) around gases/vapors (G).
The type of protection is flameproof enclosure (Ex d), able to work in places with an explosive gas atmosphere susceptible to firedamp (II) into an environment with gases from group IIC (typical gas is hydrogen).
The ambient temperature range is from -20ºC to 60ºC and the maximum superficial temperature of the equipment in normal operation or overload conditions is 85ºC (T6), so the environment around the equipment can manage gases where the auto ignition temperature is higher than 85ºC.
The equipment protection level is Gb, having a "high" level of protection, which is not a source of ignition in normal operation or during expected malfunctions.

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

Drawing 102A-1916, 102A-1917, 102A-1918, 102A-1919, 102A-1920, 102A-1921, 102A-1922, 102A-1923, 102A-1924, 102A-1925

CEPEL (Centro de Pesquisa de Energia Elétrica)
Prova de Explosão (CEPEL 06.1214X)

<table>
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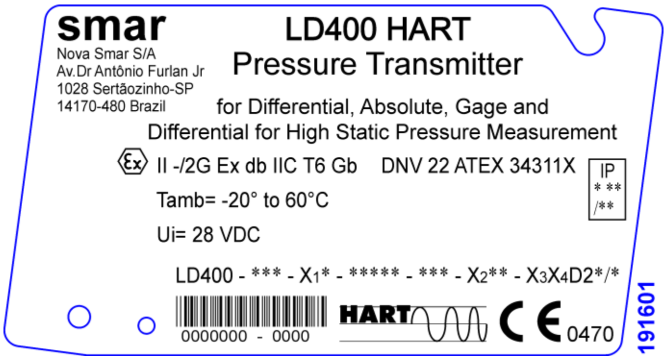
Ex db IIC T* Ga/Gb</td><td colspan="2">CEPEL 06.1214X
Ex tb IIIC T* Db</td></tr>
<tr><td>IP66W/IP68W</td><td>IP66/IP68</td><td>IP66W/IP68W</td><td>IP66/IP68</td></tr>
<tr><td colspan="2">T_{amb}: -20 °C a +85 °C para T5
T_{amb}: -20 °C a +70 °C para T6</td><td colspan="2">T_{amb}: -20 °C a +85 °C para T100ºC
T_{amb}: -20 °C a +70 °C para T85ºC</td></tr>
<tr><td colspan="2">Ou</td><td colspan="2">Ou</td></tr>
<tr><td colspan="2">CEPEL 06.1214X
Ex db e mb IIC T* Ga/Gb</td><td colspan="2">CEPEL 06.1214X
Ex tb IIIC T* Db</td></tr>
<tr><td>IP66W/IP68W</td><td>IP66/IP68</td><td>IP66W/IP68W</td><td>IP66/IP68</td></tr>
<tr><td colspan="2">T_{amb}: -20 °C a +85 °C para T5
T_{amb}: -20 °C a +70 °C para T6</td><td colspan="2">T_{amb}: -20 °C a +85 °C para T100ºC
T_{amb}: -20 °C a +70 °C para T85ºC</td></tr>
</table>

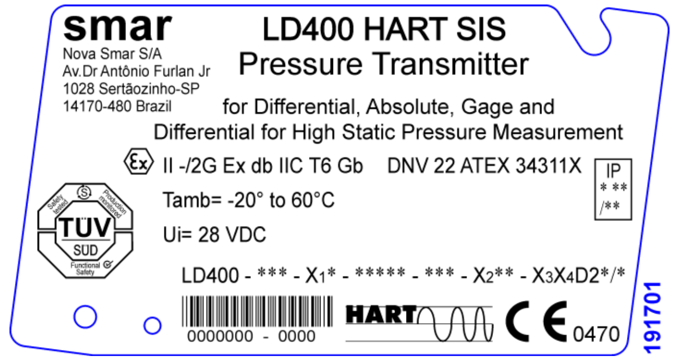
Observações:
O número do certificado é finalizado pela letra “X” para indicar que:
- Durante a instalação do equipamento é de responsabilidade do usuário, utilizar o cabo e prensa-cabo adequado quando o equipamento for instalado em ambiente com temperatura maior do que 80 ºC.
- O produto adicionalmente marcado com a letra suplementar "W" indica que o equipamento foi ensaiado em uma solução saturada a 5% de NaCl p/p, à 35 °C, pelo tempo de 200 h e foi aprovado para uso em atmosferas salinas, condicionado à utilização de acessórios de instalação no mesmo material do equipamento e de bujões de aço inoxidável ASTM-A240, para fechamento das entradas roscadas não utilizadas. Os materiais de fabricação dos equipamentos aprovados para letra "W" são: aço inoxidável AISI 316 e alumínio Copper Free SAE 336 pintados (Procedimento P-CQ-FAB764-09) com tinta Resina Poliéster ou Resina Epoxy com espessura da camada de tinta de 70 a 150 µm e 120 a 200 µm, respectivamente, ou pintados com o plano de pintura P1 e P2 (Procedimento P-CQ-FAB-765-05) com tinta Resina Epoxy ou Poliuretano Acrílico Alifático com espessura de camada de tinta de 290 µm a 405 µm e 185 µm a 258 µm, respectivamente.
- Os planos de pintura P1 e P2 são permitidos apenas para equipamento fornecido com plaqueta de identificação com marcação para grupo de gases IIB.
- O grau de proteção IP68 só é garantido se nas entradas roscadas de ½” NPT for utilizado vedante não endurecível à base de silicone conforme Procedimento P-DM-FAB277-06.
- O segundo numeral oito indica que o equipamento foi ensaiado para uma condição de submersão de dez metros por vinte e quatro horas. O acessório deve ser instalado em equipamentos com grau de proteção equivalente.
- Equipamentos com tipo de proteção Ex d aprovados para categoria Gb, não podem ter o sensor de pressão instalados em processos industriais classificadas como "Zona 0".
- As atividades de instalação, inspeção, manutenção, reparo, revisão e recuperação dos equipamentos são de responsabilidade dos usuários e devem ser executadas de acordo com os requisitos das normas técnicas vigentes e com as recomendações do fabricante.

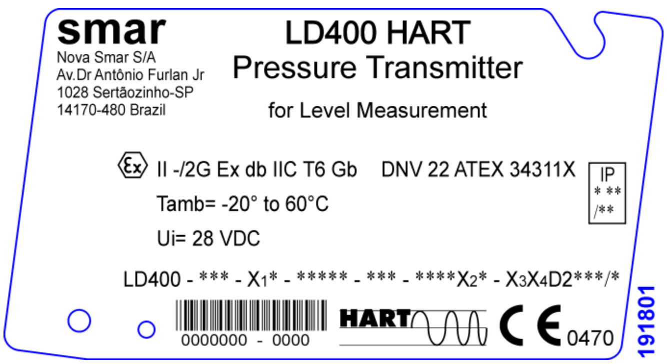
Normas Aplicáveis:
ABNT NBR IEC 60079-0:2020 Atmosferas explosivas - Parte 0: Equipamentos – Requisitos gerais
ABNT NBR IEC 60079-1:2016 Atmosferas explosivas - Parte 1: Proteção de equipamento por invólucro à prova de explosão “d”
ABNT NBR IEC 60079-7:2008 atmosferas explosivas - Parte 7: Proteção de equipamentos por segurança aumentada “e”
ABNT NBR IEC 60079-18:2016 Atmosferas explosivas - Parte 18: Construção, ensaios e marcação do tipo de proteção para equipamentos elétricos encapsulados - “m”
ABNT NBR IEC 60079-31:2014 Atmosferas explosivas - Parte 31: Proteção de equipamentos contra ignição de poeira por invólucros “t”
ABNT NBR IEC 60529:2017 Graus de proteção para invólucros de equipamentos elétricos (Código IP)
Desenhos 102A1308, 102A1319, 102A1613, 102A1616, 102A2037, 102A2038, 102A2043, 102A2044

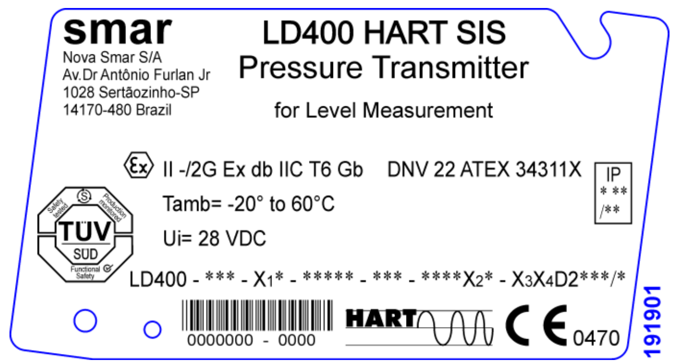
Identification Plate

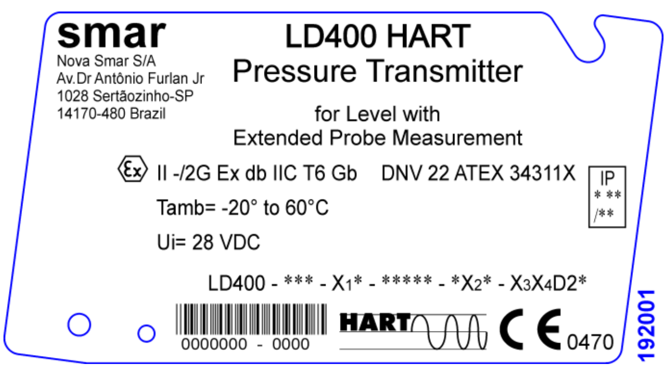
DNV Product Assurance AS

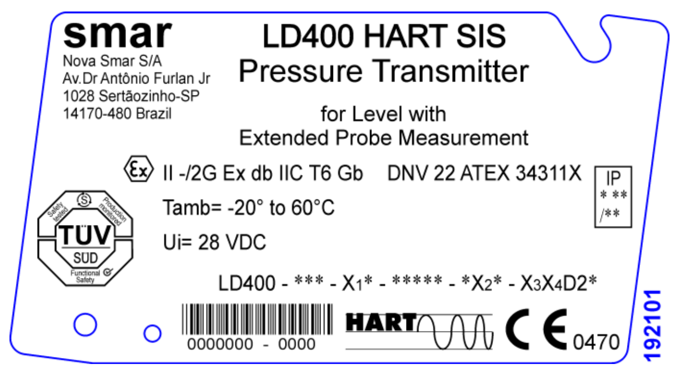


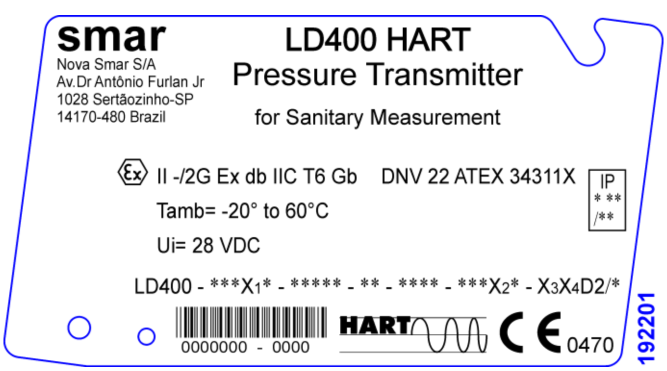


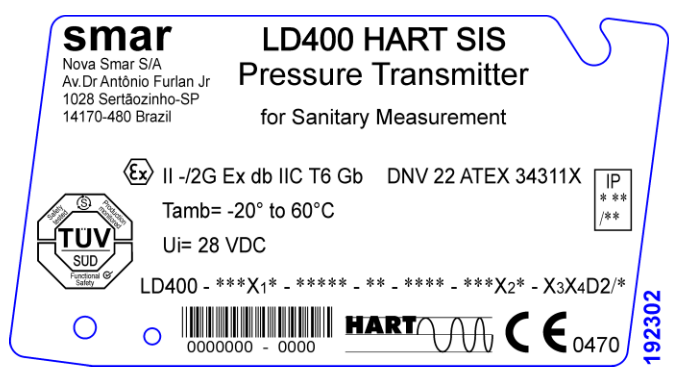


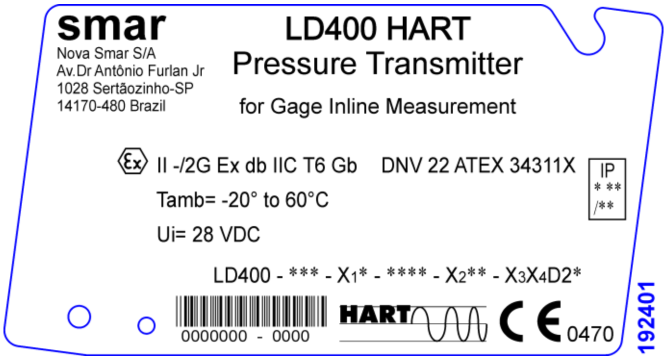


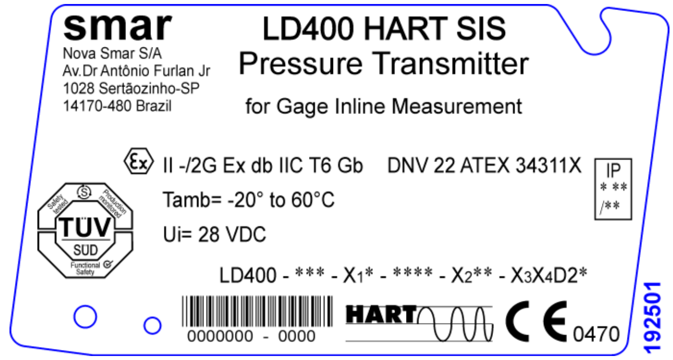




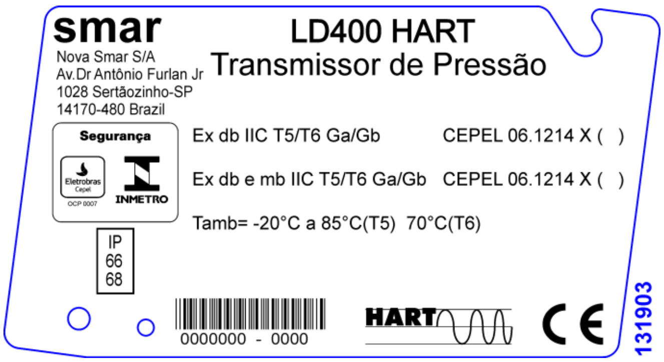


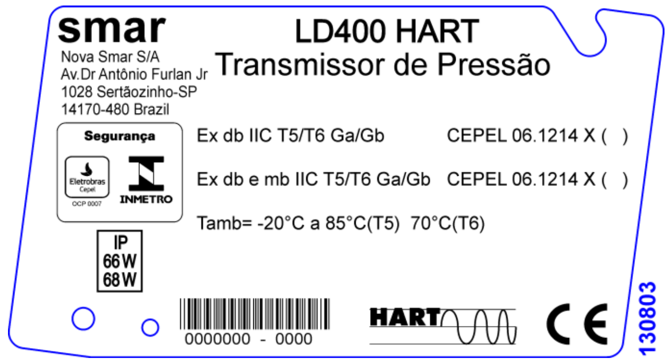


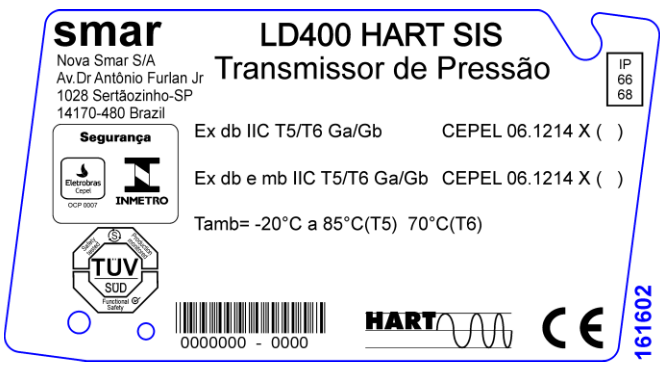


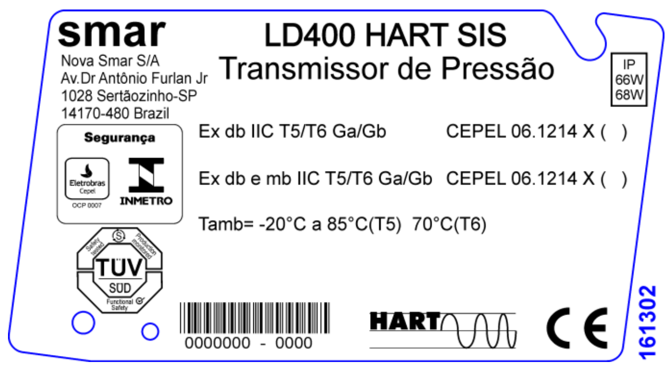


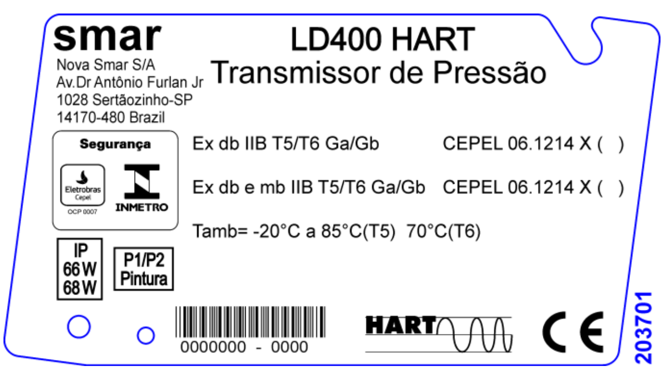
CEPEL (Centro de Pesquisa de Energia Elétrica)

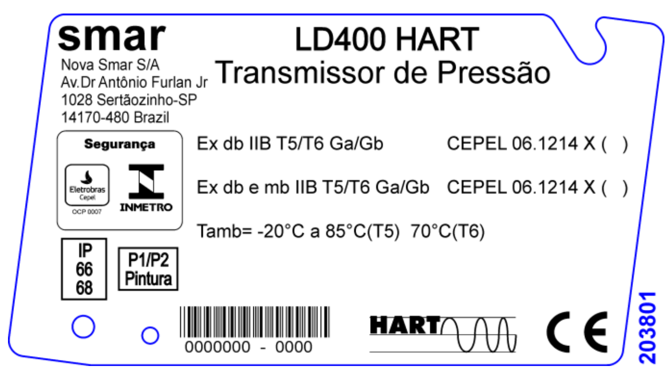


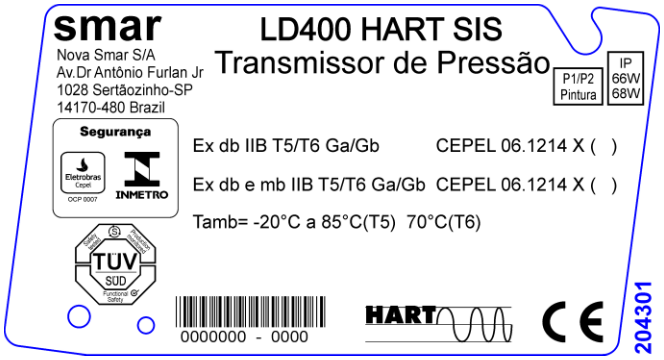











smar
LD400 HART SIS
Nova Smar S/A
Av.Dr Antônio Furlan Jr
1028 Sertãozinho-SP
14170-480 Brazil
Transmissor de Pressão
P1/P2 Pintura
IP 66W 68W
Segurança
Eletrobras Cepel
OCP 0007
INMETRO
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Ex db e mb IIB T5/T6 Ga/Gb CEPEL 06.1214 X ( )
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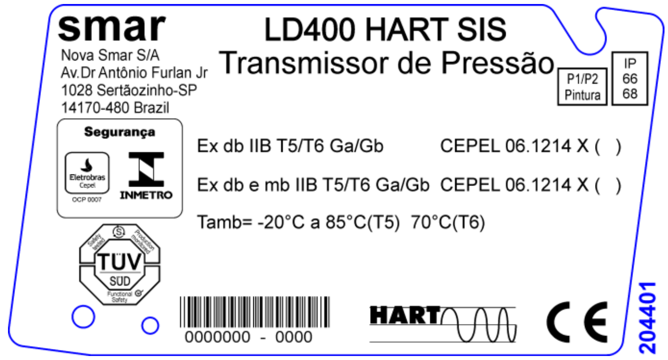
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Appendix B

SMAR	SRF – Service Request Form Pressure Transmitters	Proposal No.:

Company:	Unit:	Invoice:

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

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

PROCESS DATA							
Process Fluid:							
Calibration Range		Ambient Temperature (ºF)		Process Temperature (ºF)		Process Pressure	
Min.:	Max.:	Min.:	Max.:	Min.:	Max.:	Min.:	Max.:
Static Pressure		Vacuum					
Min.:	Max.:	Min.:	Max.:				
Normal Operation Time:				Failure Date:			

FAILURE DESCRIPTION

Please, describe the failure. Can the error be reproduced? Is it repetitive?

OBSERVATIONS

USER INFORMATION

Company:

Contact: Title: Section:

Phone: Extension: E-mail:

Date: Signature:

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