LD1.0

smar

OPERATION AND MAINTENANCE
INSTRUCTION / MANUAL

ECONOMIC CAPACITIVE PRESSURE TRANSMITTER

HART COMMUNICATION PROTOCOL

MAY / 12
LD1.0
Version 1

L D 1 . 0 M E

smar

www.smar.com

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INTRODUCTION

The **LD1.0** is a intelligent pressure transmitter for gauge measurement. It is based on a field-proven capacitive sensor that provides reliable operation and high performance.

The **LD1.0**, besides the normal functions offered by other smart transmitters, offers the following functions:

- ✓ **LOCAL ADJUSTMENT** - not only for lower and upper value, but input/output function, indication, as well.
- ✓ **PASSWORD** - three levels for different functions.
- ✓ **OPERATION COUNTER** - shows the number of changes in each function.

Get the best results of the **LD1.0** by carefully reading these instructions.

Smar's pressure transmitters are protected by U.S. patents **6,433,791 and 6,621,443**.

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

WARNING
To ensure that our products are safe and without risk to health, the manual must be read carefully before proceeding and warning labels on packages must be observed. Installation, operation, maintenance and servicing must only be carried out by suitably trained personnel and in accordance with the **Operation and Maintenance Instruction Manual**.

Waiver of responsibility

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

Warning

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

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

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

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

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

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

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

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

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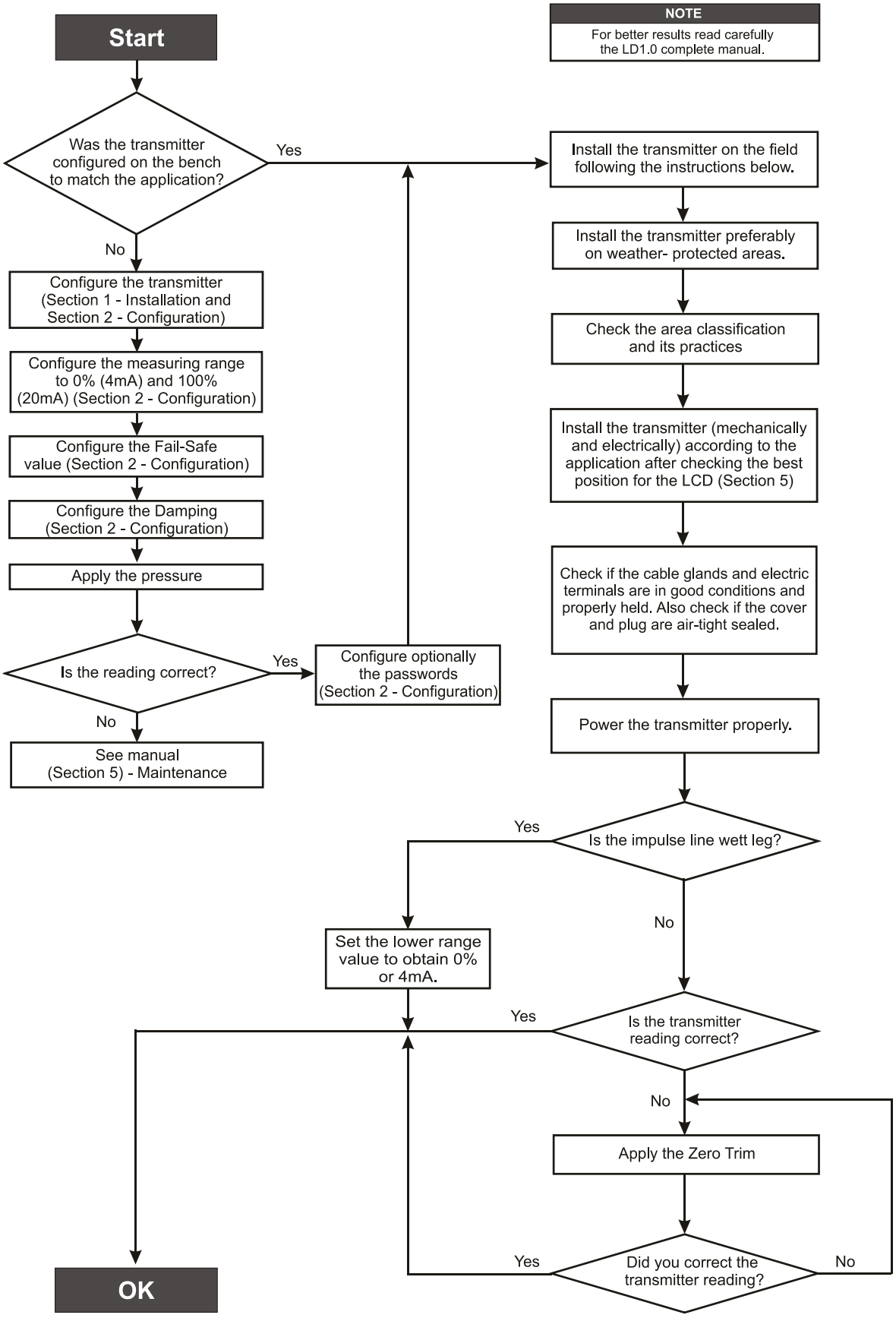


Section 1

INSTALLATION

General

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 performance.

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

The **LD1.0** has a built-in temperature sensor to compensate for temperature variations. At the factory, each transmitter is submitted to a temperature cycle, and the characteristics under different temperatures are recorded in the transmitter memory. At the field, this feature minimizes the temperature variation effect.

Mounting

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

In warm environments, the transmitter should be installed to avoid, as much as possible, direct exposure to the sun. Installation close to lines and vessels subjected to high temperatures should also be avoided. Use longer sections of impulse piping between tap and transmitter whenever the process fluid is at high temperatures. Use of sunshades or heat shields to protect the transmitter from external heat sources should be considered, if necessary.

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

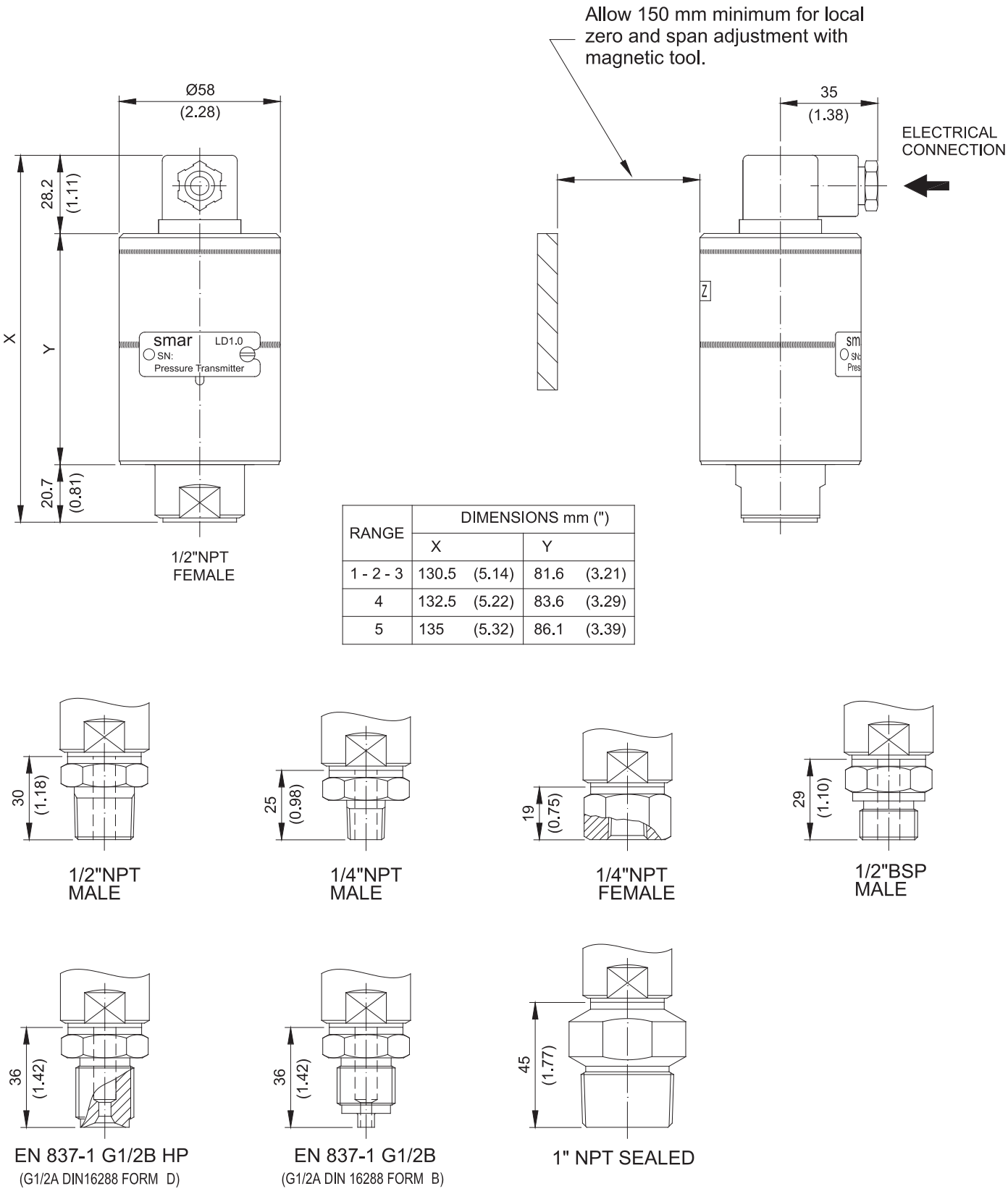
Although the transmitter is virtually insensitive to vibration, installation close to pumps, turbines or other vibrating equipment should be avoided.

The transmitter has been designed to be both rugged and lightweight at the same time. This make its mounting easier mounting positions are shown in Figure 1.1 and Figure 1.2.

Should the process fluid contain solids in suspension, install valves or rod-out fittings at regular intervals 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).

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



RANGE	DIMENSIONS mm (")			
	X		Y	
1 - 2 - 3	130.5	(5.14)	81.6	(3.21)
4	132.5	(5.22)	83.6	(3.29)
5	135	(5.32)	86.1	(3.39)

Figure 1.1 – Dimensional Drawing and Mounting Position for LD1.0

The figure 1.2 shows how to use the tool to fix the process transmitter tap.

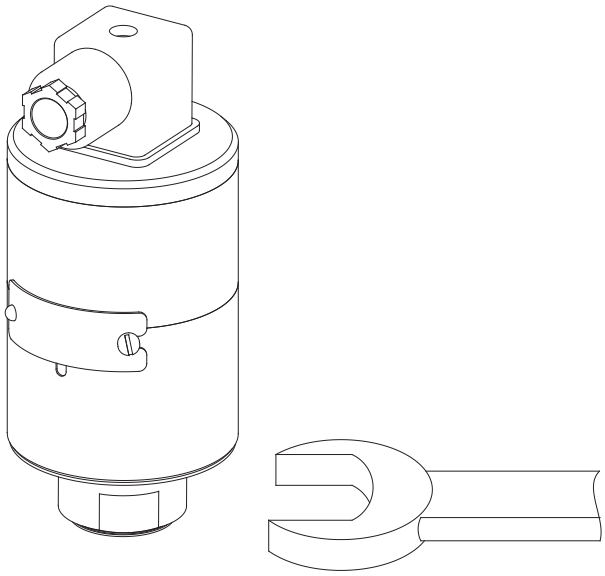


Figure 1.2 – Fixing of the Transmitter in the Tap

Observe operating safety rules during wiring, draining or blow-down.

WARNING
Normal safety precautions must be taken to avoid the possibility of an accident occurring when operating in conditions of high pressure and/or temperature. **Electrical shock can result in death or serious injury.** Avoid contact with the leads and terminals. **Process leaks could result in death or serious injury** Do not attempt to loosen or remove flange bolts while the transmitter is in service. **Replacement equipment or spare parts not approved by Smar could reduce the pressure retaining capabilities of the transmitter and may render the instrument dangerous.** Use only bolts supplied or sold by Smar as spare parts.

Some examples of installation, illustrating the position of the transmitter in relation to the taps, are shown in Figure 1.3.

The location of pressure taps and the relative position of the transmitter are indicated in Table 1.1.

Process Fluid	Location of Taps	Location of LD1.0 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
Except for dry gases, all impulse lines should slope at the ratio 1:10, in order to avoid trapping bubbles in the case of liquids, or condensate for steam or wet gases.

NOTE
For steam or other elevated temperature services, it is important that temperatures at the housing must not exceed 185 ºF (85 ºC).

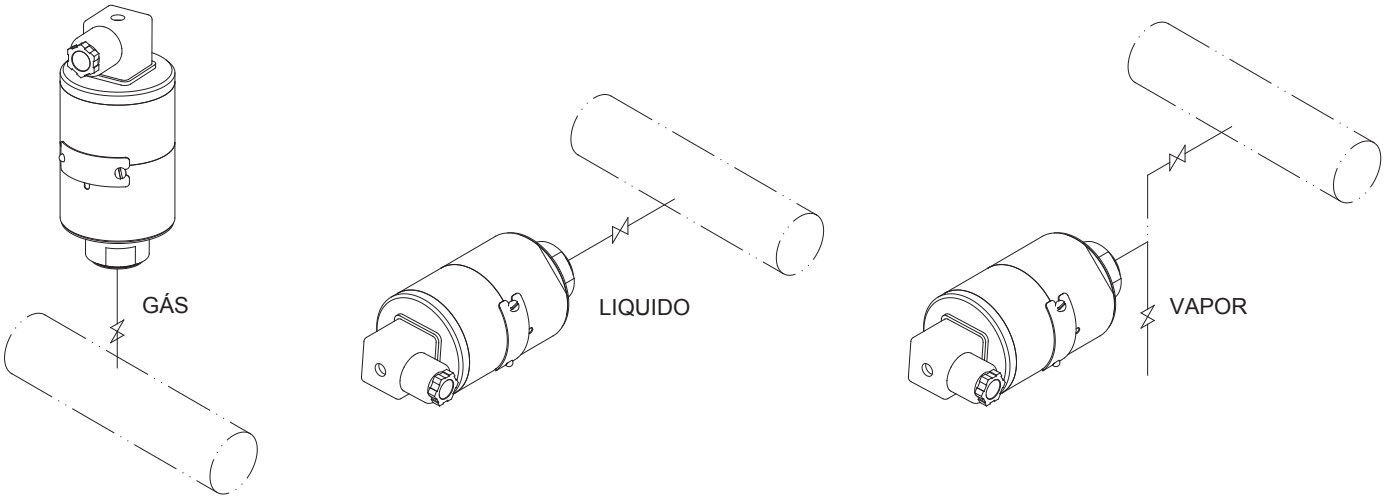
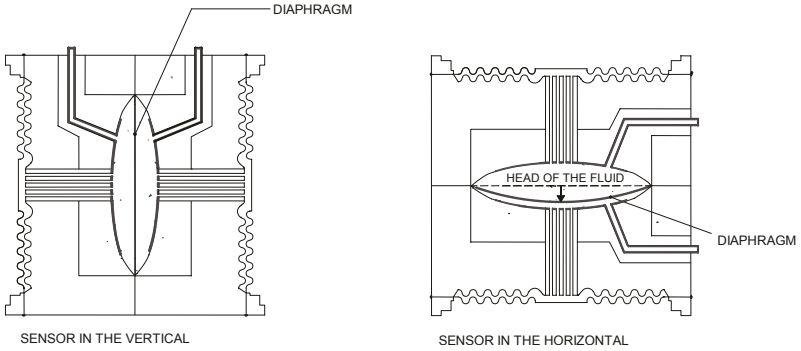


Figure 1.3 – Position of the Transmitter and Taps

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 is to compensate 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 reference for these transmitters, so there is no need for a zero value for the Lower trim.



Connector Assembly Procedure

To accomplish transmitter connection to the connector it follows the steps shown in the Figure 1.4.

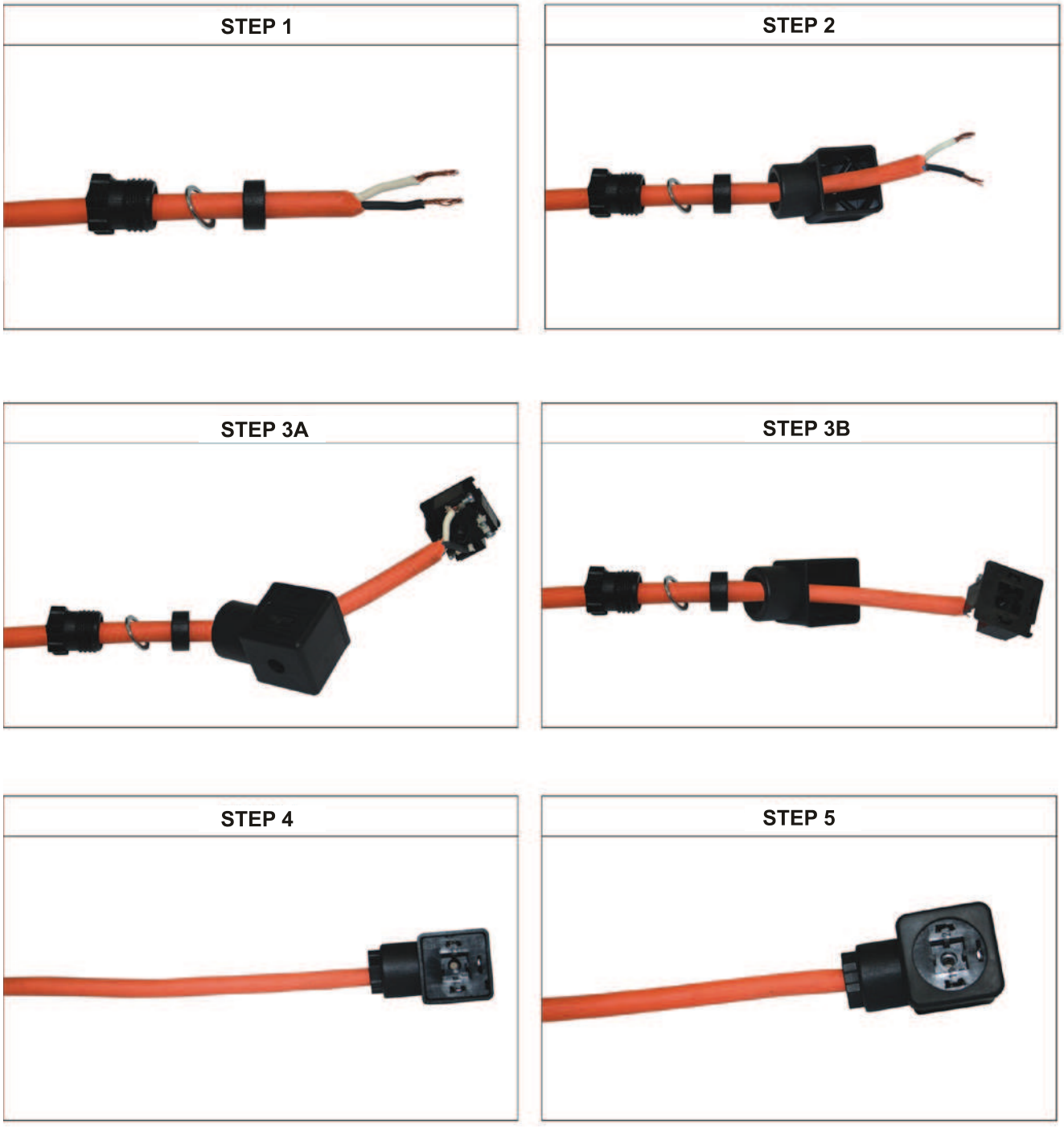


Figure 1.4 – Electric Connector Mounting

Wiring

The **LD1.0** input circuit was developed from way to allow the power supply connection without considering the polarity (See Figure 1.5).

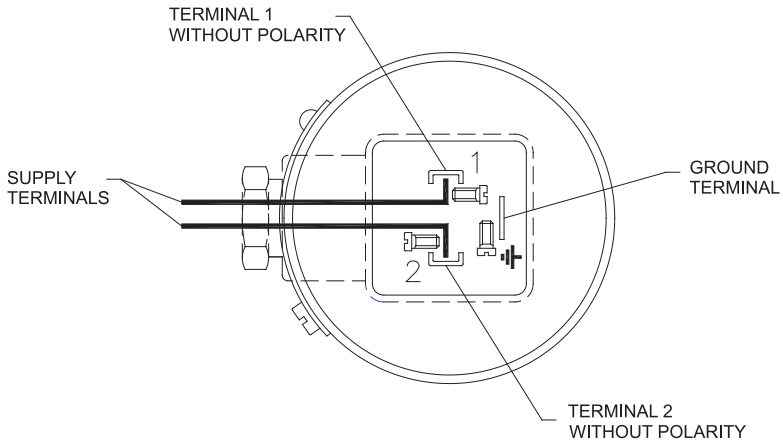


Figure 1.5 – Wiring Block

Use of twisted pair (22 AWG or greater than) cables is recommended. For sites with high electromagnetics levels (EMI above 10 V/m) shield conductors are recommended.

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

Loop Conections

Connection of the **LD1.0** should be done as in Figure 1.6. Connection in multi-drop configuration should be done as in Figure 1.7. 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 Ohm resistor will be high causing a high voltage drop. Therefore make sure that the power supply voltage is sufficient.

The configuration 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.

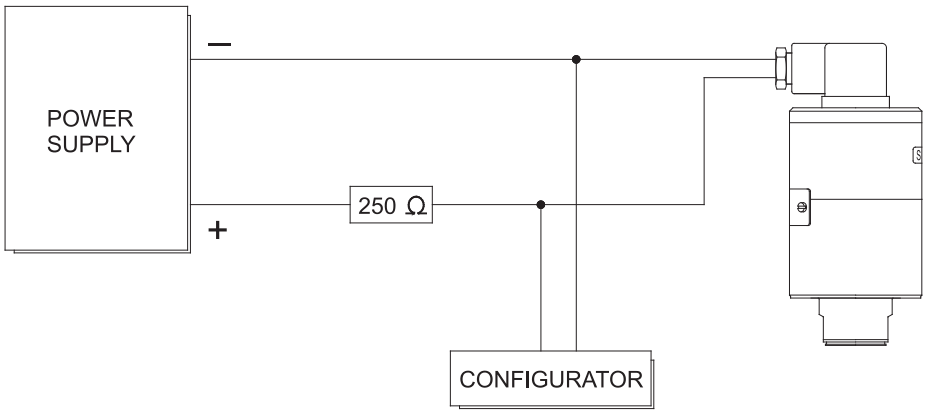


Figure 1.6 – Wiring Diagram for the LD1.0

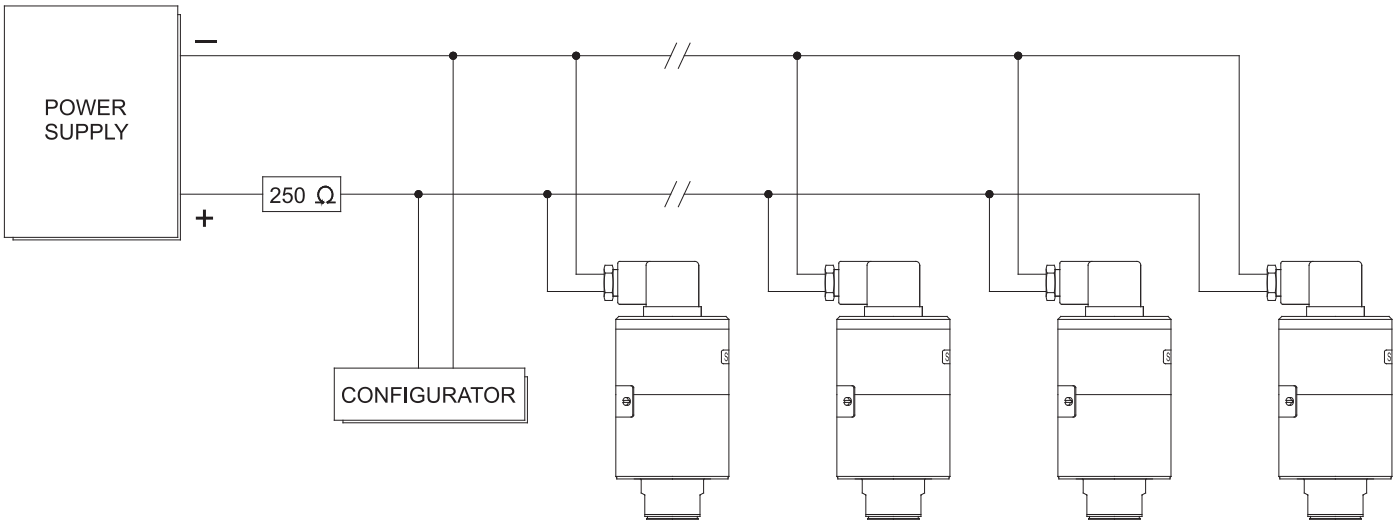


Figure 1.7 – Wiring Diagram for the LD1.0 in Multidrop Configuration

NOTE

Make sure that the transmitter is operating within the operating area as shown on the load curve (Figure 1.8). Communication requires a minimum load of 250 Ohm.

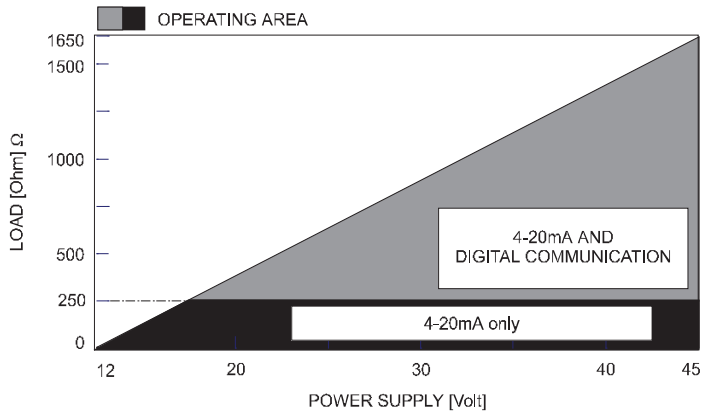


Figure 1.8 – Load Curve

CONFIGURATION

The **LD1.0** 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 Configurator 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 in its "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's output current is kept constant, with a consumption of 4 mA each. If the acknowledgement mechanism is via Tag, the transmitter's addresses may be "0" while their output current is still being controlled, even in a multidrop configuration.

In the case of the **LD1.0** the "0" address causes the **LD1.0** to control its output current and addresses "1" through "15" place the **LD1.0** in the multidrop mode with current control.

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:

$Ca \geq \Sigma Ci_j + Cc$ $\quad$ $La \geq \Sigma Li_j + Lc$

$Voc \leq min\ [Vmax_j]$ $\quad$ $Isc \leq min\ [Imax_j]$

Where:

- Ca, La - Barrier Allowable Capacitance and Inductance
- Ci_j, Li_j - Non protected internal Capacitance/Inductance of transmitter *j (j = 1 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 **LD1.0** 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 - **LD1.0** Intelligent Pressure Transmitter.

Smar developed the **CONF401** and **HPC401** software, the first one works in Windows platform (**95, 98, 2000, XP and NT**) and **UNIX**. The second one, **HPC301**, works in the most recent technology in PDA´s. They bring easy configuration and monitoring of field devices, capacity to analyze data and to modify the action of these devices. **The operation characteristics and use of each one of the configurators are stated on their respective manuals.**

Figures 3.1 and 3.2 show the front of the Palm and the CONF401 screen, with the active configuration.

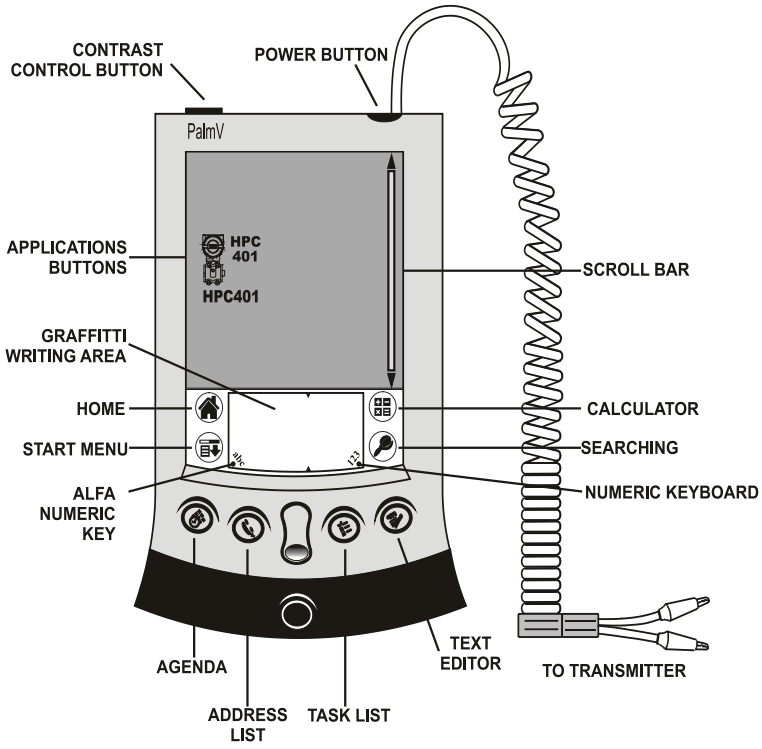


Figure 3.1 – Smar's Configurator

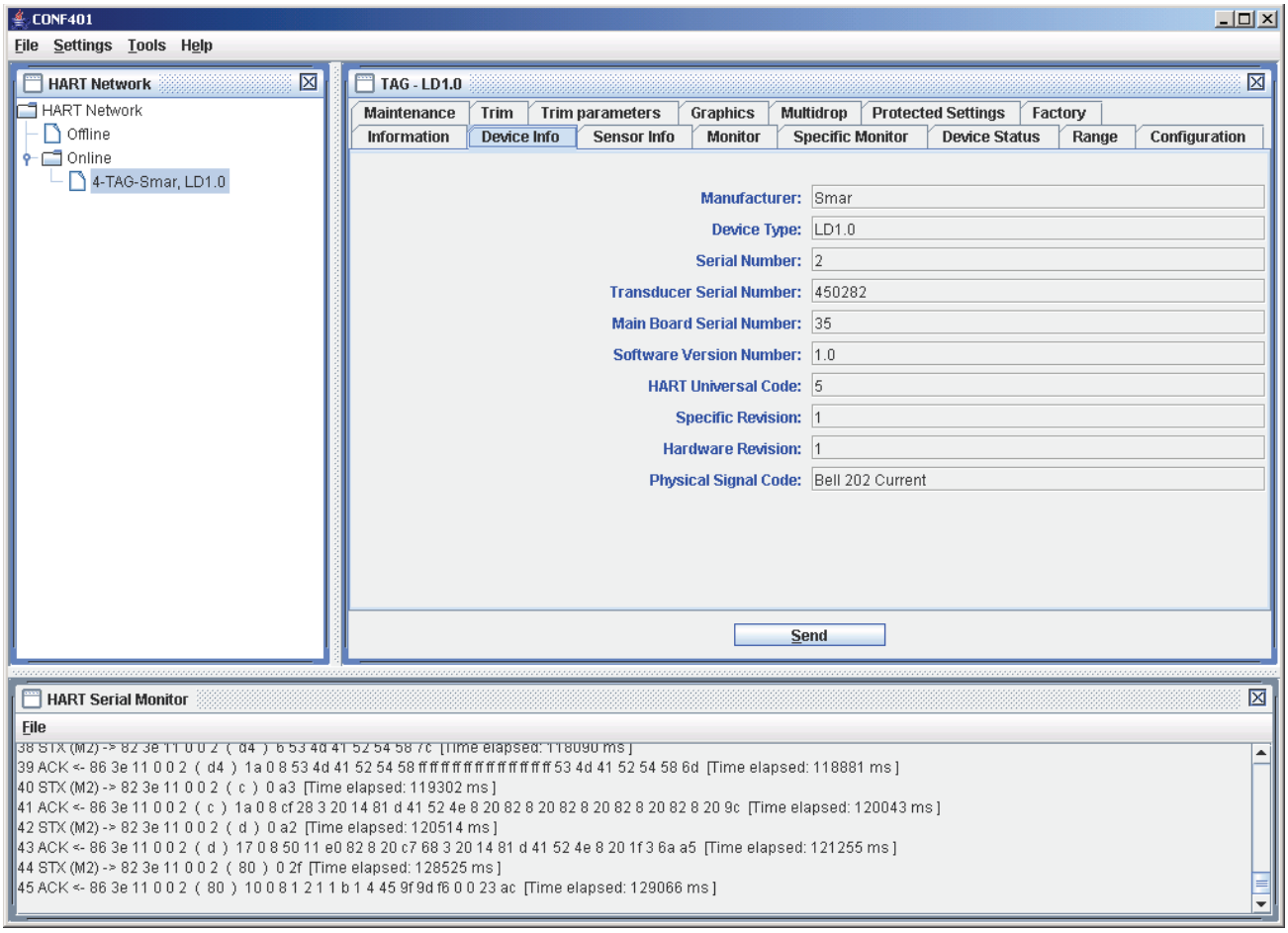


Figure 3.2 – Screen of the configurator

Configuration Features

By means of the HART® Configurator, the **LD1.0** firmware allows the following configuration features to be accessed:

- ✓ Transmitter Identification and Manufacturing Data;
- ✓ Primary Variable Trim – Pressure;
- ✓ Primary Variable Trim – Current;
- ✓ Transmitter Adjustment to the Working Range;
- ✓ Engineering Unit Selection;
- ✓ Device Configuration;
- ✓ Equipment Maintenance.

The operations, which take place between the configurator and the transmitter do not interrupt the Pressure measurement, and do not disturb the output signal. The configurator 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 **LD1.0** manufacturing and identification data is available:

TAG - 8 character alphanumeric field for identification of the transmitter;

DESCRIPTOR - 16 character alphanumeric field for additional identification of the transmitter. 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 character alphanumeric field for any other information, 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;

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 engineering units chosen by user. See Configuration Unit.

NOTE
Items marked with asterisk cannot be changed. They are read 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. This 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's microprocessor, which sets a relationship between the sensor signal and the measured pressure.

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

- ✓ The transmitter mounting position;
- ✓ The user's pressure standard differs from the factory standard;

- ✓ Sensor's 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 tap). 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 as related to the applied pressure, as per 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 to the transmitter the correct reading for the applied pressure via HART® configurator.

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.

- ✓ **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® configurator.

ATTENTION
The upper pressure trim shall always be done 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 manometric transmitter opened to atmosphere or when the absolute transmitter is applied to the vacuum. Therefore, the user does not need to enter with any value.

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 plant current Standard. In this case, the Current Trim adjustment shall be used, 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 moment for the current to stabilize and inform the transmitter the current readout of the precision Ammeter.

Transmitter Adjustment to the Working Range

This function directly affects the transmitter's 4-20 mA output. It is used to define the transmitter's working range; in this document it is referred to as the transmitter's calibration. The **LD1.0** transmitter includes two calibration features:

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

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 value.

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 value does not affect the other. 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 24 % are accepted, although with some accuracy degradation.
- ✓ The Working Range Span, determined by modulus of the difference between the Upper and Lower Values, shall be greater than the minimum span, defined by [Transmitter Range / 10]. Values up to 0.75 of the minimum span are acceptable with slight accuracy degradation.

NOTE
If the transmitter is operating with a very small span, it will be extremely sensitive to pressure variations. Keep in mind that the gain will be very high and 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 from the present Upper Value and from the new adjusted Upper value as possible, 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.

Engineering Unit Selection

Transmitter **LD1.0** includes a selection of engineering units to be used in measurement indication.

For pressure measurements, the **LD1.0** includes an option list with the most common units. The internal reference unit is inH_2O @ 20 ^{o}C; should the desired unit be other than this one, it will be automatically converted using conversion factors included in Table 3.1.

When selecting a unit, make sure that it will not require readouts greater than this limit. For User reference, Table 3.1 presents a list of recommended sensor ranges for each available unit.

CONVERSION FACTOR	NEW UNITS	RECOMMEND RANGE
1.00000	Inches H_2O at 20 ^oC	1, 2,3 & 4
0.0734241	Inches Hg at 0 ^oC	all
0.0833333	Feet H_2O at 20 ^oC	all
25.4000	Millimeters H_2O at 20 ^oC	1 & 2
1.86497	Millimeters Hg at 0 ^oC	1, 2, 3 & 4
0.0360625	Pound/square inch - psi	2, 3, 4, 5 & 6
0.00248642	Bar	3, 4, 5 & 6
2.48642	Millibar	1, 2, 3 & 4
2.53545	Gram/square centimeter	1, 2, 3 & 4
0.00253545	kilogram/square centimeter	3, 4, 5 & 6
248.642	Pascal	1
0.248642	KiloPascal	1, 2, 3 & 4
1.86497	Torr at 0 ^oC	1, 2, 3 & 4
0.00245391	Atmosphere	3, 4, 5 & 6
0.000248642	MegaPascal	4, 5 & 6
0.998205	Inches of water at 4 ^oC	1, 2, 3 & 4
25.3545	Millimeters of water at 4 ^oC	1 & 2

Table 3.1 - Available Pressure Units

In applications where the **LD1.0** 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 taking 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 **LD1.0**. Table 3.2 makes it possible to associate the new measurement to the new unit so that all supervisory systems fitted with HART® protocol can access the special unit included in this table. The user will be responsible for the consistency of such information. The **LD1.0** cannot verify if the values corresponding to 0% and 100% included by the user are compatible with the selected unit.

Equipment Configuration

The **LD1.0** enables the configuration of not only its operational services, but of instrument itself. This group includes services related to: Input Filter, Burn Out, Addressing and Passwords.

- ✓ **INPUT FILTER** - The Input Filter, also referenced to as Damping, is a first class digital filter implemented by the firmware, where the time constant may be adjusted between 0 and 128 seconds. The transmitter's 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.
- ✓ **ADDRESSING** - The **LD1.0** includes a variable parameter 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.

  The **LD1.0** is factory configured with address "0".

- ✓ **WRITING PROTECTION** - This feature is used to protect the transmitter configuration from changes via communication. All configuration data are writing protected.

The **LD1.0** include two write protection mechanisms: software and hardware locking; software locking has higher priority.
When the **LD1.0** writing software protection mechanism is enabled, it is possible, by means of specific commands, to enable or disable the write protection.

✓ **PASSWORDS** - this service enables the user to modify the operation passwords used in the **LD1.0**. Each password defines the access for a priority level (1 to 3); such configuration is stored in the **LD1.0** EEPROM.

Password Level 3 is hierarchically upper to password level 2, which is upper 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 Ordering Code is the one used for purchasing the equipment, in accordance with the User specification. There are 12 characters available in the **LD1.0** to define this code.

EXAMPLE:

1	2	3	4	5	6	7	8	9	10	11	12
L	D	1	.	0	M	2	1	I	0	H	0

OPTION	DESCRIPTION
LD1.0M	Gage Pressure Transmitter
2	Range: -500 to 500 mbar
1	Proccess Connection: 1/2” – 14 NPT - Female
I	Proccess Connection Material in 316L AISI SST
0	Without Digital Display
H	Communication Protocol: HART®
0	Without Identification Plate

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

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

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

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

LRV/URV - when any type of calibration is done;

Characterization - when any change is made in any point of the pressure characterization table in trim mode;

Multidrop - when any change is made in the communication mode, for example, multidrop or single transmitter;

Pswd/C-Level - when any change is made in the password or the level configuration.

Section 3

PROGRAMMING USING LOCAL ADJUSTMENT

The Magnetic Tool

For availability the local adjustment function it is necessary a multimeter inserted in series with the equipment supply in the current scale or the use of an accessory that was projected for the equipment connection to the multimeter without the need disconnecting the supply cables. See Figure 4.3.

The transmitter has holes for two magnetic switches activated by the magnetic tool (See Figure 3.1).

Figure 3.1 – Local Zero and Span Adjustment and Local Adjustment Switches

The holes are marked with **Z** (Zero) and **S** (Span) and from now on will be designated simply by (**Z**) and (**S**), respectively.

Simple Local Adjustment

The **LD1.0** allows only the calibration of the values inferior and superior in this configuration.

Zero and Span Reranging

The **LD1.0** can be very easily calibrated. It requires only Zero and Span adjustment in accordance with the working range. As this equipment doesn't possess display, it will be necessary the use of a multimeter for the accompaniment of the calibration.

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 **Z** adjustment hole. (See Figure 3.1)
- ✓ Wait about 2 seconds.
- ✓ Insert the magnetic tool in the **S** adjustment hole.
- ✓ Wait about 2 seconds.
- ✓ The transmitter should be reading 8 mA (see Figure 3.2a).
- ✓ Insert the magnetic tool in the **Z** adjustment hole. The transmitter should be reading 4 mA (see Figure 3.2b).
- ✓ Remove the tool.

Figure 3.2 (a) –Zero Configuration (Z)

Figure 3.2 (b) –Span Configuration (S)

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

- ✓ Apply the Lower Value pressure.
- ✓ Wait for the pressure to stabilize.
- ✓ Insert the magnetic tool in the **S** adjustment hole.
- ✓ Wait about 2 seconds.
- ✓ Insert the magnetic tool in the **Z** adjustment hole.
- ✓ Wait about 2 seconds.
- ✓ The transmitter should be reading 16 mA (see Figure 3.3a).
- ✓ Insert the magnetic tool in the **S** adjustment hole. The transmitter should be reading 20 mA (see Figure 3.3b).
- ✓ Remove the tool.

Figure 3.3 (a) –Zero Configuration (Z)

Figure 3.3 (b) – Span Configuration (S)

Section 4

MAINTENANCE PROCEDURES

General

SMAR LD1.0 intelligent pressure transmitters are extensively tested and inspected before delivery to the end user. Nevertheless, its design includes additional information for diagnosis purposes, in order to provide an easier fault detection capability and, as a consequence, an easier maintenance.

Diagnostic with the Configurator

Should any problem be noticed relating to the transmitter output, the configurator may carry out investigation, as long as power is supplied and communication and the processing unit are operating normally (see Table 4.1).

The configurator should be connected to the transmitter according to the wiring diagram shown on Section 1, Figures 1.6 and 1.7.

Error Messages

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

Table 4.1 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; • Interface damaged; • Power supply with inadequate voltage.
CMD NOT IMPLEMENTED	• Software version not compatible between configurator and transmitter. • Configurator is trying to carry out a **LD1.0** specific command in a transmitter 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.
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	• Lower value exceeds 24% of the Upper Range Limit.

ERROR MESSAGES	POTENTIAL SOURCE OF PROBLEM
HIGH	
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 PRESURE TOO HIGH	• The pressure applied was above the 24% upper range limit.
APPLIED PRESURE 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 4.1 - Error Messages and Potential Source

Diagnostic with the Transmitter

Symptom: NO LINE CURRENT

Probable Source of Trouble:

✓ **Transmitter Connections**

- 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 45 Vdc at transmitter terminals.

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 [**-**].

✓ **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 **LD1.0** terminals must be between 12 and 45 Vdc, and ripple less than 200 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 diaphragms for sediments;
- Check the pressure connection;
- Check if bypass valves are closed;
- Check if pressure applied is not over upper limit of transmitter's range.

✓ **Sensor to Main Circuit Connection**

- Check connection (male and female connectors).
- 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). Use the configurator to investigate the source of the problem.

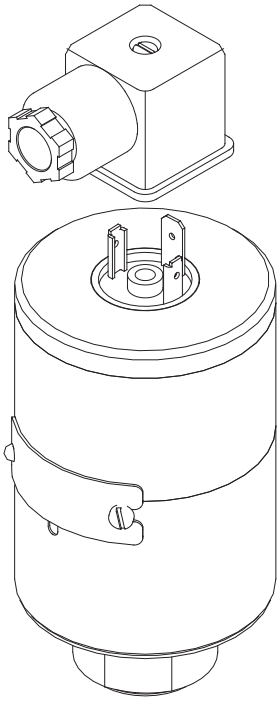


Figure 4.1 – LD1.0 Exploded View

ACCESSORIES	
ORDERING CODE	**DESCRIPTION**
	Connector for Local Adjustment calibration (see Figure 4.3)

SPARE PARTS LIST FOR TRANSMITTER			
DESCRIPTION OF PARTS	**POSITION**	**CODE**	**CATEGORY**
Electrical Connector			

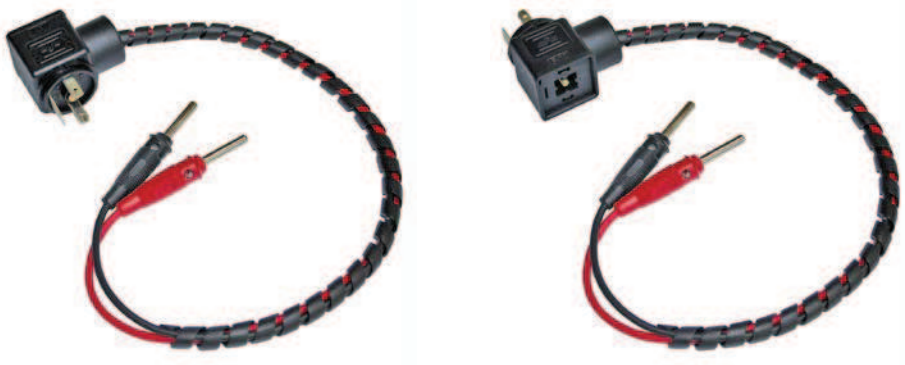
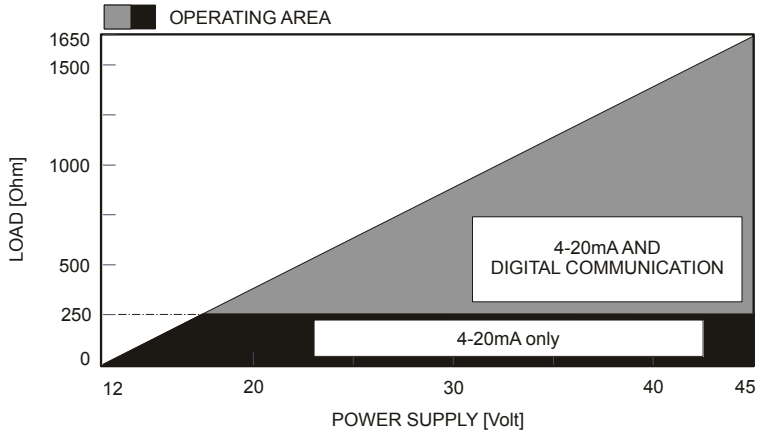


Figure 4.3 - Connector for Local Adjustment Calibration

Section 5

TECHNICAL CHARACTERISTICS

Functional Specifications	
Process Fluid	Liquid, gas or non-corrosive steam.
Output Signal and Communication Protocol	Two-wire, 4-20 mA controlled according to NAMUR NE43 Specification and with superimposed digital communication (HART Protocol Version 5).
Power Supply	12 to 45 Vdc. Input without polarization, with protection for transient suppressor. **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.
Load Limitation	
Zero and Span Adjustments	By configurator or local adjustment via magnetic tool.
Humidity and Temperature Limits	Operation (ºC) -40 ≤ T ≤ 85 Storage (ºC) -40 ≤ T ≤ 100 Humidity 0 ≤ % ≤ 100 Relative Humidity
Failure Alarm	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 choice.
Turn-on Time	Performs within specifications in less than 5 seconds after power is applied to the transmitter.
Overpressure Limits (MWP – Maximum Working Pressure)	70 bar (1000PSI) for transmitters of ranges 1; 138 bar (2000PSI) for transmitters of ranges 2, 3, 4; 310 bar (4500 PSI) for transmitters of ranges 5.
Damping Adjustment	0 to 128 seconds in addition to intrinsic sensor response time (0.2 s).
Configuration	By digital communication using the configuration software CONF401, DDCON 100 (for Windows) or HPC401 (for Palms), and can be partially configured through local adjustment. Firmware downloading via BDM.

Performance Specifications	
Response Time	Up to 200 ms.
Accuracy	±0.2%
Current Output	Resolution 0,03% span Linearity ± 0,03% span
Temperature Effect	±1% FE T Operation
Power Supply Effect	± 0.005% do span calibrado por volt.
Mounting Position Effect	Zero shift of up to 2.5 mbar which can be calibrated out. No span effect.

Physical Specifications	
Electrical Connection	DIN 43650
Process Connection	See ordering code.
Wetted Parts	**Isolating Diaphragms** Hastelloy C276

	Process Connection 316L SST
Nonwetted Parts	**Electronic Housing** 316 SST (IP67) **Fill Fluid** Silicone or Inert Fluorolube Oil **Mounting Bracket** Set up directly in the process without support need. **Identification Plate** 316 SST
Approximate Weights	0.885 Kg

Ordering Code

MODEL	INTELLIGENT PRESSURE TRANSMITTER
LD1.0	**Economic Capacitive Pressure Transmitter** (1)

COD.	TYPE	Range Limits Min	Range Limits Max	Range Limits Unit	Turn Down Max
M1	Gage	-20	20	inH_2O	10
M2	Gage	-200	200	inH_2O	50
M3	Gage	-14,7	36	psi	50
M4	Gage	-14,7	360	psi	50
M5	Gage	-14,7	2175	psi	50

COD.	Process Connection
1	1/2“ - 14 NPT - Female
2	1/4” - 18 NPT - Female
3	1/4” - 18 NPT - Female
G	G1/2” A DIN 16288 Form B Male
H	G1/2” A DIN 16288 Form D Male
M	1/2” - 14 NPT – Male
U	1/2”BSP – Male
X	1” NPT Sealed (Diaphragm 316L. Fill Fluid Silicone DC200/20)
Z	User´s specifications

COD.	Process Connection Material
I	AISI 316L SST
Z	User´s specifications

COD.	Digital Display
0	Without Display

COD.	Communication Protocol
H	HART®

COD.	Identification Plate
0	Without Certification

LD1.0	-	M2	-	1	I	-	0	H	0

NOTE
(1) This equipment is not supplied with tag plate.

Appendix A

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®		**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 observed behavior, if it is repetitive, how it reproduces, etc.)

OBSERVATIONS

USER INFORMATION

Company:

Contact: Title: Section:

Phone: Extension: E-mail:

Date: Signature:

Appendix B

SMAR WARRANTY CERTIFICATE

1. SMAR guarantees its products for a period of 24 (twenty four) months, starting on the day of issuance of the invoice. The guarantee is valid regardless of the day that the product was installed.

2. SMAR products are guaranteed against any defect originating from manufacturing, mounting, whether of a material or manpower nature, provided that the technical analysis reveals the existence of a quality failure liable to be classified under the meaning of the word, duly verified by the technical team within the warranty terms.

3. Exceptions are proven cases of inappropriate use, wrong handling or lack of basic maintenance compliant to the equipment manual provisions. SMAR does not guarantee any defect or damage caused by an uncontrolled situation, including but not limited to negligence, user imprudence or negligence, natural forces, wars or civil unrest, accidents, inadequate transportation or packaging due to the user's responsibility, defects caused by fire, theft or stray shipment, improper electric voltage or power source connection, electric surges, violations, modifications not described on the instructions manual, and/or if the serial number was altered or removed, substitution of parts, adjustments or repairs carried out by non-authorized personnel; inappropriate product use and/or application that cause corrosion, risks or deformation on the product, damages on parts or components, inadequate cleaning with incompatible chemical products, solvent and abrasive products incompatible with construction materials, chemical or electrolytic influences, parts and components susceptible to decay from regular use, use of equipment beyond operational limits (temperature, humidity, etc.) according to the instructions manual. In addition, this Warranty Certificate excludes expenses with transportation, freight, insurance, all of which are the customer's responsibility.

4. 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

5. In cases needing technical assistance at the customer's facilities during the warranty period, the hours effectively worked will not be billed, although SMAR shall be reimbursed from the service technician's transportation, meals and lodging expenses, as well dismounting/mounting costs, if any.

6. The repair and/or substitution of defective parts do not extend, under any circumstance, the original warranty term, unless this extension is granted and communicated in writing by SMAR.

7. No Collaborator, Representative or any third party has the right, on SMAR's behalf, to grant warranty or assume some responsibility for SMAR products. If any warranty would be granted or assumed without SMAR's written consent, it will be declared void beforehand.

8. Cases of Extended Warranty acquisition must be negotiated with and documented by SMAR.

9. If necessary to return the equipment or product for repair or analysis, contact us.
   See item 4.

10. In cases of repair or analysis, the customer must fill out the Revision Requisition Form (FSR) included in the instructions manual, which contains details on the failure observed on the field, the circumstances it occurred, in addition to information on the installation site and process conditions. Equipments and products excluded from the warranty clauses must be approved by the client prior to the service execution.

11. In cases of repairs, the client shall be responsible for the proper product packaging and SMAR will not cover any damage occurred in shipment.

12. Responsibility: Except for the above-mentioned general warranty conditions for SMAR products, SMAR will not assume any responsibility before the customer, without limitation, for damages, consequences, indemnity claims, loss of earnings, service expenses and other costs caused by the non-observation of the installation, operation and maintenance instructions included in SMAR manuals. Furthermore, the buyer also agrees to exempt the supplier for indemnity of damages (with exception to costs for repairs or the reposition of defective products above described) directly or indirectly caused by inadequate tests, application, operation or repair of SMAR products.

13. It is the customer's responsibility to clean and decontaminate products and accessories prior to shipping them for repair, and SMAR and its dealer reserve themselves the right to refuse the service in cases not compliant to those conditions. It is the customer's responsibility to tell SMAR and its dealer when the product was utilized in applications that contaminate the equipment with harmful products during its handling and repair. Any other damages, consequences, indemnity claims, expenses and other costs caused by the lack of decontamination will be attributed to the client. Kindly, fill out the Declaration of Decontamination prior to shipping products to SMAR or its dealers, which can be accessed at www.smar.com/doc/declarationofcontamination.pdf and include in the packaging.

14. This warranty certificate is valid only when accompanying the purchase invoice.