LD301 SERIES
SMART PRESSURE TRANSMITTERS
4 to 20 mA + HART® Digital Communication

0.075% ACCURACY
120:1 RANGEABILITY
FEATURES

✓ 0.075% accuracy
✓ 120:1 rangeability
✓ 0-125 Pa to 0-40 MPa (0-0.5 inH₂O to 0-5800 psi)
✓ Direct digital capacitance sensing (No A/D conversion)
✓ 4-20 mA output plus direct digital communication (HART® Protocol), according to NAMUR-NE-43 standard
✓ Updating time of output current in 100ms
✓ Output current resolution of 0.75µA/bit
✓ With high performance mathematical co-processor
✓ One single electronic board for all models
✓ True noninteractive zero and span
✓ Local zero and span adjustment
✓ Remote calibration
✓ Password protection
✓ On-line and off-line programming
✓ Multi-drop operation mode
✓ Output functions: linear, √x, ∛x, √x³, special function and constant current
✓ Optional 4½-digit numerical and 5-character alphanumerical LCD indicator
✓ ISO 9001 certified
✓ Indication in engineering units, configuration file, diagnosis, etc., available in the Hand-Held Terminal
✓ 16-point freely programmable output characterization
✓ Capable of handling most process fluids
✓ 16 MPa and 32 MPa static pressure (2320 psi and 4600 psi)
✓ Small and lightweight
✓ Explosion proof and weather proof housing
✓ Intrinsically safe
✓ Constant signal generation for loop tests
✓ Fully interchangeable parts for easy maintenance
✓ Optional PID control function with antireset wind-up, output limitation, rate-of-change limitation, bumpless auto/manual transfer, etc.
✓ 16 points table for PID output and input, configurable by the user
✓ EU indication, file configuration, diagnostics, calibration file, identification, etc., via Hand Held or PC through CONF301, CONF401
✓ Fail-safe level
✓ Flow totalization with persistence
✓ User unit
✓ EMI effects: Conforms to IEC 61000-6-2, IEC 61000-6-4, IEC 61326
✓ FMEDA (Failure Modes Effects and Diagnostic) Analysis
✓ MTBF (Mean Time Between Failures) of 244 years
✓ MTTR (Mean Time to Repair) of 18 minutes
✓ MTTF (Mean Time to Failure) of 244 years
✓ Applicable in safety areas according to SIL (Safety Integrity Level) requirements
✓ Write protection by hardware
✓ Easy update for Foundation Fieldbus and Profibus PA Technologies
The LD301 series uses, as its measuring principle, the well-known and field proven technique of capacitance sensing, enhanced by a microprocessor based electronics.

Designed for process control applications, these 2-wire transmitters generate a 4-20 mA signal proportional or characterized to the applied differential pressure. This signal can be transmitted over a pair of twisted wires through long distances (limited only by the wire resistance and load). Digital communication for remote calibration and monitoring is also provided, superimposing a digital signal on the same pair of wires that carries the 4-20 mA signal.

Remarkable features of the LD301 series are its 0.075% high accuracy, 120:1 rangeability, compactness and light-weightiness, PID control capability (optional), etc.

The transmitter consists of two main parts. The sensor (a capacitance variation cell) and the electronic circuit.

The sensor is schematically shown in the above drawing. A sensing diaphragm (1) is shown at the center of the cell. This diaphragm deflects, as a result of the difference between the pressures applied to the left and right sides of the sensor.

These pressures are directly applied to the isolating diaphragms (2), that provide isolation and resistance against process fluid corrosion. The pressure is transmitted to the sensing diaphragm through the filling Fluid (3).

The sensing diaphragm is also a moving capacitor plate, and the two metallized surfaces (4) are fixed plates. The sensing diaphragm deflection results in a variation on the capacitances between the moving and fixed plates.

The Electronic Circuit measures the variation of the capacitance between the moving and fixed plates, and generates a 4-20 mA signal, that can be proportional to the differential pressure applied or characterized (square root, special function, etc.) to it. Being microprocessor based, the electronic circuit is extremely versatile and accurate. Besides a "super chip", the HT3012, a 4-in-1 processor offloads the regular microprocessor adding tremendous "house power" to the LD301. This chip provides the floating-point coprocessor, the HART communication controller, the LCD controller and the D/A converter, that combined with the sensor precision, provides the high accuracy and rangeability peculiar of the LD301 series.

The HT3012 chips is a high integration chip that allows that all LD301 series can be characterized by one single electronic board, simplifying maintenance and with a high MTBF at the market.

Transmitter performance is improved by continuous monitoring of the sensor temperature and corresponding corrections.

The transmitter can also operate as a combination of transmitter plus controller. In this case, the 4-20 mA signal is used as the output of a PID control function (optional), while the digital signal may be used for remote monitoring and operation.

Besides the LD301 series was developed according to the international safety standards to attend the functional safety requirements in plants that need safety and reliability to protect people, ambient and assets, etc. The LD301 series has FMEDA analyzes allowing all serie to work in safety areas according to SIL requirements and making easier to the user the calculation for Safety Integrity Level (SIL).

MTBF is a basic measure of product and it is calculated adding the MTTR and MTTF. MTTR is the mean time to execute maintenance on all of the removable items in a product. It is the most common measure of maintainability. MTTF is the mean time expected until the first failure of a piece of equipment. It is the inverse of the failure rate.
Wetted parts of the sensor are available in the following materials:

- 316L Stainless Steel
- Hastelloy C™
- Monel 400™
- Tantalum

The isolating diaphragms are made of 316L stainless steel in the standard versions. They can optionally be provided in Hastelloy, Monel or Tantalum.

Process flanges and adapters are available in plated carbon steel, 316 stainless steel, Hastelloy C or Monel.

This ensures compatibility of the transmitter with most industrial fluids.

Electronic housing is available in the following materials:

- Aluminum
- 316 Stainless Steel

The electronic housing is a sturdy Explosion Proof and Weather Proof construction.

The electronic circuit boards are tropicalized and are intrinsically safe for use in hazardous areas.
The different versions are obtained as follows:

**DIFFERENTIAL PRESSURE (DP)**
Applying pressure to both sides of the sensor. This is also used in many level applications. For high static pressure applications the “H” model is available.

**FLOW MEASUREMENT**
The 4-20 mA signal can be made proportional to the square root of the differential pressure applied. It is normally used together with a primary flow element such as orifice plate, integral orifice, Venturi tubes, etc.

**GAGE PRESSURE**
Pressure is applied to one side of the sensor while the other side is open to atmosphere.

**ABSOLUTE PRESSURE**
A chamber is welded on one side of the sensor and then vacuum sealed. Pressure is applied to the other side of the sensor.

**LEVEL**
The transmitter is available as a flange mounted unit with a flush diaphragm, for direct installation on vessels. Extended diaphragms are also available. For food grade applications, see SR301 series catalog.

**REMOTE SEALS**
Separate diaphragm seals are installed in either one or in both sides of the sensor, providing further chemical and thermal isolation. For food grade applications, Tri-clamp and other connections according 3-A standard compliant connections are available. See SR301 series catalog.
The **LD301** can be programmed by a Hand-Held Terminal or PC (Personal computer) using the software CONF301, together with a SMAR HI311 interface (HART/RS232C).

The CONF401 is a configuration interface developed under the application MS Windows, so the human machine interface is extremely friendly.

Programming, reranging, PID adjustment (optional), setpoint changing, etc. are performed by both the Hand-Held Terminal and CONF401, when connected in parallel to any point of the 4-20 mA line. A single Hand-Held Terminal or computer can be used for programming any number of transmitters.

The local adjustment using the magnetic screwdriver allows, besides the zero and span adjustments, setpoint and other controller functions changing, totalization enabling, trim adjustments, etc.

For proper operation, the Hand-Held Terminal requires a minimum load of 250 Ohms between the power supply and the transmitter.
Working as a Conventional Transmitter

Working as a Local Controller

Working as a Controller with Computer Supervision from the Control Room
TECHNICAL CHARACTERISTICS

Functional Specifications

Process Fluid
Liquid, gas or vapor.

Output Signal
Two-wire, 4-20 mA controlled according to NAMUR NE43 Specification, with superimposed digital communication (HART® Protocol).

Power Supply
12 to 45 Vdc.

Load Limitation

![Load Limitation Graph]

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 5.0 seconds after power is applied to the transmitter.

Volumetric Displacement
Less than 0.15 cm³ (0.01 in³).

Overpressure and Static Pressure Limits
From 3.45 kPa abs. (0.5 psia)* to:
8 MPa (1150 psi) for range 1.
16 MPa (2300 psi) for ranges 2, 3 & 4.
32 MPa (4600 psi) for models H & A5.
40 MPa (5800 psi) for model M5.
52 MPa (7500 psi) for model M6.
* except the LD301A model.
Flange Test Pressure: 60 MPa (8570 psi).

For ANSI/DIN Level flanges (LD301L models):
150lb: 6 psia to 275 psi at 38 °C (-0.6 to 19 bar).
300lb: 6 psia to 720 psi at 38 °C (-0.6 to 50 bar).
PN10/16: -60 kPa to 1.4 MPa at 120 °C.
PN25/40: -60 kPa to 4 MPa at 120 °C.

These pressures will not damage the transmitter, but a new calibration may be necessary.

Humidity Limits
0 to 100% RH.

Damping Adjustment
User configurable from any value higher than zero seconds in addition to intrinsic sensor response time (0.2s) (via digital communication).

Configuration
Can be done through digital communication using the Hart Protocol or, partially, through local adjustment.

Performance Specifications

Reference conditions: range starting at zero, temperature 25 °C (77 °F), atmospheric pressure, power supply of 24 Vdc, silicone oil fill fluid, isolating diaphragms in 316L SS and digital trim equal to lower and upper range values.

Accuracy
0.1 URL ≤ span ≤ URL: ±0.075% of span;
0.025 URL ≤ span ≤ 0.1 URL: ±0.0375 [1+0.1 URL/span]% of span;
0.0085 URL ≤ span ≤ 0.025 URL: ±[0.0015+0.0046 URL/span]% of span (*)

(*) - Recommended minimum span for Range 1 is 0.025 URL.
For ranges 5 and 6, Absolute models, diaphragms in Tantalum, Monel or fill fluid in Fluorolube:
0.1 URL ≤ span ≤ URL: ± 0.1% of span;
0.025 URL ≤ span ≤ 0.1 URL: ±0.05 [1+0.1 URL/span]% of span;
0.0085 URL ≤ span ≤ 0.025 URL: ±[0.01+0.006 URL/span]% of span.

For Absolute - range 1:
± 0.2% of span
Linearity, hysteresis and repeatability effects are included.
Nonwetted Parts

- **Electronic Housing**
  Injected aluminum with polyester painting or 316 SST (NEMA 4X, IP67).

- **Blank Flange**
  Plated carbon steel, when the wetted flange is made of this same material, and 316 SST in the other cases.

- **Level Flange (LD301L)**
  316 SST.

- **Fill Fluid**
  Silicone or Fluorolube Oil.

- **Cover O-Rings**
  Buna N.

- **Mounting Bracket**
  Plated carbon steel with polyester painting or 316 SST. Accessories (bold, nuts, washers and U-clamps) in carbon steel or 316 SST.

- **Flange Bolts and Nuts**
  Plated carbon steel: Grade 7, 316 SST or Carbon Steel B7M (for nace applications).

- **Identification Plate**
  316 SST.

**Mounting**

- a) Flange mounted for models LD301L.
- b) Optional universal mounting bracket for surface or vertical/horizontal (DN 50) 2"-pipe (optional).
- c) Via bracket on manifold valve (optional).
- d) Directly on piping for closely coupled transmitter/orifice flange combinations.

**Approximate Weights**

3.15 kg (7 lb): all models, except L models.
5.85 to 9.0 kg (13 lb to 20 lb): L models depending on the flanges, extension and materials.

**Control Characteristics (optional)**

**PID**

- Proportional Gain: 0 to 100.
- Integral Time: 0.01 to 999 min/rep.
- Derivative Time: 0 to 999 s.
- Direct / Reverse Action.
- Lower and Upper output limits.
- Output rate-of-change limit: 0 to 100%/s.
- Power-on safety output.
- Antireset windup.
- Bumpless Auto/Manual transfer.
- 16 point table for PID input and output, freely user configurable.

Hastelloy is a trademark of the Cabot Corp.
Monel is a trademark of International Nickel Co.
Viton and Teflon are trademarks of E.I. DuPont de Nemours & Co.
Fluorolube is a trademark of Hooker Chemical Corp.
Hart is a trademark of HART Communication Foundation.

Smar Pressure Transmitters are protected by USA patent number 6,433,791
**ORDERING CODE**

### MODEL LD301

#### DIFFERENTIAL, GAGE, ABSOLUTE AND HIGH STATIC PRESSURE TRANSMITTERS

<table>
<thead>
<tr>
<th>CODE</th>
<th>Type and Range (L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>D1</td>
<td>Differential 0.125 to 5 kPa 0.5 to 20 in H₂O</td>
</tr>
<tr>
<td>D2</td>
<td>Differential 0.417 to 50 kPa 1.67 to 200 in H₂O</td>
</tr>
<tr>
<td>D3</td>
<td>Differential 2.08 to 250 kPa 0.3 to 36 psi</td>
</tr>
<tr>
<td>D4</td>
<td>Differential 20.8 to 2500 kPa 3 to 360 psi</td>
</tr>
<tr>
<td>M1</td>
<td>Gage 0.125 to 5 kPa 0.5 to 20 in H₂O</td>
</tr>
<tr>
<td>M2</td>
<td>Gage 0.417 to 50 kPa 1.67 to 200 in H₂O</td>
</tr>
<tr>
<td>M3</td>
<td>Gage 2.08 to 250 kPa 0.3 to 36 psi</td>
</tr>
<tr>
<td>M4</td>
<td>Gage 20.8 to 2500 kPa 3 to 360 psi</td>
</tr>
<tr>
<td>M5</td>
<td>Gage 0.208 to 25 MPa 30 to 3600 psi</td>
</tr>
<tr>
<td>M6</td>
<td>Gage 0.333 to 40 MPa 48.3 to 5800 psi</td>
</tr>
</tbody>
</table>

#### Diaphragm Material and Fill Fluid (Low Side)

- 1 316L SST Silicone Oil
- 2 316L SST Fluorolube Oil
- 3 Hastelloy C276 Silicone Oil
- 4 Hastelloy C276 Fluorolube Oil
- 5 Monel 400 Silicone Oil
- 6 Tantalum Silicone Oil
- 7 Tantalum Fluorolube Oil
- 8 Others - Specify

#### CODE Drain/Vent Valves Materials

- C Plated CS (Drain/Vent in Stainless Steel)
- I 316 SST
- H Hastelloy C276
- M Monel 400
- N 316 SST (Drain/Vent in Hastelloy C276)*
- Z Others - Specify

#### CODE Wetted O-Rings Materials

- 0 Without O-Rings
- B Buna N
- V Viton
- T Teflon
- Z Others - Specify

#### CODE Drain/Vent Position

- 0 Without Drain/Vent
- U Upper
- D Lower

- Note: For better drain/vent operation, vent valves are strongly recommended. Drain/Vent valve not available on sides with Remote Seals.

#### CODE Local Indicator

- 0 Without Indicator
- 1 With Digital Indicator

#### CODE Process Connections

- 0 ¼ - 18 NPT (Without Adapter)
- 1 ¼ - 14 NPT (With Adapter)
- 9 Remote Seal (Specify)
- V Valve manifold integrated to the transmitter
- Z Others - Specify

#### CODE Electrical Connections

- 0 Without Adapter
- A M20 x 1.5
- B Pg13.5 DIN
- Z Others - Specify

#### CODE Zero and Span Adjustments

- 1 With Local Adjustments

#### CODE Mounting Bracket for 2" Pipe or Surface Mounting

- 0 Without Bracket
- M1 316 SST Housing
- A1 316 SST Bolts and Nuts
- C1 Special Cleaning
- ZZ Special Options - Specify

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*(1) The range can be extended up to 0.75 LRL and 1.2 URL with small degradation of accuracy.

** Meets NACE material recommendations per MR-01-75

* Leave it blank for no optional items

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** TYPICAL MODEL NUMBER

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ORDERING CODE

### LEVEL TRANSMITTERS

<table>
<thead>
<tr>
<th>MODEL</th>
<th>LD301</th>
</tr>
</thead>
</table>

#### ORDERING CODE

**LD301**

**L2** | **1** | **I** | **B** | **U** | **1** | **0** | **0** | **1** | **2** | **2** | **1** | **1** | **4**

**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.

**Note:** With 316 SST extension.

**Note:** For better drain/vent operation, the side vent or drain valves are standard. If drain/vent valves are not required, use code 0.

**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.

### Diaphragm Material and Fill Fluid (Low Side)

<table>
<thead>
<tr>
<th>CODE</th>
<th>Diaphragm Material</th>
<th>Fill Fluid</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>316 SST</td>
<td>Silicone Oil</td>
</tr>
<tr>
<td>2</td>
<td>316 SST</td>
<td>Fluorolube Oil</td>
</tr>
<tr>
<td>3</td>
<td>Hastelloy C276</td>
<td>Silicone Oil*</td>
</tr>
<tr>
<td>4</td>
<td>Hastelloy C276</td>
<td>Fluorolube Oil*</td>
</tr>
<tr>
<td>5</td>
<td>Monel 400</td>
<td>Silicone Oil</td>
</tr>
</tbody>
</table>

### Flange, Adapter and Drain/Vent Valves Material (Low Side)

<table>
<thead>
<tr>
<th>CODE</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>Plated CS (Drain/Vent in Stainless Steel)</td>
</tr>
<tr>
<td>I</td>
<td>316 SST</td>
</tr>
<tr>
<td>H</td>
<td>Hastelloy C276*</td>
</tr>
<tr>
<td>M</td>
<td>Monel 400</td>
</tr>
<tr>
<td>N</td>
<td>316 SST  (Drain/Vent in Hastelloy C276)*</td>
</tr>
<tr>
<td>Z</td>
<td>Others - Specify</td>
</tr>
</tbody>
</table>

### Wetted O-Rings Material (Low Side)

<table>
<thead>
<tr>
<th>CODE</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Without O-Rings (Remote Seal)</td>
</tr>
<tr>
<td>B</td>
<td>Buna N</td>
</tr>
<tr>
<td>V</td>
<td>Viton</td>
</tr>
<tr>
<td>T</td>
<td>Teflon</td>
</tr>
<tr>
<td>Z</td>
<td>Others - Specify</td>
</tr>
</tbody>
</table>

### Drain/Vent Position (Low Side)

<table>
<thead>
<tr>
<th>CODE</th>
<th>Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Without Drain/Vent</td>
</tr>
<tr>
<td>U</td>
<td>Upper</td>
</tr>
<tr>
<td>L</td>
<td>Lower</td>
</tr>
</tbody>
</table>

### Local Indicator

<table>
<thead>
<tr>
<th>CODE</th>
<th>Indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Without Indicator</td>
</tr>
<tr>
<td>1</td>
<td>With Digital Indicator</td>
</tr>
</tbody>
</table>

### Process Connection (Low Side)

<table>
<thead>
<tr>
<th>CODE</th>
<th>Connection</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>¼ - 18 NPT (Without Adapter)</td>
</tr>
<tr>
<td>1</td>
<td>½ - 14 NPT (With Adapter)</td>
</tr>
<tr>
<td>9</td>
<td>Remote Seal (Specify)</td>
</tr>
<tr>
<td>Z</td>
<td>Others - Specify</td>
</tr>
</tbody>
</table>

### Extension Length

<table>
<thead>
<tr>
<th>CODE</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0 mm</td>
</tr>
<tr>
<td>1</td>
<td>50 mm (2&quot;)</td>
</tr>
<tr>
<td>2</td>
<td>100 mm (4&quot;)</td>
</tr>
<tr>
<td>3</td>
<td>150 mm (6&quot;)</td>
</tr>
<tr>
<td>4</td>
<td>200 mm (8&quot;)</td>
</tr>
<tr>
<td>Z</td>
<td>Others - Specify</td>
</tr>
</tbody>
</table>

### Diaphragm Material (High Side)

<table>
<thead>
<tr>
<th>CODE</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>316L SST</td>
</tr>
<tr>
<td>2</td>
<td>Hastelloy C276*</td>
</tr>
<tr>
<td>3</td>
<td>Monel 400**</td>
</tr>
<tr>
<td>4</td>
<td>Tantalum</td>
</tr>
<tr>
<td>5</td>
<td>Titanium</td>
</tr>
<tr>
<td>Z</td>
<td>Others - Specify</td>
</tr>
</tbody>
</table>

### Fill Fluid (High Side)

<table>
<thead>
<tr>
<th>CODE</th>
<th>Fluid</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>DC200 Silicone Oil</td>
</tr>
<tr>
<td>2</td>
<td>Fluorolube Oil</td>
</tr>
<tr>
<td>3</td>
<td>DC704 Silicone Oil</td>
</tr>
<tr>
<td>A</td>
<td>DC200/350 Silicone Oil - Food Grade</td>
</tr>
<tr>
<td>Z</td>
<td>Others - Specify</td>
</tr>
</tbody>
</table>

**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.

**Note:** For better drain/vent operation, the side vent or drain valves are standard. If drain/vent valves are not required, use code 0.

**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.

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* Meets NACE material recommendations per MR-01-75.
** Fluorolube fill fluid is not available for Monel Diaphragm.
*** Leave it blank for no optional items.