Rosemount 1153 Series B Alphaline® Nuclear Pressure Transmitter

INDUSTRY LEADING PERFORMANCE

- Qualified per IEEE Std. 323-1974 and IEEE Std. 344-1975
- $2.2 \times 10^7$ rads TID gamma radiation
- 4 g's ZPA seismic
- 318 °F (158.9 °C) steam temperature
- 0.25% accuracy

Product Discontinued

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INTRODUCTION

The Rosemount 1153 Series B Alphaline® Pressure Transmitters are designed for precision pressure measurements in nuclear applications requiring reliable performance and safety over a specified qualified life. These transmitters were qualified per IEEE std. 323-1974 and IEEE std. 344-1975 to radiation levels of 22 megarads TID gamma radiation, seismic levels of 4 g's, and for steam-pressure performance. Stringent quality control during the manufacturing process includes traceability of pressure-retaining parts, special nuclear cleaning, and hydrostatic testing.

TRANSMITTER DESCRIPTION

The Rosemount 1153 Transmitters are uniquely built for class 1E nuclear service while retaining the working concept and design parameters of the Rosemount 1151 Series that have become a standard of reliable service. Units are available in Absolute (A), Gage (G), Differential (D), and High-Line Differential (H) configurations, with a variety of pressure range options.

Direct electronic sensing with the completely sealed δ - Cell capacitance sensing element eliminates mechanical force transfer and problems associated with shock and vibration. Installation and commissioning are simplified by the compact design and 2-wire system compatibility. Wiring terminals and electronics are in separate compartments, so the electronics remain sealed during installation.

OPERATION

The completely sealed δ-Cell capacitance sensing element is the key to the unequalled performance and reliability. Its simple design concept is recognized as a landmark in transmitter engineering. As shown in Figure 1, process pressure is transmitted through an isolating diaphragm and silicone oil fill fluid to a sensing diaphragm in the center of the δ-Cell. A reference pressure is transmitted in like manner to the other side of the sensing diaphragm.

Displacement of the sensing diaphragm, a maximum motion of 0.004 inches (0.1 mm), is proportional to the pressure differential across it. The position of the sensing diaphragm is detected by capacitor plates on both sides of the sensing diaphragm. Differential capacitance between the sensing diaphragm and the capacitor plates is converted electronically to a 2-wire, 4–20 mA DC signal.
### Rosemount 1153 Series B

**FIGURE 2. Transmitter Dimensional Drawings**

#### 1153DB AND 1153HB

- **Pressure Range Code**: 3, 4, 5
- **Pressure Range**: 2.13 (54) in. (mm)

#### 1153AB AND 1153GB

- **Pressure Range Code**: 6, 7, 8, 9
- **Pressure Range**: 2.19 (55.6) to 2.28 (57.9) in. (mm)

**Welded drain/vent valve (2) (optional 1/4 – 18 NPT available)**

**Compression fittings (2) Swagelok® for 3/8 in. Tubing (optional 1/4 – 18 NPT available)**

**Low Side Vent (GB Only)**

**Nameplate (remove for zero and span adjust)**

**Terminal connections (this side)**

**Transmitter Circuitry (this side)**

**0.75 (19) clearance for cover removal (typical)**

**Note**

Dimensions are nominal in inches (millimeters).
SPECIFICATIONS

Nuclear Specifications
Qualified per IEEE Std. 323-1974 and IEEE Std. 344-1975 as stated in Rosemount Report 108025.

Output Code “P”

Radiation
Accuracy within ±8.0% of upper range limit during and after exposure to $2.2 \times 10^7$ rads, total integrated dosage of gamma radiation.

Seismic
Accuracy within ±0.5% of upper range limit during and after a seismic disturbance defined by a required response spectrum with a ZPA of 4 g’s.

Steam Pressure/Temperature
Accuracy within ±(4.5% of upper range limit +3.5% span) during and after sequential exposure to steam at the following temperatures and pressures:

- 318 °F (158.9 °C), 73 psig for 8 hours.
- 265 °F (129.4 °C), 24 psig for 56 hours.

Accuracy within ±5.0% of upper range limit during and after exposure to 265 °F (129.5 °C), 24 psig, for 35 hours.

Post DBE Operation
Accuracy at reference conditions shall be within ±3% of upper range limit for one year following DBE.

Output Code “R”

Radiation
Accuracy within ±4.0% of upper range limit during and after exposure to $2.2 \times 10^7$ rads, total integrated dosage of gamma radiation.

Seismic
Accuracy within ±0.5% of upper range limit during and after a seismic disturbance defined by a required response spectrum with a ZPA of 4 g’s.

Steam Pressure/Temperature
Accuracy within ±(4.5% of upper range limit +3.5% span) during and after sequential exposure to steam at the following temperatures and pressures:

- 318 °F (158.9 °C), 73 psig for 8 hours.
- 265 °F (129.4 °C), 24 psig for 56 hours.

Accuracy within ±3.0% of upper range limit during and after exposure to 265 °F (129.5 °C), 24 psig, for 35 hours.

Post DBE Operation
Accuracy at reference conditions shall be within ±3% of upper range limit for one year following DBE.

Both Output Codes

Quality Assurance Program
In accordance with NQA-1, 10CFR50, Appendix B, and ISO 9001:2000.

Nuclear Cleaning
To 1 ppm maximum chloride content.

Hydrostatic Testing
To 150% of maximum working pressure or 2,000 psi (13.8 MPa), whichever is greater.

Traceability
In accordance with NQA-1 and 10CFR50, Appendix B; chemical and physical material certification of pressure retaining parts.

Qualified Life
Dependent on continuous ambient temperature at the installation site, (see Figure 3). Replacing the amplifier and calibration circuit boards at the end of their qualified life permits extension of the transmitter’s qualified life to the module’s qualified life. See Rosemount Report 108025 for details.

FIGURE 3. Qualified Life vs. Ambient Temperature
Performance Specifications
(Based on Zero Based Ranges under Reference Conditions)

Accuracy
±0.25% of calibrated span: Includes combined effects of linearity, hysteresis, and repeatability.

Dead Band
None.

Drift
±0.2% of upper range limit for thirty months.

Temperature Effect
Ranges 4 through 9:
±(0.75% upper range limit +0.5% span) per 100 °F (55.6 °C) ambient temperature change.

Range 3:
±(1.5% upper range limit +1.0% span) per 100 °F (55.6 °C) ambient temperature change.

Overpressure Effect
Rosemount 1153DB:
Maximum zero shift after 2,000 psi (13.8 MPa) overpressure:

<table>
<thead>
<tr>
<th>Range Code</th>
<th>Overpressure Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>3, 4</td>
<td>±0.25% of upper range limit</td>
</tr>
<tr>
<td>5</td>
<td>±1.0% of upper range limit</td>
</tr>
<tr>
<td>6, 7</td>
<td>±3.0% of upper range limit</td>
</tr>
<tr>
<td>8</td>
<td>±6.0% of upper range limit</td>
</tr>
</tbody>
</table>

Rosemount 1153GB and 1153AB:
Maximum zero shift after 2,000 psi (13.8 MPa) overpressure:

<table>
<thead>
<tr>
<th>Range Code</th>
<th>Overpressure Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>3, 4</td>
<td>±0.25% of upper range limit</td>
</tr>
<tr>
<td>5</td>
<td>±1.0% of upper range limit</td>
</tr>
<tr>
<td>6, 7</td>
<td>±3.0% of upper range limit</td>
</tr>
<tr>
<td>8</td>
<td>±6.0% of upper range limit</td>
</tr>
</tbody>
</table>

Maximum shift after 4,500 psi (31.0) MPa overpressure:

<table>
<thead>
<tr>
<th>Range Code</th>
<th>Overpressure Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>±0.5% of upper range limit</td>
</tr>
</tbody>
</table>

Rosemount 1153HB:
Maximum zero shift after 3,000 psi (20.68 MPa) overpressure:

<table>
<thead>
<tr>
<th>Range Code</th>
<th>Overpressure Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>±1.0% of upper range limit</td>
</tr>
<tr>
<td>5</td>
<td>±2.0% of upper range limit</td>
</tr>
<tr>
<td>6, 7</td>
<td>±5.0% of upper range limit</td>
</tr>
</tbody>
</table>

Static Pressure Zero Effect

Rosemount 1153DB: Per 1,000 psi (6.89 MPa):

<table>
<thead>
<tr>
<th>Range Code</th>
<th>Zero Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>3, 6–8</td>
<td>±0.5% of upper range limit</td>
</tr>
</tbody>
</table>

Rosemount 1153HB: Per 1,000 psi (6.89 MPa):

<table>
<thead>
<tr>
<th>Range Code</th>
<th>Zero Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Ranges</td>
<td>±0.66% of upper range limit</td>
</tr>
</tbody>
</table>

Static Pressure Span Effect
The effect is systematic and can be calibrated out for a particular pressure before installation.

Correction uncertainty is ±0.5% of input reading/per 1,000 psi (6.89 MPa).

Power Supply Effect
Less than 0.005% of output span/volt.

Load Effect
No load effect other than the change in voltage supplied to the transmitter.

Mounting Position Effect
No span effect. Zero shift of up to 1.5 inH₂O (372 Pa), which can be calibrated out.

Response Time
Fixed time constant (63%) at 100 °F (37.8 °C) as follows:

<table>
<thead>
<tr>
<th>Range Code</th>
<th>Response Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>2 seconds or less</td>
</tr>
<tr>
<td>4</td>
<td>0.5 seconds or less</td>
</tr>
<tr>
<td>5–9</td>
<td>0.2 seconds or less</td>
</tr>
</tbody>
</table>

Adjustable damping available through special N-option.
Functional Specifications

Service
Liquid, gas, or vapor.

Output
4–20 mA DC.

Power Supply
Design limits as shown in Figure 4 and Figure 5. See qualification report #108025 for additional detail.

Transmitter Load Limits

Span and Zero
Continuously adjustable externally.

Zero Elevation and Suppression
Maximum zero elevation: 600% of calibrated span (D, G, and H units only).
Maximum zero suppression: 500% of calibrated span.
Zero elevation and suppression must be such that neither the calibrated span nor the upper or lower range value exceeds 100% of the upper range limit.

Temperature Limits
Normal Operating Limits: 40 to 200 °F (4.4 to 93.3 °C).
Qualified Storage Limits: –40 to 120 °F (–40 to 48.9 °C).

Humidity Limits
0–100% relative humidity (NEMA 4X).

Volumetric Displacement
Less than 0.01 in³ (0.16 cm³).

Turn-on Time
Two seconds maximum. No warm-up required.

Pressure Ranges

<table>
<thead>
<tr>
<th>Range Code</th>
<th>Pressure Ranges</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>0–5 to 0–30 inH₂O (D units only)</td>
</tr>
<tr>
<td></td>
<td>(0–1.24 to 0–7.46 kPa)</td>
</tr>
<tr>
<td>4</td>
<td>0–25 to 0–150 inH₂O (0–6.22 to 37.3 kPa)</td>
</tr>
<tr>
<td>5</td>
<td>0–125 to 0–750 inH₂O (0–31.08 to 186.4 kPa)</td>
</tr>
<tr>
<td>6</td>
<td>0–17 to 0–100 psi (0–0.12 to 0–0.69 MPa)</td>
</tr>
<tr>
<td>7</td>
<td>0–50 to 0–300 psi (0–0.34 to 0–2.07 MPa)</td>
</tr>
<tr>
<td>8</td>
<td>0–170 to 0–1,000 psi (D units only)</td>
</tr>
<tr>
<td></td>
<td>(0–1.17 to 0–6.89 MPa)</td>
</tr>
<tr>
<td>9</td>
<td>0–500 to 0–3,000 psi (G units only)</td>
</tr>
<tr>
<td></td>
<td>(0–3.45 to 0–20.68 MPa)</td>
</tr>
</tbody>
</table>

<table>
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<tr>
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<tr>
<td></td>
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<td></td>
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</tr>
<tr>
<td></td>
<td>(0–3.45 to 0–20.68 MPa)</td>
</tr>
</tbody>
</table>
Maximum Working Pressure

Rosemount 1153DB and 1153HB:
Static Pressure Limit

Rosemount 1153GB and 1153AB:
Upper Range Limit

Static Pressure and Overpressure Limits

Rosemount 1153DB:
0.5 psia to 2,000 psig (3.4 kPa abs to 13.8 MPa) maximum rated static pressure for operation within specifications. Overpressure limit is 2,000 psig (13.8 MPa) on either side without damage to the transmitter.

Rosemount 1153HB:
0.5 psia to 3,000 psig (3.4 kPa abs to 20.7 MPa) maximum rated static pressure for operation within specifications. Overpressure limit is 3,000 psig (20.7 MPa) on either side without damage to the transmitter.

Overpressure Limits

Rosemount 1153GB and 1153AB:
Operates within specifications from 0.5 psia (3.4 kPa abs) to upper range limit. Overpressure limits without damage to transmitter:

- Range Codes 3–8
  Overpressure limit is 2,000 psig (13.8 MPa).

- Range Code 9
  Overpressure limit is 4,500 psig (31.0 MPa).

Physical Specifications

Materials of Construction

Isolating Diaphragms
316L SST.

Drain/Vent Valves
316 SST

Process Flanges
CF-8M (Cast version of 316 SST)

Process O-rings
316L SST.

Electronics Housing O-rings
Ethylene Propylene

Fill Fluid
Silicone Oil

Flange Bolts and Nuts
Plated alloy steel, per ASTM A-540.

Electronics Housing
Low Copper-Aluminum with epoxy-polyester paint.

Mounting Bracket
Carbon steel AISI 1010 or 1020, with epoxy-polyester paint.

Mounting Bolts (bracket to transmitter)
SAE J429 carbon steel, Grade 2 or Grade 5.

Weight
13 lb (5.9 kg) including mounting bracket.

Electrical Connections
1/2–14 NPT conduit with screw terminals.

Process Connections
3/8 inch Swagelok compression fittings, 316 SST (1/4–18 NPT optional).
FIGURE 7. Wiring Connections

FIGURE 8. Typical Rosemount 1153 Series B Pressure Transmitter Exploded View
FIGURE 9. Typical Mounting Configuration

Center of Gravity-Includes Bracket
(C.G. is Centered in Lateral Direction)

0.9 (22.9)

2.62 (66.5)

4.5 (114.3)

1.41 (35.8)

5/16 Bolts (4)
(Customer Supplied)

Rigid Panel

Panel Mounting Hole Pattern

Mounting Bracket for Panel Mount Shown in Typical Mounting Configuration

8.5 (216)

10 Max.
(254)

1 (25.4)

6.02 (153)

2.81 (71.4)

1.41 (35.8)

2.81 (71.4)

4.1 (104.1)

NOTE
All dimensions are nominal in inches (millimeters).
# Ordering Information

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1153</td>
<td>Alphaline Pressure Transmitters for Nuclear Applications</td>
</tr>
</tbody>
</table>

## Code | Pressure Measurement |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>Differential Pressure, 2,000 psig (13.8 MPa) Static Pressure Rating</td>
</tr>
<tr>
<td>H</td>
<td>Differential Pressure, 3,000 psig (20.68 MPa) Static Pressure Rating</td>
</tr>
<tr>
<td>A</td>
<td>Absolute Pressure</td>
</tr>
<tr>
<td>G</td>
<td>Gage Pressure</td>
</tr>
</tbody>
</table>

## Code | Series |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>Painted Aluminum Housing; qualified per IEEE Std 323-1974 and IEEE Std 344-1975</td>
</tr>
</tbody>
</table>

## Code | Output |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>P</td>
<td>Standard 4–20 mA</td>
</tr>
<tr>
<td>R&lt;sup&gt;(1)&lt;/sup&gt;</td>
<td>Improved Radiation Performance, 4–20 mA</td>
</tr>
</tbody>
</table>

## Code | Flange Option |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Welded (\frac{3}{8}) in. Swagelok Compression Fitting Process Connection and Welded Drain/Vent Valve</td>
</tr>
<tr>
<td>B&lt;sup&gt;(2)&lt;/sup&gt;</td>
<td>(\frac{3}{8})–18 NPT Process Connection and Welded Drain/Vent Valve</td>
</tr>
<tr>
<td>C&lt;sup&gt;(2)&lt;/sup&gt;</td>
<td>(\frac{3}{8})–18 NPT Process Connection and Drain Hole (Drain/Vent Valve not supplied)</td>
</tr>
<tr>
<td>D</td>
<td>One Flange Code Option A and One Remote Seal</td>
</tr>
<tr>
<td>E&lt;sup&gt;(2)&lt;/sup&gt;</td>
<td>One Flange Code Option B and One Remote Seal</td>
</tr>
<tr>
<td>F&lt;sup&gt;(2)&lt;/sup&gt;</td>
<td>One Flange Code Option C and One Remote Seal</td>
</tr>
<tr>
<td>G</td>
<td>Two Remote Seals</td>
</tr>
<tr>
<td>H</td>
<td>Welded (\frac{3}{8}) in. Swagelok Compression Fittings on Both Process Connection and Drain/Vent Connection</td>
</tr>
<tr>
<td>J&lt;sup&gt;(2)&lt;/sup&gt;</td>
<td>Welded (\frac{3}{8}) in. Swagelok Compression Process Connection and (\frac{3}{8})–18 NPT Drain Hole</td>
</tr>
<tr>
<td>L</td>
<td>One Flange Code Option H and One Remote Seal</td>
</tr>
<tr>
<td>M&lt;sup&gt;(2)&lt;/sup&gt;</td>
<td>One Flange Code Option J and One Remote Seal</td>
</tr>
</tbody>
</table>

### Typical Model Number: 1153 DB 4 R A

<sup>(1)</sup> The Rosemount 1153 Series B with Output Code R Electronics is also available with adjustable damping. This option is specified by adding “N0037” to the end of the complete model number, for example, 1153DB4RAN0037.

<sup>(2)</sup> Note: Customer assumes responsibility for qualifying interfaces on these options. Contact Rosemount Nuclear Instruments, Inc. for details.
Standard Accessories
All models are shipped with a mounting bracket. One instruction manual is included per shipment.

Calibration
Transmitters are factory calibrated to customer’s specified range. If calibration is not specified, transmitters are calibrated at maximum range. Calibration is at reference conditions (ambient temperature and pressure).

Options
Consult N-Options Product Data Sheet (PDS 00813-0100-2655), or contact Rosemount Nuclear Instruments, Inc. for special transmitter needs.

Tagging
The transmitter will be tagged at no charge, in accordance with customer requirements (96 characters maximum). All tags are SST. The standard tag is permanently attached to the transmitter. Standard tag character is 0.125 in. (3.18mm). A wire-on tag is available on request.

Documentation
Certification is provided for each Rosemount 1153 Series B transmitter for accuracy, special cleaning, hydrostatic testing, and traceability. Chemical and physical reports and identification of pressure-retaining parts are on file at Rosemount Nuclear Instruments, Inc.
## IMPORTANT NOTICE -- ERRATA

Model 1153 Series B Product Data Sheet 00813-0100-4302 Rev BA (January 2008)

<table>
<thead>
<tr>
<th>No.</th>
<th>Affected Pages</th>
<th>Description of Change</th>
<th>Effect Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>7</td>
<td>Electronics Housing – Low-copper aluminum with polyurethane paint</td>
<td>1/24/11</td>
</tr>
<tr>
<td>3</td>
<td>7</td>
<td>Mounting Bracket – Carbon steel AISI 1010 or 1020, with urethane or polyurethane paint</td>
<td>1/24/11</td>
</tr>
</tbody>
</table>

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a–Cell is a trademarks of Rosemount, Inc.

Swagelok is a registered trademark of Swagelok Co.

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