Rosemount 1154 Alphaline®
Nuclear Pressure Transmitter

INDUSTRY LEADING PERFORMANCE
• Qualified per IEEE Std. 323-1974 and IEEE Std. 344-1975
• $1.1 \times 10^8$ rads TID Gamma Radiation
• 7 g's ZPA Seismic
• 420 °F (215.6 °C) Steam Temperature
• 0.25% Accuracy

Product Discontinued

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RESULTS DRIVEN BY PROVEN MEASUREMENT

INTRODUCTION

Rosemount 1154 Alphaline® Nuclear Pressure Transmitters are designed for precision pressure measurements in nuclear applications requiring reliable performance and safety over a specified qualified life. These transmitters have been qualified per IEEE Std. 323-1974 and IEEE Std. 344-1975 to radiation levels of 110 megarads TID gamma radiation, seismic levels of 7g’s, and steam-pressure performance up to 420 °F (216 °C). Stringent quality control during the manufacturing process includes traceability of pressure retaining parts, special nuclear cleaning, and hydrostatic testing.

TRANSMITTER DESCRIPTION

Rosemount 1154 transmitters are uniquely built for Class 1E nuclear service while retaining the working concept and design parameters of the Rosemount 1151 transmitters that have set industry standards for reliable service. Transmitters are available in gage (G), differential (D), and high-line differential (H) configurations, with a variety of pressure range choices.

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 two-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 of the Rosemount 1154 transmitters. 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 1154

FIGURE 2. Rosemount 1154DP and 1154HP Dimensional Drawings

FIGURE 3. Rosemount 1154GP Dimensional Drawings

NOTE
All dimensions are nominal in inches (millimeters).
**ROEMOUNT 1154 SPECIFICATIONS**

**Nuclear Specifications**
Qualified per IEEE Std. 323-1974 and IEEE Std. 344-1975 as stated in Rosemount Report D8400102.

**Radiation**
Accuracy within ±(1.5% of upper range limit + 1.0% of span) during and after exposure to 55 megarads TID gamma radiation at the centerline per the following dose rate: 2 megarads/hr for 2 hours, 1.5 megarad/hr for 4 hours, 1 megarad/hr up to 55 megarads TID and an additional 55 megarads TID at a rate of 1 megarad/hr during post-accident operation.
- Range Code 0
- ±(2.25% of upper range limit + 1.0% of span).

**Seismic**
Accuracy within ±0.5% of upper range limit after a seismic disturbance defined by a required response spectrum with a ZPA of 7 g's.
- Range Code 0
- ±0.75% of upper range limit.

**Steam Pressure/Temperature**
Accuracy within ±(2.5% upper range limit + 0.5% of span) during and after sequential exposure to steam at the following temperatures and pressures, concurrent with chemical spray for the first 24 hours.
- 420 °F (215.6 °C), 50 psig for 3 minutes
- 350 °F (176.6 °C), 110 psig for 7 minutes
- 320 °F (160 °C), 75 psig for 8 hours
- 265 °F (129.4 °C), 24 psig for 56 hours
- Range Code 0
- ±(3.75% of upper range limit + 0.5% of span).

**Chemical Spray**
Composition is 0.28 molar boric acid, 0.064 molar sodium thiosulfate, and sodium hydroxide to make an initial pH of 11.0 and a subsequent pH ranging from 8.5 to 11.0. Chemical spray is sprayed at a rate of 0.25 gal/min/ft².

**Post DBE Operation**
Accuracy at reference conditions shall be within ±2.5% of upper range limit (±3.75% for Range Code 0) for one year following DBE.

**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, as shown in Figure 4. Replacing 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 D8400102 for details.

*FIGURE 4. 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 (±0.3% of upper range limit for Range Code 0).

Temperature Effect

Range Codes 4–9
±(0.75% upper range limit +0.5% span) per 100 °F (55.6 °C) ambient temperature change.

Range Code 0
±(1.13% upper range limit +0.5% span) per 100 °F (55.6 °C) ambient temperature change.

Overpressure Effect

Rosemount 1154DP
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>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 and 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 1154GP
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>4</td>
<td>±0.25% of upper range limit</td>
</tr>
<tr>
<td>5, 6, 7, and 8</td>
<td>±1.0% of upper range limit</td>
</tr>
</tbody>
</table>

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>

After 6,000 psi (41.37 MPa) overpressure:

<table>
<thead>
<tr>
<th>Range Code</th>
<th>Overpressure Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>±0.25% of upper range limit</td>
</tr>
</tbody>
</table>

Rosemount 1154HP
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 and 7</td>
<td>±5.0% of upper range limit</td>
</tr>
</tbody>
</table>

Static Pressure Zero Effect

Rosemount 1154DP
Per 1,000 psi (6.89 MPa):

<table>
<thead>
<tr>
<th>Range Code</th>
<th>Static Pressure Zero Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 and 5</td>
<td>±0.2% of upper range limit</td>
</tr>
<tr>
<td>6, 7, and 8</td>
<td>±0.5% of upper range limit</td>
</tr>
</tbody>
</table>

Rosemount 1154HP
Per 1,000 psi (6.89 MPa):

<table>
<thead>
<tr>
<th>Range Code</th>
<th>Static Pressure Zero Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>4, 5, 6 and 7</td>
<td>±0.66% of upper range limit</td>
</tr>
</tbody>
</table>

Static Pressure Span Effect

Effect is systematic and can be calibrated out for a particular pressure before installation. Correction uncertainty is ±0.5% of input reading/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:

- **Range Code 4**
  0.5 seconds or less.

- **All other Range Codes**
  0.2 seconds or less.

Adjustable damping option is available through a special N-Option.
Rosemount 1154

Functional Specifications

Service
Liquid, gas, or vapor.

Output
4–20 mA dc.

Power Supply
Design limits as shown in Figure 5. See qualification report D8400102 for additional detail.

Span and Zero
Continuously adjustable externally.

Zero Elevation and Suppression

Maximum Zero Elevation
600% of calibrated span
(400% of calibrated span for Range Code 0).

Maximum Zero Suppression
500% of calibrated span
(300% of calibrated span for Range Code 0).

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 (−40.0 to 48.9 °C).

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

Volumetric Displacement
Less than 0.01 in.³ (0.16 cm³)

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

Pressure Ranges

Rosemount 1154DP and 1154HP:

<table>
<thead>
<tr>
<th>Range Code</th>
<th>Pressure Ranges</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>0–25 to 0–150 inH₂O (0–6.22 to 0–37.3 kPa)</td>
</tr>
<tr>
<td>5</td>
<td>0–125 to 0–750 inH₂O (0–31.08 to 0–186.4 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 (0–1.17 to 0–6.89 MPa)</td>
</tr>
</tbody>
</table>

(D units only)

Rosemount 1154GP:

<table>
<thead>
<tr>
<th>Range Code</th>
<th>Pressure Ranges</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>0–25 to 0–150 inH₂O (0–6.22 to 0–37.3 kPa)</td>
</tr>
<tr>
<td>5</td>
<td>0–125 to 0–750 inH₂O (0–31.08 to 0–186.4 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 (0–1.17 to 0–6.89 MPa)</td>
</tr>
<tr>
<td>9</td>
<td>0–500 to 0–3,000 psi (0–3.45 to 0–20.68 MPa)</td>
</tr>
<tr>
<td>0</td>
<td>0–1,000 to 0–4,000 psi (0–6.89 to 0–27.56 MPa)</td>
</tr>
</tbody>
</table>

Maximum Working Pressure

Rosemount 1154DP and 1154HP:
Static pressure limit

Rosemount 1154GP:
Upper range limit

Static Pressure and Overpressure Limits

Rosemount 1154DP
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 1154HP
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 1154GP:
Operates within specifications from 0.5 psia (3.4 kPa abs) to upper range limit. Overpressure limits without damage to the transmitter:

<table>
<thead>
<tr>
<th>Range Code</th>
<th>Overpressure Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>4–8</td>
<td>2,000 psig (13.8 MPa)</td>
</tr>
<tr>
<td>9</td>
<td>4,500 psig (31.0 MPa)</td>
</tr>
<tr>
<td>0</td>
<td>6,000 psig (41.34 MPa)</td>
</tr>
</tbody>
</table>

Physical Specifications (All Models)
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
316 SST.

Mounting Bracket:
316L SST.

Mounting Bolts (Bracket to Transmitter)
SAE J429 carbon steel, Grade 2 or Grade 5

Weight
24 lb (10.9 kg) including mounting bracket.

Electrical Connections
$1\frac{1}{2}$–14 NPT conduit with screw terminals.

Process Connections
FIGURE 6. Electrical Block Diagram

- Sensor
- Demodulator
- Current Detector
- Oscillator
- Osc. Control Amp.
- Voltage Regulator
- Curr. Control Amp.
- Current Limiter
- Reverse Polarity Protection
- Current Control
- Test Signal
- Power Supply

FIGURE 7. Wiring Connections

Terminal Side Cover Removed
FIGURE 8. Typical Rosemount 1154 Transmitter Exploded View
FIGURE 9. Rosemount 1154 Typical Mounting Configuration

NOTE
All dimensions are nominal in inches (millimeters).
### ORDERING INFORMATION

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
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<tbody>
<tr>
<td>1154</td>
<td><em>Alphaline Pressure Transmitters for Nuclear Applications Qualified per IEEE Std. 323-1974 and Std. 344-1975</em></td>
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<table>
<thead>
<tr>
<th>Code</th>
<th>Pressure Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>DP</td>
<td>Differential Pressure, 2,000 psig (13.8 MPa) Static Pressure Rating</td>
</tr>
<tr>
<td>HP</td>
<td>Differential Pressure, 3,000 psig (20.68 MPa) Static Pressure Rating</td>
</tr>
<tr>
<td>GP</td>
<td>Gage Pressure</td>
</tr>
</tbody>
</table>

#### PRESSURE RANGES at 68 °F

<table>
<thead>
<tr>
<th>Code</th>
<th>Rosemount 1154DP (Differential)</th>
<th>Rosemount 1154HP (Differential)</th>
<th>Rosemount 1154GP (Gage)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>0–25 to 0–150 inH₂O (0–6.22 to 0–37.3 kPa)</td>
<td>0–25 to 0–150 inH₂O (0–6.22 to 0–37.3 kPa)</td>
<td>0–25 to 0–150 inH₂O (0–6.22 to 0–37.3 kPa)</td>
</tr>
<tr>
<td>5</td>
<td>0–125 to 0–750 inH₂O (0–31.08 to 0–186.4 kPa)</td>
<td>0–125 to 0–750 inH₂O (0–31.08 to 0–186.4 kPa)</td>
<td>0–125 to 0–750 inH₂O (0–31.08 to 0–186.4 kPa)</td>
</tr>
<tr>
<td>6</td>
<td>0–17 to 0–100 psi (0–0.12 to 0–0.69 MPa)</td>
<td>0–17 to 0–100 psi (0–0.12 to 0–0.69 MPa)</td>
<td>0–17 to 0–100 psi (0–0.12 to 0–0.69 kPa)</td>
</tr>
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<td>7</td>
<td>0–50 to 0–300 psi (0–0.34 to 0–2.07 MPa)</td>
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<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 (0–6.89 to 0–6.89 MPa)</td>
<td>—</td>
<td>0–170 to 0–1,000 psi (0–6.89 to 0–6.89 MPa)</td>
</tr>
<tr>
<td>9</td>
<td>—</td>
<td>—</td>
<td>0–500 to 0–3,000 psi (0–3.45 to 0–20.68 MPa)</td>
</tr>
<tr>
<td>0</td>
<td>—</td>
<td>—</td>
<td>0–1,000 to 0–4,000 psi (0–6.89 to 0–27.56 MPa)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Code</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>R(1)</td>
<td>Standard 4–20 mA</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Code</th>
<th>Flange Option</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Welded ¾-in. Swagelok Compression Fitting Process Connection and Welded Drain/Vent Valve</td>
</tr>
<tr>
<td>B(2)</td>
<td>¼–18 NPT Process Connection and Welded Drain/Vent Valve</td>
</tr>
<tr>
<td>C(2)</td>
<td>¼–18 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(2)</td>
<td>One Flange Code Option B and One Remote Seal</td>
</tr>
<tr>
<td>F(2)</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 ¾-in. Swagelok Compression Fittings on Both Process Connection and Drain/Vent Connection</td>
</tr>
<tr>
<td>J(2)</td>
<td>Welded ¾-in. Swagelok Compression Fitting Process Connection and ¼–18 NPT Drain Hole</td>
</tr>
<tr>
<td>L</td>
<td>One Flange Code Option H and One Remote Seal</td>
</tr>
<tr>
<td>M(2)</td>
<td>One Flange Code Option J and One Remote Seal</td>
</tr>
</tbody>
</table>

*Typical Model Number: 1154 DP 4 R A*

1. The Rosemount 1154 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 “1154DP4RAN0037.”

2. Customer assumes responsibility for qualifying connection 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-Option Product Data Sheet 00813-0100-2655 or call 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 height is 0.125 in. (3.18 mm). A wire-on tag is available on request.

Documentation
Certification is provided for each Rosemount 1154 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 1154 Product Data Sheet 00813-0100-4514 Rev BA (January 2008)

<table>
<thead>
<tr>
<th>No.</th>
<th>Affected Pages</th>
<th>Description of Change</th>
<th>Effect Date</th>
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