Three-component dynamic force sensors are offered in both ICP® and charge output configurations for dynamic and quasi-static force measurement applications. Each utilizes an array of precision-aligned, quartz sensing crystals. Measurements along the z-axis are proportional to applied compression, tension, and impact forces. Measurements along the x- and y-axes are proportional to shear forces that are imposed upon preloaded crystals by the test fixture.

ICP® styles contain built-in, microelectronic signal conditioning circuitry to provide clean, low-impedance output signals that can be transmitted over low cost cables and in adverse, industrial environments. Multi-pin connectors facilitate a single point hookup with common, multi-conductor cable. Charge output styles achieve higher temperature operation, and are suitable for applications requiring flexible setup and maximum signal-to-noise.

Versions are available with ranges to 10k lb (45k N) in the z-axis (perpendicular to top surface), and to 4000 lb (18 kN) in the x- and y-axes. Both ICP® and charge output styles are available. Metric mounting holes are also available.

As with all PCB® instrumentation, these sensors are complemented with toll-free applications assistance, 24-hour customer service, and are backed by a no-risk policy that guarantees satisfaction or your money refunded.
ICP® sensors contain built-in signal conditioning circuitry for ease of use and setup. They require excitation from low cost, constant-current signal conditioners and use ordinary coaxial cables for signal transmission. The sensor output signal is at a very low impedance, which permits operation in dirty, harsh, factory environments and signal transmission over long cable lengths with no loss of signal quality.

**Notes:**
1. The Discharge Time Constant (DTC) determines low frequency response according to the relationship $f_{-5\%}=\frac{3}{2\pi\tau}$. Sensors accurately follow transient events lasting a few percent of the DTC. For square wave events, the DTC should be 100 times the event duration. For ramp shape events, the DTC should be 50 times the event duration and for a half sine pulse the DTC should be 20 times the event duration.
2. See page 2.23 for complete accessory listings. [3] See page 1.17 for a description of options (specifications for optional versions may differ slightly. Consult factory before ordering). For complete listing of metric accessory model number and threads, see page 2.23. [4] Resolution, System Discharge Time Constant and Low Frequency range are dependent upon sensor cable and signal conditioning used.
3. Recommended pre-load is required to meet published specification and calibration.
4. Recommended pre-load is required to meet published specification and calibration.
5. Recommended pre-load is required to meet published specification and calibration.

**Environmental Specifications**

**Temperature Range**
- **°F**: -40 to +125
- **°C**: -40 to +52

**Electrical Specifications**

- **Discharge Time Constant [1]**
  - **(z-axis)**: second
  - **(x-, y-axis)**: second
- **Output Impedance**: ohm
- **Output Bias Voltage**: +12V
- **Voltage Excitation**: +20 to 30
- **Constant Current Excitation**: mA
- **Capacitance (all axes)**: pF
- **Insulation Resistance**: ohm
- **Polarity (in direction of markings)**: positive
- **Physical Specifications**
- **Recommended Pre-Load**: lb (N)
- **Connector**: type
- **Stiffness**: Ib/in (kN/m)
- **Stability**: type
- **Material**: (stainless steel)
- **Maximum Allowable Force**: lbs (N)
- **Maximum Allowable Bending Moment**: lbs in (N m)
- **Weight**: oz (g)

**Supplied Accessories [2]**

- **Mounting Stud (brass-copper)**
- **Mounting Stud Thread**
- **Anti-Friction Washer**
- **Pilot Bushing**

**Options [3]**

- **Reverse Shear Polarity**: positive
- **ICP® Sensor System Diagram**

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**Typical ICP® Sensor System Diagram**

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Series 260/261 3-Component Dynamic Force Sensors

**3-Component ICP® Quartz Ring Styles**

Model 260A01
Model 260A02
Model 260A03

**Component Quartz Force Sensors**

<table>
<thead>
<tr>
<th>Performance Specifications</th>
<th>Unit</th>
<th>260A01</th>
<th>260A02</th>
<th>260A03</th>
<th>260A11</th>
<th>260A12</th>
<th>260A13</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compression or Tension Range (z-axis)</td>
<td>lb (N)</td>
<td>1000</td>
<td>5000</td>
<td>1000</td>
<td>45k</td>
<td>1000</td>
<td>4500</td>
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<tr>
<td>Shear Range (x-, y-axis)</td>
<td>lb (N)</td>
<td>500</td>
<td>2200</td>
<td>4000</td>
<td>325</td>
<td>500</td>
<td>2200</td>
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<tr>
<td>Maximum Compression or Tension (z-axis)</td>
<td>lb (N)</td>
<td>1120</td>
<td>6000</td>
<td>1120</td>
<td>18k</td>
<td>1120</td>
<td>6000</td>
</tr>
<tr>
<td>Maximum Shear (x-, y-axis)</td>
<td>lb (N)</td>
<td>680</td>
<td>3000</td>
<td>4400</td>
<td>19k</td>
<td>660</td>
<td>3000</td>
</tr>
<tr>
<td>Sensitivity (x, y-axis)</td>
<td>value</td>
<td>3.55 mV/lb</td>
<td>3.55 mV/lb</td>
<td>2.5 mV/lb</td>
<td>15 pC/lb</td>
<td>7.2 pC/lb</td>
<td></td>
</tr>
<tr>
<td>Sensitivity (z-axis)</td>
<td>value</td>
<td>3.55 mV/lb</td>
<td>2.5 mV/lb</td>
<td>1.25 mV/lb</td>
<td>32 pC/lb</td>
<td>7.2 pC/lb</td>
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</tr>
<tr>
<td>Resolution (broadband)</td>
<td>lb (N)</td>
<td>0.006</td>
<td>0.002</td>
<td>0.006</td>
<td>see note [4]</td>
<td>see note [4]</td>
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<tr>
<td>Resolution (broadband)</td>
<td>lb (N)</td>
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<td>0.001</td>
<td>0.001</td>
<td>see note [4]</td>
<td>see note [4]</td>
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<tr>
<td>Cross-talk Fx = Fy</td>
<td>%</td>
<td>≤ 1</td>
<td>≤ 1</td>
<td>≤ 1</td>
<td>≤ 1</td>
<td>≤ 1</td>
<td></td>
</tr>
<tr>
<td>Cross-talk Fy = Fx</td>
<td>%</td>
<td>≤ 1</td>
<td>≤ 1</td>
<td>≤ 1</td>
<td>≤ 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amplitude Linearity</td>
<td>%</td>
<td>≤ 1</td>
<td>≤ 1</td>
<td>≤ 1</td>
<td>≤ 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upper Frequency Limit</td>
<td>Hz</td>
<td>90k</td>
<td>90k</td>
<td>39k</td>
<td>90k</td>
<td>90k</td>
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</tr>
<tr>
<td>Low Frequency Response (-5%)</td>
<td>Hz</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
<td>see note [4]</td>
<td>see note [4]</td>
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</tr>
<tr>
<td>Temperature Range</td>
<td>°F</td>
<td>-40 to +125</td>
<td>-40 to +125</td>
<td>-40 to +125</td>
<td>-73 to +177</td>
<td>-73 to +177</td>
<td>-73 to +177</td>
</tr>
<tr>
<td>Temperature Range</td>
<td>°C</td>
<td>-40 to +52</td>
<td>-40 to +52</td>
<td>-40 to +52</td>
<td>-40 to +52</td>
<td>-40 to +52</td>
<td>-40 to +52</td>
</tr>
</tbody>
</table>

**Environmental Specifications**

**Temperature Range**
- **°F**: -40 to +125
- **°C**: -40 to +52

**Electrical Specifications**

- **Discharge Time Constant [1]**
  - **(z-axis)**: second
  - **(x-, y-axis)**: second
- **Output Impedance**: ohm
- **Output Bias Voltage**: +12V
- **Voltage Excitation**: +20 to 30
- **Constant Current Excitation**: mA
- **Capacitance (all axes)**: pF
- **Insulation Resistance**: ohm
- **Polarity (in direction of markings)**: positive
- **Physical Specifications**
- **Recommended Pre-Load**: lb (N)
- **Connector**: type
- **Stiffness**: Ib/in (kN/m)
- **Stability**: type
- **Material**: (stainless steel)
- **Maximum Allowable Force**: lbs (N)
- **Maximum Allowable Bending Moment**: lbs in (N m)
- **Weight**: oz (g)

**Supplied Accessories [2]**

- **Mounting Stud (brass-copper)**
- **Mounting Stud Thread**
- **Anti-Friction Washer**
- **Pilot Bushing**

**Options [3]**

- **Reverse Shear Polarity**: positive
- **ICP® Sensor System Diagram**

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**Notes:**
1. The Discharge Time Constant (DTC) determines low frequency response according to the relationship $f_{-5\%}=\frac{3}{2\pi\tau}$. Sensors accurately follow transient events lasting a few percent of the DTC. For square wave events, the DTC should be 100 times the event duration. For ramp shape events, the DTC should be 50 times the event duration and for a half sine pulse the DTC should be 25 times the pulse duration. To ensure measurement system compatibility, use OC coupled or Long Time Constant signal conditioners for long duration transient measurements. [2] See page 2.13 for complete accessory listings. [3] See page 1.17 for a description of options (specifications for optional versions may differ slightly. Consult factory before ordering). For complete listing of metric accessory model number and threads, see page 2.23. [4] Resolution, System Discharge Time Constant and Low Frequency range are dependent upon sensor cable and signal conditioning used. [5] Recommended pre-load is required to meet published specification and calibration.
3-Component ICP® Triaxial Force Link Styles

3-Component Quartz Force Links

<table>
<thead>
<tr>
<th>Model Number</th>
<th>ICP® Models</th>
<th>Charge Output</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>261A01</td>
<td>261A02</td>
</tr>
<tr>
<td>Performance Specifications</td>
<td>Unit</td>
<td>English</td>
</tr>
<tr>
<td>Compressive or Tensile Range (z-axis)</td>
<td>lb (N)</td>
<td>1000</td>
</tr>
<tr>
<td>Shear Range (x-, y-axis)</td>
<td>lb (N)</td>
<td>50</td>
</tr>
<tr>
<td>Maximum Compressive or Tensile Range (z-axis)</td>
<td>lb (N)</td>
<td>1320</td>
</tr>
<tr>
<td>Maximum Shear (x-, y-axis)</td>
<td>lb (N)</td>
<td>660</td>
</tr>
<tr>
<td>Sensitivity (± 20%) (x-, y-axis)</td>
<td>value</td>
<td>2.5 mV/lb</td>
</tr>
<tr>
<td>Sensitivity (± 20%) (x-, y-axis)</td>
<td>value</td>
<td>2.2 mV/lb</td>
</tr>
<tr>
<td>Resolution (broadband) (z-axis)</td>
<td>lb (N)</td>
<td>0.008</td>
</tr>
<tr>
<td>Resolution (broadband) (x-, y-axis)</td>
<td>Hz</td>
<td>0.01</td>
</tr>
<tr>
<td>Amplitude Linearity [%]</td>
<td>≤ 1</td>
<td>≤ 1</td>
</tr>
<tr>
<td>Cross-talk Fx ÷ Fy, Fy ÷ Fx [%]</td>
<td>%</td>
<td>± 3</td>
</tr>
<tr>
<td>Upper Frequency Limit</td>
<td>Hz</td>
<td>11k</td>
</tr>
<tr>
<td>Low Frequency Response (-5%) (x-axis)</td>
<td>Hz</td>
<td>0.001</td>
</tr>
<tr>
<td>Low Frequency Response (-5%) (y-axis)</td>
<td>Hz</td>
<td>0.001</td>
</tr>
</tbody>
</table>

Environmental Specifications

| Temperature Range | °F | -65 to +250 | -65 to +250 | -65 to +250 | -100 to +350 | -100 to +350 | -100 to +350 |
|                   | °C | -54 to +121 | -54 to +121 | -54 to +121 | -73 to +177 | -73 to +177 | -73 to +177 |

Electrical Specifications

| Discharge Time Constant [1] (z-axis) | second | second | second | second | second | second |
|                                     | ≥ 500 | ≥ 500 | ≥ 500 | ≥ 500 | see note [4] | see note [4] |
| Output Impedance | ohm | ≤ 100 | ≤ 100 | ≤ 100 | N/A | N/A | N/A |
| Output Bias Voltage | µVDC | 8 to 14 | 8 to 14 | 8 to 14 | N/A | N/A | N/A |
| Voltage Excitation | µVDC | 20 to 30 | 20 to 30 | 20 to 30 | N/A | N/A | N/A |
| Constant Current Excitation | mA | 2 to 20 | 2 to 20 | 2 to 20 | N/A | N/A | N/A |
| Capacitance (all axes) | pF | N/A | N/A | N/A | 18 | 70 | 70 |
| Insulation Resistance | ohm | N/A | N/A | N/A | > 10⁶ | > 10⁶ | > 10⁶ |
| Polarity (in direction of markings) | positive | positive | positive | negative | negative | negative |

Physical Specifications

<table>
<thead>
<tr>
<th>Connector</th>
<th>type</th>
<th>4-pin male</th>
<th>4-pin male</th>
<th>4-pin male</th>
<th>10-32 (three)</th>
<th>10-32 (three)</th>
<th>10-32 (three)</th>
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</thead>
<tbody>
<tr>
<td>Stiffness (x-axis)</td>
<td>lb/in [kN/m]</td>
<td>10</td>
<td>1.75</td>
<td>6</td>
<td>1.1</td>
<td>15</td>
<td>2.6</td>
</tr>
<tr>
<td>Sealing</td>
<td>type</td>
<td>hermetic weld</td>
<td>hermetic weld</td>
<td>hermetic weld</td>
<td>hermetic weld</td>
<td>hermetic weld</td>
<td></td>
</tr>
<tr>
<td>Material (stainless steel)</td>
<td>type</td>
<td>17-4</td>
<td>17-4</td>
<td>17-4</td>
<td>17-4</td>
<td>17-4</td>
<td></td>
</tr>
<tr>
<td>Maximum Allowable Bending Moment (x-, y-axis)</td>
<td>lb-in [N-m]</td>
<td>14</td>
<td>19</td>
<td>40</td>
<td>54</td>
<td>240</td>
<td>325</td>
</tr>
<tr>
<td>Weight</td>
<td>oz [gm]</td>
<td>14</td>
<td>388</td>
<td>34</td>
<td>975</td>
<td>96</td>
<td>2.9k</td>
</tr>
</tbody>
</table>

Optional Models


Notes:
[1] The Discharge Time Constant (DTC) determines low frequency response according to the relationship f-5%=3/(2πDTC). Sensors accurately follow transient events lasting a few percent of the DTC. For square wave events, the DTC should be 100 times the event duration. For ramp shape events, the DTC should be 50 times the event duration. To ensure measurement system compatibility, use DC coupled or Long Time Constant signal conditioners for long duration transient measurements.
Series 484 Line-powered, DC-coupled, ICP® Sensor Signal Conditioners

Condition ICP® sensors and provide a DC coupled signal path for long duration, quasi-static measurements.
- Selectable AC or DC coupled signal path
- Versions offering gain ×1, ×10, ×100
- Versions offering clamped zero output for applications involving repetitive pulse inputs
- Convenient, line-powered, benchtop styles
- Supports calibration requirements

Series 440 Modular Signal Conditioners for ICP® & Charge Output Piezoelectric Sensors

Mix and match modules into a variety of chassis to achieve the functions and number of channels desired.
- Modules for conditioning ICP® and charge output sensors
- AC or DC-coupled options
- Expands as needs grow
- Line or battery powered

Series 480 Battery Powered, ICP® Sensor Signal Conditioners

For portable measurement and testing applications.
- Single and 3-channel versions available
- Unity or variable gain versions
- Powered by standard 9 VDC batteries
- Rechargeable option
- AC power adaptor option

Model 421A13 3-channel Industrial Charge Amplifier

Specifically designed for machinery interface of piezoelectric charge output force and strain sensors.
- Each channel independently ranged incrementally for 100 to 100,000 pC input
- Fixed long discharge time constant
- ±5 Volt output at selected pC FS input
- Remote reset
- Low Broadband noise (1 to 10 kHz)
- 15 to 30 VDC powered

PCB Piezotronics Test & Measurement Force, Strain and Torque product offering includes piezoelectric and strain gage force sensors, load cells, and torque sensors for research & development, process monitoring, assembly force control, end-of-line quality check requirements and general component test. Additional Test & Measurement products include sensors for acoustics, pressure, acceleration, shock, vibration, and supporting electronics. PCB® products are backed by our Total Customer Satisfaction policy, which guarantees your satisfaction or your money refunded.

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