3-Component Dynamic Force Sensors

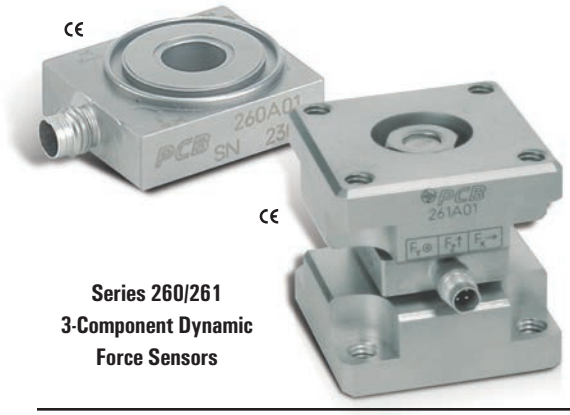
Conduct Simultaneous Force Measurements in Three Orthogonal Directions

Highlights

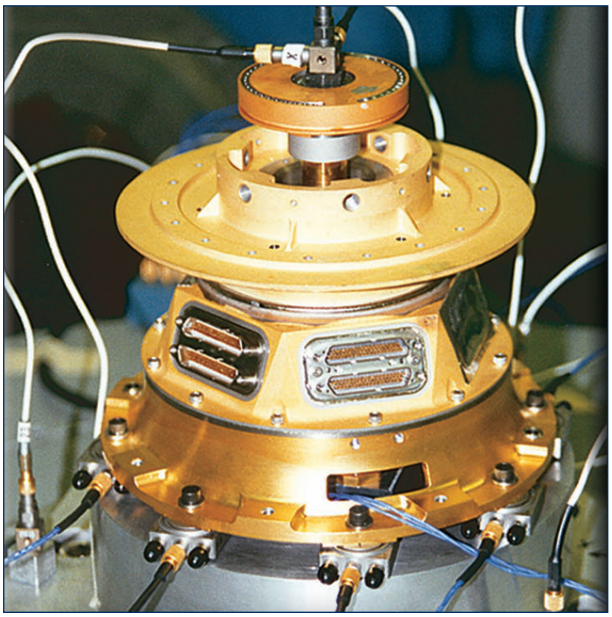
- Standard Fz Ranges up to 10 klb
- Standard Fx, Fy Ranges up to 4000 lb
- Stainless Steel Construction Hermetically Sealed
- Choice of ICP® or Charge Versions

Applications

- Automotive Chassis and Other Vehicle Dynamic Measurements
- Monitor Cutting Tool Forces and Detect Tool Wear
- Provide Feedback for Force Limited Vibration Testing
- Measure Input Forces for Modal Analysis and Structural Testing
- Assess and Study Biomechanic Ability, Chart Therapy Progress
- Monitor Machine and Engine Mounts for Imbalance or Looseness
- Measure Impact Forces During Drop Testing and Crash Testing



Series 260/261 3-Component Dynamic Force Sensors



A satellite component undergoes force limited vibration testing with 3-component force sensors used in the feedback control loop that monitors input excitation force.

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.

3-Component ICP® Quartz Ring Styles

Model 260A01

Model 260A02

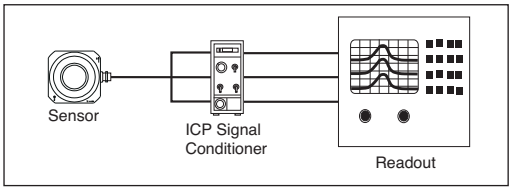
Model 260A03

Component Quartz Force Sensors

		ICP® Models						Charge Output					
Model Number		**260A01**		**260A02**		**260A03**		**260A11**		**260A12**		**260A13**	
Performance Specifications	**Unit**	**English**	**SI**	**English**	**SI**	**English**	**SI**	**English**	**SI**	**English**	**SI**	**English**	**SI**
Compression or Tension Range (z-axis)	lb (N)	1000	4500	1000	4500	10k	45k	1000	4500	1000	4500	10k	45k
Shear Range (x-, y-axis)	lb (N)	500	2200	1000	4500	4000	18k	500	2200	1000	4500	4000	18k
Maximum Compression or Tension (z-axis)	lb (N)	1320	6000	1320	6000	11k	50k	1320	6000	1320	6000	11k	50k
Maximum Shear (x-, y-axis)	lb (N)	660	3000	1000	4500	4400	19k	660	3000	1000	4500	4400	19k
Sensitivity (± 20%) (z-axis)	value value	2.5 mV/lb 0.56 mV/N		2.5 mV/lb 0.56 mV/N		0.25 mV/lb 0.06 mV/N		15 pC/lb 3.4 pC/N		15 pC/lb 3.4 pC/N		15 pC/lb 3.4 pC/N	
Sensitivity (± 20%) (x-, y-axis)	value value	10 mV/lb 2.2 mV/N		5 mV/lb 1.1 mV/N		1.25 mV/lb 0.28 mV/N		32 pC/lb 7.2 pC/N		32 pC/lb 7.2 pC/N		32 pC/lb 7.2 pC/N	
Resolution (broadband) (z-axis) (x-, y-axis)	lb (N) rms lb (N) rms	0.006 0.002	0.027 0.009	0.006 0.006	0.027 0.027	0.05 0.01	0.22 0.045	see note [4] see note [4]		see note [4] see note [4]		see note [4] see note [4]	
Amplitude Linearity [5]	% FS	≤ 1		≤ 1		≤ 1		≤ 1		≤ 1		≤ 1	
Cross-Talk Fx ÷ Fy Fx, Fy ÷ F	% %	± 3 ± 5		± 3 ± 5		± 3 ± 5		± 3 ± 5		± 3 ± 5		± 3 ± 5	
Upper Frequency Limit	Hz	90k		90k		39k		90k		90k		39k	
Low Frequency Response (-5%) (z-axis) (x-, y-axis)	Hz Hz	0.01 0.001		0.01 0.001		0.01 0.001		see note [4] see note [4]		see note [4] see note [4]		see note [4] see note [4]	
Environmental Specifications													
Temperature Range	°F °C	-65 to +250 -54 to +121		-65 to +250 -54 to +121		-65 to +250 -54 to +121		-100 to +350 -73 to +177		-100 to +350 -73 to +177		-100 to +350 -73 to +177	
Electrical Specifications													
Discharge Time Constant [1] (z-axis) (x-, y-axis)	second second	≥ 50 ≥ 500		≥ 50 ≥ 500		≥ 50 ≥ 500		see note [4] see note [4]		see note [4] see note [4]		see note [4] see note [4]	
Output Impedance	ohm	≤ 100		≤ 100		≤ 100		N/A		N/A		N/A	
Output Bias Voltage	+VDC	8 to 14		8 to 14		8 to 14		N/A		N/A		N/A	
Voltage Excitation	+VDC	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		30		70	
Insulation Resistance	ohm	N/A		N/A		N/A		$> 10^{12}$		$> 10^{12}$		$> 10^{12}$	
Polarity (in direction of markings)		positive		positive		positive		negative		negative		negative	
Physical Specifications													
Recommended Pre-Load	lb (N)	5000	22k	10k	44.5k	40k	178k	5000	22k	10k	44.5k	40k	177k
Connector	type	4-pin male		4-pin male		4-pin male		10-32	(three)	10-32	(three)	10-32	(three)
Stiffness (z-axis) (x-, y-axis)	lb/µin (kN/µm) lb/µin (kN/µm)	10 4	1.75 0.70	19 6	3.3 1.05	40 15	7 2.6	10 4	1.75 0.70	19 6	3.3 1.05	40 15	7 2.6
Sealing	type	hermetic weld		hermetic weld		hermetic weld		hermetic weld		hermetic weld		hermetic weld	
Material (stainless steel)	type	17-4		17-4		17-4		17-4		17-4		17-4	
Maximum Allowable Torque (z-axis)	ft-lb (N-m)	14	19	40	54	240	325	14	19	40	54	240	325
Maximum Allowable Bending Moment (x-, y-axis)	ft-lb (N-m)	13	17.6	70	94	325	441	13	17.6	70	94	325	441
Weight	oz (gm)	.93	26	1.59	45	9.6	271	.87	24.6	1.5	42.5	9.9	280
Supplied Accessories [2]													
Mounting Stud (beryllium-copper)	model	081A70		081A74		081A71		081A70		081A74		081A71	
Mounting Stud Thread	size	5/16-24		1/2-20		7/8-14		5/16-24		1/2-20		7/8-14	
Anti-Friction Washer	model	082B02		082M12		082B06		082B02		082M12		082B06	
Pilot Bushing	model	083A10		083A13		083A11		083A10		083A13		083A11	
Optional Models													
Reverse Shear Polarity	model	–		–		–		260A31		260A32		260A33	
Options [3]	**prefix**	**M,W**		**M,W**		**M,W**		**M,W**		**M,W**		**M,W**	

Notes: [1] The Discharge Time Constant (DTC) determines low frequency response according to the relationship f-5%=3/(2π(DTC)). 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 DC 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.

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.



Typical ICP® Sensor System Diagram

3-Component ICP® Triaxial Force Link Styles

Model 261A01

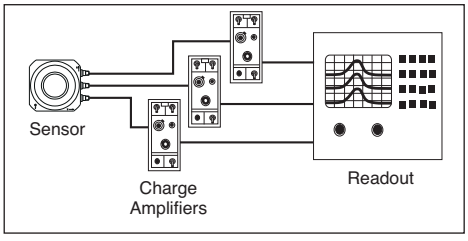
Model 261A02

Model 261A03

3-Component Quartz Force Links

		ICP® Models						Charge Output					
Model Number		**261A01**		**261A02**		**261A03**		**261A11**		**261A12**		**261A13**	
Performance Specifications	**Unit**	**English**	**SI**	**English**	**SI**	**English**	**SI**	**English**	**SI**	**English**	**SI**	**English**	**SI**
Compression or Tension Range (z-axis)	lb (N)	1000	4500	1000	4500	10k	45k	1000	4500	1000	4500	10k	45k
Shear Range (x-, y-axis)	lb (N)	500	2200	1000	4500	4000	18k	500	2200	1000	4500	4000	18k
Maximum Compression or Tension (z-axis)	lb (N)	1320	6000	1320	6000	11k	50k	1320	6000	1320	6000	11k	50k
Maximum Shear (x-, y-axis)	lb (N)	660	3000	1000	4500	4400	19k	660	3000	1000	4500	4400	19k
Sensitivity (± 20%) (x-, y-axis)	value value	2.5 mV/lb 0.56 mV/N		2.5 mV/lb 0.56 mV/N		0.25 mV/lb 0.06 mV/N		15 pC/lb 3.4 pC/N		15 pC/lb 3.4 pC/N		15 pC/lb 3.4 pC/N	
Sensitivity (± 20%) (x-, y-axis)	value value	10 mV/lb 2.2 mV/N		5 mV/lb 1.1 mV/N		1.25 mV/lb 0.28 mV/N		32 pC/lb 7.2 pC/N		32 pC/lb 7.2 pC/N		32 pC/lb 7.2 pC/N	
Resolution (broadband) (z-axis) (x-, y-axis)	lb (N) rms lb (N) rms	0.006 0.027 0.002 0.009		0.006 0.027 0.006 0.027		0.05 0.22 0.01 0.045		see note [4] see note [4]		see note [4] see note [4]		see note [4] see note [4]	
Amplitude Linearity [5]	% FS	≤ 1		≤ 1		≤ 1		≤ 1		≤ 1		≤ 1	
Cross-Talk Fx ÷ Fy Fx, Fy ÷ F	% %	± 3 ± 5		± 3 ± 5		± 3 ± 5		± 3 ± 5		± 3 ± 5		± 3 ± 5	
Upper Frequency Limit	Hz	11k		10k		6k		11k		10k		6k	
Low Frequency Response (-5%) (z-axis) (x-, y-axis)	Hz Hz	0.01 0.001		0.01 0.001		0.01 0.001		see note [4] see note [4]		see note [4] see note [4]		see note [4] see note [4]	
Environmental Specifications													
Temperature Range	°F °C	-65 to +250 -54 to +121		-65 to +250 -54 to +121		-65 to +250 -54 to +121		-100 to +350 -73 to +177		-100 to +350 -73 to +177		-100 to +350 -73 to +177	
Electrical Specifications													
Discharge Time Constant [1] (z-axis) (x-, y-axis)	second second	≥ 50 ≥ 500		≥ 50 ≥ 500		≥ 50 ≥ 500		see note [4] see note [4]		see note [4] see note [4]		see note [4] see note [4]	
Output Impedance	ohm	≤ 100		≤ 100		≤ 100		N/A		N/A		N/A	
Output Bias Voltage	+VDC	8 to 14		8 to 14		8 to 14		N/A		N/A		N/A	
Voltage Excitation	+VDC	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		30		70	
Insulation Resistance	ohm	N/A		N/A		N/A		$> 10^{12}$		$> 10^{12}$		$> 10^{12}$	
Polarity (in direction of markings)		positive		positive		positive		negative		negative		negative	
Physical Specifications													
Connector	type	4-pin male		4-pin male		4-pin male		10-32	(three)	10-32	(three)	10-32	(three)
Stiffness (z-axis) (x-, y-axis)	lb/µin (kN/µm) lb/µin (kN/µm)	10 1.75 4 0.70		19 3.3 6 1.1		40 7 15 2.6		10 1.75 4 0.70		19 3.3 6 1.1		40 7 15 2.6	
Sealing	type	hermetic weld		hermetic weld		hermetic weld		hermetic weld		hermetic weld		hermetic weld	
Material (stainless steel)	type	17-4		17-4		17-4		17-4		17-4		17-4	
Maximum Allowable Torque (z-axis)	ft-lb (N-m)	14	19	40	54	240	325	14	19	40	54	240	325
Maximum Allowable Bending Moment (x-, y-axis)	ft-lb (N-m)	13	17.6	70	94	325	441	13	17.6	70	94	325	441
Weight	oz (gm)	14	386	34	975	96	2.9k	14	386	34	975	96	2.9k
Optional Models													
Reverse Shear Polarity	model	–		–		–		260A31		260A32		260A33	
Options [3]	**prefix**	**W**		**W**		**W**		**W**		**W**		**W**	

Notes: [1] The Discharge Time Constant (DTC) determines low frequency response according to the relationship f-5%=3/(2π(DTC)). 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 DC 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.



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 INC.
MTS SYSTEMS CORPORATION
3425 Walden Avenue, Depew, NY 14043-2495 USA
Toll-Free in USA 800-828-8840
24-hour SensorLine℠ 716-684-0001
Fax 716-684-0987 **E-mail** info@pcb.com
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