



PIEZOELECTRIC FORCE RINGS



- ICP® & charge outputs available
- Measure events with microsecond rise times
- 30 models ranging from: 10 lb to 100000 lb (44.5 N to 444.8 kN)
- Stable quartz element, stainless steel housing, & hermetic construction
- Individually calibrated, NIST traceable, & A2LA accredited
- Mounting stud, pilot bushing, & anti-friction washer included

MEASURING DYNAMIC FORCE WITH FORCE RINGS

Quartz, piezoelectric force rings from PCB® output a high integrity signal under compressive force in cyclical loading applications. Force rings possess extreme stiffness and accuracy, making them ideal for measuring microsecond duration events common to metal forming equipment (crimp, bend, stake, or stamp), drop test, and product testing applications.

All PCB piezoelectric force rings incorporate quartz crystals as the sensing element. Quartz is one of the most stable piezoelectric materials available with stiffness ten times that of steel. The sensor's internally preloaded quartz element makes real-time output at high frequencies possible. During multi-stage sensor assembly, internal components are precisely aligned, preloaded and laser welded together providing a hermetic seal.

Each PCB force sensor is calibrated to NIST (National Institute of Standards and Technology) standards and ships with a serialized calibration certificate. Calibration procedures follow accepted guidelines as recommended by ANSI (American National Standards Institute) and ISA (Instrument Society of America). Calibration of force sensors at PCB is in accordance with ISA-37-10 and complies with ISO 17025 & ANSI/NCSL Z540-1.

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ICP® OUTPUT FORCE RINGS

An ICP® force sensor generates an internal, electrostatic charge from piezoelectric crystals but incorporates a built-in MOSFET microelectronic amplifier to convert the high impedance charge into a low impedance voltage signal. This internal circuit requires power from a separate, constant current source. The low impedance voltage output allows operation over standard coaxial or multiconductor cable without signal degradation.

ICP® FEATURES

Harsh Environments - The low impedance output and solid-state, hermetic construction make ICP® force sensors well suited for continuous, unattended force monitoring in harsh factory environments.

Cost Per Channel - An ICP® sensor system cost per channel is substantially lower than charge type since they operate through standard coaxial cable without the need for expensive charge amplifiers

SPECIFICATIONS							
ICP® output with UNF mounting stud, washer, & pilot bushing	ICP® output with metric mounting stud, washer, & pilot bushing	Sensitivity (mV/lb)	Sensitivity (mV/kN)	Measurement range (lb)	Measurement range (kN)	Mounting stud UNF thread	Mounting stud metric thread
201B01*		500	112405	10	0.0445	10-32	M5 x 0.8
201B02*		50	11240	100	0.4448	10-32	M5 x 0.8
201B03*		10	2248	500	2.224	10-32	M5 x 0.8
201B04*		5	1124	1000	4.448	10-32	M5 x 0.8
201B05*		1	224.8	5000	22.24	10-32	M5 x 0.8
202B	M202B	0.50	112.4	10000	44.48	5/16-24	M8 x 1.0
203B	M203B	0.25	56.2	20000	88.96	3/8-24	M10 x 1.0
204C	M204C	0.12	27.0	40000	177.92	1/2-20	M14 x 1.25
205C	M205C	0.08	18.0	60000	266.90	5/8-18	M16 x 1.5
206C	M206C	0.06	13.5	80000	355.86	7/8-14	M22 x 2.0
207C	M207C	0.05	11.2	100000	444.80	1 1/8-12	M30 x 2.0

* Model includes washer with both UNF & metric mounting studs and associated bushings.



Anti-Friction Washer



Mounting Stud



Pilot Bushing



ICP® Force Sensor



Standard Coaxial Cable



ICP® Signal Conditioner

Technical details & documentation are subject to change. Check www.pcb.com or contact PCB technical support for latest revisions.

Tech Note: For longer duration events, PCB recommends use of a DC coupled or extended discharge time constant (DTC) signal conditioner to improve the low frequency roll off for calibration purposes and for sensor usage in slower events, such as process monitoring applications.

CHARGE OUTPUT FORCE RINGS

PCB offers charge output models (without ICP® microelectronics) in the same sizes and ranges as our ICP® force sensors. Charge output models are capable of higher operating temperatures, up to 400 °F (204 °C). Charge sensors require the use of external charge amplifiers, providing flexibility to scale the amplitude of the output signal. Some applications require charge mode force sensors for use over extended force ranges, frequencies, and events with varying pulse widths (via controlling the discharge time constant).

CHARGE OUTPUT FEATURES

Charge Reset - The unloaded output point on charge sensors can be reset to zero with use of specific signal conditioners that include the charge reset feature (See PCB model 443B102). This feature resets the zero point to match the unloaded force, effectively nulling the charge potential to zero to account for any mass differences during tooling changes. Charge reset is frequently used for calibration and re-zeroing in systems performing critical measurement of cyclic, repetitive operations.

Time Constant & Scaling Flexibility - PCB charge type force sensors utilize stand-alone charge amplifiers which can be easily reconfigured for specific discharge time constants. These sensors can also be configured for scaling and/or cabled for multi-sensor summing prior to data capture. This is extremely useful in sensor arrays to optimize the number of data channels.

Charge systems rely on low noise cables and a high insulation resistance cable to avoid signal degradation over long cable lengths or in areas with environmental contamination (fluids, particulate, or electrical noise). Charge amplified systems excel at measuring below 50 kHz as the feedback capacitor can exhibit filtering characteristics above this range.

SPECIFICATIONS							
Charge output with UNF mounting stud, washer, & pilot bushing	Charge output with metric mounting stud, washer, & pilot bushing	Sensitivity (pC/lb)	Sensitivity (pC/kN)	Measurement range (lb)	Measurement range (kN)	Mounting stud UNF thread	Mounting stud metric thread
211B*		18	4047	5000	22.24	10-32	M5 x 0.8
212B	M212B			10000	44.48	5/16-24	M8 x 1.0
213B	M213B			20000	88.96	3/8-24	M10 x 1.0
214B	M214B			40000	177.92	1/2-20	M14 x 1.25
215B	M215B			60000	266.90	5/8-18	M16 x 1.5
216B	M216B			80000	355.86	7/8-14	M22 x 2.0
217B	M217B	17	3822	100000	444.80	1 1/8-12	M30 x 2.0

* Model includes washer with both UNF & metric mounting studs and associated bushings.



Charge Output Force Sensor



Shielded, Low Noise Cable



Dual-Mode Signal Conditioner

Tech Note: PCB charge output force rings are negative polarity in compression as most external charge amplifiers invert the signal. For static applications, such as weight or load measurement, consider PCB general purpose and fatigue rated, strain gage load cells.

MODEL 410C01 SINGLE CHANNEL ICP® SIGNAL CONDITIONER

DIN RAIL MOUNT (35MM) FOR ELECTRICAL SYSTEM ENCLOSURES

- Delivers excitation power for ICP® sensors
- Provides peak track hold and waveform analog output signals, 0 to 10 volts
- Offers AC or DC signal coupling and choice of 7 gain settings
- Setup configurable via USB or ethernet communications

MODEL 482C24 FOUR CHANNEL, ICP® SIGNAL CONDITIONER

GENERAL PURPOSE BENCHTOP UNIT WITH AC/DC COUPLING

- Rear mounted BNC connections with unity gain
- AC line power, 100 - 240 VAC 50/60 Hz standard
- Selectable gain from x0.1 to x200
- Range of models with more advanced features: in/out filters, ethernet, integral display (482C16)

MODEL 443B02 DUAL-MODE, SIGNAL CONDITIONER

ADJUSTABLE SIGNAL CONDITIONER FOR ICP® & CHARGE OUTPUT SENSORS

- Front mounted BNC connections
- AC line power, 100 - 240 VAC 50/60 Hz
- Built in: charge reset button, in/out filters, medium & long discharge time constant settings

SERIES 422EXX ICP® POWERED, INLINE CHARGE CONVERTERS

CONVERTS HIGH IMPEDANCE SIGNAL TO LOW IMPEDANCE VOLTAGE COMPATIBLE WITH ICP®

- 2 connection types: dual BNC jack or 10-32 jack to BNC jack
- 7 sensitivity choices: 0.10, 0.25, 0.50, 1.0, 4.0, 10, 100 mV/pC
- Low impedance output: ± 5 volt DC
- TEDS versions available (TLD Prefix: TLD422EXX)

PCB CABLE ASSEMBLIES FOR ICP® AND CHARGE OUTPUT SENSORS

Coaxial Cable Material & Type	Electrical Connectors (sensor end first)	Cable Model by Length					
		3 ft	5 ft	10 ft	20 ft	30 ft	50 ft
		(0.9 m)	(1.5 m)	(3.0 m)	(6.1 m)	(9.1 m)	(15.2 m)
002 - White FEP, General Purpose	10-32 Plug to 10-32 Plug	002A03	002A05	002A10	002A20	002A30	002A50
002 - White FEP, General Purpose	10-32 Plug to BNC Plug	002C03	002C05	002C10	002C20	002C30	002C50
003 - Blue TFE, Low Noise	10-32 Plug to 10-32 Plug	003A03	003A05	003A10	003A20	003A30	003A50
003 - Blue TFE, Low Noise	10-32 Plug to BNC Plug	003C03	003C05	003C10	003C20	003C30	003C50
012 - Black PVC, RG58/U	BNC Plug to BNC Plug	012A03	012A05	012A10	012A20	012A30	012A50

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