



Automotive Sensors & Instrumentation

Accelerometers, Preamplifiers, Microphones, Force Sensors, Pressure Sensors, Load Cells, Torque Sensors, Strain Sensors, Signal Conditioners, Instrumentation, and Accessories





Driven to Help You Succeed

PCB® Automotive Sensors division is a dedicated technical sales and support group, located in Novi, Michigan, USA, devoted to the testing needs of the global transportation market. This team is focused on development and application of sensors and related instrumentation for specific vehicle development test programs, including vehicle & powertrain NVH; modal analysis; component & system performance; powertrain development; road load data acquisition; durability; driveability; ride & handling; and motorsport.

Each section in this catalog provides a complete overview of the products we offer for the specific vehicle application. Sensor specifications have been tailored to those important for the application. Please see the PCB® Test & Measurement catalog, or the PCB® web site for complete specifications for all sensors and instrumentation.

Since 1967, PCB® has been a supplier of precision sensors and instrumentation. Unmatched customer service, state-of-the-art manufacturing capabilities, and worldwide distribution have contributed to steady growth and success. The PCB® team of Design, Engineering, Sales, and Customer Service individuals, draw upon vast in-house manufacturing resources to continually provide new, more beneficial sensing solutions. PCB® offers 24-hour customer support, a strategic global distribution network, a Lifetime Warranty Plus, and a Best Price guarantee. For more information about PCB®, visit www.pcb.com.

Let us assist you with your next automotive test and measurement application. Contact us today at:



Toll-Free in USA: **888-684-0014**

24-hour SensorLineSM: **716-684-0001**

Fax: **248-478-2094**

Email: **automotivesales@pcb.com**

www.pcb.com/auto





Table of Contents

Numerical Model Number Indexpg. 2

Applications:

Vehicle & Powertrain NVH	pg. 3
Automotive Modal Analysis	pg. 15
Automotive Component & System Performance	pg. 27
Powertrain Development	pg. 39
Road Load Data Acquisition	pg. 49
Vehicle & Component Durability	pg. 57
Driveability and Ride & Handling	pg. 69
Motorsport	pg. 73

Product Specifications:

Electronics	pg. 85
Accessories	pg. 99
Cables & Adaptors	pg. 111
Custom Sensors & Options	pg. 119
Services & Qualifications	pg. 120

LIFETIME WARRANTY+
Products Guaranteed for Life & More!

See page 120.



Product Model Listing

Item Number

0		
070A70	98	
070A71	98	
086C03	22, 80	
086D05	22, 80	
086D20	22	
086E80	22	
1		
106M160	8	
108A02	43	
108A04	43	
112A05	37, 43	
113B03	37	
116B03	43	
1203-01A/B	36, 53, 82	
1203-03A/B	36, 53, 82	
1203-05A/B	36, 53, 82	
130A40	12	
130D20	12, 33, 78	
130D21	12, 33, 78	
130D22	12, 33	
1303-02A	36	
1303-03A	36	
1303-04A	36	
140A14	43	
1403-03A/B	66	
1403-04A/B	66	
1403-05A/B	66	
1404-02A/B	66	
1404-03A/B	66	
1501 Series	37, 44, 53, 80	
1502 Series	37, 44, 53, 80	
1515-106 Series	36, 72	
1621-02A	36	
2		
201B02	35, 81	
201B03	35, 81	
201B04	35, 55, 81	
201B05	35, 55, 81	
202B	55	
203B	55	
204C	55	
2050A	24	
208C01	23, 35, 65, 81	
208C02	23, 35, 65, 81	
208C03	23, 35, 65, 81	
208C04	35, 65, 81	
208C05	35, 65, 81	
2100 Series	25	
2100E11	24	
221B01	65	
221B02	65	
221B03	65	
221B04	65	
221B05	65	
2540	10	
2541	10	
2560	10	
2570	10	
2575	10	
260A01	44, 54, 82	
260A02	44, 54, 82	
260A03	44, 54, 82	
261A01	44, 82	
288D01	23	
3		
320C03	20, 62	
320C04	62	
320C15	20, 62	
320C18	20, 62	
320C33	62	
333B30	6, 18	
333B32	6, 18	
333B40	18	
333B42	18	
333B50	18	
333B52	18	
339A30	9, 20, 41, 52, 62, 79	
339A31	9, 20, 41, 52, 62, 79	
340A50	8, 42	
352A21	5, 60	
352A24	5, 17, 33, 60	
352A56	5, 17	
352A73	5, 60	
352B01	60	
352B10	5, 17, 60	
352C03	6, 18, 61	
352C04	18, 61	
352C15	6	
352C22	5, 17, 33, 60, 79	
352C23	5, 17, 33, 60, 79	
352C33	6, 18, 33, 61	
352C34	6, 18, 33, 61	
352C41	6, 18, 61	
352C42	18, 61	
352C43	6, 61	
352C44	61	
352C65	6, 18, 33, 61	
352C66	6, 18, 33, 61	
352C67	6, 61	
352C68	18, 61	
353B01	64	
353B02	64	
353B03	64	
353B04	64	
353B11	63	
353B12	63	
353B13	63	
353B14	63	
353B15	63	
353B16	63	
353B17	63	
353B18	63	
353B31	64	
353B32	64	
353B33	64	
353B34	64	
353B77	63	
354C10	7, 52	
355B02	6	
356A01	7, 19, 52, 79	
356A02	7, 19, 34	
356A12	19, 34, 52	
356A13	7, 52	
356A15	7, 19, 34, 52, 79	
356A16	7, 19, 34, 72	
356A17	7, 34, 72	
356A24	7	
356A25	19	
356A31	19	
356A32	7, 19, 34, 52	
356A33	7, 19, 34, 52	
356A61	9, 41	
356A63	9, 20, 41	
356A66	9, 20, 41	
356A67	9, 41	
356A70	8, 21, 42	
356A71	8, 21, 42	
356B11	7	
356B18	7, 19, 72	
356B20	7, 52	
356B21	7, 34, 52	
356B41	8, 34, 71	
357A08	8, 21	
357A09	21	
357B03	8, 21, 64	
357B04	8, 21, 64	
357B11	8, 21, 42, 64	
357B14	8, 21	
357B21	64	
357B22	64	
357B61	42, 64	
357C71	8	
3711 Series	29, 51, 59, 71, 75	
3713 Series	29, 51, 59, 71, 75	
3741 Series	51, 59, 71, 75	
377A12	10	
377A13	10	
377A26	12	
377B02	10, 32	
377B11	10	
377B20	10, 32	
377C01	10, 78	
377C10	10	
378A13	11	
378B02	11	
378B11	11	
378B20	11	
378C01	11	
379A01	12	
394C06	26	
4		
400B76	20	
400B76-T	20	
401B04	98	
410B01	91	
421A11	48, 68, 95	
421A13	48, 68, 95	
421A25	68, 95	
422E Series	48, 68, 93, 94	
426A10	11, 32	
426A11	11, 32	
426A30	11, 32	
426B02	12	
426B03	11, 78	
426B31	11	
426E01	11, 32	
442B02	92	
442B06	91	
442C04	92	
443B01	92	
443B02	48, 92	
478A01	68, 72, 83, 96	
478A16	96	
478B05	68, 72, 83, 96	
480B10	86	
480B21	38, 67, 83, 86	
480C02	10, 38, 67, 83, 86	
480E09	38, 67, 83, 86	
481A Series	10, 38, 83, 90	
482 Series	88	
482C05	38, 48, 67, 83, 88	
482C16	38, 48, 67, 83, 89	
482C27	68, 72, 83, 96	
482C54	38, 48, 67, 83, 89	
484B06	38, 83, 91	
484B11	91	
485B12	87	
485B36	10, 87	
492B	98	
5		
5240	25	
5302D Series	30, 31, 45, 46, 76, 77	
5308D Series	30, 31, 45, 46, 76, 77	
5309D Series	30, 31, 45, 46, 76, 77	
5310D Series	30, 31, 45, 46, 76, 77	
5410-01A	56	
5411-01A	56	
5412-01A	56	
5413-01A	56	
5414-01A	56	
5415-01A	56	
5416-01A	56	
5417-01A	56	
6		
603C01	47	
607A11	47	
608A11	47	
622B01	47	
65A	43	
682A05	47	
7		
740B02	53	
8		
8030S	24	
8032S	24	
8159 Series	38, 67, 83, 97	
8161 Series	38, 67, 72, 97	
8162 Series	38, 67, 72, 83, 97	
8175-01A	56	
831	14	
Alpha		
A320C15	62	
CAL200	13	
CAL250	13	
GK291D	22	
GK291D20	22	
GK291E80	22	
HT352C44	61	
HT354C02	7	
HT356A01	20, 52, 79	
HT356A02	20	
HT356A15	52, 79	
HT356A33	20	
HT356A63	41	
HT356A66	41	
HT356A67	41	
HT356B21	52	
HT378B02	11, 32, 42, 78	
HT426E01	11, 32	
HVM100	71	
J320C03	62	
J352C33	61	
J353B03	64	
J353B18	63	
J353B33	64	
J353B77	63	
JM352C68	61	
JM353B18	63	
LaserTach™	14, 48	
M1203-01A/B	36, 53, 82	
M1203-03A/B	36, 53, 82	
M1203-05A/B	36, 53, 82	
M1403-03A/B	66	
M1403-04A/B	66	
M1403-05A/B	66	
M1404-02A/B	66	
M1404-03A/B	66	
M320C15	20, 62	
M320C18	20, 62	
M352C65	18, 61	
M352C68	61	
M353B11	63	
M353B12	63	
M353B15	63	
M353B18	63	
M353B77	63	
M354C02	7	
M354C10	52	
M603C01	47	
M607A11	47	
M608A11	47	
M622B01	47	
PulseDriver	48	



Vehicle & Powertrain NVH Sensors

Accelerometers, Preamplifiers, Microphones, Signal Conditioners,
Sound Level Meters, and Accessories





NVH - Noise, Vibration & Harshness



NVH stands for Noise, Vibration, and Harshness and is an industry term associated with the treatment of vibration and audible sounds. Noise denotes unwanted sound; and hence the need to negate these sounds and vibrations.

Vibrations above and below a specific range may not be detectable to the human ear, but may still require treatments for improved product performance and longevity. The frequency of the noise is paramount, as it dictates which method of treatment or what material will work best. Harshness usually refers to treatments of transient frequencies or shock.

NVH refinement has become an essential vehicle development attribute, as it is directly related to legislative compliancy, product quality, driving pleasure, brand image, and most importantly customer satisfaction.

Advanced NVH test methods and analytical simulation tools are prerequisites in today's fast paced automotive market to ensure front-end optimization of lowered levels of sound and vibration and enhanced design while still maintaining a balance with fuel efficiency, driveability, and system & component performance. PCB Piezotronics, Inc. offers a complete sensor and instrumentation solution for the measurement of NVH attributes from concept through to post production assessment. Due to shortened product development cycles, many automotive manufacturers and their suppliers are choosing to consolidate NVH testing with other development activities including: road load data acquisition, powertrain performance testing, and calibration development, to name a few. PCB® facilitates this trend with diverse sensor offerings in acceleration, acoustic, pressure, force, torque, load, and strain technologies allowing an efficient test and instrumentation strategy to capture performance and attribute measurements.

Concept Development

The concept stage of the vehicle development process not only determines the most fundamental architecture of the automotive structure, but also offers an opportunity to reduce the amount of downstream development effort needed to achieve performance and attribute targets by optimizing core structures and system configurations and striking a balance between fuel economy, emissions, performance, ride, and NVH. Typical NVH activities could include:

- Structural Computer Aided Engineering (CAE) and modal analyses
- Dynamic system simulations
- Powertrain mounting strategies
- Body mounting concepts
- Suspension configurations
- Vehicle simulations
- Competitor benchmarking

During the concept stage, performance and attribute targets are defined based on market expectations and cascaded down to system and component specifications.

Powertrain NVH Development

Due to the ever increasing importance of fuel economy, performance, and NVH in the development of today's engine, the NVH engineer must work closely with the engine and powertrain calibration and combustion engineers to strike a balance between the efficiency of combustion and the reduction of combustion forces that result in noise,

vibration, and driveability issues. This development often takes place in a performance and emissions test cell where a less than ideal acoustic environment predicates the use of accelerometers as an indication of relative engine forces and inferred noise strength. Engine component suppliers also play a strong role in overall powertrain noise target attainment. From structural members such as engine blocks, oil pans, valve covers, and mount brackets to integrated systems such as transmissions, fuel injectors, power steering pumps, and turbos; component and engine manufacturers alike spend significant test time in hemi-anechoic dynamometer test cells to develop systems to meet the NVH targets that cascaded from the concept phase. These tests could include:

- Engine NVH benchmarking
- Sound intensity mapping
- Source identification
- Modal analysis
- Ancillary noise development
- Turbo noise development
- Intake noise development

The impact of this development work is focused on achieving overall vehicle NVH targets, specifically targeting overall engine noise and sound design and inputs into the engine mounts. PCB® designs and manufactures a line of NVH and powertrain development sensors that take into account the harsh environment associated with powertrain testing offering high temperature microphone systems and accelerometers that are both rugged and hermetically sealed.

Vehicle NVH Development

The integration of the powertrain into a vehicle structure is the most critical activity in the development process. Reduction of structure-borne noise and vibration paths are minimized in this phase through fine-tuning of powertrain, exhaust, and body mounts. Airborne noise paths are reduced through sound package development. This fine-tuning, along with intake and exhaust development, account for the interior sound design of the vehicle. As with powertrain NVH development, the NVH engineer must also work with the calibration engineer to assess possible trade-offs with fuel economy, emissions, NVH, and driveability; and with the ride & handling engineer to assess trade-offs with ride quality and vehicle handling. Today's NVH engineer has numerous analytical and experimental tools and tests to aid in the systematic and continuous NVH development leading up to the production build of the vehicle, including:

- Issue resolution using Noise Path Analysis (NPA)
- Sound Quality Analysis (SQA)
- Intake and exhaust orifice noise refinement for sound design
- Noise Transfer Functions (NTF)
- Modal analysis for structural optimization
- Engine mount tuning
- Transmission loss for acoustic package refinement
- End-of-line NVH test methods for quality control
- Noise masking studies for pass-by and curb-side noise reduction
- Acoustical array set-ups for noise identification

As levels of noise and vibration have decreased in today's cars, tractors, construction equipment, motorcycles, and snowmobiles, the expectations of today's consumers have increased. With this comes heightened requirements for attributes such as wind noise, road noise, powertrain noise, road idle quality, and driver comfort. These attributes are now indicators of quality and PCB® is there every step of the way with products and instrumentation designed to aid in your NVH testing now and into the future.



Single Axis and Triaxial, ICP® Accelerometers for NVH Applications

PCB® offers a complete line of single and triaxial ICP® accelerometers for NVH applications ranging from highly sensitive and lightweight sensors for low level inputs and mild environments to units with high ranges, hermetically sealed connectors, and rugged titanium construction for severe inputs and environments. With a variety of packages, mounting, and output cabling options, these sensors can accommodate virtually any NVH testing situation, including idle and ride quality. Optional “TEDS” circuitry offers ‘smart sensing’ solutions for automating sensor performance bookkeeping and structure coordinate mapping.

Single Axis and Triaxial, ICP® Accelerometers for NVH Applications

						
Model Number	352C23	352A73	352C22	352B10	352A24	352A56
Sensitivity	5 mV/g	5 mV/g	10 mV/g	10 mV/g	100 mV/g	100 mV/g
Measurement Range	1000 g pk	1000 g pk	500 g pk	500 g pk	50 g pk	50 g pk
Broadband Resolution	0.003 g rms	0.002 g rms	0.002 g rms	0.003 g rms	0.0002 g rms	0.0006 g rms
Frequency Range (± 10%)	1.5 to 15k Hz	1.5 to 25k Hz	0.7 to 13k Hz	1 to 17k Hz	0.8 to 10k Hz	0.3 to 15k Hz
Temperature Range	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C
Electrical Connector	3-56 Coaxial Jack	Integral Cable	3-56 Coaxial Jack	Integral Cable	3-56 Coaxial Jack	5-44 Coaxial Jack
Sealing	Epoxy	Hermetic	Epoxy	Hermetic	Epoxy	Hermetic
Housing Material	Anodized Aluminum	Titanium	Anodized Aluminum	Titanium	Anodized Aluminum	Titanium
Weight	0.2 gm	0.3 gm	0.5 gm	0.7 gm	0.8 gm	1.8 gm
Size	0.11 x 0.34 x 0.16 in 2.8 x 8.6 x 4.1 mm	0.11 x 0.34 x 0.16 in 2.8 x 8.6 x 4.1 mm	0.14 x 0.45 x 0.25 in 3.6 x 11.4 x 6.4 mm	0.32 x 0.24 in 8.1 x 6.1 mm	0.19 x 0.48 x 0.28 in 4.8 x 12.2 x 7.1 mm	0.26 x 0.57 x 0.3 in 6.6 x 14.5 x 7.6 mm
Mounting	Adhesive	Adhesive	Adhesive	Adhesive	Adhesive	Adhesive
Supplied Accessories						
Cable	030A10	—	030A10	—	030A10	—
Wax/Adhesive	080A109	080A109	080A109	080A109 080A90	080A109	080A109
Removal Tool	039A26	039A26	039A27	—	039A28	039A31
Additional Versions						
Titanium Housing	—	—	352A21	—	—	—
Additional Accessories						
Connector Adaptor	070A02	070A02	070A02	070A02	070A02	—
Mating Cable Connectors	EK	AL	EK	AL	EK	AG
Recommended Cables	030	—	030	—	030	018 Flexible, 003 CE





Vehicle & Powertrain NVH Sensors

Single Axis, ICP® Accelerometers for NVH Applications

						
Model Number	352C65	352C41	333B30	352C03	352C33	355B02
Sensitivity	100 mV/g	10 mV/g	100 mV/g	10 mV/g	100 mV/g	10 mV/g
Measurement Range	50 g pk	500 g pk	50 g pk	500 g pk	50 g pk	500 g pk
Broadband Resolution	0.00016 g rms	0.0008 g rms	0.00015 g rms	0.0005 g rms	0.00015 g rms	0.0005 g rms
Frequency Range (± 10%)	0.3 to 12k Hz	0.5 to 10k Hz	0.5 to 3000 Hz [1]	0.3 to 15k Hz	0.3 to 15k Hz	0.6 to 12k Hz
Temperature Range	-65 to +200 °F -54 to +93 °C	-65 to +250 °F -54 to +121 °C	0 to +150 °F -18 to +66 °C	-65 to +250 °F -54 to +121 °C	-65 to +200 °F -54 to +93 °C	-65 to +250 °F -54 to +121 °C
Electrical Connector	5-44 Coaxial Jack	10-32 Coaxial Jack	10-32 Coaxial Jack	10-32 Coaxial Jack	10-32 Coaxial Jack	10-32 Coaxial Jack
Sealing	Hermetic	Hermetic	Hermetic	Hermetic	Hermetic	Hermetic
Housing Material	Titanium	Titanium	Titanium	Titanium	Titanium	Titanium
Weight	2.0 gm	2.8 gm	4.0 gm	5.8 gm	5.8 gm	10 gm
Size	5/16 x 0.33 in 5/16 in x 8.4 mm	3/8 x 0.38 in 3/8 in x 9.7 mm	0.4 in Cube 10.2 mm Cube	7/16 x 0.62 in 7/16 in x 15.7 mm	7/16 x 0.62 in 7/16 in x 15.7 mm	0.40 x 0.95 x 0.63 in 10.2 x 24.1 x 16.0 mm
Mounting	5-40 Stud	Adhesive	5-40 Thread	10-32 Thread	10-32 Thread	Through Hole
Supplied Accessories						
Wax/Adhesive	080A109	080A109 080A90	080A109 080A90	080A109	080A109	080A109
Adhesive Mounting Base	080A15	—	080A25	080A	080A	—
Mounting Stud/Screw	—	—	081A27 M081A27	081B05 M081B05	081B05 M081B05	081B45
Additional Versions						
Alternate Electrical	352C67 - Integrated Cable	352C43 Ground Isolated	—	—	—	—
Alternate Connector Position	352C66 - Top	—	—	—	352C34 - Top	—
Alternate Mounting	—	—	333B32 - Adhesive	—	—	—
Alternate Sensitivity	352C15 - 10 mV/g	—	—	—	—	—
Additional Accessories						
Magnetic Mounting Base	080A30	—	—	080A27	080A27	—
Triaxial Mounting Adaptor	080B16 080A196	—	—	080B10	080B10	—
Removal Tool	—	—	039A08	—	—	—
Mating Cable Connectors	AG	EB	EB	EB	EB	EB
Recommended Cables	018 Flexible, 003 CE	002 Low Cost, 003 CE	002 Low Cost, 003 CE	002 Low Cost, 003 CE	002 Low Cost, 003 CE	002 Low Cost, 003 CE
Notes						
[1] Range shown is ± 5%						



Vehicle & Powertrain NVH Sensors



Triaxial, ICP® Accelerometers for NVH Applications

						
Model Number	356A01	356A24	356B11	356B21	354C10	356A32
Sensitivity	5 mV/g	10 mV/g	10 mV/g	10 mV/g	10 mV/g	100 mV/g
Measurement Range	± 1000 g pk	± 500 g pk	± 500 g pk	± 500 g pk	± 500 g pk	± 50 g pk
Broadband Resolution	0.003 g rms	0.002 g rms	0.003 g rms	0.003 g rms	0.003 g rms	0.0003 g rms
Frequency Range (± 10%)	2 to 8000 Hz [1]	0.5 to 12k Hz	2 to 10k Hz [1]	2 to 10k Hz [1]	2 to 8000 Hz [1]	0.7 to 5000 Hz
Temperature Range	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C
Electrical Connector	Integral Cable	8-36 4-Pin Jack	Integral Cable	8-36 4-Pin Jack	Integral Cable	8-36 4-Pin Jack
Sealing	Hermetic	Hermetic	Hermetic	Hermetic	Hermetic	Hermetic
Housing Material	Titanium	Titanium	Titanium	Titanium	Titanium	Titanium
Weight	1.0 gm	3.1 gm	4.0 gm	4.0 gm	5.0 gm	5.4 gm
Size	0.25 in Cube 6.35 mm Cube	0.28 x 0.47 x 0.47 in 7 x 12 x 12 mm	0.4 in Cube 10.2 mm Cube	0.4 in Cube 10.2 mm Cube	0.3 x 0.55 x 0.55 in 7.6 x 14 x 14 mm	0.45 in Cube 11.4 mm Cube
Mounting	Adhesive	Adhesive	5-40 Thread	5-40 Thread	Through Hole	5-40 Thread
Supplied Accessories						
Cable Assembly	034G05	034K10	034G05	034K10	034G05	034K10
Wax/Adhesive	080A109 080A90	080A109 080A90	080A109	080A109	—	080A109
Adhesive Mounting Base	—	—	080A	080A	—	080A
Mounting Studs/Screws	—	—	081A27 M081A27 081A90	081A27 M081A27 081A90	081B93	081A27 M081A27 081A90
Additional Versions						
Alternate Cable Type	356A13 099 Twisted 4-cond	—	—	—	—	—
Alternate Connector	—	—	—	356A33 - 1/4-28 4-Pin	—	—
Alternate Sensitivity	—	—	—	356B20 - 1 mV/g	—	—
Additional Accessories						
Magnetic Mounting Base	—	—	080A30	080A30	—	080A30
Removal Tool	—	—	039A08	039A08	—	039A09
Mating Cable Connectors	AY	EH	AY	EH	AY	EH
Recommended Cables	034	034	034	036	034	034
Notes						
[1] Range shown is ± 5%						

Triaxial, ICP® Accelerometers for NVH Applications

						
Model Number	356A16	356A17	356A02	356A15	M354C02	356B18
Sensitivity	100 mV/g	500 mV/g	10 mV/g	100 mV/g	10 mV/g	1000 mV/g
Measurement Range	± 50 g pk	± 10 g pk	± 500 g pk	± 50 g pk	± 500 g pk	± 5 g pk
Broadband Resolution	0.0001 g rms	0.00006 g rms	0.0005 g rms	0.0002 g rms	0.0005 g rms	0.00005 g rms
Frequency Range (± 10%)	0.3 to 6000 Hz	0.3 to 4000 Hz	0.5 to 6000 Hz	1.4 to 6500 Hz	0.3 to 4000 Hz	0.3 to 5000 Hz
Temperature Range	-65 to +176 °F -54 to +80 °C	-65 to +176 °F -54 to +80 °C	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C	-20 to +170 °F -29 to +77 °C
Electrical Connector	1/4-28 4-Pin Jack	1/4-28 4-Pin Jack	1/4-28 4-Pin Jack	1/4-28 4-Pin Jack	1/4-28 4-Pin Jack	1/4-28 4-Pin Jack
Sealing	Epoxy	Epoxy	Hermetic	Hermetic	Hermetic	Epoxy
Housing Material	Anodized Aluminum	Anodized Aluminum	Titanium	Titanium	Titanium	Anodized Aluminum
Weight	7.4 gm	9.3 gm	10.5 gm	10.5 gm	15.5 gm	25.0 gm
Size	0.55 in Cube 14 mm Cube	0.55 in Cube 14 mm Cube	0.55 in Cube 14 mm Cube	0.55 in Cube 14 mm Cube	13/16 x 0.45 in 13/16 in x 11.4 mm	0.8 in Cube 20.3 mm Cube
Mounting	10-32 Thread	5-40 Thread	10-32 Thread	10-32 Thread	Through Hole	10-32 Thread
Supplied Accessories						
Wax/Adhesive	080A109	080A109	080A109 080A90	080A109 080A90	080A109	080A109
Adhesive Mounting Base	080A12	080A145	080A12	080A12	—	080A68
Mounting Stud/Screw	081B05 M081B05	081A27 M081A27	081B05 M081B05	081B05 M081B05	081B60	081B05 M081B05
Additional Versions						
High Temperature Option	—	—	—	—	HT354C02	—
Additional Accessories						
Magnetic Mounting Base	080A27	—	080A27	080A27	080M162	080A27
Removal Tool	039A10	039A10	039A10	039A10	—	—
Mating Cable Connectors	AY	AY	AY	AY	AY	AY
Recommended Cables	034	034	034	034	034	034



Vehicle & Powertrain NVH Sensors

Charge Output Accelerometers for NVH Applications

						
	Single Axis			Triaxial		
Model Number	357A08	357B11	357B03	356A70	356A71	357C71
Sensitivity	0.35 pC/g	3.0 pC/g	10 pC/g	2.7 pC/g	10 pC/g	10 pC/g
Measurement Range	± 1000 g pk	± 2300 g pk	± 2000 g pk	± 500 g pk	± 500 g pk	± 1000 g pk
Broadband Resolution	[1]	[1]	[1]	[1]	[1]	[1]
Frequency Range (+ 10%)	20k Hz	16k Hz	12k Hz	7000 Hz	7000 Hz	4000 Hz [2]
Temperature Range	-100 to +350 °F -73 to +177 °C	-95 to +500 °F -71 to +260 °C	-95 to +500 °F -71 to +260 °C	-95 to +490 °F -70 to +254 °C	-95 to +490 °F -70 to +254 °C	-65 to +900 °F -54 to +482 °C
Electrical Connector	3-56 Coaxial Jack	5-44 Coaxial Jack	10-32 Coaxial Jack	5-44 Coaxial Jack	10-32 Coaxial Jack	7/16-27 2-Pin Jack
Sealing	Epoxy	Hermetic	Hermetic	Hermetic	Hermetic	Hermetic
Housing Material	Anodized Aluminum	Titanium	Titanium	Titanium	Titanium	Inconel
Weight	0.16 gm	2.0 gm	11.0 gm	7.9 gm	22.7 gm	75.0 gm
Size	0.11 x 0.16 x 0.27 in 2.8 x 4.1 x 6.9 mm	5/16 x 0.33 in 5/16 in x 8.4 mm	1/2 x 0.81 in 1/2 in x 20.6 mm	0.73 x 0.9 x 0.4 in 18.5 x 22.9 x 10.2 mm	0.96 x 1.0 x 0.5 in 24.4 x 25.4 x 12.7mm	1.0 x 0.75 in 25.4 x 19 mm
Mounting	Adhesive	5-40 Stud	10-32 Thread	Through Hole	Through Hole	Through hole
Supplied Accessories						
Cable Assembly	030A10	—	—	—	—	—
Wax/Adhesive	080A109	—	080A109	080A90	080A90	—
Removal Tool	039A29	—	—	—	—	—
Adhesive Mounting Base	—	—	—	—	080A170	—
Mounting Stud/Screw	—	—	081B05 M081B05	081A46	081A94	081A99
Additional Versions						
Alternate Connection Position	—	357B14 - Top	357B04 - Top	—	—	—
Alternate Electrical Connector	—	357B14 10-32 Coaxial Jack	—	—	—	—
Alternate Mounting	—	—	—	340A50 - Metric	—	—
Additional Accessories						
Adhesive Mounting Base	—	—	080A	—	—	—
Magnetic Mounting Base	—	080A30	080A27	—	—	—
Triaxial Mounting Adaptor	080A194	080B16 080A196	080B10	—	—	—
Connector Adaptor	070A02	—	—	—	—	—
Mating Cable Connectors	EK	AG	EB	AF, AG	EB	GN
Recommended Cables	030	018 Flexible, 003	003	003	003	013
Notes						
[1] Resolution is dependent upon cable length and signal conditioner [2] Range shown is + 5%						

Triaxial, ICP® Seat Pad Accelerometer

	
Model Number	356B41
Sensitivity	100 mV/g
Measurement Range	± 10 g pk
Broadband Resolution	0.0002 g rms
Frequency Range (± 5 %)	0.5 to 1000 Hz
Temperature Range	+14 to +122 °F -10 to +50 °C
Electrical Connector	Integral Cable
Sealing	Hermetic
Weight	272 gm
Size	7.87 x 0.472 in 200 x 12 mm
Supplied Accessory	
Cable Assembly	010G05

Airbag Deployment ICP® Pressure Sensor

PCB's high intensity acoustic pressure sensor is specially designed for measuring automotive airbag deployment noise and total impulse of airbag noise, to aid in systems designs which minimize these damaging hearing events. This rugged pressure microphone is hermetically sealed and features ICP® output for ease of use and set up time.

Airbag Deployment ICP® Pressure Sensor

	
Model Number	106M160
Sensitivity (± 25 %)	79.8 mV/kPa
Measurement Range	189 dB
Frequency Range (-3 dB)	25 kHz
Temperature Range	- 100 to + 250 °F - 73 to + 121 °C
Electrical Connector	10-32 Coaxial Jack
Sealing	Welded Hermetic
Diaphragm	Stainless Steel
Housing Material	Stainless Steel
Weight (with clamp nut)	18.0 gm
Supplied Accessories	
Clamp Nut, Thread & Hex	060A12
Seal Ring	065A37



Filtered, Triaxial, ICP® Accelerometers for Powertrain NVH Applications

High frequency, metal-to-metal impacts are common during the combustion events of today's powertrain. These impacts can excite the high frequency resonance of the piezoelectric crystal in any accelerometer (PCB® or otherwise) to saturate the signal and cause clipping in the contained ICP® signal conditioning amplifier. Any system, once driven nonlinear, will produce spurious frequencies at, above, and below the frequencies contained in its input stimulus. If not recognized, this frequency production results in erroneous test data when it extends into the frequency range of interest. To help alleviate this event, PCB® offers low pass filtering in select triaxial accelerometers which suppresses the effects of any crystal resonance before they can enter and over range the ICP® signal conditioning amplifier. This prefiltering minimizes the opportunity for erroneous frequency content to be generated and accepted as valid data. This filtering, however, causes slight phase shifts in the higher frequency data. If phase is important in your analysis (e.g. operating mode shapes, transfer path analysis, vibroacoustics, etc.) then a single reference channel can be used to extract correct phase in post processing routines. A more automated solution may be possible with some of the data acquisition units. Contact PCB® for additional information.

In addition to filtering, PCB® Series 339A Triaxial ICP® accelerometers are designed with a temperature coefficient of less than 0.0125% / °F (0.02% / °C), which allows for precision amplitude data for test applications with large thermal shifts such as powertrain vibration testing, powertrain NVH, certain vehicle systems NVH tests, road load data acquisition, and durability testing in climatic chambers.

Filtered, Triaxial, ICP® Accelerometers for Powertrain NVH Applications

						
Model Number	356A61	339A30	339A31	356A63	356A66	356A67
Sensitivity	10 mV/g	10 mV/g	10 mV/g	10 mV/g	10 mV/g	10 mV/g
Measurement Range	± 500 g pk	± 500 g pk	± 500 g pk	± 500 g pk	± 500 g pk	± 500 g pk
Broadband Resolution	0.008 g rms	0.008 g rms	0.008 g rms	0.008 g rms	0.002 g rms	0.0005 g rms
Frequency Range (± 5%) (y or z axis)	2 to 4000 Hz	2 to 9000 Hz	2 to 9000 Hz	2 to 4000 Hz	2 to 4000 Hz	0.5 to 2500 Hz
Frequency Range (± 5%) (x axis)	2 to 4000 Hz	2 to 10k Hz	2 to 10k Hz	2 to 4000 Hz	2 to 4000 Hz	0.5 to 3000 Hz
Temperature Range	-65 to +325 °F -54 to +163 °C	-65 to +325 °F -54 to +163 °C	-65 to +325 °F -54 to +163 °C	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C
Temperature Coefficient	0.20 %/°F 0.11 %/°C	≤ 0.01 %/°F ≤ 0.02 %/°C	≤ 0.01 %/°F ≤ 0.02 %/°C	0.25 %/°F 0.14 %/°C	0.20 %/°F 0.11 %/°C	0.22 %/°F 0.12 %/°C
Electrical Connector	Integral Cable	8-36 4-Pin Jack	8-36 4-Pin Jack	1/4-28 4-Pin Jack	1/4-28 4-Pin Jack	1/4-28 4-Pin Jack
Sealing	Welded Hermetic	Hermetic	Hermetic	Hermetic	Hermetic	Hermetic
Housing Material	Titanium	Titanium	Titanium	Titanium	Titanium	Titanium
Weight	4.0 gm	4.0 gm	5.5 gm	5.3 gm	9.0 gm	10.5 gm
Size	0.4 in Cube 10.2 mm Cube	0.4 in Cube 10.2 mm Cube	0.55 x 0.4 x 0.4 in 14.0 x 10.2 x 10.2 mm	0.4 in Cube 10.2 mm Cube	0.55 in Cube 14.0 mm Cube	0.55 in Cube 14.0 mm Cube
Mounting	5-40 Thread	Adhesive	5-40 Stud	5-40 Thread	10-32 Thread	10-32 Thread
Supplied Accessories						
Wax/Adhesive	080A109	080A109	080A109	080A109	080A109 080A90	080A109
Adhesive Mounting Base	080A	—	080A	080A	080A12	080A12
Mounting Studs/Screws	081A27 M081A27 081A90	—	081A27 M081A27 081A90	081A27 M081A27 081A90	081B05 M081B05	081B05 M081B05
Cable Assembly	034G05	034K10	034K10	—	—	—
Additional Versions						
High Temperature Option	—	—	—	HT356A63	HT356A66	HT356A67
Additional Accessories						
Magnetic Mounting Base	080A30	—	—	080A30	080A27	080A27
Removal Tool	039A08	039A08	039A08	039A08	039A10	039A10
Mating Cable Connectors	AY	EH	EH	AY	AY	AY
Recommended Cables	034	034	034	034	034	034





Vehicle & Powertrain NVH Sensors

Microphones & Preamplifiers for NVH Applications

PCB® offers a variety of acoustic measurement products complemented by an assortment of preamplifiers, signal conditioners, A-weighting filters, handheld calibrators, and accessories all designed to assist in obtaining the highest quality measurement data possible for your NVH testing needs.

Modern Prepolarized & Traditional, Externally Polarized Precision Condenser Microphones for NVH Applications

A wide variety of traditional externally polarized and modern prepolarized free-field, pressure, and random incidence precision condenser microphones are available from PCB®. For measurement tests such as buzz, squeak and rattle (BSR), noise path analysis/transfer path analysis (NPA/TPA), and pass-by noise, these microphones offer the rugged design and exceptional performance in high humidity needed for NVH testing.

Prepolarized (0V) Precision Condenser Microphone Cartridges for NVH Applications

							
Model Number	377C01	377C10	377A12	377B02	377B11	377A13	377B20
Diameter	1/4 in	1/4 in	1/4 in	1/2 in	1/2 in	1/2 in	1/2 in
Response	Free-Field	Pressure	Pressure	Free-Field	Pressure	Pressure	Random Incidence
Open Circuit Sensitivity	2 mV/Pa	1 mV/Pa	0.25 mV/Pa	50 mV/Pa	50 mV/Pa	12.5 mV/Pa	50 mV/Pa
Frequency Range (± 2 dB)	5.4 to 80k Hz	4 to 70k Hz	4 to 20k Hz	3.15 to 20k Hz	3.15 to 10k Hz	4 to 20k Hz	3.14 to 12.5k Hz
Dynamic Range - 3% Distortion Limit [1]	165 dB	170 dB	187 dB	146 dB	146 dB	155 dB	146 dB
Dynamic Range - Cartridge Thermal Noise [1]	28 dB (A)	28 dB (A)	68 dB (A)	15 dB (A)	15 dB (A)	20 dB (A)	15 dB (A)
Temperature Range	-40 to +248 °F -40 to +120 °C	-40 to +248 °F -40 to +120 °C	-40 to +248 °F -40 to +120 °C	-40 to +248 °F -40 to +120 °C	-40 to +248 °F -40 to +120 °C	-40 to +248 °F -40 to +120 °C	-40 to +248 °F -40 to +120 °C
Notes							
[1] re 20 μ Pa							

Externally Polarized (200V) Precision Condenser Microphone Cartridges for NVH Applications

					
Model Number	2540	2541	2560	2570	2575
Diameter	1/2 in	1/2 in	1/2 in	1 in	1 in
Response	Free-Field	Free-Field	Random Incidence	Free-Field	Random Incidence
Open Circuit Sensitivity	14.5 mV/Pa	44.5 mV/Pa	45.2 mV/Pa	48 mV/Pa	45 mV/Pa
Frequency Range (± 2 dB)	4 to 40k Hz	3.15 to 20k Hz	2.6 to 10k Hz	2.6 to 20k Hz	2.6 to 8000 Hz
Dynamic Range - 3% Distortion Limit [1]	160 dB	146 dB	146 dB	146 dB	146 dB
Dynamic Range - Cartridge Thermal Noise [1]	20 dB (A)	15 dB (A)	15 dB (A)	10 dB (A)	10 dB (A)
Temperature Range	-40 to +302 °F -40 to +150 °C	-40 to +302 °F -40 to +150 °C	-40 to +302 °F -40 to +150 °C	-40 to +302 °F -40 to +150 °C	-40 to +302 °F -40 to +150 °C
Notes					
[1] re 20 μ Pa					

Recommended ICP® Signal Conditioners

		
Model 480C02	Series 481A	Model 485B36
Single channel, battery powered, with BNC input/output connection	16-channel, line powered (DC power optional)	USB powered, dual channel



ICP® Preamplifiers for Prepolarized (0V) & Externally Polarized (200V) Microphones for NVH Applications

PCB® designs and manufactures both ICP® preamplifiers for prepolarized microphones and traditional preamplifiers for use with externally polarized microphones. Small and rugged, with a low noise floor and a large dynamic range, these stainless steel preamplifiers are needed for NVH testing such as 1m hemi-sphere acoustic measurements, pass-by noise testing and more.

The industry exclusive Model HT426E01 high temperature microphone preamplifier is designed to overcome specific high temperature challenges associated with powertrain and vehicle systems NVH testing such as exhaust and induction noise testing and turbo noise testing.

Model HT378B02, as seen in the photograph on the right, is PCB®'s high-value/high-temperature microphone system which includes a preamplifier (Model HT426E01) and a microphone (Model 377B02).



Preamplifiers for NVH Applications

	Prepolarized					Externally Polarized	
Model Number	426B03	426E01	HT426E01	426A10	426A11	426A30	426B31
Diameter	1/4 in	1/2 in	1/2 in	1/2 in	1/2 in	1/2 in	1/4 in
Gain (Attenuation)	-0.08 dB [1]	-0.05 dB [1]	-0.06 dB [2]	-0.1 dB [1]	-0.16 dB [1]	-0.2 dB [1]	-0.14 dB [3]
Frequency Response (± 0.1 dB)	5 to 125k Hz	6.3 to 125k Hz	6.3 to 126k Hz	80 to 125k Hz	5 to 125k Hz	10 to 126k Hz	10 to 126k Hz
Electrical Noise (A-weight)	≤ 3.2 µV [1]	≤ 2.8 µV [1]	≤ 4.9 µV [2]	≤ 3.6 µV	≤ 7.5 µV [1]	≤ 2.8 µV [1]	≤ 4.8 µV [3]
Electrical Noise (Linear) [1]	≤ 5.6 µV [1]	≤ 5 µV [1]	≤ 13.4 µV [2]	≤ 11.2 µV	≤ 5.7 µV [1]	≤ 5 µV [1]	≤ 12 µV [3]
Output Voltage (Maximum)	± 8 V pk	± 7 V pk	± 7 V pk	± 7 V pk	± 5 V pk	± 14 V pk	± 25 V pk
Temperature Range	-40 to +158 °F -40 to +70 °C	-40 to +176 °F -40 to +80 °C	-40 to +248 °F -40 to +120 °C	-40 to +176 °F -40 to +80 °C	-40 to +158 °F -20 to +70 °C	-40 to +185 °F -40 to +85 °C	-4 to +167 °F -20 to +75 °C
Output Connector	10-32 Coaxial Jack	BNC Jack	BNC Jack	BNC Jack	BNC Jack	7-Pin LEMO	Integral Cable with 7-Pin LEMO
TEDS IEEE P1451.4	Yes	Yes	Yes	Yes	Yes	No	No

Notes

[1] Measured with an 18 pF reference microphone [2] Measured with a 12 pF reference microphone [3] Measured with a 6.8 pF reference microphone

TEDS Microphone & Preamplifier Systems, IEEE 1451.4 Compliant

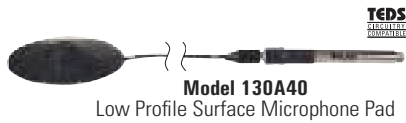
Mated System Pair	377C01 426B03	377B02 426E01	377B02 HT426E01	377B11 426E01	377A13 426E01	377B20 426E01
TEDS Version 0.9	378C01	378B02	HT378B02	378B11	378A13	378B20
TEDS Version 1.0	TLD378C01	TLD378B02	HTLD378B02	TLD378B11	TLD378A13	TLD378B20



Vehicle & Powertrain NVH Sensors

ICP® Array Microphones for NVH Applications

PCB® Series 130 ICP® Array Microphones provide a cost-effective method for large channel count sound pressure measurements such as beam forming, holography and sound pressure mapping. Powered by standard ICP® sensor signal conditioners, these microphones are interchangeable with ICP® accelerometers and include an integrated preamplifier. Array kits are also available, complete with patch panel, cables, and signal conditioners.



ICP® Array Microphones with Integral Preamplifier for NVH Applications

Model Number	130A40	130D20	130D21	130D22
Microphone Diameter	1/4 in	1/4 in	1/4 in	1/4 in
Response	Pressure	Free-Field	Free-Field	Free-Field
Sensitivity (± 3 dB at 250 Hz)	45 mV/Pa	45 mV/Pa	45 mV/Pa	45 mV/Pa
Frequency Response (± 1 dB)	100 to 4000 Hz	100 to 4000 Hz	100 to 4000 Hz	100 to 4000 Hz
Frequency Response (-2 to $+5$ dB)	20 to 10k Hz ± 2 dB	20 to 15k Hz	20 to 15k Hz	20 to 15k Hz
Dynamic Range (10 to 10k Hz, ref. 20 μ Pa)	< 30 to > 122 dB	< 30 to > 122 dB	< 30 to > 122 dB	< 30 to > 122 dB
Polarization Voltage	0 V	0 V	0 V	0 V
Temperature Range	+14 to +122 °F -10 to +55 °C	+14 to +122 °F -10 to +55 °C	+14 to +122 °F -10 to +55 °C	+14 to +122 °F -10 to +55 °C
Connector	10-32 Jack	BNC Jack	10-32 Jack	SMB
TEDS IEEE P1451.4	Optional	Optional	Optional	Optional

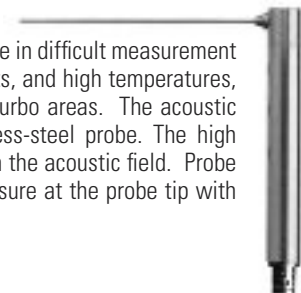


Array Stand

Model 379A01 array microphone stand & holders - Grid holds array microphones with a fixed spacing of 8 cm, and can be configured from 4x4 square to 1x16 line. The array system can be expanded for more microphones with purchase of additional microphone holders. Tilts and rotates for easy positioning.

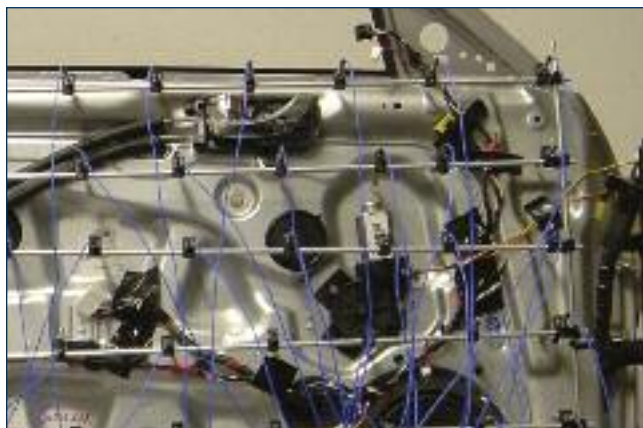
High Temperature Probe Microphone

Model 377A26 probe microphones are compact units designed for use in difficult measurement situations, such as those found in small cavities, harsh environments, and high temperatures, such as NVH measurement testing in transmissions, exhaust and turbo areas. The acoustic signal is guided to the microphone through a detachable, stainless-steel probe. The high acoustic input impedance of the probe tip minimizes its influence on the acoustic field. Probe microphones are internally compensated to equalize the static pressure at the probe tip with the internal microphone pressure.



In-line "A-weighting" Filter

The Model 426B02 in-line A-weighting filter is powered by constant current excitation and is compatible with ICP® microphone preamplifiers. When using this filter, however, a minimum of 4 mA excitation current is required of the ICP® sensor signal conditioner or readout device, which incorporates ICP® sensor power.



Microphone Power Supply

- 0 and 200 volt polarization voltage
- Extended battery life (40 hours)
- 0, 20, and 40 dB gain
- Selectable flat (Z), A, and C-weighting



Model 480A25

Recommended Precision Handheld Acoustic Calibrators

PCB® offers calibrators for microphones that meet IEC and ANSI standards. These units are easy to use and available with optional adaptors for use with a variety of microphone diameters. These units are lightweight, portable, and battery operated.



Model CAL200
Acoustic Calibrator

Model CAL250
Acoustic Calibrator

Recommended Precision Calibrators for NVH Applications

Model Number	CAL200	CAL250
Microphone Sizes	1/4 ^[1] and 1/2 in	1/8 ^[1] , 1/4 ^[1] , 1/2, and 1 in
Frequency	1000 Hz ± 1%	250 Hz ± 0.8%
Output Level (re 20 µPa)	94 dB, 114 dB ± 0.2 dB	114 ± 0.1 dB
Barometric Pressure Compensation	Automatic	Automatic
ANSI S1.40-2006 Compliant	Yes	Yes
IEC 60942-2003 Class 1	Yes	Yes
Notes		
[1] With optional adaptors		

Recommended Sensor Accessories



Recommended Acoustic Accessories





Vehicle & Powertrain NVH Sensors

Recommended Sound Level Meter



Model 831 handheld sound level meter features a small, lightweight ergonomic design; real-time 1/1 and 1/3 octave spectra, and comes standard with a 120 dB dynamic range. Ten customizable markers are provided to annotate time history data. The sound level meter also has audio and voice recording with replay, supported by up to 2 GB of on-board memory and optional USB 2.0 data stick. The unit features one-hand operation, and has an easy-to-read backlit display. Plus, when used with a PC, the USB cable provides instrument power and recharges batteries.

A full line of accessories is available including software, sound level calibrators, outdoor microphone systems with electrostatic actuators, weatherproof enclosures for short and long-term monitoring and a variety of tripods and tilt-down poles.



For complete specifications on Model 831, please visit Larson Davis at www.larsondavis.com/model831.htm.

As a division of PCB Piezotronics, Inc., Larson Davis provides complete solutions for noise and vibration measurement and analysis.



Recommended LaserTach™



The LaserTach™ ICP® tachometer senses the speed of rotating equipment and outputs an analog voltage signal for referencing vibration signals to shaft speed. The sensor allows for measurements in excess of 30,000 RPM from distances as far as 20 inches (51 cm). A status LED provides positive, visual indication of proper signal pickup. The standard BNC jack connects the sensor to any constant current excitation source (> 3mA). Unlike magnetic tachometer pickups, the LaserTach™ does not require the rotating equipment to be a ferrous material – only a visually contrasting section of the shaft needs to be available. This is typically accomplished with a small piece of reflective or retro-reflective tape. The unit powers from standard ICP® sensor signal

conditioning and requires only a single coaxial or twisted pair cable connection. This facilitates deployment of multiple speed sensors using the same cabling and signal conditioning as your other ICP® sensor arrays.

- Operates with standard ICP® sensor signal conditioning
- Easy to install – 20 inch range in a standard bolt package offers flexibility
- One pulse per revolution eliminates need to oversample all channels for a high frequency tachometer signal
- Simplifies cable management for dynamic testing of rotating equipment

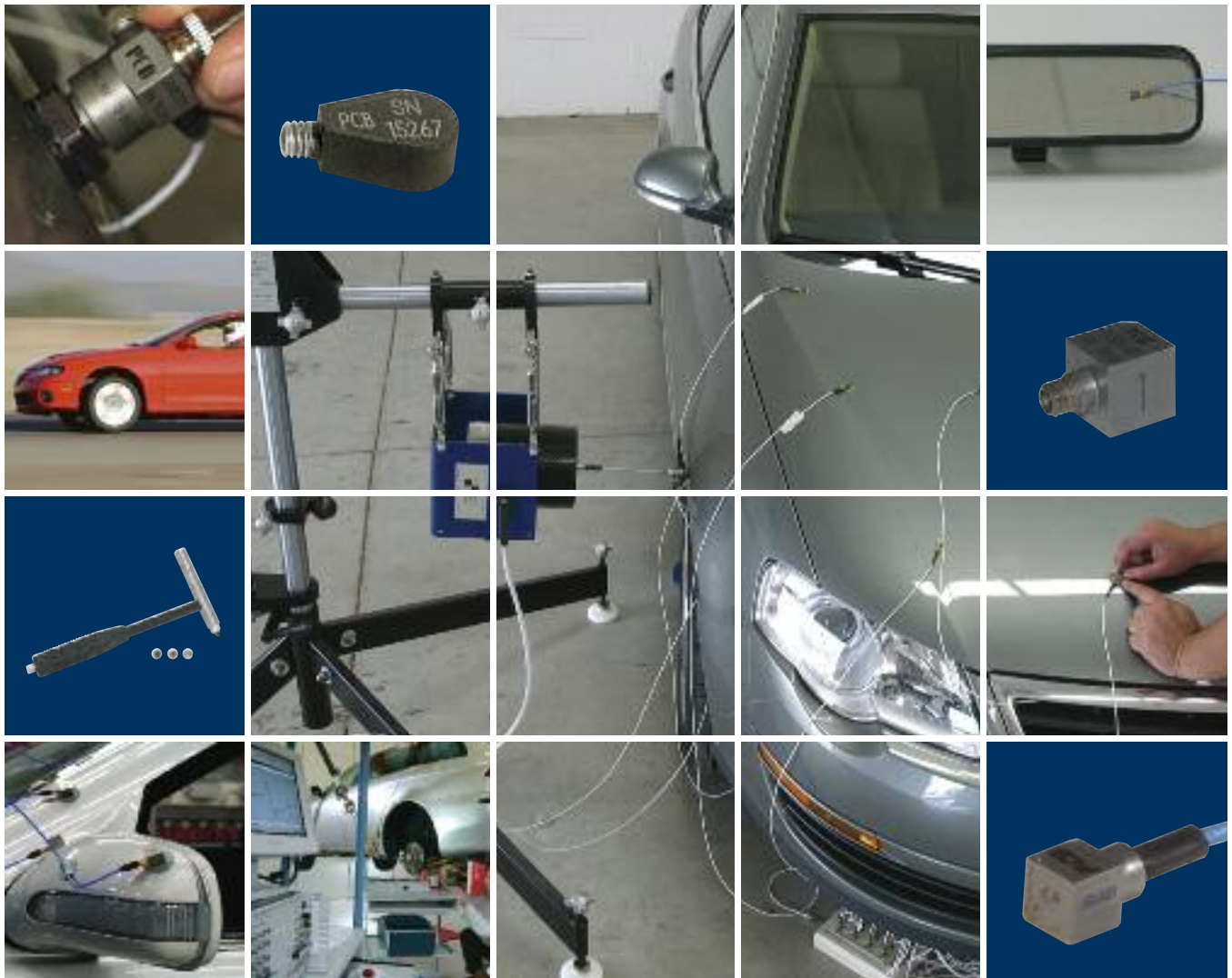
For complete specifications on the LaserTach™, please visit www.modalshop.com





Automotive Modal Analysis

Accelerometers; Dynamic Force Sensors; Modally Tuned®, ICP®, Impact Hammers;
Electrodynamic Modal Shakers; and Accessories





Classical vs. Operational Modal Analysis

Classical modal analysis is the process of extracting dynamic characteristics of a vibrating system from measured force inputs and vibratory responses, whereas operational modal analysis extracts the dynamic characteristics of a vibrating system in its operating environment solely from vibratory responses. Both of these methods offer distinct advantages and disadvantages in designing and developing today's automotive structures (e.g., automobiles, trucks, ATV, etc.) and their systems and components (e.g., body, engine, exhaust, etc.)

Why Classical Modal Analysis?

Classical modal analysis is a more mature technique, in comparison to operational modal analysis, and is extremely useful in the design of automotive structures. The understanding and visualization of scaled mode shapes is invaluable in the design process to identify areas of weakness and provide direction on structural improvements. Enhanced computing power and advances in finite element analysis (FEA) techniques have increased the fidelity of today's automotive analytical model and in several cases have reduced the need for classical modal analysis, especially with legacy structures. However, classical testing will continue to be required to give engineers the confidence they need to continue to bring new product into development in today's competitive automotive market. Common applications for classical modal analysis include:

- Modal alignment
- Analytical model correlation
- Design studies
- Force response simulation
- Cascade target setting

Modal alignment is performed early in the design process to mitigate risk of structural resonance issues in the automotive structure. The desired resonant behavior of structures, systems, and components is mapped out prior to design and development and is predominately used as a constraint in the design process. Adherence to this requirement is performed analytically and experimentally with early development prototypes.

Four Primary Assumptions of Classical Modal Analysis

Whether it is quick troubleshooting or full model correlation, successful classical modal analysis relies heavily on adhering to the four primary assumptions: observability, linearity, time invariance and reciprocity.

Modes of interest are observable:



PCB® offers a wide range of cost effective modal analysis sensors to accurately depict structural behavior of automotive components and systems.

- Response Degrees of Freedom (DOF) need to have adequate spatial resolution (both sensor location and orientation) to represent the modes of interest
- The input location and forcing function need to adequately excite the modes of interest

Test structure behaves linearly:



Linearity checks can be easily performed with the 100 lb modal shaker from The Modal Shop.

- The input and output characteristics need to remain proportional within the measurement range
- This assumption is best confirmed using precisely controlled inputs from a shaker at a range of input force levels and comparing the resulting Frequency Response Function (FRF) measurements

Test article exhibits time invariance & stationarity:



To reduce test time and minimize errors due to invariance, PCB® offers several solutions to multi-channel data acquisition, including bank switching.

- Modal parameter estimation algorithms need to assume consistent global modal frequencies and vectors
- Modal parameters need to remain consistent throughout the entire data set
- Changes in the test environment (temperature, humidity, etc.) during the data acquisition process need to be minimal

Maxwell's theory of reciprocity must be followed:



To ensure reciprocity PCB® offers an impedance sensor that simultaneously measures both force and acceleration at the input location.

- The FRF matrix is symmetric; meaning the FRF between input A and output B is the same as the FRF between input B and output A
- Excite with shakers and measure response with an array of accelerometers or rove the input with an impact hammer and fix a few reference accelerometers

Why Operational Modal Analysis?

Although the technique is still being refined, many of today's automotive engineers choose operational modal analysis over classical modal analysis because of its simplicity of test, in situ test configuration, and ability to separate closely coupled modes. Unlike classical modal analysis, there is no requirement for instrumented force applicators such as modal shakers or impact hammers, only that the excitation is random in time and that it is spatial. This can be accomplished either from operational forces and/or external inputs. The ability to test the structure in situ allows for efficiency and flexibility. Assuming adequate spatial resolution on the responses, closely coupled modes can be extracted due to the random nature of forces acting on the test structure. When done correctly, this technique will extract the same modal information as a classical modal test including natural frequencies, damping ratios, and mode shapes. Obtaining this real-world data allows automotive engineers to confirm dynamic properties of automotive structures based on true boundary conditions and actual excitation sources and levels.



PCB® manufactures accelerometers, dynamic force sensors, instrumented impact hammers, electrodynamic modal shakers and accessories specifically designed for detection, measurement, motion, shock, and vibration to meet your modal analysis needs. Products are designed and manufactured in our state-of-the-art facilities, and together with our global distribution network and Total Customer Satisfaction guarantee, you can rely on us to deliver products and solutions for your demanding requirements.

Every effort has been made to ensure the information presented in this brochure is accurate at the time of printing. For the most current specifications on all our products, please visit our web site at www.pcb.com. The web site also offers educational and technical information, as well as the latest product releases and tradeshow events.

PCB® prides itself on being able to respond to your needs. Strategic investment in machinery, capabilities, and personnel allow us to design, test, and manufacture products for specialized applications. Please contact one of our highly trained representatives to discuss your unique needs.

Response Output Measurements

General Purpose, ICP® Accelerometers for Automotive Modal Analysis

Overall, the optimal accelerometer for automotive modal analysis is one that has high sensitivity with excellent resolution, a wide frequency range and small mass. Trade-offs are usually made since a large sensor's inertial mass is directly proportional to resolution and sensitivity and inversely proportional to frequency range. For very small objects, like brake pads or rearview mirrors, a small, lightweight accelerometer with a wide frequency range is preferred over a larger accelerometer with high sensitivity, in order to minimize errors due to mass loading a small structure. For larger structures, such as body-in-white, a larger accelerometer with better resolution and higher sensitivity is optimal. While the choice of an accelerometer is similar between a classical and operational modal analysis test, there is a significant contrast in the ambient and operating condition in which the measurement is made. An operational modal test is performed in a structure's ambient environment which can be quite harsh, requiring hermetically sealed connectors and good temperature resistivity. The operating inputs can also be quite severe requiring the sensor to have good amplitude range and a robust construction.

PCB® offers a complete line of ICP® single axis and triaxial accelerometers for automotive modal analysis ranging from highly sensitive and lightweight sensors for low level inputs and mild environments to units with high ranges, hermetically sealed connectors, and rugged titanium construction for severe inputs and environments. With a variety of packages, mounting, and output cabling options, these sensors can accommodate virtually any automotive modal analysis testing situation. Optional "TEDS" circuitry offers 'smart sensing' solutions for automating sensor performance bookkeeping and structure coordinate mapping.

Small, Lightweight, ICP® Accelerometers for Automotive Modal Analysis

Specific automotive modal analysis testing can also require small, lightweight accelerometers for high-frequency response, low noise, minimal mass loading, and installation in space restricted locations. PCB® offers a line of ceramic shear ICP® accelerometers housed in lightweight aluminum or robust hermetically sealed titanium. By minimizing the mass of the sensor, mass loading effects are reduced, leading to improved measurement accuracy.

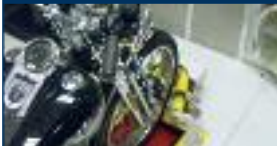
Small, Lightweight, Single Axis, ICP® Accelerometers for Automotive Modal Analysis

	CE	CE	CE	CE	CE
					
Model Number	352C23	352C22	352B10	352A24	352A56
Sensitivity	5 mV/g	10 mV/g	10 mV/g	100 mV/g	100 mV/g
Measurement Range	1000 g pk	500 g pk	500 g pk	50 g pk	50 g pk
Broadband Resolution	0.003 g rms	0.002 g rms	0.003 g rms	0.0002 g rms	0.0006 g rms
Frequency Range (± 10 %)	1.5 to 15k Hz	0.7 to 13k Hz	1.0 to 17k Hz	0.8 to 10k Hz	0.3 to 15k Hz
Temperature Range	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C
Electrical Connector	3-56 Coaxial Jack	3-56 Coaxial Jack	Integral Cable	3-56 Coaxial Jack	5-44 Coaxial Jack
Sealing	Epoxy	Epoxy	Hermetic	Epoxy	Hermetic
Housing Material	Anodized Aluminum	Anodized Aluminum	Titanium	Anodized Aluminum	Titanium
Weight	0.2 gm	0.5 gm	0.7 gm	0.8 gm	1.8 gm
Size	0.11 x 0.34 x 0.16 in 2.8 x 8.6 x 4.1 mm	0.14 x 0.45 x 0.25 in 3.6 x 11.4 x 6.4 mm	0.32 x 0.24 in 8.1 x 6.1 mm	0.19 x 0.48 x 0.28 in 4.8 x 12.2 x 7.1 mm	0.26 x 0.57 x 0.30 in 6.6 x 14.5 x 7.6 mm
Mounting	Adhesive	Adhesive	Adhesive	Adhesive	Adhesive
Supplied Accessories					
Wax/Adhesive	080A109	080A109	080A90	080A109 080A90	080A109
Removal Tool	039A26	039A27	—	039A28	039A31
Cable	030A10	030A10	—	030A10	—
Additional Accessories					
Connector Adaptor	070A02	070A02	070A02	070A02	—
Mating Cable Connectors	EK	EK	AL	EK	AG
Recommended Cables	030	030	—	030	018 Flexible, 003 CE



Automotive Modal Analysis

Small, Lightweight, Single Axis, ICP® Accelerometers for Automotive Modal Analysis

					
Model Number	352C65	352C42	352C41	352C03	352C33
Sensitivity	100 mV/g	100 mV/g	10 mV/g	10 mV/g	100 mV/g
Measurement Range	50 g pk	50 g pk	500 g pk	500 g pk	50 g pk
Broadband Resolution	0.00016 g rms	0.0005 g rms	0.0008 g rms	0.0005 g rms	0.00015 g rms
Frequency Range (± 10 %)	0.3 to 12k Hz	0.5 to 10k Hz	0.3 to 15k Hz	0.3 to 15k Hz	0.3 to 15k Hz
Temperature Range	-65 to +200 °F -54 to +93 °C	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C	-65 to +200 °F -54 to +93 °C
Electrical Connector	5-44 Coaxial Jack	10-32 Coaxial Jack	10-32 Coaxial Jack	10-32 Thread	10-32 Coaxial Jack
Sealing	Hermetic	Hermetic	Hermetic	Hermetic	Hermetic
Housing Material	Titanium	Titanium	Titanium	Titanium	Titanium
Weight	2.0 gm	2.8 gm	2.8 gm	5.8 gm	5.8 gm
Size	5/16 x 0.33 in 5/16 in x 8.4 mm	3/8 x 0.38 in 3/8 in x 9.7 mm	3/8 x 0.38 in 3/8 in x 9.7 mm	7/16 x 0.62 in 7/16 in x 15.7 mm	7/16 x 0.62 in 7/16 in x 15.7 mm
Mounting	5-40 Stud	Adhesive	Adhesive	10-32 Thread	10-32 Thread
Supplied Accessories					
Wax/Adhesive	080A109	080A109, 080A90	080A109, 080A90	080A109	080A109
Adhesive Mounting Base	080A15	—	—	080A	080A
Mounting Studs	—	—	—	081B05 M081B05	081B05 M081B05
Additional Versions					
Alternate Connector	352C68 - 10-32 Coaxial Jack	—	—	—	—
Top Connector Position	352C66	—	—	352C04	352C34
Metric Mounting Thread	M352C65	—	—	—	—
Additional Accessories					
Magnetic Mounting Base	080A30	—	—	080A27	080A27
Triaxial Mounting Adaptor	080B16	—	—	080B10	080B10
Mating Cable Connectors	AG	EB	EB	EB	EB
Recommended Cables	018 Flexible, 003 CE	002 Low Cost, 003 CE	002 Low Cost, 003 CE	002 Low Cost, 003 CE	002 Low Cost, 003 CE

General Purpose, Single Axis, ICP® Accelerometers for Automotive Modal Analysis

						
Model Number	333B30	333B32	333B40	333B42	333B50	333B52
Sensitivity	100 mV/g	100 mV/g	500 mV/g	500 mV/g	1000 mV/g	1000 mV/g
Measurement Range	50 g pk	50 g pk	10 g pk	10 g pk	5 g pk	5 g pk
Broadband Resolution	0.00015 g rms	0.00015 g rms	0.00005 g rms	0.00005 g rms	0.00005 g rms	0.00005 g rms
Frequency Range (± 5 %)	0.5 to 3000 Hz	0.5 to 3000 Hz	0.5 to 3000 Hz	0.5 to 3000 Hz	0.5 to 3000 Hz	0.5 to 3000 Hz
Temperature Range	0 to +150 °F -18 to +66 °C	0 to +150 °F -18 to +66 °C	0 to +150 °F -18 to +66 °C	0 to +150 °F -18 to +66 °C	0 to +150 °F -18 to +66 °C	0 to +150 °F -18 to +66 °C
Electrical Connector	10-32 Coaxial Jack	10-32 Coaxial Jack	10-32 Coaxial Jack	10-32 Coaxial Jack	10-32 Coaxial Jack	10-32 Coaxial Jack
Sealing	Hermetic	Hermetic	Hermetic	Hermetic	Hermetic	Hermetic
Housing Material	Titanium	Titanium	Titanium	Titanium	Titanium	Titanium
Weight	4.0 gm	4.0 gm	7.5 gm	7.5 gm	7.5 gm	7.5 gm
Size	0.4 in Cube 10.2 mm Cube	0.4 in Cube 10.2 mm Cube	0.45 in Cube 11.4 mm Cube	0.45 in Cube 11.4 mm Cube	0.45 in Cube 11.4 mm Cube	0.45 in Cube 11.4 mm Cube
Mounting	5-40 Thread	Adhesive	5-40 Thread	Adhesive	5-40 Thread	Adhesive
Supplied Accessories						
Wax/Adhesive	080A109, 080A90	080A109, 080A90	080A109, 080A90	080A109, 080A90	080A109, 080A90	080A109, 080A90
Adhesive Mounting Base	080A25	—	080A25	—	080A25	—
Mounting Studs	081A27 M081A27	—	081A27 M081A27	—	081A27 M081A27	—
Additional Accessories						
Removal Tool	039A08	039A08	039A09	039A09	039A09	039A09
Mating Cable Connectors	EB	EB	EB	EB	EB	EB
Recommended Cables	002 Low Cost, 003 CE	002 Low Cost, 003 CE	002 Low Cost, 003 CE	002 Low Cost, 003 CE	002 Low Cost, 003 CE	002 Low Cost, 003 CE



Small, Lightweight, Triaxial, ICP® Accelerometers for Automotive Modal Analysis

					
Model Number	356A01	356A31	356A33	356A12	356A32
Sensitivity	5 mV/g	10 mV/g	10 mV/g	100 mV/g	100 mV/g
Measurement Range	± 1000 g pk	± 500 g pk	± 500 g pk	± 50 g pk	± 50 g pk
Broadband Resolution	0.003 g rms	0.002 g rms	0.003 g rms	0.0002 g rms	0.0003 g rms
Frequency Range (± 5 %)	1.0 to 8000 Hz	1.0 to 10k Hz	2.0 to 10k Hz	0.4 to 6000 Hz [1]	0.7 to 5000 Hz [1]
Temperature Range	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C	-65 to +170 °F -54 to +77 °C	-65 to +250 °F -54 to +121 °C
Electrical Connector	Integral Cable	8-36 4-Pin Jack	1/4-28 4-Pin Jack	Integral Cable	8-36 4-Pin Jack
Sealing	Hermetic	Hermetic	Hermetic	Hermetic	Hermetic
Housing Material	Titanium	Titanium	Titanium	Titanium	Titanium
Weight	1.0 gm	4.5 gm	5.3 gm	5.4 gm	5.4 gm
Size	0.25 in Cube 6.35 mm Cube	0.45 in Cube 11.4 mm Cube	0.4 in Cube 10.2 mm Cube	0.45 in Cube 11.4 mm Cube	0.45 in Cube 11.4 mm Cube
Mounting	Adhesive	Adhesive	5-40 Thread	5-40 Thread	5-40 Thread
Supplied Accessories					
Wax/Adhesive	080A109, 080A90	080A109	080A109	080A109	080A109
Adhesive Mounting Base	—	—	080A	080A	080A
Mounting Studs/Screws	—	—	081A27, 081A90 M081A27	081A27 M081A27	081A27 M081A27
Cable Assembly	034G05	034K10	034G05	034G05	034K10
Additional Accessories					
Magnetic Mounting Base	—	—	—	080A30	080A30
Removal Tool	—	039A09	039A08	030A09	039A09
Mating Cable Connectors	AY	EH	AY	AY	EH
Recommended Cables	034	034	034	034	034
Note					
[1] Range shown is ± 10 %					

General Purpose, Triaxial, ICP® Accelerometers for Automotive Modal Analysis

					
Model Number	356A16	356A02	356A25	356A15	356B18
Sensitivity	100 mV/g	10 mV/g	25 mV/g	100 mV/g	1000 mV/g
Measurement Range	± 50 g pk	± 500 g pk	± 200 g pk	± 50 g pk	± 5 g pk
Broadband Resolution	0.0001 g rms	0.0005 g rms	0.0002 grms	0.0002 g rms	0.00005 g rms
Frequency Range (± 10%)	0.3 to 6000 Hz	0.5 to 6500 Hz	0.5 to 6500 Hz	1.4 to 6500 Hz	0.3 to 5000 Hz
Temperature Range	-65 to +176 °F -54 to +80 °C	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C	-20 to +170 °F -29 to +77 °C
Electrical Connector	1/4 - 28 4-Pin Jack	1/4-28 4-Pin Jack	1/4-28 4-Pin Jack	1/4 - 28 4-Pin Jack	1/4 - 28 4-Pin Jack
Sealing	Epoxy	Hermetic	Hermetic	Hermetic	Epoxy
Housing Material	Anodized Aluminum	Titanium	Titanium	Titanium	Anodized Aluminum
Weight	7.4 gm	10.5 gm	10.5 gm	10.5 gm	25.0 gm
Size	0.55 in Cube 14.0 mm Cube	0.55 in Cube 14.0 mm Cube	0.55 in Cube 14.0 mm Cube	0.55 in Cube 14.0 mm Cube	0.8 in Cube 20.3 mm Cube
Mounting	10-32 Thread	10-32 Thread	10-32 Thread	10-32 Thread	10-32 Thread
Supplied Accessories					
Wax/Adhesive	080A109	080A90, 080A109	080A109	080A90, 080A109	080A109
Adhesive Mounting Base	080A12	080A12	080A12	080A12	080A68
Mounting Studs	081B05 M081B05	081B05 M081B05	081B05 M081B05	081B05 M081B05	081B05 M081B05
Additional Accessories					
Magnetic Mounting Base	080A27	080A27	080A27	080A27	080A27
Removal Tool	039A10	039A10	039A10	039A10	—
Mating Cable Connectors	AY	AY	AY	AY	AY
Recommended Cables	034	034	034	034	034



Automotive Modal Analysis

Filtered and High Temperature, ICP® Accelerometers for Operational Modal Analysis

Filtered, ICP®, triaxial accelerometers prevent overloads due to excessive high frequency excitation commonly encountered with powertrain testing. High temperature ICP® accelerometers are specially designed and tested to survive temperature extremes beyond the range of standard ICP® accelerometers. These accelerometers are ideal for use in engine, turbo, exhaust and other automotive high temperature testing environments.

Filtered and High Temperature, ICP® Accelerometers

						
	Filtered Triaxial Accelerometers		Filtered and High Temperature, Triaxial, ICP® Accelerometers	High Temperature, Single Axis, ICP® Accelerometers [1]		
Model Number	356A63	356A66	339A30	320C18	320C15	320C03
Sensitivity	10 mV/g	10 mV/g	10 mV/g	10 mV/g	10 mV/g	10 mV/g
Measurement Range	± 500 g pk	± 500 g pk	± 500 g pk	500 g pk	500 g pk	500 g pk
Broadband Resolution	0.008 g rms	0.002 g rms	0.008 g rms	0.005 g rms	0.005 g rms	0.005 g rms
Frequency Range (± 10 %)	2.0 to 4000 Hz	2.0 to 4000 Hz [2]	2 to 10k Hz [2]	1.5 to 18k Hz	1.5 to 18k Hz	0.7 to 9000 Hz
Temperature Range	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C	-65 to +325 °F -54 to +163 °C	-100 to +325 °F -73 to +163 °C	-100 to +325 °F -73 to +163 °C	-100 to +325 °F -73 to +163 °C
Electrical Connector	1/4-28 4-Pin Jack	1/4-28 4-Pin Jack	8-36 4-Pin Jack	10-32 Coaxial Jack	5-44 Coaxial Jack	10-32 Coaxial Jack
Sealing	Hermetic	Hermetic	Hermetic	Hermetic	Hermetic	Hermetic
Housing Material	Titanium	Titanium	Titanium	Titanium	Titanium	Titanium
Weight	5.3 gm	9.0 gm	4.0 gm	1.7 gm	2.0 gm	10.5 gm
Size	0.4 in Cube 10.2 mm Cube	0.55 in Cube 14.0 mm Cube	0.4 in Cube 10.2 mm Cube	9/32 x 0.74 in 9/32 in x 18.8 mm	5/16 x 0.43 in 5/16 in x 10.9 mm	1/2 x 0.81 in 1/2 in x 20.6 mm
Mounting	5-40 Thread	10-32 Thread	Adhesive	5-40 Stud	5-40 Stud	10-32 Thread
Supplied Accessories						
Wax/Adhesive	080A109	080A109, 080A90	080A109	080A109	080A109	080A109
Adhesive Mounting Base	080A	080A12	—	080A15	080A15	—
Mounting Studs	081A27 M081A27 081A90	081B05 M081B05	—	—	—	081B05 M081B05
Additional Versions						
Alternate Mounting	—	—	339A31 - 5-40 Stud	M320C18 - Metric	M320C15 - Metric	—
Additional Accessories						
Magnetic Mounting Base	080A30	080A27	—	080A30	080A30	080A27
Triaxial Mounting Adaptor	—	—	—	080B16 080A196	080B16 080A196	080B10
Removal Tool	039A08	039A10	039A08	—	—	—
Mating Cable Connectors	AY	AY	EH	EB	AF, AG	EB
Recommended Cables	034	034	034	002 Low Cost, 003 CE	002 Low Cost, 003 CE	002 Low Cost, 003 CE
Notes						
[1] See also the high temperature (HT) versions of Models 356A01, 356A02, and 356A33 – each have a temperature range of -100 to +325 °F (-73 to +163 °C) [2] Range shown is ± 5 %						

Transducer Electronic Data Sheet (TEDS)

A sensor incorporating a Transducer Electronic Data Sheet (TEDS) is a mixed-mode (analog/digital) sensor with a built-in read/write memory that contains information about the sensor and its use. A TEDS sensor has an internal memory that includes information about the manufacturer, specifications and calibration, defined by IEEE standard 1451.4, effectively giving it the ability of “plug-and-play” self-identification within a measurement system. Using the same two-wire design of traditional piezoelectric with internal charge amplifier transducers, the TEDS sensor can flip between analog and digital modes, functioning with either a typical analog output, or with a digital bit stream output. Although a TEDS sensor can be connected to any ICP® sensor signal conditioner, only a TEDS-capable ICP® signal conditioner and data acquisition equipment support the digital communication mode.

Most PCB® accelerometers are available to order with TEDS functionality by specifying the unit's model number with a “T” prefix. Model 400B76 TEDS sensor interface kit provides users with full access to support both reading and writing information to the TEDS sensor. Its Windows® GUI supports both IEEE and LMS templates, communicating with a TEDS sensor over a USB port. Model 400B76-T includes an adaptor that allows reading and writing to triaxial accelerometers with one mouse click.





Charge Output Accelerometers for Automotive Modal Analysis

PCB® charge output accelerometers utilize piezoceramic sensing elements, in shear mode configurations, to directly output an electrostatic charge signal that is proportional to applied acceleration. These sensors do not contain built-in signal conditioning electronics. As a result, external signal conditioning is required to interface their generated measurement signals to readout or recording instruments. The sensors' charge output signals can be conditioned with either a laboratory-style, adjustable charge amplifier or an in-line fixed charge converter.

Charge Output Accelerometers for Automotive Modal Analysis

						
Single Axis				Triaxial		
Model Number	357A08	357A09	357B11	357B03	356A70	356A71
Sensitivity	0.35 pC/g	1.7 pC/g	3.0 pC/g	10.0 pC/g	2.7 pC/g	10.0 pC/g
Measurement Range	± 1000 g pk	± 2000 g pk	± 2300 g pk	± 2000 g pk	± 500 g pk	± 500 g pk
Frequency Range (+10 %) [1]	20k Hz	13k Hz	16k Hz	12k Hz	7000 Hz	7000 Hz
Temperature Range	-100 to +350 °F -73 to +177 °C	-100 to +350 °F -73 to +177 °C	-95 to +500 °F -71 to +260 °C	-95 to +500 °F -71 to +260 °C	-95 to +490 °F -70 to +254 °C	-95 to +490 °F -70 to +254 °C
Electrical Connector	3-56 Coaxial Jack	3-56 Coaxial Jack	5-44 Coaxial Jack	10-32 Coaxial Jack	5-44 Coaxial Jack	10-32 Coaxial Jack
Sealing	Epoxy	Epoxy	Hermetic	Hermetic	Hermetic	Hermetic
Housing Material	Anodized Aluminum	Titanium	Titanium	Titanium	Titanium	Titanium
Weight	0.16 gm	0.6 gm	2.0 gm	11 gm	7.9 gm	22.7 gm
Size (Length x Width x Height)	0.11 x 0.16 x 0.27 in 2.8 x 4.1 x 6.9 mm	0.14 x 0.45 x 0.25 in 3.6 x 11.4 x 6.4 mm	5/16 x 0.33 in 5/16 in x 8.4 mm	1/2 x 0.81 in 1/2 in x 20.6 mm	0.73 x 0.90 x 0.40 in 18.5 x 22.9 x 10.2 mm	0.96 x 1.00 x 0.50 in 24.4 x 25.4 x 12.7 mm
Mounting	Adhesive	Adhesive	5-40 Stud	10-32 Thread	Through Hole	Through Hole
Supplied Accessories						
Cable Assembly	030A10	030A10	—	—	—	—
Wax/Adhesive	080A109	080A109	—	080A109	—	—
Quick Bonding Gel	—	—	—	—	080A90	080A90
Adhesive Mounting Base	—	—	—	—	—	080A170
Removal Tool	039A29	039A27	—	—	—	—
Mounting Studs	—	—	—	081B05 M081B05	081A46	081A94
Additional Versions						
Alternate Electrical Connector	—	—	357B14 10-32 Coaxial Jack	—	—	—
Top Connector Position	—	—	357B14	357B04	—	—
Additional Accessories						
Adhesive Mounting Base	—	—	080A15	080A	—	080A170
Magnetic Mounting Base	—	—	080A30	080A27	—	—
Triaxial Mounting Adaptor	080A194	—	080B16, 080A196	080B10	—	—
Connector Adaptor	0709A02	0709A02	—	—	—	—
Mating Cable Connectors	EK	EK	AG	EB	AF, AG	EB
Recommended Cables	030	030	018 Flexible, 003	003	003	003
Notes						
[1] Dependant on charge amplifier (signal conditioner)						





Modally Tuned®, ICP®, Impact Hammers for Automotive Modal Analysis

Modally Tuned®, ICP®, impact hammers are easy-to-use solutions for delivering impulse forces into automotive test structures. “Modal tuning” is a technology that ensures the structural characteristics of the hammer do not affect measurement results. This is accomplished by eliminating hammer resonances in the frequency range of interest from corrupting the test data, resulting in more accurate and consistent outcomes.

Modally Tuned®, ICP®, impact hammers are also available in convenient kits which include the response accelerometers, signal conditioners, cables, and accessories needed for automotive component structural testing. Consult the PCB® web site at www.pcb.com for further details.

Model Number	GK291E80	GK291D	GK291D20
Supplied Kit Components	Model	Model	Model
Impact Hammer	086E80	086C03	086D20
Accelerometer #1	352B10	352B10	353B33
Accelerometer #2	352C68	352C68	352B
Signal Conditioner (2 ea.)	480E09	480E09	480E09
Hammer Cable	Integral	003D10	003D20
Accelerometer Cable (2 ea.)	003C10	003C10	003C20
Cable Adaptor	070A02 (2 ea.)	070A02	--
Output Cable (2 ea.)	003D03	003D03	003D03

Modally Tuned®, ICP®, Impact Hammers for Automotive Modal Analysis

				
Application	Rearview Mirrors, Printed Circuit Boards for ECMs, Lightly Damped Door Panels	Body-in-white Structures, Engine Components, Steering Columns	Light-Duty Truck Frames, Engines, Exhaust Systems	Heavy-Duty Truck Frames, Suspensions, Bus Structures
Model Number	086E80	086C03	086D05	086D20
Sensitivity	100 mV/lbf 22.5 mV/N	10 mV/lbf 2.25 mV/N	1 mV/lbf 0.23 mV/N	1 mV/lbf 0.23 mV/N
Measurement Range	±50 lbf pk ±220 N pk	±500 lbf pk ±2200 N pk	±5000 lbf pk ±22,000 N pk	±5000 lbf pk ±22,000 N pk
Resonant Frequency	≥ 100 kHz	≥ 22 kHz	≥ 22 kHz	≥ 22 kHz
Hammer Mass	4.8 gm	0.16 kg	0.32 kg	1.1 kg
Tip Diameter	0.10 in 2.5 mm	0.25 in 6.3 mm	0.25 in 6.3 mm	2.0 in 50.8 mm
Hammer Length	4.2 in 106.7 mm	8.5 in 215.9 mm	9.0 in 228.6 mm	14.5 in 368.3 mm
Electrical Connection	5-44 Coaxial Jack	BNC Jack	BNC Jack	BNC Jack
Extender Mass Weight	1.25 gm	75 gm	200 gm	-
Supplied Accessories				
Miniature Coaxial Cable	018G10	—	—	—
Wax	080A109	—	—	—
Extender Mass	084A13	—	084A09	—
Plastic Handle	084A14	—	—	—
Aluminum Handle	084A17	—	—	—
Tip Cover	084A28	—	—	—
Mounting Studs	—	081B05	081B05	—
Aluminum Extender	—	084A08	—	—
Hard Tip	—	084B03	084B03	084A63
Medium Tip	—	084B04	084B04	084A62
Soft Tip	—	084C05	084C05	084A61
Super Soft Tip	—	084C11	084A50	084A60
Tip Cover (4 each)	—	085A10	085A10	—



Dynamic Force Sensors for Automotive Modal Analysis

	CE		TEDS COMPLIANT	CE	
Model Number	288D01		208C01	208C02	208C03
	Acceleration	Force			
Sensitivity	100 mV/g 10.2 mV/(m/s²)	100 mV/lb 22.4 mV/N	500 mV/lb 112 mV/N	50 mV/lb 11 mV/N	10 mV/lb 2.2 mV/N
Measurement Range	± 50 g pk	± 50 lbf pk ± 222.4 N pk	10 lb 44 N	100 lb 445 N	500 lb 2224 N
Broadband Resolution	0.002 g rms	0.002 lb 0.0089 N	0.0001 lb rms 0.00045 N rms	0.001lb rms 0.004 N rms	0.005 lb rms 0.02 N rms
Upper Frequency Limit	7000 Hz	—	36 kHz	36 kHz	36 kHz
Electrical Connector	10-32 Coaxial Jack	10-32 Coaxial Jack	10-32 Coaxial Jack	10-32 Coaxial Jack	10-32 Coaxial Jack
Housing Material	Titanium	Titanium	Stainless Steel	Stainless Steel	Stainless Steel
Sealing	Hermetic	Hermetic	Hermetic	Hermetic	Hermetic
Weight	19.2 gm	19.2 gm	22.7 gm	22.7 gm	22.7 gm
Size	11/16 x 0.82 in 11/16 in x 20.83 mm	11/16 x 0.82 in 11/16 in x 20.83 mm	5/8 x 0.625 in 5/8 in x 15.88 mm	5/8 x 0.625 in 5/8 in x 15.88 mm	5/8 x 0.625 in 5/8 in x 15.88 mm
Mounting	10-32 Thread	10-32 Thread	10-32 Thread	10-32 Thread	10-32 Thread
Supplied Accessories					
Mounting Stud	081B08 M081B08	081B08 M081B08	081B05 M081A62	081B05 M081A62	081B05 M081A62
Adhesive Mounting Base	080A	080A	—	—	—
Thread Locker	—	—	080A81	080A81	080A81
Impact Cap	—	—	084A03	084A03	084A03
Additional Accessories					
Mating Cable Connectors	EB	EB	EB, EJ	EB, EJ	EB, EJ
Recommended Cables	002 Low Cost, 003 CE	002 Low Cost, 003 CE	002 Low Cost, 003 CE	002 Low Cost, 003 CE	002 Low Cost, 003 CE

PCB® recommends the use of Model 288D01 impedance sensor for all automotive modal testing applications. This sensor simultaneously measures an applied, driving point force and response acceleration in a single location. This is extremely important for multiple input test techniques to satisfy Maxwell's theory of reciprocity. In cases where it is not possible to use the impedance sensor, use of Series 208 force sensor is recommended.





Recommended Electrodynamic Modal Shaker System & Accessories from The Modal Shop

Modal Shaker

For many modal test applications, an electrodynamic shaker system is best suited for creating an appropriate input forcing function. Distributing adequate input force energy across the test structure and obtaining accurate and reliable input force measurements is critical for successful modal testing. This often requires a shaker that is highly portable, rugged, and easy to setup in order to facilitate the best exciter location (relative to the test structure) while minimizing any unwanted interaction between the exciter and test structure. Model 2100E11 Modal Shaker, a lightweight electrodynamic modal exciter, is capable of providing 100 lbf (440 N) of peak force excitation in a small footprint weighing just 33 pounds (15 kg). With a 1" stroke and frequency range up to 3000 Hz, Model 2100E11 is suitable for a multitude of automotive modal analysis applications.

Recommended Modal Shaker

	
Model Number	2100E11
Output Force, sine pk	100 lb 445 N
Output Force, random RMS	70 lb 311 N
Stroke Length, pk - pk	1.0 in 25.4 mm
Frequency Range	2 to 3000 Hz
First Resonance Frequency, nominal	> 3600 Hz
Maximum Acceleration	102 g
Maximum Velocity	5.2 ft/s
Protection Features	Over-travel Over-current (10A fuse)
Maximum Current	10A
DC Resistance, armature, nominal	3.8 Ω
Armature Suspension System	8 pieces composite beam flexures
Effective Armature Mass	0.45 kg
Weight	15.0 kg
Size	12.0 x 12.0 x 8.0 in 30.5 x 30.5 x 20.3 cm
Temperature Range (< 85% RH)	+ 41 to +95 °F + 5 to + 35 °C
Continuous Operation	8 hours
Included	2150G, 2155G, K2160G Stinger Kits



AirRide Mounts

AirRides provide excellent isolation and support of heavy structures during modal testing. They meet the modal challenge of keeping the mounting (rigid body) frequencies well below the frequency of the first deflection mode. Used exclusively for body-in-white vehicle modal tests, they offer a typical mounting frequency of 1.35 Hz for a 310 lb. mass (Model 8030S) or 2.88 Hz for a 650 lb. mass (Model 8032S). Since the natural frequency does not vary appreciably with load, several mounts may be used to support a structure at various loading points with good agreement on overall system mounting frequencies. AirRides offer the highest degree of isolation of any type of vibration isolator.

Recommended AirRide Mounts

		
Model Number	8030S	8032S
Maximum Load	680 lb 309 kg	1790 lb 814 kg
Maximum Pressure	80 PSIG 552 kPa	100 PSIG 690 kPa
Mounting Frequency	1.35 Hz for 310 lb mass	2.88 Hz for 650 lb mass
Mounting Pillar	1/2 - 13 UNC 2B x 1 in depth	1/2 - 13 UNC 2B x 1 in depth
Mounting Base	8 15/16 in mounting holes	8 15/16 in mounting holes
Size	7.5 x 8.5 in 190.5 x 215.9 mm	7.5 x 7.5 in 190.5 x 190.5 mm

Lateral Excitation Stand

Model 2050A lateral excitation stand provides a versatile means of adapting a modal shaker for horizontal input. Vehicles often require a means of inputting lateral force. The stand facilitates excitation with a tensioned piano wire stinger, which significantly reduces force measurement errors from unmeasured transverse forces. Combining both lateral and vertical excitation more evenly distributes input energy for better signal-to-noise, and helps to excite uncoupled lateral structural modes. Model 2050A allows the shaker to be precisely located in both the horizontal and vertical directions.



Recommended Lateral Excitation Stand

Model Number	2050A
Vertical Adjustment Range	4 to 49 in 102 to 1245 mm
Horizontal Adjustment Range	0 to 13.5 in 0 to 343 mm
Maximum Support Load	160 lb 72.7 kg
Weight	120 lb 54.5 kg
Size	39.0 x 49.5 x 75.0 in 990 x 1260 x 1910 mm
Included	K2160G Piano Wire Stinger Kit



Recommended Modal Accessories from The Modal Shop



3D Optical Digitizer

Model 5240 3D Optical Digitizer is ideal for locating modal analysis measurement points, up to 80% faster than manual geometry definition, with a tape measure, with accuracy of better than ± 0.01 in (± 0.25 mm) across a 1 m sphere. The 5240 system's wireless, handheld probe provides the ability to measure accurate coordinates without mechanical restrictions. The probe's locator tip accurately measures the coordinates of remote, or obscured, test points.

- 7 lb (3.2 kg) array weight
- Lightweight, small, rugged and portable
- Automatic digitization with wireless handheld flexibility
- Continuous self-calibration and data validation guarantees system accuracy
- Audible feedback informs user of accepted data points
- Easy repositioning of array and dynamic reference frame (DRF) for increased working volume

Excitation Stingers

Series 2100 Excitation Stinger consists of thin, flexible rods with attachment means at both ends. The stinger transmits force in the stiff axial direction and flexes laterally to reduce input side loads to the structure. This uniaxial force delivered by the flexible stinger increases the accuracy of the measurement. The stinger also helps isolate the exciter armature from the structure, lessening inadvertent shocks, and possibly preventing damage to a fragile exciter armature. Likewise, the stinger can protect a fragile structure from large, inadvertent excitations.

- Provides convenient excitation connection
- Alleviates need for alignment accuracy
- Reduces force sensor measurement error
- Isolates fragile exciter armatures
- Adapts to different mounting threads



For complete specifications on Modal Shakers and Accessories, please visit www.modalshop.com

Based in Cincinnati, Ohio, USA, PCB Piezotronics' sister company, The Modal Shop, specializes in sound and vibration sensing systems for the multichannel, acoustics, modal, and NVH markets. In addition to sensors, calibration systems, and applications engineering support, a variety of modal testing equipment is available as part of the rental program, and an experienced team of in-house experts is available to both perform and provide advice on both classical and operating automotive modal analysis applications.





Recommended Signal Conditioning Systems Solutions for Large, Multi-channel Automotive Modal Analysis



The third primary assumption of classical modal analysis is the time invariance of the test article. This assumption essentially requires that the modal properties of a structure do not change over time. As a result, the consistency of the data set is critical to accurate parameter estimation. The best way to ensure data consistency is to acquire all data simultaneously, a single "snapshot" in time eliminating any variance due to changing environmental or boundary conditions. Although this is the optimal solution it is often not economically feasible to purchase all the required channels of sensors, signal conditioning and data acquisition.

Traditionally, when a completely simultaneous measurement system is not realizable, the test engineer has had to resort to roving accelerometers in order to capture all necessary response data. This approach distresses the assumption of time invariance and can cause significant complications. First, it takes time to acquire the complete data set and the structure may indeed change throughout the testing over the course of hours or days. Second, roving a set of accelerometers actually produces an inconsistent mass distribution on the test article.

Bank Switching is a very effective means to acquire high quality consistent data sets while minimizing financial investment. Fully instrumenting the test structure with a complete set of accelerometers, and bank-switching signals from groups of accelerometers into a smaller, more affordable multi-channel simultaneous data acquisition system is an ideal compromise. Using the computer controlled automation of PCB® Series 440 signal conditioner, multiple data sets are acquired in just minutes, nominally longer than a full simultaneous acquisition, but substantially shorter than the hours or days of testing when roving accelerometers.

Handheld Calibrator and Mounting Accessories

Model 394C06 handheld shaker is a small, self-contained, battery powered, vibration exciter specifically designed to conveniently verify accelerometer and vibration system performance. It accepts sensors weighting up to 210 grams in weight and delivers a controlled, 1 g mechanical excitation.



Adhesive Mounting Bases
Models 080A, 080A12, 080A15, 080A25, 080A68, 080A70



Removal Tools
Models 039A08, 039A09, 039A10, 039A26, 039A27, 039A28, 039A29, 039A31



Magnetic Mounting Bases
Models 080A27, 080A30



Adhesive
Model 080A90
Note: A debonder should always be used to avoid sensor damage.



Triaxial Mounting Adapters
Models 080B10, 080B16

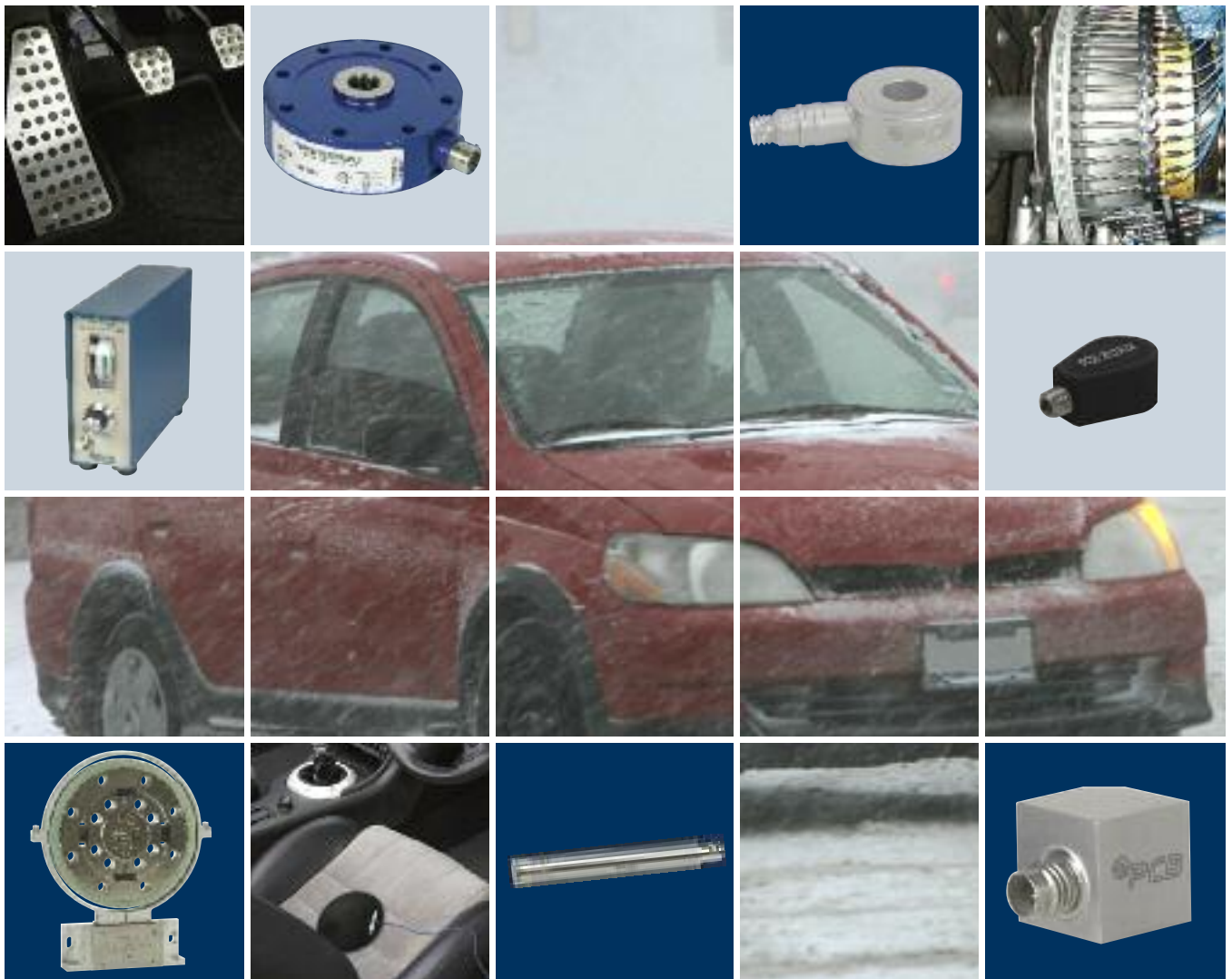


Petro Wax
Model 080A109



Automotive Component & System Performance Sensors

Accelerometers, Preamplifiers, Microphones, Force Sensors, Torque Sensors, Load Cells, Pressure Sensors, and Signal Conditioners





Automotive Component & System Performance Sensors

Better, faster, stronger. This has been the mantra of the automotive industry since the introduction of the first automobile and the launch of the world's first high speed train. Performance has always been measured by power and speed, but today's automotive performance demands efficiency and flexibility and at the same time, minimizing costs, materials and time. With this need for lowering costs and accelerating product-to-market timelines, automotive companies need to quickly and accurately capture the performance specifications of their products. These include vehicle performance attributes such as lateral and longitudinal acceleration, speed and braking distance, as well as system and component performance specifications such as:

- Engine horsepower and torque
- Transmission performance
- Axle and differential torque capacity
- Brake system performance
- Steering system performance
- HVAC performance
- Hand clutch and throttle effort (Motorcycle, ATV)
- Foot pedal effort (Brake, Clutch, Accelerator)
- Closing efforts (Glove Box, Hood, Trunk, Doors)
- Seat motor performance



Vehicle Performance Testing

PCB® offers a variety of sensors and instrumentation for the most demanding performance testing. PCB® Series 3711 (uniaxial) and 3713 (triaxial) DC response accelerometers are designed to meet the rugged requirements of vehicle testing. Hermetically sealed in titanium housings, these gas damped silicon MEMS sensors provide excellent performance while being protected from harsh contaminants. These sensors are inherently insensitive to base strain and transverse acceleration effects and offer high frequency overload protection, a must in minimizing the effects of road impacts. These sensors are ideal for measuring vertical road inputs as well as vehicle lateral and longitudinal acceleration.

The requirements for power and torque have increased steadily over the last 25 years as efficiencies in combustion have made it possible to increase horsepower without sacrificing fuel economy. These advancements have been made possible with the facilitation of dynamometer testing. Torque sensors are not only used in chassis and powertrain dynos but are also used insitu. PCB® Series 5300D TORKDISC® In-line Rotary Torque Sensor Systems are specifically designed for these applications where axial space is at a premium. Series 5300D incorporates dual high level filtered analog outputs, AC and DC coupled, providing both static and dynamic torque measurement capability that can be recorded separately and independently scaled; which is particularly beneficial when high DC levels are present or when low levels of AC content is of particular interest, as in rotational dynamics. These sensors are vital for vehicle performance, emissions, and fuel economy testing or for component performance testing on transfer cases, axles, differentials, pumps, fans, and electric motors.

These sensors and others used in vehicle-level performance testing can also be found in the Driveability and Ride & Handling and Motorsports brochures.

Component and Systems Performance Testing

Whether its measuring load required to engage a clutch pedal, brake line pressure during a panic stop, or the maximum vibration of an antenna motor in operation, PCB® products can quickly and accurately measure performance criteria of your automotive components and systems. PCB® manufactures accelerometers, force sensors, load cells, microphones, pressure transducers, strain sensors, torque sensors, signal conditioners, cables and accessories designed to meet all your component and system performance testing requirements.



DC Response Accelerometers for Performance Applications

PCB® Series 3711 (single axis) and 3713 (triaxial) DC response accelerometers are designed to measure low-frequency vibration and motion, and are offered in full-scale ranges from ± 3 to ± 200 g, to accommodate a variety of component and systems performance testing requirements. The units feature gas-damped, silicon MEMS sensing elements that provide performance, while hermetically sealed titanium housings provide protection from harsh contaminants. These units are inherently insensitive to base strain and transverse acceleration effects, and offer high frequency overload protection. Electrically, the units offer a single-ended output signal for each channel with power and ground leads.

DC Response Accelerometers for Performance Applications					
Series 3711 and 3713		Sensitivity	Measurement Range (pk)	Frequency (± 10%)	Broadband Resolution (rms)
		10 mV/g	± 200 g	0 to 1500 Hz	5.3 mg
		40 mV/g	± 50 g	0 to 1500 Hz	4.4 mg
		40 mV/g, 2.5 V offset	± 50 g	0 to 1500 Hz	4.4 mg
		100 mV/g	± 20 g	0 to 1500 Hz	3.6 mg
		100 mV/g, 2.5 V offset	± 20 g	0 to 1500 Hz	3.6 mg
		700 mV/g	± 3 g	0 to 150 Hz	1.1 mg
Model Number			3711 Single Axis	3713 Triaxial	
Overload Limit (Shock)			± 5000 g pk	± 5000 g pk	
Temperature Range			-65 to +250 °F -54.0 to +121 °C	-65 to +250 °F -54 to +121 °C	
Excitation Voltage			5 to 30 VDC	5 to 30 VDC	
Housing Material			Titanium	Titanium	
Sealing			Hermetic	Hermetic	
Size			0.45 x 0.85 x 0.85 in 11.4 x 21.6 x 21.6 mm	1.1 in Cube 28 mm Cube	
Weight	Connector style Integral cable style	14 gm 78 gm		78 gm 169 gm	
Electrical Connector			1/4-28 4-Pin or 10 ft. (3 m) Integral Cable	9-Pin or 10 ft. (3 m) Integral Cable	
Output Configuration			Single-Ended	Single-Ended	
Supplied Accessories					
Easy Mount Clip			080A152	—	
Adhesive Base			—	080A208	
Mounting Screws/Studs			081A64 M081A64	081A05 M081A05	
Additional Accessories					
Triaxial Mounting Block			080A153	—	
Mounting Cable Connectors			AY	EN	
Recommended Cables			034	037	





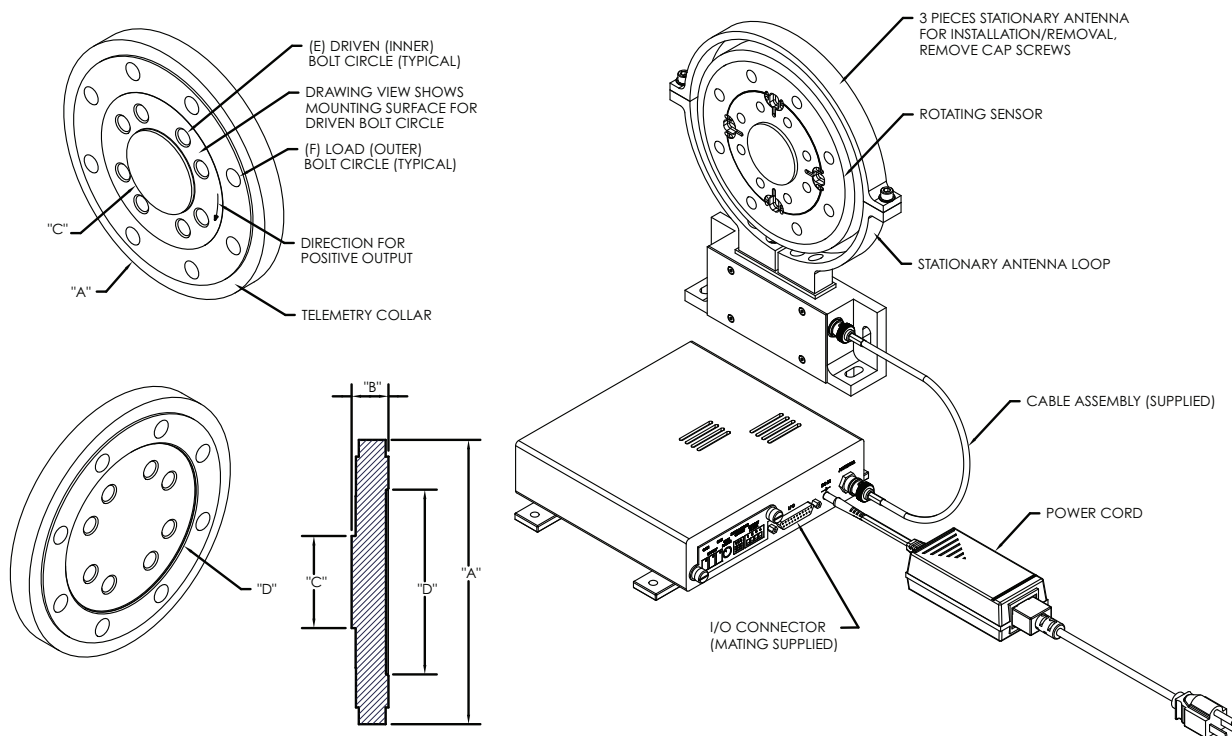
Series 5300D

TORKDISC® In-line Rotary Torque Sensor System for Performance Applications

PCB® Series 5300D sensors are designed for test applications requiring a robust rotary torque transducer where axial space is at a premium. Onboard, the transducer is a field proven electronic module that converts the torque signals into a high-speed digital representation. Once in digital form, this data is transmitted to a non-contacting pick-up loop, with no risk of noise or data corruption. A remote receiver unit converts the digital data to a high-level analog output voltage, and a serial digital output.

Series 5300D incorporates dual high level analog outputs, AC and DC coupled, providing both static and dynamic torque measurement capability that can be recorded separately and independently scaled; which is particularly beneficial when high DC levels are present or when low levels of AC content is of particular interest. Series 5300D also features industry leading bandwidth, DC to 8500 Hz, resulting in increased dynamic response characteristics. The DC coupled output features an 8-pole low pass elliptical filter with user selectable frequencies for minimal roll off at each filter selection. A 2-pole Butterworth high pass filter with a wide range of user selectable cut off frequencies is included with the AC coupled output.

These sensors are vital for vehicle performance, emissions, and fuel economy testing or for component performance testing on transfer cases, axles, differentials, pumps, fans, and electric motors.



The TORKDISC® and receiver make up a complete system. No additional signal conditioning is required. The receiver box provides voltage and digital output via a 25-pin I/O connector.

TORKDISC® In-line Rotary Torque Sensor System Dimensions

	A	B	C	D	E	F
Series	O.D. - Outside Diameter (including telemetry collar)	Overall Thickness	Pilot	Pilot	Driven (inner) Bolt Circle	Load (outer) Bolt Circle
5302D	7.00 in 177.8 mm	1.10 in 27.9 mm	1.999 in 50.8 mm	4.375 in 111.1 mm	(8) 3/8-24 threaded holes, spaced on a 3.00 in (76.20 mm) B.C.	(8) 0.406 in (10.31 mm) dia. through holes equally spaced on a 5.00 in (127.0 mm) B.C.
5308D	8.49 in 215.5 mm	1.10 in 27.9 mm	2.748 in 69.9 mm	5.513 in 140.0 mm	(8) 5/8-11 threaded holes, spaced on a 3.75 in (95.25 mm) B.C.	(8) 0.531 in (13.49 mm) dia. through holes equally spaced on a 6.5 in (165.0 mm) B.C.
5309D	10.49 in 241.0 mm	1.64 in 41.7 mm	3.998 in 101.5 mm	7.500 in 190.5 mm	(12) 5/8-11 threaded holes, spaced on a 6.0 in (152.4 mm) B.C.	(16) 0.531 in (13.49 mm) dia. through holes equally spaced on a 8.5 in (215.9 mm) B.C.
5310D	17.98 in 456.7 mm	2.09 in 53.0 mm	5.499 in 139.7 mm	11.001 in 279.4 mm	(12) 7/8-14 threaded holes, spaced on a 9.0 in (228.6 mm) B.C.	(16) 0.780 in (19.8 mm) dia. through holes equally spaced on a 13.0 in (330.2 mm) B.C.

Notes [1] Extraneous load limits reflect the maximum axial load, lateral load, and bending moment that may be applied singularly without electrical or mechanical damage to the sensor. Where combined extraneous loads are applied, decrease loads proportionally. Request Application Note AP-1015 regarding the effects of extraneous loads on the torque sensor output



TORKDISC® Rotary Torque Sensor System

Model Number	Unit	5302D-05A	5302D-03A	5302D-01A	5302D-02A	5302D-04A	5308D-01A	5308D-02A
Continuous Rated Capacity	in-lb N-m	250 28	1000 113	2000 226	5000 565	6250 706	10k 1130	20k 2260
Bolt Joint Slip Torque	in-lb N-m	3300 373	3300 373	3300 373	10k 1130	10k 1130	35k 4000	35k 4000
Safe Overload	in-lb N-m	750 85	3000 339	6000 678	15k 1695	15k 1695	30k 3400	60k 6775
Failure Overload	in-lb N-m	1000 113	4000 452	8000 904	20k 2260	20k 2260	40k 4500	80k 9040
Torsional Stiffness	in-lb/rad N-m/rad	300k 34k	2.9M 328k	5.8M 655k	14.5M 1.6M	14.5M 1.6M	33.5M 3.8M	67M 7.6M
Torsional Angle @ Capacity	degrees	0.125	0.02	0.02	0.02	0.02	0.017	0.017
Rotating Inertia	in-lb sec ² N-m sec ²	0.030 0.003	0.056 0.006	0.056 0.006	0.117 0.013	0.117 0.013	0.24 0.027	0.24 0.027
Axial Load Limit [1]	lb N	62.5 278	250 1112	500 2224	1000 4448	1000 4448	1350 6000	2700 12k
Lateral Load Limit [1]	lb N	62.5 278	250 1112	500 2224	1000 4448	1000 4448	1650 7300	3375 15k
Bending Moment Limit [1]	in-lb N-m	125 14	750 85	1500 169	3000 339	3000 339	5000 565	7500 850
Maximum Speed	RPM	15k	15k	15k	15k	15k	10k	10k
Rotor Weight	lb kg	2 0.91	3.5 1.59	3.5 1.59	9 4.08	9 4.08	10 4.5	10 4.5
Rotor Material		Aluminum	Aluminum	Aluminum	Steel	Steel	Steel	Steel
Model Number	Unit	5308D-03A	5309D-01A	5309D-02A	5310D-03A	5310D-01A	5310D-02A	5310D-04A
Continuous Rated Capacity	in-lb N-m	30k 3400	50k 5650	100k 11.3k	120k 13.6k	180k 20.3k	200k 22.5k	225k 25.4k
Bolt Joint Slip Torque	in-lb N-m	35k 4000	85k 9600	110k 12.4k	268k 30.3k	268k 30.3k	268k 30.3k	268k 30.3k
Safe Overload	in-lb N-m	75k 8475	100k 11.3k	200k 22.6k	360k 40.7k	540k 61.0k	600k 67.8k	675k 76.3k
Failure Overload	in-lb N-m	100k 11.3k	125k 14k	250k 28.2k	480k 54.2k	720k 81.3k	800k 90.4k	900k 101.7k
Torsional Stiffness	in-lb/rad N-m/rad	100M 11.3M	115M 13M	230M 26M	730k 82.5k	1.1B 24M	1.2B 138M	1.35B 152.5M
Torsional Angle @ Capacity	degrees	0.017	0.017	0.017	0.01	0.01	0.01	0.01
Rotating Inertia	in-lb sec ² N-m sec ²	0.24 0.027	0.874 0.099	0.874 0.099	7.514 0.849	7.514 0.849	7.514 0.849	7.514 0.849
Axial Load Limit [1]	lb N	4000 17.8k	5000 22.2k	10k 44.5k	12k 53.4k	13.5k 60k	14k 62k	15k 66.7k
Lateral Load Limit [1]	lb N	5000 22.2k	5000 22.2k	10k 44.5k	12k 53.4k	13.5k 60k	14k 62k	15k 66.7k
Bending Moment Limit [1]	in-lb N-m	10k 1130	25k 2825	50k 5650	80k 9039	90k 10.2k	95k 10.7k	100k 11.3k
Maximum Speed	RPM	10k	10k	10k	4500	4500	4500	4500
Rotor Weight	lb kg	10 4.5	30 13.6	30 13.6	100 45	100 45	100 45	100 45
Rotor Material		Steel	Steel	Steel	Steel	Steel	Steel	Steel

Series 5300D Common Specifications

System Output		Temperature	
Voltage Output A	AC Coupled, 0 to ± 10 volt w/ independent coarse gain control (16 increments)	Rotor Temp. Range Compensated	+70 to +170 °F (+21 to +77 °C)
Voltage Output B	DC Coupled, 0 to ± 10 volt w/ independent fine and coarse gain control	System Temp. Effect on Output [2]	± 0.002% FS/°F (± 0.0036% FS/°C)
Digital Output:	QSPI	System Temp. Effect on Zero [2]	± 0.002% FS/°F (± 0.0036% FS/°C)
System Performance		Rotor/Stator Temp. Range Usable	+32 to +185 °F (0 to +85 °C)
Accuracy	Overall, 0.1% FS, combined effect of Non-Linearity, Hysteresis, & Repeatability	Rotor/Stator Optional Temp. Range Usable	+32 to +250 °F (0 to +121 °C)
Voltage Output A Filter (AC)	2-pole Butterworth high pass w/ selectable cutoff frequencies of 5, 10, 20, 200, 500, & 735 Hz, & 8-pole low pass determined by the DC coupled output cutoff frequency selection	Receiver Temp. Range Usable	0 to +122 °F (-17 to +50 °C)
Voltage Output B Filter (DC)	8-pole elliptical low pass w/selectable cutoff frequencies of > 8.5k, 5k, 2.5k, 1.25k, 625, 313, 10, & 1 Hz	Mechanical	
Bandwidth	DC to 8500 Hz anti-alias	Permissible Radial Float, Rotor to Stator	± 0.25 in (± 6.35 mm)
Digital resolution	16-bit	Permissible Axial Float, Rotor to Stator	± 0.25 in (± 6.35 mm)
Analog Resolution	0.030% FS (10 volts/32,768)	Dynamic Balance	ISO G 2.5
Digital Sample Rate	26,484 samples/sec	Sensor Positional Sensitivity	≅ 0.1% FS (180° rotation)
Group Delay	≅ 110 microseconds at 10 kHz	Power	
Noise	≤10 mV at 10 kHz	Power Requirements	9 to 18 VDC, 15 watts (90 to 240VAC 50-60 Hz, adaptor is supplied)
Noise Spectral Density	<0.0005%FS per root Hz typical	Miscellaneous	
		Symmetry Adjustment	Factory and user adjustable ± 0.5% FS
		Supplied Cable, Stator to Receiver	24 ft. (7.3 m), RG 58/U (BNC plug/stator side, TNC plug/receiver side)
		Optional Cable, Stator to Receiver	80 ft. (24.4 m), RG 58/U (contact factory for longer lengths)
		Output Interface	DB-25 female connector (mating supplied w/backshell)
		Calibration	Unipolar shunt calibration, invoked from the receiver front panel
		Stator Assembly	Top half of loop is removable for easy installation over rotor
		Notes	
		[2] Within compensated range	



ICP® Preamplifiers for Prepolarized & Externally Polarized Microphones for Performance Applications

PCB® designs and manufactures both ICP® preamplifiers for prepolarized microphones and traditional preamplifiers for use with externally polarized microphones. Small and rugged, with a low noise floor and a large dynamic range, these stainless steel preamplifiers are needed for performance testing.



Prepolarized Precision Condenser Microphone Cartridges for Performance Applications



Model Number	377B02	377B20
Diameter	1/2 in	1/2 in
Response	Free-Field	Random Incidence
Open Circuit Sensitivity (at 250 Hz)	50 mV/Pa	50 mV/Pa
Frequency Range (± 2 dB)	3.15 to 20k Hz	3.15 to 12.5k Hz
Polarization Voltage	0 V	0 V
Dynamic Range - 3% Distortion Limit [1]	146 dB	146 dB
Dynamic Range - Cartridge Thermal Noise [1]	15 dB (A)	15 dB (A)
Temperature Range	-40 to +248 °F -40 to +120 °C	-40 to +248 °F -40 to +120 °C
Notes		
[1] re 20 µPa		

Preamplifiers for Performance Applications

Model Number	Prepolarized				Externally Polarized
	426E01	HT426E01	426A10	426A11	426A30
Diameter	1/2 in	1/2 in	1/2 in	1/2 in	1/2 in
Gain (Attenuation)	-0.05 dB	-0.06 dB	-0.1 dB	-0.16 dB	-0.25 dB
Frequency Response (± 0.2 dB)	6 to 125k Hz	6 to 126k Hz	80 to 125k Hz	5 to 125k Hz	0.9 to 126k Hz
Electrical Noise (A-weight)	< 2.8 µV	< 4.9 µV	< 3.6 µV	< 5 µV [2]	< 4.5 µV
Electrical Noise (Flat) [1]	< 5 µV	< 13.4 µV	< 11.2 µV	< 4.2 µV	< 7 µV
Output Voltage (max)	7 V pk	7 V pk	7 V pk	5 V pk	14 V pk
Constant Current Excitation	2 to 20 mA	2 to 20 mA	2 to 20 mA	2 to 20 mA	—
Temperature Range	-40 to +176 °F -40 to +80 °C	-40 to +248 °F -40 to +120 °C	-40 to +176 °F -40 to +80 °C	-4 to +158 °F -20 to +70 °C	-40 to +185 °F -40 to +85 °C
Output Connector	BNC Jack	BNC Jack	BNC Jack	BNC Jack	7-pin LEMO
TEDS IEEE P1451.4	Yes	Yes	Yes	Yes	No
Notes					
[1] 20 to 20k Hz [2] with AWT switch in ON position					



Model 426E01
1/2" ICP® Preamplifier



Model HT426E01
High Temperature 1/2" ICP® Preamplifier



Model 426A10
1/2" ICP® Preamplifier



Model 426A11
1/2" ICP® Preamplifier with gain and filter switches



Model 426A30
1/2" Preamplifier

High Temperature Acoustic Measurement System

Model Number	HT378B02
Nominal Diameter	1/2 in 12.5 mm
Response Characteristic	Free-Field
Open Circuit Sensitivity at 250 Hz (± 1.7 dB)	50 mV/Pa
Frequency Range (± 1 dB)	5 to 10k Hz
Frequency Range (± 2 dB)	3.15 to 20k Hz
Lower Limiting Frequency (-3 dB Point)	1 to 2.4 Hz
Dynamic Range (3% Distortion Value)	146 dB [1]
Dynamic Range at Nominal Sensitivity	135 dB [1]
Noise Floor (Cartridge Thermal Noise)	17 dBA [1] [2]
Excitation Voltage	20 to 32 VDC
Polarization Voltage	0 Volts (Prepolarized Style)
Constant Current Excitation	2 to 10 mA, ICP® Sensor Power
Operating Temperature - System	-40 to +250 °F -40 to +120 °C
Connector	BNC Jack
Size (Diameter x Length, with Grid Cap)	0.52 x 3.88 in 13.2 x 98 mm
Microphone Component	377B20
Preamplifier Component	HT426E01
Notes	
[1] re 20 µV [2] 4.9 Vrms, minimum 7 Vpk	

High Temperature Acoustic Measurement System for Performance Applications

Industry exclusive PCB® Model HT378B02 is the world's first IEC compliant microphone and preamplifier combination that has an operating capability to 120 °C (250 °F), perfect for acoustic measurements near high performance powertrain components, underhood, engine, manifold and other high temperature applications for component and system performance testing.



Model HT378B02



Microphones and Preamplifiers for Performance Applications

PCB® Series 130 ICP® Array Microphones provide a cost-effective method for large channel count sound pressure measurements such as beam forming, holography and sound pressure mapping. Powered by standard ICP® sensor signal conditioners, these microphones are interchangeable with ICP® accelerometers and include an integrated preamplifier. Array kits are also available, complete with patch panel, cables, and signal conditioners.



ICP® Array Microphones with Integral Preamplifier for Performance Applications			
Model Number	130D20	130D21	130D22
Microphone Diameter	1/4 in	1/4 in	1/4 in
Response	Free-Field	Free-Field	Free-Field
Sensitivity (± 3 dB at 250 Hz)	45 mV/Pa	45 mV/Pa	45 mV/Pa
Frequency Response (± 1 dB)	100 to 4000 Hz	100 to 4000 Hz	100 to 4000 Hz
Frequency Response ($-2, +5$ dB)	20 to 15k Hz	20 to 15k Hz	20 to 15k Hz
Dynamic Range (10 Hz to 10k Hz, ref. 20 μ Pa)	< 30 to > 122 dB	< 30 to > 122 dB	< 30 to > 122 dB
Polarization Voltage	0 V	0 V	0 V
Temperature Range	+14 to +122 °F -10 to +55 °C	+14 to +122 °F -10 to +55 °C	+14 to +122 °F -10 to +55 °C
Connector	BNC Jack	10-32 Jack	SMB
TEDS IEEE P1451.4	Optional	Optional	Optional



Single Axis, ICP® Accelerometers for Performance Applications

Model Number	352C23	352C22	352A24	352C65	352C33
Sensitivity	5 mV/g	10 mV/g	100 mV/g	100 mV/g	100 mV/g
Measurement Range	± 1000 g pk	± 500 g pk	50 g pk	50 g pk	50 g pk
Broadband Resolution	0.003 g rms	0.002 g rms	0.0002 g rms	0.00016 g rms	0.00015 g rms
Frequency Range ($\pm 10\%$)	1.5 to 15k Hz	0.7 to 13k Hz	0.8 to 10k Hz	0.3 to 12k Hz	0.3 to 15k Hz
Temperature Range	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C	-65 to +200 °F -54 to +93 °C	-65 to +200 °F -54 to +93 °C
Electrical Connector	3-56 Coaxial Jack	3-56 Coaxial Jack	3-56 Coaxial Jack	5-44 Coaxial Jack	10-32 Coaxial Jack
Sealing	Epoxy	Epoxy	Epoxy	Hermetic	Hermetic
Housing Material	Anodized Aluminum	Anodized Aluminum	Anodized Aluminum	Titanium	Titanium
Weight	0.2 gm	0.5 gm	0.8 gm	2.0 gm	5.8 gm
Size	0.11 x 0.34 x 0.16 in 2.8 x 8.6 x 4.1 mm	0.14 x 0.45 x 0.25 in 3.6 x 11.4 x 6.4 mm	0.19 x 0.48 x 0.28 in 4.8 x 12.2 x 7.1 mm	5/16 x 0.33 in 5/16 in x 8.4 mm	7/16 x 0.62 in 7/16 in x 15.7 mm
Mounting	Adhesive	Adhesive	Adhesive	5-40 Stud	10-32 Thread
Supplied Accessories					
Cable	030A10	030A10	030A10	—	—
Wax/Adhesive	080A109	080A109	080A109	080A109	080A109
Adhesive Mounting Base	—	—	—	080A15	080A
Removal Tool	039A26	039A27	039A28	—	—
Mounting Studs/Screws	—	—	—	—	081B05 M081B05
Additional Versions					
Alternate Connector Position	—	—	—	352C66 - Top	352C34 - Top
Additional Accessories					
Magnetic Mounting Base	—	—	—	080A30	080A27
Triaxial Mounting Adaptor	—	—	—	080B16 080A196	080B10
Connector Adaptor	070A02	070A02	070A02	—	—
Mating Cable Connectors	EK	EK	EK	AG	EB
Recommended Cables	030	030	030	018 Flexible, 003 CE	002 Low Cost, 003 CE



Automotive Component & System Performance Sensors

Triaxial, ICP® Accelerometers for Performance Applications

						
Model Number	356A33	356A32	356A16	356A17	356A02	356A15
Sensitivity	10 mV/g	100 mV/g	100 mV/g	500 mV/g	10 mV/g	100 mV/g
Measurement Range	±500 g pk	± 50 g pk	± 50 g pk	± 10 g pk	± 500 g pk	± 50 g pk
Broadband Resolution	0.003 rms	0.0003 g rms	0.0001 g rms	0.00006 g rms	0.0005 g rms	0.0002 g rms
Frequency Range (± 10%)	2 to 10k Hz [1]	0.7 to 5000 Hz	0.3 to 6000 Hz	0.3 to 4000 Hz	0.5 to 6000 Hz	1.4 to 6500 Hz
Temperature Range	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C	-65 to +176 °F -54 to +80 °C	-65 to +176 °F -54 to +80 °C	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C
Electrical Connector	1/4-28 4-Pin Jack	8-36 4-Pin Jack	1/4-28 4-Pin Jack	1/4-28 4-Pin Jack	1/4-28 4-Pin Jack	1/4-28 4-Pin Jack
Sealing	Hermetic	Hermetic	Epoxy	Epoxy	Hermetic	Hermetic
Housing Material	Titanium	Titanium	Anodized Aluminum	Anodized Aluminum	Titanium	Titanium
Weight	5.3 gm	5.4 gm	7.4 gm	9.3 gm	10.5 gm	10.5 gm
Size	0.4 in cube 10.2 mm cube	0.45 in cube 11.4 mm cube	0.55 in cube 14 mm cube	0.55 in cube 14 mm cube	0.55 in cube 14 mm cube	0.55 in cube 14 mm cube
Mounting	5-40 Thread	5-40 Thread	10-32 Thread	5-40 Thread	10-32 Thread	10-32 Thread
Supplied Accessories						
Cable	—	034K10	—	—	—	—
Wax/Adhesive	080A109	080A109	080A109	080A109	080A109 080A90	080A109 080A90
Adhesive Mounting Base	080A	080A	080A12	080A145	080A12	080A12
Mounting Studs/Screws	081A27 M081A27 081A90	081A27 M081A27 081A90	081B05 M081B05	081A27 M081A27	081B05 M081B05	081B05 M081B05
Additional Versions						
Alternate Electrical Connector	356B21 8-36 4-Pin Jack	—	—	—	—	—
Alternate Cable Option	—	356A12 Integral Cable	—	—	—	—
Additional Accessories						
Magnetic Mounting Base	—	080A30	080A27	—	080A27	080A27
Removal Tool	039A08	039A09	039A10	039A10	039A10	039A10
Mating Cable Connectors	AY	EH	AY	AY	AY	AY
Recommended Cables	034	034	034	034	034	034
Notes						
[1] Frequency Range (± 5%)						



Triaxial, ICP® Seat Pad Accelerometer

	
Model Number	356B41
Sensitivity	100 mV/g
Measurement Range	± 10 g pk
Broadband Resolution	0.0002 g rms
Frequency Range (± 5 %)	0.5 to 1000 Hz
Temperature Range	+14 to +122 °F -10 to +50 °C
Electrical Connector	Integral Cable
Sealing	Hermetic
Weight	272 gm
Size	7.87 x 0.472 in 200 x 12 mm
Supplied Accessory	
Cable	010G05



ICP® Quartz Force Ring for Performance Applications

				
Model Number	201B02	201B03	201B04	201B05
Sensitivity	50 mV/lb 11,240 mV/kN	10 mV/lb 2248 mV/kN	5 mV/lb 1124 mV/kN	1 mV/lb 224.8 mV/kN
Measurement Range (Compression)	100 lb 0.4448 kN	500 lb 2.224 kN	1000 lb 4.448 kN	5000 lb 22.24 kN
Maximum Static Force (Compression)	600 lb 2.67 kN	3000 lb 13.34 kN	6000 lb 26.69 kN	8000 lb 35.59 kN
Broadband Resolution	0.002 lb-rms	0.01 lb-rms	0.02 lb-rms	0.10 lb-rms
Low Frequency Response (-5 %)	0.001 Hz	0.0003 Hz	0.0003 Hz	0.0003 Hz
Temperature Range	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C
Preload	100 lb 0.445 kN	200 lb 0.89 kN	400 lb 1.78 kN	1000 lb 4.448 kN
Electrical Connector	10-32 Coaxial Jack	10-32 Coaxial Jack	10-32 Coaxial Jack	10-32 Coaxial Jack
Sealing	Hermetic	Hermetic	Hermetic	Hermetic
Housing Material	Stainless Steel	Stainless Steel	Stainless Steel	Stainless Steel
Weight	10 gm	10 gm	10 gm	10 gm
Size [1]	0.65 x 0.31 x 0.25 x 0.50 in 16.5 x 7.9 x 6.0 x 12.7 mm	0.65 x 0.31 x 0.25 x 0.50 in 16.5 x 7.9 x 6.0 x 12.7 mm	0.65 x 0.31 x 0.25 x 0.50 in 16.5 x 7.9 x 6.0 x 12.7 mm	0.65 x 0.31 x 0.25 x 0.50 in 16.5 x 7.9 x 6.0 x 12.7 mm
Size (OD) (Sensor)	0.650 in 16.51 mm	0.650 in 16.51 mm	0.650 in 16.51 mm	0.650 in 16.51 mm
Mounting	10-32 Thread	10-32 Thread	10-32 Thread	10-32 Thread
Supplied Accessories				
Assembly Lubricant	080A82	080A82	080A82	080A82
Mounting Stud	081A11	081A11	081A11	081A11
Anti-Friction Washer	082B01	082B01	082B01	082B01
Pilot Bushing	083B01	083B01	083B01	083B01
Notes				
[1] Diameter x Height x Bolt Diameter x Sensing Surface				

Multi-Purpose, ICP® Force Sensors for Performance Applications

					
Model Number	208C01	208C02	208C03	208C04	208C05
Measurement Range (Compression)	10 lb 0.04448 kN	100 lb 0.4448 kN	500 lb 2.224 kN	1000 lb 4.448 kN	5000 lb 22.24 kN
Sensitivity	500 mV/lb 112,410 mV/kN	50 mV/lb 11,241 mV/kN	10 mV/lb 2248 mV/kN	5 mV/lb 1124 mV/kN	1 mV/lb 224.8 mV/kN
Maximum Static Force (Compression)	60 lb 0.27 kN	600 lb 2.669 kN	3000 lb 13.5 kN	6000 lb 26.69 kN	8000 lb 35.59 kN
Broadband Resolution	0.0001 lb-rms	0.001 lb-rms	0.005 lb-rms	0.01 lb-rms	0.05 lb-rms
Low Frequency Response (-5 %)	0.01 Hz	0.001 Hz	0.0003 Hz	0.0003 Hz	0.0003 Hz
Temperature Range	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C
Electrical Connector	10-32 Coaxial Jack	10-32 Coaxial Jack	10-32 Coaxial Jack	10-32 Coaxial Jack	10-32 Coaxial Jack
Sealing	Hermetic	Hermetic	Hermetic	Hermetic	Hermetic
Housing Material	Stainless Steel	Stainless Steel	Stainless Steel	Stainless Steel	Stainless Steel
Weight	22.7 gm	22.7 gm	22.7 gm	22.7 gm	22.7 gm
Size	5/8 x 0.5 in 5/8 in x 12.7 mm	5/8 x 0.5 in 5/8 in x 12.7 mm	5/8 x 0.5 in 5/8 in x 12.7 mm	5/8 x 0.5 in 5/8 in x 12.7 mm	5/8 x 0.5 in 5/8 in x 12.7 mm
Mounting	10-32 Thread	10-32 Thread	10-32 Thread	10-32 Thread	10-32 Thread
Supplied Accessories					
Thread Locker	080A81	080A81	080A81	080A81	080A81
Mounting Studs	081B05 M081A62	081B05 M081A62	081B05 M081A62	081B05 M081A62	081B05 M081A62
Impact Cap	084A03	084A03	084A03	084A03	084A03



Automotive Component & System Performance Sensors

Pedal Effort Load Sensors for Performance Applications

PCB® Series 1515-106 sensors are designed to measure load applied to the brake, accelerator, and clutch pedals during acceleration, deceleration, and transmission shift events. All models include an anti-slip spherical loading surface to minimize the effects of off-axis loading.

Pedal Effort Load Sensor for Performance Applications



Model Number	1515-106-01A	1515-106-02A	1515-106-03A
Measurement Range	100 lb 0.44 kN	200 lb 0.89 kN	300 lb 1.33 kN
Overload Limit	500 lb 2.20 kN	1000 lb 4.40 kN	1500 lb 6.67 kN
Temperature Range	-65 to +200 °F -54 to +93 °C		
Weight	0.49 kg		
Size	2.63 x 1.19 in 66.80 x 30.23 mm		
Housing Material	Plated Steel		
Electrical Connector	Pigtail ends		

Strain Gage Load Cells for Performance Applications

PCB® Model 1621 is designed for multi-cycle, high repetition automotive component test applications, and are ideal for fatigue testing on vehicle doors, hoods, and trunks. These load cells are also conducive to life cycle testing on hinges, latches, handles, bushings, seat backs, springs, and other automotive components.

Strain Gage Load Cells for Performance Applications



Model Number	1621-02A
Sensitivity	2 mV/V
Measurement Range	1000 lb 4.45 kN
Overload	5000 lb 22.3 kN
Non-Linearity	≤ 0.05 % FS
Hysteresis	≤ 0.05 % FS
Non-Repeatability	≤ 0.02 % FS
Temperature Range	-65 to +200 °F -54 to +93 °C
Bridge Resistance	350 ohm
Excitation Voltage	10 VDC
Weight	0.454 kg
Size	2.25 x 1.00 x 2.75 in 5.72 x 25.4 x 69.9 mm
Mounting	1/2 - 20 Thread
Electrical Connector	21R-10-6P

Low Profile Load Cell Sensors for Performance Applications



Model Number	1303-02A	1303-03A	1303-04A	1203-01A	1203-03A	1203-05A
Sensitivity	2 mV/V	2 mV/V	2 mV/V	2 mV/V	2 mV/V	3 mV/V
Measurement Range	5000 lb 22.24 kN	10,000 lb 44.48 kN	20,000 lb 88.96 kN	500 lb 2.224 kN	2000 lb 8.896 kN	10,000 lb 44.48 kN
Overload Limit	7500 lb 33.36 kN	15,000 lb 66.72 kN	30,000 lb 133.45 kN	750 lb 3.336 kN	3000 lb 13.34 kN	15,000 lb 66.72 kN
Non-Linearity	≤ 0.2 % FS	≤ 0.2 % FS	≤ 0.2 % FS	≤ 0.05 % FS	≤ 0.05 % FS	≤ 0.05 % FS
Hysteresis	≤ 0.2 % FS	≤ 0.2 % FS	≤ 0.2 % FS	≤ 0.05 % FS	≤ 0.05 % FS	≤ 0.05 % FS
Non-Repeatability	≤ 0.05 % FS	≤ 0.05 % FS	≤ 0.05 % FS	≤ 0.02 % FS	≤ 0.02 % FS	≤ 0.02 % FS
Temperature Range	-65 to +200 °F -54 to +93 °C	-65 to +200 °F -54 to +93 °C	-65 to +200 °F -54 to +93 °C	-65 to +200 °F -54 to +93 °C	-65 to +200 °F -54 to +93 °C	-65 to +200 °F -54 to +93 °C
Bridge Resistance	350 ohm	350 ohm	350 ohm	700 ohm	700 ohm	700 ohm
Excitation Voltage	10 VDC	10 VDC	10 VDC	10 VDC	10 VDC	10 VDC
Weight	0.23 kg	0.57 kg	0.57 kg	1.31 kg	1.31 kg	1.31 kg
Size	1.71 x 4.5 in 43.4 x 114.3 mm	1.71 x 4.5 in 43.4 x 114.3 mm	1.71 x 4.5 in 43.4 x 114.3 mm	4.12 x 1.37 in 104.6 x 34.8 mm	4.12 x 1.37 in 104.6 x 34.8 mm	4.12 x 1.37 in 104.6 x 34.8 mm
Mounting	1 - 14 Thread	1 - 14 Thread	1 - 14 Thread	5/8 - 18 Thread	5/8 - 18 Thread	5/8 - 18 Thread
Electrical Connector	PT02E-10-6P	PT02E-10-6P	PT02E-10-6P	PT02E-10-6P	PT02E-10-6P	PT02E-10-6P

Additional Versions

Alternate Electrical Connector	—	—	—	1203-01B PC04E-10-6P	1203-03B PC04E-10-6P	1203-05B PC04E-10-6P
Alternate Mounting	—	—	—	M1203-01A M1203-01B Metric	M1203-03A M1203-03B Metric	M1203-05A M1203-05B Metric

Additional Accessories

Mounting Base	—	—	—	084A100 M084A100	084A100 M084A100	084A100 M084A100
---------------	---	---	---	---------------------	---------------------	---------------------



Pressure Transducers for Performance Applications

Manufactured with an unique thin-film process to "atomically fuse" sensitive resistive material behind a recessed diaphragm, PCB® Series 1500 Pressure Transducers achieve high accuracy repeatability, and stability expected of today's measurement and control requirements. Series 1500 sensors are used for shock absorber, struts, and brake systems studies, as well as for DC line pressure with response time up to 1 msec, and intake manifold pressure.

Pressure Sensors for Performance Applications

		
Series Number	1501	1502
Output	0 to 5 VDC FS	0 to 10 VDC FS
Supply Voltage (Vs)	6.5 to 30 VDC	11.5 to 30 VDC
Pressure Ranges [1]	From 0 to 10 psi (69 kPa) FS up to 0 to 6000 psi (41,370 kPa) FS	
Accuracy [1][2]	≤ ±0.25% FS or ≤ ±0.5% FS	
Response Time	≤ 1 ms	
Burst Pressure	> 35x for ≤ 100 psi (≤ 670 kPa) > 20x for ≤ 1000 psi (≤ 41,370 kPa) > 5x for ≤ 6000 psi (≤ 41,370 kPa)	
Operating Temperature [1]	-40 to +260 °F -40 to +125 °C	
Compensated Temperature Range	-5 to +180 °F -20 to +80 °C	
Thermal Error over Compensated Range	≤ 2% FS	
Acceleration Sensitivity	≤ ±0.03% FS/g	
Vibration Survivability Rating	35 g peak sinusoidal (5 to 2000 Hz)	
Pressure Ports [1]	English, NPT, SI, and "M" Threads	
Materials:		
Wetted parts	17-4 PJ SS	
Housing	316/316L SS	
Electrical Connection [1]	Solder Tabs, Connector or Integral Cable	
Notes		
[1] Consult your PCB Piezotronics representative for specific ordering information and options		
[2] Accuracy is calculated as the square root of the sum of the squares of non-linearity, non-repeatability and hysteresis		

High Temperature Pressure Sensors for Performance Applications

  		
Model Number	113B03	112A05
Sensitivity	0.39 pC/psi 0.056 pC/kPa	1.1 pC/psi 0.160 pC/kPa
Measurement Range	5 kpsi 103,420 kPa	5 kpsi 34,475 kPa
Maximum Pressure (static)	15 kpsi 103,420 kPa	10 kpsi 68,950 kPa
Resolution [1]	10 mpsi 0.07 kPa	4 mpsi 0.028 kPa
Resonant Frequency	≥ 500 kHz	≥ 200 kHz
Rise Time(Reflected)	≤ 1.0 μ sec	≤ 2.0 μ sec
Non-Linearity [2]	$\leq 1.0\%$ FS	$\leq 1.0\%$ FS
Acceleration Sensitivity	≤ 0.002 psi/g ≤ 0.0014 kPa/(m/s ²)	≤ 0.003 psi/g ≤ 0.0021 kPa/(m/s ²)
Temperature Range	-400 to $+400$ °F -240 to $+204$ °C	-400 to $+600$ °F -240 to $+316$ °C
Temperature Coefficient of Sensitivity	$\leq 0.03\%$ /°F $\leq 0.054\%$ /°C	$\leq 0.03\%$ /°F $\leq 0.054\%$ /°C
Maximum Shock	20,000 g pk 196,140 m/s ² pk	10,000 g pk 98,070 m/s ² pk
Capacitance	12 pF	18 pF
Insulation Resistance	≥ 1012 ohm	≥ 1012 ohm
Housing Material	Stainless Steel	Stainless Steel
Diaphragm	Invar	Stainless Steel
Sealing	Welded Hermetic	Welded Hermetic
Electrical Connector	10-32 Coaxial Jack	10-32 Coaxial Jack
Weight (with Clamp Nut)	6.0 gm	6.0 gm
Supplied Accessories		
Clamp Nuts	060A03 060A05	060A03 060A05
Seal Ring	065A02	065A02
Seal Sleeve	065A05	065A05
Notes		
[1] Resolution dependent on range setting and cable length used in charge system		
[2] Zero-based, least-squares, straight line method		





Automotive Component & System Performance Sensors

Recommended Signal Conditioners for Performance Applications

PCB® provides the appropriate signal conditioning necessary for sensor excitation and to prepare measurement signals for readout, recording, analysis, or control. Available features include gain, integration, filtering, weighting, biasing, alarm relays, zero clamping, and conversion to rms to peak values. Additionally, essential cables and accessories to support a successful installation are available.

Recommended ICP® Signal Conditioner for Force Sensors

CE



Model 484B06

Single-channel, line powered with AC/DC coupling and BNC input/output connection



Recommended General ICP® Signal Conditioners

CE



Model 482C05

4-channel, line powered, unity gain with BNC input/output connection

CE



Model 482C16

4-channel, line powered with incremental gain x0.1 to x200, and RS-232

CE



Model 482C54

4-channel, line powered, charge (0.1, 1.0, 10.0 mV/pC) with incremental gain, TEDS, 10k LPF, and RS-232

CE



Model 480C02

Single channel, battery powered with BNC input/output connection

CE



Series 481A

16-channel, line-powered, can be configured with options including gain, filtering, switched outputs, integration, rms conversion, computer control, and more

CE



Model 480B21

3-channel, battery powered with gain x1, x10, x100

CE



Model 480E09

Single channel, battery powered with gain x1, x10, x100, and BNC input/output connection

Recommended Signal Conditioners for Strain Gage Load Cell Sensors



Series 8159

Provides 5 or 10 VDC strain gauge bridge excitation which delivers ± 10 VDC and 4 to 20 mA output signals, and operates from 115 or 230 VAC power



Series 8162

In-line, IP66 enclosure, operates from 12 to 18 VDC, provides 10 VDC sensor excitation, delivers ± 10 V and 4 to 20 mA outputs



Series 8161

Provides 5 or 10 VDC bridge excitation, and delivers ± 5 or ± 10 volts and 4-20 mA output signals, and operates from 12 to 28 VDC power. Adjustable zero and span with built-in shunt calibration.



Powertrain Development Sensors

Accelerometers, Microphones, Torque Sensors, Pressure Sensors,
Force Sensors, and Instrumentation





Powertrain - the group of components that generate power to propel a vehicle on land, sea, or air including engine, transmission, driveshaft, differential, drive wheel, track, and propeller. Powertrain development is a key requirement in successfully competing in today's transportation market of cars, trucks, motorcycles, off-highway vehicles, ATVs, and watercraft. Historically, powertrain development has been about increasing the power-to-weight ratio of the combustion engine to increase vehicle performance but in the last few decades this development activity has been focused more on balancing the need for power and torque of the vehicle with legislative emission requirements and the public desire for increased fuel efficiency and vehicle refinement. This balancing act has led to new powertrain technologies including:

- Vehicle Systems
 - Series gas/diesel/electric hybrid
 - Parallel gas/diesel/electric hybrid
 - Electric propulsion
- Diesel Engines
 - Modular injection
 - Low pressure Exhaust Gas Recirculation (EGR)
 - Electronic Valve Control (EVC)
 - Spark ignition
 - Fuel derivatives (ultra low sulfur diesel, biofuel, synthetic)
- Gas Engines
 - Cylinder deactivation
 - Direct injection
 - 2 stroke
 - Fuel derivatives (ethanol, natural gas, hydrogen)
- Transmission / Driveline
 - Continuous Variable Transmission (CVT)
 - Multi-gear automatic transmissions (8+ gears)
 - Dual Clutch Transmission (DCT)
 - Regenerative braking

The increasing economic pressure to reduce manufacturing costs while satisfying public and legislative requirements have led to powertrain designs that involve higher internal pressures, are subject to greater instantaneous forces, have increased electronic signatures, and are

more complex in their design and mechanical operation. These factors provide a significant challenge for the test and development community in measuring the vibration, pressure, torque and force of powertrain components. PCB® understands these challenges and offers solutions.

PCB® Series 339A triaxial accelerometers are ideal for measuring vibration in powertrain testing applications. Housed in a 10mm titanium cube, these hermetically sealed sensors offer standard high temperature capability and a low temperature coefficient that is a prerequisite in the powertrain test environment. With a temperature coefficient of less than 0.0125% / °F (0.02% / °C), these sensors provide precision amplitude data for powertrain tests where engine block surface temperatures can shift more than 250 °F during a single test. In addition, these sensors come standard with a built in filter to alleviate signal saturation commonly associated with crystal resonance excited by the high frequency metal-to-metal impacts in engines.

PCB® TORKDISC® In-line Rotary Torque Sensor System offers a simple solution to measuring powertrain torque where axial space is at a premium. With an overall thickness of 1 to 2 inches (25.4 to 50.8 mm), PCB® Series 5300D incorporates dual high level analog outputs, AC and DC coupled, providing both static and dynamic torque measurement capability that can be recorded separately and independently scaled; which is particularly beneficial when high DC levels are present or when low levels of AC content (rotational dynamics) is of particular interest.

In addition to the unique performance attributes of the Series 339A and TORKDISC® sensors, PCB® offers a complete solution to your testing requirements including pressure, force, sound, electronics, and cabling. PCB® sensors have been successfully used in powertrain development activities such as:

- Performance improvement
- Emissions development and certification
- Fuel economy
- Gear efficiency
- EGR system development
- Variable valve timing calibration
- Ignition system calibration
- Charge distribution
- Vehicle calibration on test bed
- Design of Experiments (DoE) calibration
- Combustion system (diesel and gasoline)
- Exhaust valve leakage evaluation
- Turbo system development
- Crankcase pumping development
- Valvetrain evaluation
- Oil carry over
- Friction studies
- Cold start stability and emissions
- Thermal and lubrication survey
- Hybrid calibration
- Diesel after-treatment development and calibration
- Powertrain NVH
- Cooler fouling evaluations

PCB® products are designed and manufactured in our state-of-the-art facilities, and together with our global distribution network and Total Customer Satisfaction guarantee, you can rely on us to deliver products and solutions for your demanding requirements.



Filtered, Triaxial, ICP® Accelerometers for Powertrain Development Applications

Subtle, metal-to-metal impacts are common during the combustion events of today's powertrain. These impacts can excite the high frequency resonance of the piezoelectric crystal in any accelerometer (PCB® or otherwise) to saturate the signal and cause clipping in the contained ICP® signal conditioning amplifier. Any system, once driven non-linear, will produce spurious frequencies at, above, and below the frequencies contained in its input stimulus. If not recognized, this frequency production results in erroneous test data when it extends into the frequency range of interest. To help alleviate this event, PCB® offers low pass filtering in select triaxial accelerometers which suppresses the effects of any crystal resonance before they can enter and over range the ICP® signal conditioning amplifier. This prefiltering minimizes the opportunity for erroneous frequency content to be generated and accepted as valid data. This filtering, however, causes slight phase shifts in the higher frequency data. If phase is important in your analysis (e.g. operating mode shapes, transfer path analysis, vibroacoustics, etc.) then a single reference channel can be used to extract correct phase in post processing routines. A more automated solution may be possible with some of the data acquisition units. Contact PCB® for additional information.

In addition to filtering, PCB® Series 339A Triaxial ICP® accelerometers are designed with a temperature coefficient of less than 0.0125% / °F (0.02% / °C), which allows for precision amplitude data for test applications with large thermal shifts such as powertrain vibration testing, powertrain NVH, certain vehicle systems NVH tests, road load data acquisition, and durability testing in climatic chambers.

Filtered, Triaxial, ICP® Accelerometers for Powertrain NVH Applications

						
Model Number	356A61	339A30	339A31	356A63	356A66	356A67
Sensitivity	10 mV/g	10 mV/g	10 mV/g	10 mV/g	10 mV/g	10 mV/g
Measurement Range	± 500 g pk	± 500 g pk	± 500 g pk	± 500 g pk	± 500 g pk	± 500 g pk
Broadband Resolution	0.008 g rms	0.008 g rms	0.008 g rms	0.008 g rms	0.002 g rms	0.0005 g rms
Frequency Range (± 5%) (y or z axis)	2 to 4000 Hz	2 to 9000 Hz	2 to 9000 Hz	2 to 4000 Hz	2 to 4000 Hz	0.5 to 2500 Hz
Frequency Range (± 5%) (x axis)	2 to 4000 Hz	2 to 10k Hz	2 to 10k Hz	2 to 4000 Hz	2 to 4000 Hz	0.5 to 3000 Hz
Temperature Range	-65 to +325 °F -54 to +163 °C	-65 to +325 °F -54 to +163 °C	-65 to +325 °F -54 to +163 °C	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C
Temperature Coefficient	0.20 %/°F 0.11 %/°C	≤ 0.01 %/°F ≤ 0.02 %/°C	≤ 0.01 %/°F ≤ 0.02 %/°C	0.25 %/°F 0.14 %/°C	0.20 %/°F 0.11 %/°C	0.22 %/°F 0.12 %/°C
Electrical Connector	Integral Cable	8-36 4-Pin Jack	8-36 4-Pin Jack	1/4-28 4-Pin Jack	1/4-28 4-Pin Jack	1/4-28 4-Pin Jack
Sealing	Welded Hermetic	Hermetic	Hermetic	Hermetic	Hermetic	Hermetic
Housing Material	Titanium	Titanium	Titanium	Titanium	Titanium	Titanium
Weight	4.0 gm	4.0 gm	5.5 gm	5.3 gm	9.0 gm	10.5 gm
Size	0.4 in Cube 10.2 mm Cube	0.4 in Cube 10.2 mm Cube	0.55 x 0.4 x 0.4 in 14.0 x 10.2 x 10.2 mm	0.4 in Cube 10.2 mm Cube	0.55 in Cube 14.0 mm Cube	0.55 in Cube 14.0 mm Cube
Mounting	5-40 Thread	Adhesive	5-40 Stud	5-40 Thread	10-32 Thread	10-32 Thread
Supplied Accessories						
Wax/Adhesive	080A109	080A109	080A109	080A109	080A109 080A90	080A109
Adhesive Mounting Base	080A	—	080A	080A	080A12	080A12
Mounting Studs	081A27 M081A27 081A90	—	081A27 M081A27 081A90	081A27 M081A27 081A90	081B05 M081B05	081B05 M081B05
Cable Assembly	034G05	034K10	034K10	—	—	—
Additional Versions						
High Temperature Option	—	—	—	HT356A63	HT356A66	HT356A67
Additional Accessories						
Magnetic Mounting Base	080A30	—	—	080A30	080A27	080A27
Removal Tool	039A08	039A08	039A08	039A08	039A10	039A10
Mating Cable Connectors	AY	EH	EH	AY	AY	AY
Recommended Cables	034	034	034	034	034	034





Sensors for Powertrain Development

Charge Output Accelerometers for High Temperature Powertrain Development Applications

Model Number	357B11	357B61	356A70	340A50	356A71
	Single Axis		Triaxial		
Sensitivity	3.0 pC/g	10 pC/g	2.7 pC/g	2.7 pC/g	10 pC/g
Measurement Range	± 2300 g pk	± 1000 g pk	± 500 g pk	± 1000 g pk	± 500 g pk
Broadband Resolution	[1]	[1]	[1]	[1]	[1]
Frequency Range (+10 %)	16 kHz	5000 Hz [2]	7000 Hz	10 kHz	7000 Hz
Temperature Range	-95 to +500 °F -71 to +260 °C	-65 to +900 °F -54 to +482 °C	-94 to +490 °F -70 to +254 °C	-94 to +500 °F -70 to +260 °C	-94 to +490 °F -70 to +254 °C
Electrical Connector	5-44 Coaxial Jack	10-32 Coaxial Jack	5-44 Coaxial Jack	M3 Coaxial Jack	10-32 Coaxial Jack
Sealing	Hermetic	Hermetic	Hermetic	Hermetic	Hermetic
Housing Material	Titanium	Inconel	Titanium	Titanium	Titanium
Weight	2.0 gm	30.0 gm	7.9 gm	11.0 gm	22.7 gm
Size (Hex x Height)	5/16 x 0.33 in 5/16 in x 8.4 mm	5/8 x 1 in 5/8 in x 25.4 mm	0.73 x 0.9 x 0.4 in 18.5 x 22.9 x 10.2 mm	0.85 x 0.5 x 0.4 in 21.6 x 12.7 x 10.2 mm	0.96 x 1.0 x 0.5 in 24.4 x 25.4 x 12.7 mm
Mounting Thread	5-40 Stud	10-32 Thread	Through Hole	Through Hole	Through Hole
Supplied Accessories					
Cable Assembly	—	023A10	—	—	—
Wax/Adhesive	—	—	080A90	080A109 080A90	080A90
Mounting Studs/Screws	—	081A107 M081A107	081A46	081A95	081A94
Additional Accessories					
Adhesive Mounting Base	—	080A12	—	080A147 (Supplied)	080A170 (Supplied)
Magnetic Mounting Base	080A30	080A27	—	—	—
Triaxial Mounting Adaptor	080B16 080A196	080B11	—	—	—
Mating Cable Connectors	AG	FZ	AF, AG	EP	EB
Recommended Cables	018 Flexible, 003	023	003	003	003
Notes					
[1] Resolution is dependent upon cable length and signal conditioner [2] Range is ± 5%					

High Temperature Acoustic Measurement System

Model Number	HT378B02
Nominal Diameter	1/2 in 12.5 mm
Response Characteristic	Free-Field
Open Circuit Sensitivity at 250 Hz (± 1.7 dB)	50 mV/Pa
Frequency Range (± 1 dB)	5 to 10k Hz
Frequency Range (± 2 dB)	3.15 to 20k Hz
Lower Limiting Frequency (-3 dB Point)	1 to 2.4 Hz
Dynamic Range (3% Distortion Value)	146 dB [1]
Dynamic Range at Nominal Sensitivity	135 dB [1]
Noise Floor (Cartridge Thermal Noise)	17 dBA [1] [2]
Excitation Voltage	20 to 32 VDC
Polarization Voltage	0 Volts (Prepolarized Style)
Constant Current Excitation	2 to 10 mA, ICP® Sensor Power
Operating Temperature - System	-40 to +250 °F -40 to +120 °C
Connector	BNC Jack
Size (Diameter x Length, with Grid Cap)	0.52 x 3.88 in 13.2 x 98 mm
Microphone Component	377B20
Preamplifier Component	HT426E01
Notes	
[1] re 20 µV [2] 4.9 Vrms, minimum 7 Vpk	



High Temperature Acoustic Measurement System for Powertrain Applications

Industry exclusive PCB® Model HT378B02 is the world's first IEC compliant microphone and preamplifier combination that has an operating capability to 120 °C (250 °F), perfect for acoustic measurements near high performance powertrain components, underhood, engine, manifold and other high temperature applications.



Model HT378B02



Pressure Sensors for Powertrain Development Applications

		
Model Number	112A05	116B03
Sensitivity	1.1 pC/psi 0.16 pC/kPa	6 pC/psi 0.87 pC/kPa
Measurement Range	5 kpsi 34,475 kPa	100 psi 690 kPa
Maximum Static Pressure	10 kpsi 68,950 kPa	3 kpsi 20,685 kPa
Resolution [1]	4 mpsi 0.028 kPa	0.3 mpsi 0.0021 kPa
Resonant Frequency	> 200 kHz	> 55 kHz
Rise Time (Reflected)	< 2 µsec	< 9 µsec
Non-Linearity [2]	< 1 %	< 1 %
Acceleration Sensitivity	<0.003 psi/g <0.0021 psi/(m/s ²)	<0.002 psi/g <0.0014 psi/(m/s ²)
Temperature Range	-400 to +600 °F -240 to +316 °C	-400 to +750 °F -240 to +399 °C
Electrical Connector	10-32 jack	10-32 jack
Housing Material	17-4 Stainless Steel	316 Stainless Steel
Diaphragm Material	316 Stainless Steel	316 Stainless Steel
Sealing	Welded Hermetic	Welded Hermetic
Supplied Accessories		
Seal Rings	065A02 065A05	065A37
Clamp Nuts	060A03 060A05	060A12 060A14
Seal Sleeve	065A05	—
Additional Accessories		
Pipe Thread Mounting Adaptor	062A01	062A06
English Mounting Adaptor	061A01	061A60
Metric Mounting Adaptor	061A10	-
Water-cooled Mounting Adaptor	064B02	064B06
Notes		
[1] Resolution dependent on range setting and cable length used in charge system [2] Zero-based, least-squares, straight line method		

Spark Plug Adaptor for use with Pressure Probe for Powertrain Development Applications

PCB® Model 65A is a convenient and low-cost method of monitoring or measuring normal and abnormal combustion and compression pressures in an unmodified internal combustion engine. The spark plug adaptor coupled with a 112 type sensor is sensitive to pressure but insensitive to vibratory motion and strain via acceleration compensation. The results are exceptionally sharp, clean and free of spurious signals which often times mask or obscure the actual pressure signal.



(Spark plug supplied by customer)

Recommended Accessories for Models 112A05 and 116B03

Water-cooled Mounting Adaptors



Model 064B02

Model 064B06

ICP® Pressure Sensor for Fuel Injection Applications

		
Model Number	108A02	108A04
Sensitivity	0.5 mV/psi 0.073 mV/kPa	0.15 mV/psi 0.022 mV/kPa
Measurement Range	10 kpsi 68,950 kPa	30 kpsi 207,000 kPa
Maximum Static Pressure	50 kpsi 344,750 kPa	50 kpsi 344,750 kPa
Resolution	200 mpsi 1.4 kPa	500 mpsi 3.5 kPa
Resonant Frequency	≥ 250 kHz	≥ 250 kHz
Rise Time	≤ 2 μ sec	≤ 2 μ sec
Non-Linearity [1]	≤ 2 % FS	≤ 2 % FS
Acceleration Sensitivity	≤ 0.05 psi/g ≤ 0.035 kPa/(m/s ²)	≤ 0.05 psi/g ≤ 0.035 kPa/(m/s ²)
Temperature Range	-100 to +275 °F -73 to +135 °C	-100 to +275 °F -73 to +135 °C
Electrical Connector	10-32 Coaxial Jack	10-32 Coaxial Jack
Housing Material	C-300	C-300
Diaphragm	C-300	C-300
Sealing	Welded Hermetic	Welded Hermetic
Weight	12 gm	13.6 gm
Supplied Accessories		
Seal Ring	065A06	065A06
Notes		
[1] Zero-based, least-squares, straight line method		

Cylinder Combustion Knock Sensor Ring for Powertrain Development Applications

	
Model Number	140A14
Sensitivity	10 pC/lb 2248.2 pC/kN
Measurement Range	1000 lb 4448 kN
Maximum Static Force	3000 lb 13,344 kN
Non-Linearity [1]	≤ 2.0 % FS
Temperature Range	-65 to +400 °F -54 to +204 °C
Output Polarity (Positive Pressure)	Negative
Capacitance	19 pF
Housing Material	Stainless Steel
Sealing	Welded Hermetic
Electrical Connector	10-32 Coaxial Jack
Supplied Accessories	
Cable	003A03
Spacer	065M118
Notes	
[1] Zero-based, least-squares, straight line method	



Pressure Sensors for Powertrain Development Applications

Manufactured with a unique thin-film process to "atomically fuse" sensitive resistive material behind a recessed diaphragm, PCB® Series 1500 Pressure Transducers achieve high accuracy repeatability, and the stability expected of today's measurement and control requirements. Series 1500 sensors are used for shock absorber, struts, and brake systems studies, as well as for DC line pressure with response time up to 1 msec, and intake manifold pressure.

CE



Series 1500

Pressure Sensors for Powertrain Development Applications

Series Number	1501	1502
Output	0 to 5 VDC FS	0 to 10 VDC FS
Supply Voltage (Vs)	6.5 to 30 VDC	11.5 to 30 VDC
Pressure Ranges [1]	From 0 to 10 psi (69 kPa) FS up to 0 to 6000 psi (41,370 kPa) FS	
Accuracy [1][2]	≤ ±0.25% FS or ≤ ±0.5% FS	
Response Time	≤ 1 ms	
Burst Pressure	> 35x for ≤ 100 psi (≤ 670 kPa) > 20x for ≤ 1000 psi (≤ 41,370 kPa) > 5x for ≤ 6000 psi (≤ 41,370 kPa)	
Operating Temperature [1]	-40 to +260 °F -40 to +125 °C	
Compensated Temperature Range	-5 to +180 °F -20 to +80 °C	
Thermal Error over Compensated Range	≤ 2% FS	
Acceleration Sensitivity	≤ ±0.03% FS/g	
Vibration Survivability Rating	35 g peak sinusoidal (5 to 2000 Hz)	
Pressure Ports [1]	English, NPT, SI, and "M" Threads	
Materials:	17-4 PJ SS 316/316L SS	
Wetted parts		
Housing		
Electrical Connection [1]	Solder Tabs, Connector or Integral Cable	

Notes

[1] Consult your PCB Piezotronics representative for specific ordering information and options

[2] Accuracy is calculated as the square root of the sum of the squares of non-linearity, non-repeatability and hysteresis

Triaxial, ICP® Force Sensors for Powertrain Development Applications



CE



CE



CE



CE



Model Number	260A01	260A02	260A03	261A01
Measurement Range (z axis)	1000 lb 4.45 kN	1000 lb 4.45 kN	10,000 lb 44.48 kN	1000 lb 4.45 kN
Measurement Range (x or y axis)	500 lb 2.22 kN	1000 lb 4.45 kN	4000 lb 17.79 kN	500 lb 2.22 kN
Sensitivity (z axis)	2.5 mV/lb 0.56 mV/N	2.5 mV/lb 0.56 mV/N	0.25 mV/lb 0.06 mV/N	2.5 mV/lb 0.56 mV/N
Sensitivity (x or y axis)	10 mV/lb 2.25 mV/N	5 mV/lb 1.12 mV/N	1.25 mV/lb 0.28 mV/N	10 mV/lb 2.25 mV/N
Broadband Resolution (z axis)	0.006 lb-rms	0.006 lb-rms	0.05 lb-rms	0.006 lb-rms
Broadband Resolution (x or y axis)	0.002 lb-rms	0.006 lb-rms	0.01 lb-rms	0.002 lb-rms
Upper Frequency Limit	90 kHz	90 kHz	39 kHz	10 kHz
Non-Linearity	≤ 1 % FS	≤ 1 % FS	≤ 1 % FS	≤ 1 % FS
Temperature Range	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C
Housing Material	Stainless Steel	Stainless Steel	Stainless Steel	Stainless Steel
Sealing	Hermetic	Hermetic	Hermetic	Hermetic
Size	1.075 x 0.95 x 0.39 in 27.3 x 24.1 x 9.9 mm	1.35 x 1.25 x 0.39 in 34.3 x 31.8 x 9.9 mm	2.25 x 2.25 x 0.79 in 57.1 x 57.1 x 20.07 mm	1.65 x 1.66 x 1.66 in 41.96 x 42.04 x 42.04 mm
Weight	26 gm	45 gm	271 gm	386 gm
Supplied Accessories				
Mounting Stud	081A70	081A74	081A71	—
Anti-Friction Washer	082B02	082M12	082B06	—
Pilot Bushing	083A10	083A13	083A11	—
Additional Accessories				
Mating Cable Connectors	AY	AY	AY	AY
Recommended Cable	010	010	010	010

Notes

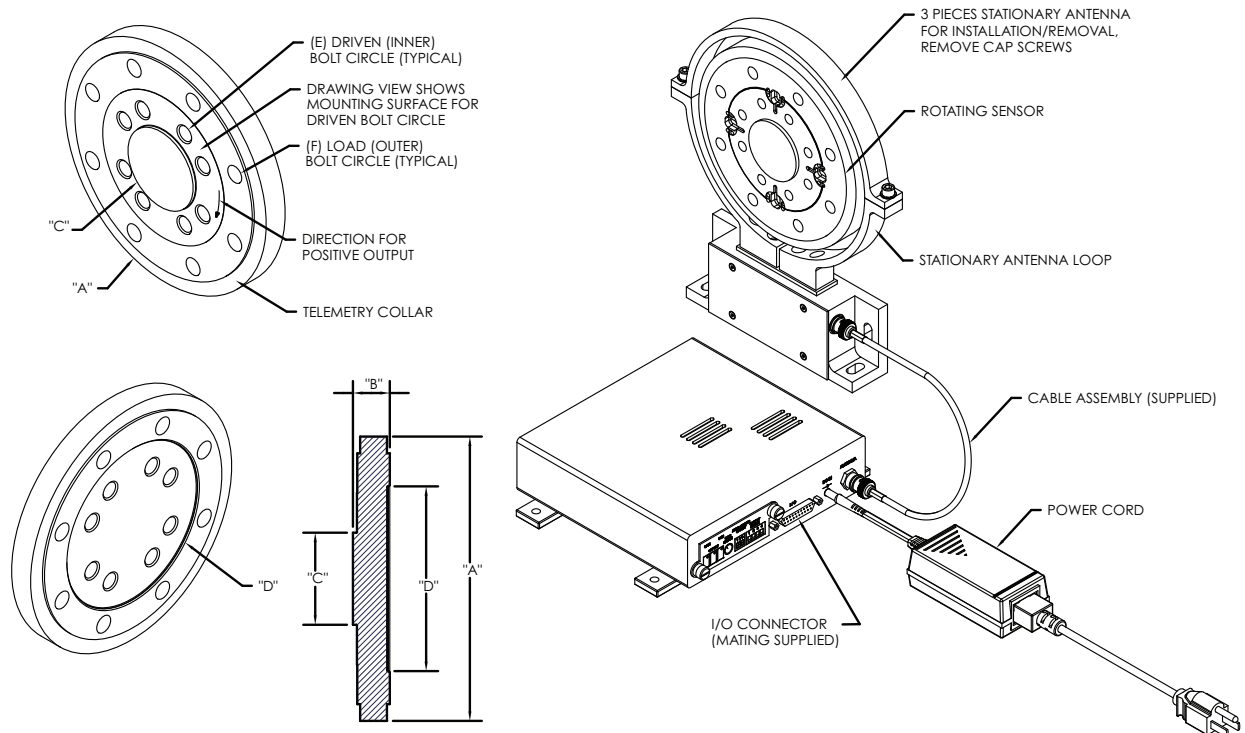
Charge mode versions of each of these models are also available



TORKDISC® In-line Rotary Torque Sensor System for Powertrain Development Applications

PCB® Series 5300D sensors are designed for dynamometer and other test applications requiring a robust rotary torque transducer where axial space is at a premium. Onboard, the transducer is a field proven electronic module that converts the torque signals into a high-speed digital representation. Once in digital form, this data is transmitted to a non-contacting pick-up loop, with no risk of noise or data corruption. A remote receiver unit converts the digital data to a high-level analog output voltage, and a serial digital output.

Series 5300D incorporates dual high level analog outputs, AC and DC coupled, providing both static and dynamic torque measurement capability that can be recorded separately and independently scaled; which is particularly beneficial when high DC levels are present or when low levels of AC content is of particular interest. Series 5300D also features industry leading bandwidth, DC to 8500 Hz, resulting in increased dynamic response characteristics. The DC coupled output features an 8-pole low pass elliptical filter with user selectable frequencies for minimal roll off at each filter selection. A 2-pole Butterworth high pass filter with a wide range of user selectable cut off frequencies is included with the AC coupled output.



The TORKDISC® and receiver make up a complete system. No additional signal conditioning is required. The receiver box provides voltage and digital output via a 25-pin I/O connector.

TORKDISC® In-line Rotary Torque Sensor System Dimensions

	A	B	C	D	E	F
Series	O.D. - Outside Diameter (including telemetry collar)	Overall Thickness	Pilot	Pilot	Driven (inner) Bolt Circle	Load (outer) Bolt Circle
5302D	7.00 in 177.8 mm	1.10 in 27.9 mm	1.999 in 50.8 mm	4.375 in 111.1 mm	(8) 3/8-24 threaded holes, spaced on a 3.00 in (76.20 mm) B.C.	(8) 0.406 in (10.31 mm) dia. through holes equally spaced on a 5.00 in (127.0 mm) B.C.
5308D	8.49 in 215.5 mm	1.10 in 27.9 mm	2.748 in 69.9 mm	5.513 in 140.0 mm	(8) 5/8-11 threaded holes, spaced on a 3.75 in (95.25 mm) B.C.	(8) 0.531 in (13.49 mm) dia. through holes equally spaced on a 6.5 in (165.0 mm) B.C.
5309D	10.49 in 241.0 mm	1.64 in 41.7 mm	3.998 in 101.5 mm	7.500 in 190.5 mm	(12) 5/8-11 threaded holes, spaced on a 6.0 in (152.4 mm) B.C.	(16) 0.531 in (13.49 mm) dia. through holes equally spaced on a 8.5 in (215.9 mm) B.C.
5310D	17.98 in 456.7 mm	2.09 in 53.0 mm	5.499 in 139.7 mm	11.001 in 279.4 mm	(12) 7/8-14 threaded holes, spaced on a 9.0 in (228.6 mm) B.C.	(16) 0.780 in (19.8 mm) dia. through holes equally spaced on a 13.0 in (330.2 mm) B.C.

Notes [1] Extraneous load limits reflect the maximum axial load, lateral load, and bending moment that may be applied singularly without electrical or mechanical damage to the sensor. Where combined extraneous loads are applied, decrease loads proportionally. Request Application Note AP-1015 regarding the effects of extraneous loads on the torque sensor output



Sensors for Powertrain Development

TORKDISC® Rotary Torque Sensor System

Model Number	Unit	5302D-05A	5302D-03A	5302D-01A	5302D-02A	5302D-04A	5308D-01A	5308D-02A
Continuous Rated Capacity	in-lb N-m	250 28	1000 113	2000 226	5000 565	6250 706	10k 1130	20k 2260
Bolt Joint Slip Torque	in-lb N-m	3300 373	3300 373	3300 373	10k 1130	10k 1130	35k 4000	35k 4000
Safe Overload	in-lb N-m	750 85	3000 339	6000 678	15k 1695	15k 1695	30k 3400	60k 6775
Failure Overload	in-lb N-m	1000 113	4000 452	8000 904	20k 2260	20k 2260	40k 4500	80k 9040
Torsional Stiffness	in-lb/rad N-m/rad	300k 34k	2.9M 328k	5.8M 655k	14.5M 1.6M	14.5M 1.6M	33.5M 3.8M	67M 7.6M
Torsional Angle @ Capacity	degrees	0.125	0.02	0.02	0.02	0.02	0.017	0.017
Rotating Inertia	in-lb sec ² N-m sec ²	0.030 0.003	0.056 0.006	0.056 0.006	0.117 0.013	0.117 0.013	0.24 0.027	0.24 0.027
Axial Load Limit [1]	lb N	62.5 278	250 1112	500 2224	1000 4448	1000 4448	1350 6000	2700 12k
Lateral Load Limit [1]	lb N	62.5 278	250 1112	500 2224	1000 4448	1000 4448	1650 7300	3375 15k
Bending Moment Limit [1]	in-lb N-m	125 14	750 85	1500 169	3000 339	3000 339	5000 565	7500 850
Maximum Speed	RPM	15k	15k	15k	15k	15k	10k	10k
Rotor Weight	lb kg	2 0.91	3.5 1.59	3.5 1.59	9 4.08	9 4.08	10 4.5	10 4.5
Rotor Material		Aluminum	Aluminum	Aluminum	Steel	Steel	Steel	Steel
Model Number	Unit	5308D-03A	5309D-01A	5309D-02A	5310D-03A	5310D-01A	5310D-02A	5310D-04A
Continuous Rated Capacity	in-lb N-m	30k 3400	50k 5650	100k 11.3k	120k 13.6k	180k 20.3k	200k 22.5k	225k 25.4k
Bolt Joint Slip Torque	in-lb N-m	35k 4000	85k 9600	110k 12.4k	268k 30.3k	268k 30.3k	268k 30.3k	268k 30.3k
Safe Overload	in-lb N-m	75k 8475	100k 11.3k	200k 22.6k	360k 40.7k	540k 61.0k	600k 67.8k	675k 76.3k
Failure Overload	in-lb N-m	100k 11.3k	125k 14k	250k 28.2k	480k 54.2k	720k 81.3k	800k 90.4k	900k 101.7k
Torsional Stiffness	in-lb/rad N-m/rad	100M 11.3M	115M 13M	230M 26M	730k 82.5k	1.1B 24M	1.2B 138M	1.35B 152.5M
Torsional Angle @ Capacity	degrees	0.017	0.017	0.017	0.01	0.01	0.01	0.01
Rotating Inertia	in-lb sec ² N-m sec ²	0.24 0.027	0.874 0.099	0.874 0.099	7.514 0.849	7.514 0.849	7.514 0.849	7.514 0.849
Axial Load Limit [1]	lb N	4000 17.8k	5000 22.2k	10k 44.5k	12k 53.4k	13.5k 60k	14k 62k	15k 66.7k
Lateral Load Limit [1]	lb N	5000 22.2k	5000 22.2k	10k 44.5k	12k 53.4k	13.5k 60k	14k 62k	15k 66.7k
Bending Moment Limit [1]	in-lb N-m	10k 1130	25k 2825	50k 5650	80k 9039	90k 10.2k	95k 10.7k	100k 11.3k
Maximum Speed	RPM	10k	10k	10k	4500	4500	4500	4500
Rotor Weight	lb kg	10 4.5	30 13.6	30 13.6	100 45	100 45	100 45	100 45
Rotor Material		Steel	Steel	Steel	Steel	Steel	Steel	Steel

Series 5300D Common Specifications

System Output		Temperature	
Voltage Output A	AC Coupled, 0 to ± 10 volt w/ independent coarse gain control (16 increments)	Rotor Temp. Range Compensated	+70 to +170 °F (+21 to +77 °C)
Voltage Output B	DC Coupled, 0 to ± 10 volt w/ independent fine and coarse gain control	System Temp. Effect on Output [2]	± 0.002% FS/°F (± 0.0036% FS/°C)
Digital Output:	QSPI	System Temp. Effect on Zero [2]	± 0.002% FS/°F (± 0.0036% FS/°C)
System Performance		Rotor/Stator Temp. Range Usable	+32 to +185 °F (0 to +85 °C)
Accuracy	Overall, 0.1% FS, combined effect of Non-Linearity, Hysteresis, & Repeatability	Rotor/Stator Optional Temp. Range Usable	+32 to +250 °F (0 to +121 °C)
Voltage Output A Filter (AC)	2-pole Butterworth high pass w/ selectable cutoff frequencies of 5, 10, 20, 200, 500, & 735 Hz, & 8-pole low pass determined by the DC coupled output cutoff frequency selection	Receiver Temp. Range Usable	0 to +122 °F (-17 to +50 °C)
Voltage Output B Filter (DC)	8-pole elliptical low pass w/selectable cutoff frequencies of > 8.5k, 5k, 2.5k, 1.25k, 625, 313, 10, & 1 Hz	Mechanical	
Bandwidth	DC to 8500 Hz anti-alias	Permissible Radial Float, Rotor to Stator	± 0.25 in (± 6.35 mm)
Digital resolution	16-bit	Permissible Axial Float, Rotor to Stator	± 0.25 in (± 6.35 mm)
Analog Resolution	0.030% FS (10 volts/32,768)	Dynamic Balance	ISO G 2.5
Digital Sample Rate	26,484 samples/sec	Sensor Positional Sensitivity	± 0.1% FS (180° rotation)
Group Delay	≅ 110 microseconds at 10 kHz	Power	
Noise	≤10 mV at 10 kHz	Power Requirements	9 to 18 VDC, 15 watts (90 to 240VAC 50-60 Hz, adaptor is supplied)
Noise Spectral Density	< 0.0005%FS per root Hz typical	Miscellaneous	
		Symmetry Adjustment	Factory and user adjustable ± 0.5% FS
		Supplied Cable, Stator to Receiver	24 ft. (7.3 m), RG 58/U (BNC plug/stator side, TNC plug/receiver side)
		Optional Cable, Stator to Receiver	80 ft. (24.4 m), RG 58/U (contact factory for longer lengths)
		Output Interface	DB-25 female connector (mating supplied w/backshell)
		Calibration	Unipolar shunt calibration, invoked from the receiver front panel
		Stator Assembly	Top half of loop is removable for easy installation over rotor
		Notes	
		[2] Within compensated range	



Model 682A05 Bearing Fault Detector

The implications of repeating a powertrain development test due to test equipment failure is significant, in terms of cost and time. With compressed development schedules these failures can delay the launch of powertrain components, engines, and ultimately vehicles. PCB® can help in this area by offering sensors and instrumentation to monitor the health of test systems requiring routine maintenance

Model 682A05 Bearing Fault Detector (BFD) is an advanced vibration signal conditioner designed to provide the earliest warning of imminent dynamometer failure due to bearing degradation. The unit works with a 100 mV/g ICP® accelerometer and serves to deliver two, 4-20 mA output signals that are proportional to the measured vibration levels of operating rotating machinery. In order to enable detection of a wide variety of machinery faults, the 4-20 mA signals are conditioned to characterize two, unique vibration measurements; one containing high frequency peak data and the other containing low frequency rms data. These 4-20 mA signals may be monitored, alongside other plant process variables, using control systems. An additional analog voltage output signal is provided for spectral analysis of the monitored vibration for fault diagnostic purposes.

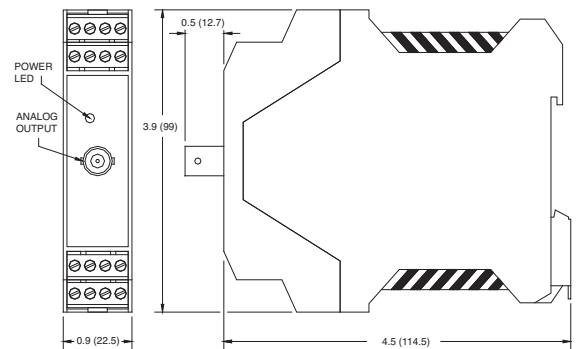
The unit employs a patented signal conditioning technique that provides the unique ability to detect bearing and gear problems at their earliest stages, thus permitting ample maintenance planning to avert a catastrophic failure. The simplified 4-20 mA signal monitoring approach represents a cost effective alternative to complex vibration monitoring instrumentation and associated training.

- Provides early warning of bearing and gear faults
- Detects impacting associated with spalling, cracking, and lubrication problems
- Outputs 4-20 mA signals for peak acceleration and overall vibration
- Offers analog output signal for spectral analysis and diagnostics
- Conducts continuous vibration monitoring — 24/7
- Accepts input from ICP® accelerometers
- Patented technology
- Easy to install

Incorporating the 682A05 into a predictive maintenance strategy protects investment and decreases the risk of delayed product development due to test equipment failure.



Model 682A05
Bearing Fault Detector



Dimensions shown are in inches (millimeters)

ICP® Accelerometers for use with Bearing Fault Detector

Model Number	607A11	603C01	622B01	608A11
Sensitivity	100 mV/g	100 mV/g	100 mV/g	100 mV/g
Measurement Range	± 50 g	± 50 g	± 50 g	± 50 g
Broadband Resolution	350 µg	350 µg	50 µg	350 µg
Frequency Range (±10%)	0.5 to 10k Hz	0.5 to 10k Hz	0.42 to 10k Hz	0.5 to 10k Hz
Temperature Range	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C
Electrical Connector	Molded Integral Cable	2-Pin MIL-C-5015	2-Pin MIL-C-5015	Molded Integral Cable
Sealing	Welded Hermetic	Welded Hermetic	Welded Hermetic	Molded
Housing Material	Stainless Steel	Stainless Steel	Stainless Steel	Stainless Steel
Weight	31 gm	51 gm	94 gm	99.3 gm [1]
Size (Hex x Height)	9/16 x 0.97 in 9/16 in x 24.6 mm	11/16 x 1.65 in 11/16 in x 42.2 mm	7/8 x 2.06 in 7/8 in x 52.3 mm	9/16 x 2.5 in 9/16 in x 64 mm
Mounting	1/4-28 Stud	1/4-28 Thread	1/4-28 Thread	1/4-28 Thread
Supplied Accessory				
Mounting Studs	080A156 080A159	081A40	081A40	081A40
Additional Version				
Metric Mounting	M607A11	M603C01	M622B01	M608A11
Notes				
[1] Weight with 10 ft. of cable				



Sensors for Powertrain Development

Recommended LaserTach™



The LaserTach™ ICP® tachometer senses the speed of rotating equipment and outputs an analog voltage signal for referencing vibration signals to shaft speed. The sensor allows for measurements in excess of 30,000 RPM from distances as far as 20 inches (51 cm). A status LED provides positive, visual indication of proper signal pickup. The standard BNC jack connects the sensor to any constant current excitation source (> 3mA). Unlike magnetic tachometer pickups, the LaserTach™ does not require the rotating equipment to be a ferrous material – only a visually contrasting section of the shaft needs to be available. This is typically accomplished with a small piece of reflective or retro-reflective tape. The unit powers from standard ICP® sensor signal conditioning and requires only a single coaxial or twisted pair cable connection. This facilitates deployment of multiple speed sensors using the same cabling and signal conditioning as your other ICP® sensor arrays.

- Operates with standard ICP® sensor signal conditioning
- Easy to install – 20 inch range in a standard bolt package offers flexibility
- One pulse per revolution eliminates need to oversample all channels for a high frequency tachometer signal
- Simplifies cable management for dynamic testing of rotating equipment

Recommended PulseDriver™ - Preamplifier/Divider for Tachometer Signals

The PulseDriver™ conditions a voltage pulsetrain from a magnetic pickup or similar sensor for input to standard ICP® sensor signal conditioners. In addition, PulseDriver™ includes an adjustable divider circuit to compensate for 'N per revolution' pulse patterns. Rather than boosting data acquisition sample rates to accommodate the high frequency content of these high frequency pulse patterns, test engineers can divide the pulse train down to a square wave with a fundamental frequency equal to the shaft speed. Front-panel rotary switches adjust the divide frequency of the unit by up to 255.

Standard BNC input and output connectors connect the PulseDriver™ to the tachometer pickup and signal conditioners. Either standalone ICP® sensor signal conditioners from PCB® or embedded signal conditioning common to most data acquisition front ends may be used. This allows test engineers to acquire tachometer or speed sensor data using the same cabling used for vibration, acoustic, and strain data, simplifying their test setup and equipment configuration.

- Simplifies the connection of tachometers to data acquisition systems through standard ICP® sensor signal conditioning
- Offers versatility with versions available for both magnetic and optical tachometer pickups
- Eliminates need to oversample all channels due to high frequency tach signal by compensating for 'N per revolution' pulse patterns with integrated divider circuit
- Simplifies cable management for dynamic testing of rotating equipment



Recommended General ICP® Signal Conditioners

		
Model 482C05	Model 482C16	Model 482C54
4-channel, line powered unity gain BNC input/output connectors	4-channel, line powered, incremental gain x0.1 to x200, digital control interface RS-232	4-channel, line powered, charge, incremental gain, TEDS, digital control interface RS-232

Recommended Signal Conditioners for Charge Output Accelerometers

		
Series 422E	Model 421A11/421A13	Model 443B02
In-line charge converter, range from 0.1 mV/pC to 100 mV/pC	1- or 3-channel versions available, three user selectable input ranges, rugged, surface mountable, sealed aluminum enclosures	1-channel, dual-mode charge amplifier system, provides acceleration, velocity, or displacement output signal formats



Sensors for Road Load Measurements

Accelerometers, Pressure Sensors, Force Sensors, Strain Sensors, Load Cells, and Signal Conditioners





Road Load Measurements

Road load tests measure the transient and steady state inputs of a vehicle as it operates over a road surface in the anticipated market region of use or over a replicated drive profile on a test track. Road load measurements take into account all projected vehicle and driving parameters such as mass, inertia, air and rolling resistance, road characteristics, engine loads, and vehicle speed.

Road load data is one of the best sources of fundamental information necessary for analysis of the design, reliability, and structural integrity of vehicle components. The sensors must be accurate, but most importantly, they must be robust and reliable to survive the shock, heat, humidity, and contamination associated with various measurement locations on the vehicle and the adverse conditions of the road profile. One of the key measurements for Road Load Data Acquisition (RLDA) is spindle force and motion, a measure of road input into the vehicle. The accuracy of both phase and amplitude are critical for this application as these multi-axis measurements are processed and used to drive vehicle simulators for durability validation. Any deviation from actual amplitude and phase could yield erroneous failure modes in the vehicle structure. PCB® sensor solutions ensure the accuracy of both amplitude and phase in a robust package ideally suited for ambient test environments.

PCB® Series 5400 Multi-Axis Wheel Force Transducers are designed as rugged one-piece units that mount between the vehicle hub and the wheel rim, delivering highly accurate road load data measurement and superior performance in a durable water-resistant package. Possessing superior temperature compensation properties and integral overload stops, these sensors provide a high level of confidence in data acquired during aggressive road events, including; hard acceleration, heavy braking, limit handling, and rough terrain.

PCB® Series 3711 (single axis) and 3713 (triaxial) single-ended DC accelerometers are ideal for measuring low frequency spindle response under harsh conditions. Hermetically sealed in a titanium package, these DC accelerometers offer protection from the severe nature of RLDA testing including excellent high frequency overload protection from abrupt changes in road profiles and insensitivity to base strain and transverse acceleration effects. PCB® Series 3741 (single axis) differential DC accelerometers are also instrumental for RLDA testing. The differential output signal of these units enables common-mode noise rejection while its packaging incorporates gas damping and mechanical over-range stops for added durability.

In addition to spindle force and motion, several other measurements are routinely taken including shock, brake and steering system fluid pressures. PCB® Series 1500 Thin-Film Pressure Transducers are designed to achieve high accuracy, repeatability, and stability in pressure measurements from vacuum to 6000 psi.

Stress profiles on components are sometimes desired in the collection of road load data. PCB® offers a series of ICP® strain sensors, Series 240 and 740, that are easy to install and non-invasive. These units measure stress forces along the structure to which the sensors are mounted and can be powered by any ICP® signal conditioner.

PCB® products are designed and manufactured in our state-of-the-art facilities, and together with our global distribution network and Total Customer Satisfaction guarantee, you can rely on us to deliver products and solutions for your demanding requirements.



DC Response Accelerometers for Durability Applications

PCB® Series 3741 DC response accelerometers are offered in a variety of full-scale ranges, from ± 2 to ± 200 g, to accommodate vehicle and component durability testing requirements. The units feature silicon MEMS sensing elements for uniform, repeatable performance. Gas damping, mechanical over range stops, and a low profile, hard-anodized, aluminum housing are utilized for added durability. Electrically, the units offer a differential output signal for common-mode noise rejection. PCB® Series 3711 (single axis) and 3713 (triaxial) DC response accelerometers are designed to measure low-frequency vibration and motion, and are offered in full-scale ranges from ± 3 to ± 200 g, to accommodate a variety of vehicle and component durability testing requirements. The units feature gas-damped, silicon MEMS sensing elements that provide performance, while hermetically sealed titanium housings provide protection from harsh contaminants. These units are inherently insensitive to base strain and transverse acceleration effects, and offer high frequency overload protection. Electrically, the units offer a single-ended output signal for each channel with power and ground leads.

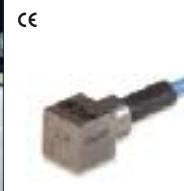
DC Response Accelerometers for Road Load Applications					
Series 3741		Sensitivity	Measurement Range (pk)	Frequency (± 10%)	Broadband Resolution (rms)
		10 mV/g	± 200 g	0 to 2000 Hz	5.1 mg
		20 mV/g	± 100 g	0 to 2000 Hz	4.5 mg
		40 mV/g	± 50 g	0 to 2000 Hz	2.5 mg
		66.7 mV/g	± 30 g	0 to 2000 Hz	2.5 mg
		200 mV/g	± 10 g	0 to 200 Hz	1.1 mg
		1000 mV/g	± 2 g	0 to 150 Hz	0.3 mg
Series 3711 and 3713					
		10 mV/g	± 200 g	0 to 1500 Hz	5.3 mg
		40 mV/g	± 50 g	0 to 1500 Hz	4.4 mg
		40 mV/g, 2.5 V offset	± 50 g	0 to 1500 Hz	4.4 mg
		100 mV/g	± 20 g	0 to 1500 Hz	3.6 mg
		100 mV/g, 2.5 V offset	± 20 g	0 to 1500 Hz	3.6 mg
		700 mV/g	± 3 g	0 to 150 Hz	1.1 mg
Model Number		3741 Single Axis	3711 Single Axis	3713 Triaxial	
Overload Limit (Shock)		± 5,000 g pk	± 5000 g pk	± 5000 g pk	
Temperature Range		-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54.0 to +121 °C	-65 to +250 °F -54 to +121 °C	
Excitation Voltage		6 to 30 VDC	5 to 30 VDC	5 to 30 VDC	
Housing Material		Anodized Aluminum	Titanium	Titanium	
Sealing		Epoxy	Hermetic	Hermetic	
Size		0.30 x 1.00 x 0.85 in 7.62 x 25.4 x 21.6 mm	0.45 x 0.85 x 0.85 in 11.4 x 21.6 x 21.6 mm	1.1 in Cube 28 mm Cube	
Weight	Connector style Integral cable style	— 10 gm	14 gm 78 gm	78 gm 169 gm	
Electrical Connector		10 ft. (3 m) Integral Cable	1/4-28 4-Pin or 10 ft. (3 m) Integral Cable	9-Pin or 10 ft. (3 m) Integral Cable	
Output Configuration		Differential	Single-Ended	Single-Ended	
Supplied Accessories					
Easy Mount Clip		—	080A152	—	
Adhesive Base		—	—	080A208	
Mounting Screws/Studs		081A103 M081A103	081A64 M081A64	081A05 M081A05	
Additional Accessories					
Triaxial Mounting Block		080A208	080A153	—	
Mounting Cable Connectors		—	AY	EN	
Recommended Cables		—	034	037	





Sensors for Road Load Measurements

Triaxial ICP® Accelerometers for Road Load Applications

						
Model Number	356A01	356B21	339A30	354C10	356A32	356A15
Sensitivity	5 mV/g	10 mV/g	10 mV/g	10 mV/g	100 mV/g	100 mV/g
Measurement Range	± 1000 g pk	± 500 g pk	± 500 g pk	± 500 g pk	± 50 g pk	± 50 g pk
Broadband Resolution	0.003 g rms	0.003 g rms	0.008 g rms	0.003 g rms	0.0003 g rms	0.0002 g rms
Frequency Range (± 5%)	1 to 8000 Hz [1]	2 to 10k Hz	2 to 10k Hz	2 to 8000 Hz	0.7 to 5000 Hz [1]	1.4 to 6500 Hz [1]
Temperature Range	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C	-65 to +325 °F -54 to +163 °C	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C
Temperature Coefficient	0.22 %/ °F 0.12 %/ °C	0.18 %/ °F 0.10 %/ °C	≤ 0.01 %/ °F ≤ 0.02 %/ °C	0.23 %/ °F 0.13 %/ °C	0.20 %/ °F 0.11 %/ °C	0.20 %/ °F 0.11 %/ °C
Electrical Connector	Integral Cable	8-36 4-Pin Jack	8-36 4-Pin Jack	Integral Cable	8-36 4-Pin Jack	1/4-28 4-Pin Jack
Sealing	Hermetic	Hermetic	Hermetic	Hermetic	Hermetic	Hermetic
Housing Material	Titanium	Titanium	Titanium	Titanium	Titanium	Titanium
Weight	1.0 gm	4.0 gm	4.0 gm	5.0 gm	5.4 gm	10.5 gm
Size	0.25 in Cube 6.35 mm Cube	0.4 in Cube 10.2 mm Cube	0.4 in Cube 10.2 mm Cube	0.3 x 0.55 x 0.55 in 7.6 x 14 x 14 mm	0.45 in Cube 11.4 mm Cube	0.55 in Cube 14 mm Cube
Mounting	Adhesive	5-40 Thread	Adhesive	Through Hole	5-40 Thread	10-32 Thread
Supplied Accessories						
Cable Assembly	034G05	034K10	034K10	034G05	034K10	—
Wax/Adhesive	080A109 080A90	080A109	080A109	—	080A109	080A109 080A90
Adhesive Mounting Base	—	080A	—	—	080A	080A12
Mounting Studs/Screws	—	081A27 M081A27 081A90	—	081B93	081A27 M081A27 081A90	081B05 M081B05
Additional Versions						
Alternate Cable Type	356A13 099 Twisted 4-cond	—	—	—	—	—
Alternate Connector	—	356A33 1/4-28 4-Pin	—	—	356A12 Integral Cable	—
Alternate Sensitivity	—	356B20 - 1 mV/g	—	—	—	—
Alternate Mounting	—	—	339A31 5-40 Stud	M354C10 Metric	—	—
Alternate Option	HT356A01 High Temperature	HT356B21 High Temperature	—	—	—	HT356A15 High Temperature
Additional Accessories						
Magnetic Mounting Base	—	080A30	—	—	080A30	080A27
Removal Tool	—	039A08	039A08	—	039A09	039A10
Mating Cable Connectors	AY	EH	EH	AY	EH	AY
Recommended Cables	034	036	034	034	034	034
Notes						
[1] Range shown is ± 10%						





Low Profile Load Cell Sensors for Road Load Applications



Model Number	1203-01A	1203-03A	1203-05A
Sensitivity	2 mV/V	2 mV/V	3 mV/V
Measurement Range	500 lb 2.224 kN	2000 lb 8.896 kN	10,000 lb 44.48 kN
Overload Limit	750 lb 3.336 kN	3000 lb 13.34 kN	15,000 lb 66.72 kN
Non-Linearity	≤ 0.05 % FS	≤ 0.05 % FS	≤ 0.05 % FS
Hysteresis	≤ 0.05 % FS	≤ 0.05 % FS	≤ 0.05 % FS
Non-Repeatability	≤ 0.02 % FS	≤ 0.02 % FS	≤ 0.02 % FS
Temperature Range	-65 to +200 °F -54 to +93 °C	-65 to +200 °F -54 to +93 °C	-65 to +200 °F -54 to +93 °C
Bridge Resistance	700 ohm	700 ohm	700 ohm
Excitation Voltage	10 VDC	10 VDC	10 VDC
Weight	1.31 kg	1.31 kg	1.31 kg
Size	4.12 x 1.37 in 104.6 x 34.8 mm	4.12 x 1.37 in 104.6 x 34.8 mm	4.12 x 1.37 in 104.6 x 34.8 mm
Mounting	5/8 - 18 Thread	5/8 - 18 Thread	5/8 - 18 Thread
Electrical Connector	PT02E-10-6P	PT02E-10-6P	PT02E-10-6P
Additional Versions			
Alternate Electrical Connector	1203-01B PC04E-10-6P	1203-03B PC04E-10-6P	1203-05B PC04E-10-6P
Alternate Mounting	M1203-01A M1203-01B Metric	M1203-03A M1203-03B Metric	M1203-05A M1203-05B Metric
Additional Accessories			
Mounting Base	084A100 M084A100	084A100 M084A100	084A100 M084A100



Pressure Sensors for Road Load Applications

Manufactured with a unique thin-film process to "atomically fuse" sensitive resistive material behind a recessed diaphragm, PCB® Series 1500 Pressure Transducers achieve high accuracy repeatability, and stability expected of today's measurement and control requirements. Series 1500 sensors are used for shock absorber, struts, and brake systems studies, as well as for DC line pressure with response time up to 1 msec, and intake manifold pressure.

Pressure Sensors for Road Load Applications



Series Number	1501	1502
Output	0 to 5 VDC FS	0 to 10 VDC FS
Supply Voltage (Vs)	6.5 to 30 VDC	11.5 to 30 VDC
Pressure Ranges [1]	From 0 to 10 psi (69 kPa) FS up to 0 to 6000 psi (41,370 kPa) FS	
Accuracy [1][2]	≤ ±0.25% FS or ≤ ±0.5% FS	
Response Time	≤ 1 ms	
Burst Pressure	> 35x for ≤ 100 psi (≤ 670 kPa) > 20x for ≤ 1000 psi (≤ 6,890 kPa) > 5x for ≤ 6000 psi (≤ 41,370 kPa)	
Operating Temperature [1]	-40 to +260 °F -40 to +125 °C	
Compensated Temperature Range	-5 to +180 °F -20 to +80 °C	
Thermal Error over Compensated Range	≤ 2% FS	
Acceleration Sensitivity	≤ ±0.03% FS/g	
Vibration Survivability Rating	35 g peak sinusoidal (5 to 2000 Hz)	
Pressure Ports [1]	English, NPT, SI, and "M" Threads	
Materials:	Wetted parts Housing	
	17-4 PJ SS 316/316L SS	
Electrical Connection [1]	Solder Tabs, Connector or Integral Cable	

Notes

[1] Consult your PCB Piezotronics representative for specific ordering information and options

[2] Accuracy is calculated as the square root of the sum of the squares of non-linearity, non-repeatability and hysteresis



Sensors for Road Load Measurements

Triaxial, ICP® Force Sensors for Road Load Applications



CE



CE



CE



Model Number	260A01	260A02	260A03
Measurement Range (z axis)	1000 lb 4.45 kN	1000 lb 4.45 kN	10,000 lb 44.48 kN
Measurement Range (x or y axis)	500 lb 2.22 kN	1000 lb 4.45 kN	4000 lb 17.79 kN
Sensitivity (z axis)	2.5 mV/lb 0.56 mV/N	2.5 mV/lb 0.56 mV/N	0.25 mV/lb 0.06 mV/N
Sensitivity (x or y axis)	10 mV/lb 2.25 mV/N	5 mV/lb 1.12 mV/N	1.25 mV/lb 0.28 mV/N
Broadband Resolution (z axis)	0.006 lb-rms	0.006 lb-rms	0.05 lb-rms
Broadband Resolution (x or y axis)	0.002 lb-rms	0.006 lb-rms	0.01 lb-rms
Upper Frequency Limit	90 kHz	90 kHz	39 kHz
Non-Linearity	≤ 1 % FS	≤ 1 % FS	≤ 1 % FS
Temperature Range	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C
Housing Material	Stainless Steel	Stainless Steel	Stainless Steel
Sealing	Hermetic	Hermetic	Hermetic
Size	1.075 x 0.95 x 0.39 in 27.3 x 24.1 x 9.9 mm	1.35 x 1.25 x 0.39 in 34.3 x 31.8 x 9.9 mm	2.25 x 2.25 x 0.79 in 57.1 x 57.1 x 20.07 mm
Weight	26 gm	45 gm	271 gm
Supplied Accessories			
Mounting Stud	081A70	081A74	081A71
Anti-Friction Washer	082B02	082M12	082B06
Pilot Bushing	083A10	083A13	083A11
Additional Accessories			
Mating Cable Connectors	AY	AY	AY
Recommended Cable	010	010	010

Notes

Charge mode versions of each of these models are also available





ICP® Quartz Force Ring for Road Load Applications



CE



CE



CE



CE



Model Number	201B04	201B05	202B	203B	204C
Measurement Range (Compression)	1000 lb 4.448 kN	5000 lb 22.24 kN	10 klb 44.48 kN	20 klb 88.96 kN	40 klb 177.92 kN
Sensitivity	5 mV/lb 1124 mV/kN	1 mV/lb 224.8 mV/kN	0.50 mV/lb 112.4 mV/kN	0.25 mV/lb 56.2 mV/kN	0.12 mV/lb 27 mV/kN
Maximum Static Force (Compression)	6000 lb 26.69 kN	8000 lb 35.59 kN	15 klb 66.72 kN	25 klb 111.2 kN	50 klb 222.4 kN
Broadband Resolution	0.02 lb-rms	0.10 lb-rms	0.20 lb-rms	0.4 lb-rms	0.80 lb-rms
Low Frequency Response (-5 %)	0.0003 Hz	0.0003 Hz	0.0003 Hz	0.0003 Hz	0.0003 Hz
Temperature Range	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C
Temperature Coefficient of Sensitivity	≤ 0.03 %/°F ≤ 0.054 %/°C	≤ 0.03 %/°F ≤ 0.054 %/°C	≤ 0.03 %/°F ≤ 0.054 %/°C	≤ 0.11 %/°F ≤ 0.198 %/°C	≤ 0.08 %/°F ≤ 0.14 %/°C
Electrical Connector	10-32 Coaxial Jack	10-32 Coaxial Jack	10-32 Coaxial Jack	10-32 Coaxial Jack	10-32 Coaxial Jack
Sealing	Hermetic	Hermetic	Hermetic	Hermetic	Hermetic
Housing Material	Stainless Steel	Stainless Steel	Stainless Steel	Stainless Steel	Stainless Steel
Weight	10 gm	10 gm	19 gm	38 gm	57 gm
Size (Diameter x Height x Through Hole Diameter)	0.65 x 0.31 x 0.25 in 16.5 x 7.9 x 6 mm	0.65 x 0.31 x 0.25 in 16.5 x 7.9 x 6 mm	0.87 x 0.39 x 0.375 in 22.1 x 9.91 x 10 mm	1.10 x 0.430 x .5 in 27.9 x 10.9 x 12 mm	1.34 x 0.47 x 0.625 in 34 x 12 x 16 mm
Supplied Accessories					
Assembly Lubricant	080A82	080A82	080A82	080A82	080A82
Mounting Stud	081A11	081A11	081A12	081A13	081A14
Pilot Bushing	083B01	083B01	083B02	083B03	083B04
Anti-Friction Washer	082B01	082B01	082B02	082B03	082B04





Sensors for Road Load Measurements



PCB® Series 5400 Multi-Axis Wheel Force Transducers

PCB® Series 5400 Multi-Axis Wheel Force Transducers are designed as rugged one-piece sensors that mount between the vehicle hub and the wheel rim, delivering highly accurate road load data measurement and superior performance in a durable water-resistant package. Possessing superior temperature compensation properties and integral overload stops, these sensors provide a high level of confidence in data acquired during aggressive road events, including heavy braking tests.



Wheel Force Transducer	
Series 5400 Common Specifications	
Non-Linearity	± 0.5%
Non-Repeatability	± 0.25%
Hysteresis	± 0.5%
Crosstalk	± 1% typical ± 3% full scale, maximum
Excitation	± 15 VDC
Output (all axes)	5 VDC (± 0.2%, nominal)
Temperature Range	-13 to +302 °F -25 to +150 °C
Temperature Effect on Output (Maximum)	0.003% FS/°F 0.005% FS/°C
Angle Encoder	Sine/cosine resolver
Coordinates	SAE Standard
Bridge Resistance	Fx, Fy, Fz & My 2800 Ohm, Mx & Mz 1400 Ohm, nominal
Isolation Resistance	2000 MOhm
Overload Capacity (all axes)	150% FS overload capacity, simultaneously
Natural Frequency	> 300 Hz
Shock Tolerance	50 g pk
Environmental	Dust-tight, water resistant, short-term submersible, corrosion resistant

Available in a wide variety of sizes for vehicles including passenger cars; light-, medium- and heavy-duty trucks; commercial vehicles including tractor trailers, buses, agriculture, and earth-moving equipment; and military vehicles. Passenger car and light truck units use a custom hub adaptor to accommodate a wide range of vehicle sizes while maintaining vehicle geometry. Heavy truck units mount directly to the vehicle hub. All units can be fitted with either slip ring or telemetry signal transmission, and come equipped with on-board signal conditioning and calibration circuitry for each channel of data measurement, making their setup and use with the Transducer Interface Unit (TIU) quick and easy.

PCB® Series 5400 units are available in light-weight aluminum, high-strength stainless steel, and titanium. All units accept modified rims, mounting a wide range of tire sizes, wheel diameters, and offsets. Special one-piece, forged high-strength aluminum rims are available for heavy truck applications. A universal hub adaptor is available that allows for front steer, dual drive, trailer, and tag axes, as well as various super single rims for extra wide tires.

Model Number	Unit	5410-01A Passenger Car AL	5411-01A Light Truck AL	5412-01A Light Truck XL	5413-01A Medium Truck XL	5414-01A Heavy Truck USA	5415-01A Heavy Truck EURO	5416-01A Heavy Truck SSU	5417-02A Heavy Vehicle SS
Fx	lb	6700	9000	9900	13.5k	31.5k	31.5k	31.5k	45k
	N	30k	40k	44k	60k	140k	140k	140k	200k
Fz	lb	6700	9000	9900	13.5k	31.5k	31.5k	31.5k	45k
	N	30k	40k	44k	60k	140k	140k	140k	200k
Fy	lb	3375	4500	4900	6700	15.4k	15.4k	15.4k	22.5k
	N	15k	20k	22k	30k	70k	70k	70k	100k
Mx	in-lb	36k	45k	75k	88k	265k	265k	265k	398k
	N-m	4000	5000	8500	10k	30k	30k	30k	45k
Mz	in-lb	36k	45k	75k	88k	265k	265k	265k	398k
	N-m	4000	5000	8500	10k	30k	30k	30k	45k
My	in-lb	50k	60k	75k	88k	265k	265k	265k	398k
	N-m	5600	6500	8500	10k	30k	30k	30k	45k
Material		Aluminum	Aluminum	Aluminum	Aluminum	Aluminum	Aluminum	Aluminum	Stainless Steel
Additional Versions									
Alternate Material		5410-03A Titanium	5411-03A Titanium	5412-03A Titanium	5413-03A Titanium	5414-03A Titanium	5415-03A Titanium	5416-03A Titanium	5417-03A Titanium

Recommended Signal Conditioner for Wheel Force Transducers

PCB® Model 8175-01A Transducer Interface Unit (TIU) consists of power supplies and signal conditioning electronics required to convert the six force and moment signals from the Wheel Force Transducer into equivalent signals referenced to the wheel axes. Each TIU provides power and signal conditioning for one Wheel Force Transducer.

The TIU provides the signal conditioning that is required to convert the wheel force transducer outputs into DC voltages. These voltages are proportional to the instantaneous forces and moments measured. During operation, the wheel is mounted on a test vehicle and the vehicle is driven along a predetermined course. An analog or digital data recorder then records the output voltages.

A TIU Remote Module permits communications between multiple stacked TIUs when more than one Wheel Force Transducer is used.



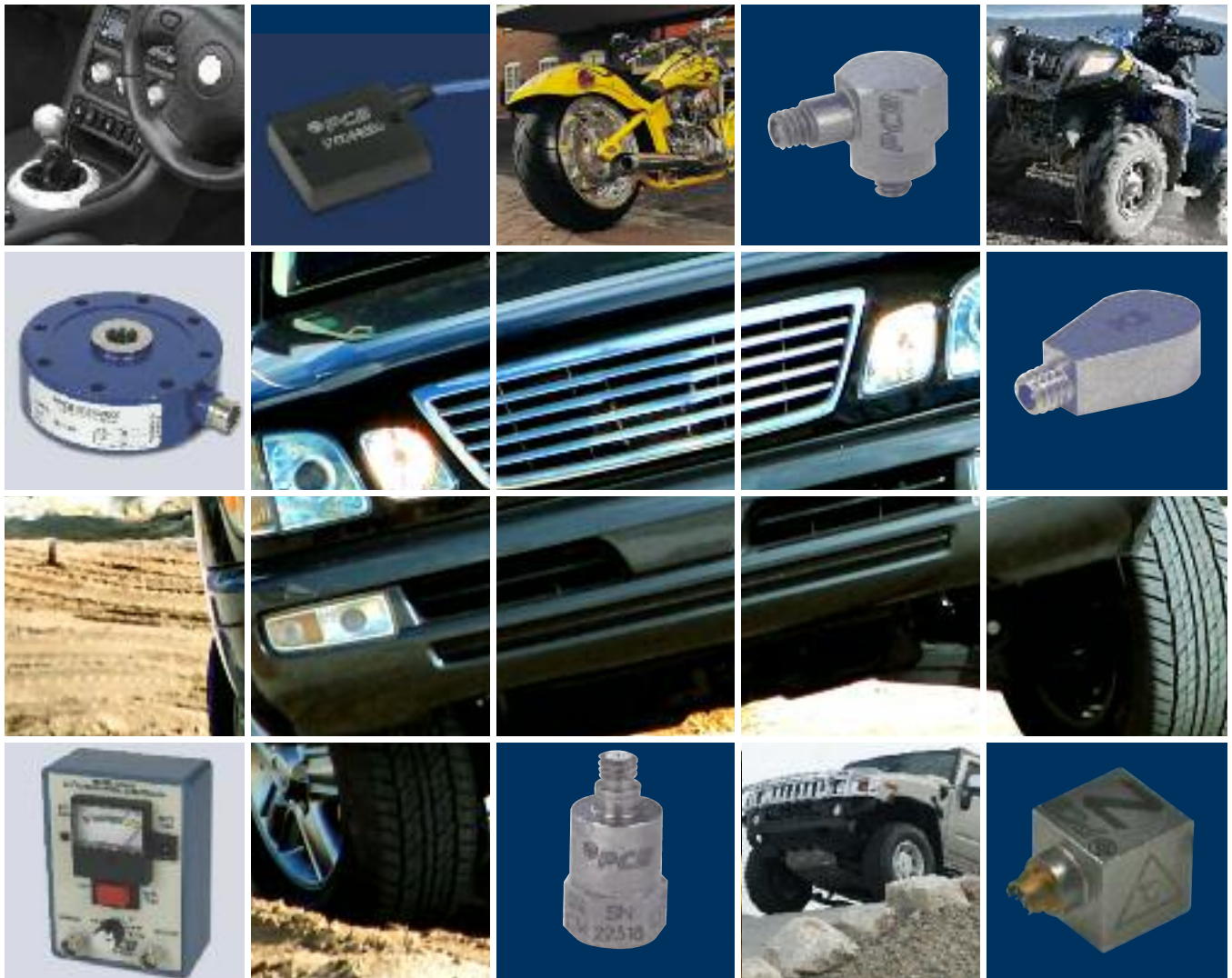
Model 8175-01A

- Six 10 VDC analog inputs
- 14-bit A/D resolution
- 3 digital encoder inputs
- 8 analog outputs
- 5000 Hz signal bandwidth
- 90 kHz sample rate



Vehicle & Component Durability Sensors

Accelerometers, Load Cells, Force Sensors, and Signal Conditioners





Vehicle & Component Durability

Due to the increasing competitive pressure in the global Automotive Industry, vehicle development schedules have decreased from 4-5 years a decade ago, to less than 2 years today. This has allowed manufacturers to react more judiciously to changing consumer demands, market conditions, and legislative requirements. The challenge for the vehicle development community is to meet these condensed timelines without negatively affecting quality and performance attributes such as warranty, fuel economy, crash worthiness, NVH (Noise, Vibration, and Harshness), and driver comfort. At the most fundamental core of any development program is vehicle and component durability testing. The success of a durability program lies in its ability to replicate the summation of all major inputs a vehicle would likely see in its operating environment in the shortest time possible. A poorly executed durability program can cost a manufacturer millions in warranty costs, reduced sales, and a loss of customer loyalty. In order to expedite durability testing without sacrificing due diligence, many vehicle manufacturers have adopted virtual development methods that are coupled with traditional durability testing. With these virtual techniques, however, comes more scrutiny on the reliability, repeatability, and accuracy of the limited physical tests.

Robustness, flexibility, reliability and fidelity of sensors and instrumentation are compulsory for any successful durability test program. It is rarely feasible for a complete durability program, or a significant portion of it, to be repeated due to faulty equipment or sensors. PCB® designs sensors with these requirements in mind to support compressed product development time and to ensure that a vehicle, system, and component is measured successfully and accurately the first time. A typical durability test program consists of the following key test elements:

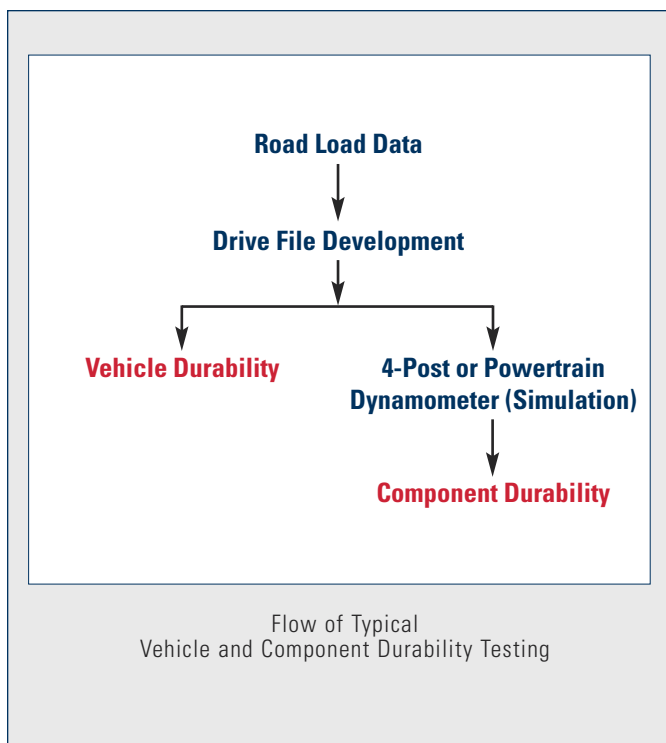
Full Vehicle Durability

Road load tests measure the transient and steady state inputs of a vehicle as it operates over a road surface in the intended market region or over a replicated drive profile on a test track. The road load test accounts for vehicle and driving parameters such as mass, inertia, air & rolling resistance, road characteristics, engine loads, and vehicle speed.

Data gathered from Road Load Data Acquisition (RLDA) is processed and analyzed and used for control of a powertrain/chassis dynamometer in the case of a powertrain durability program; or multi-axis hydraulic shakers for a vehicle structural durability program. Simulated durability programs are separated as it becomes almost impossible to control both load profiles. Full vehicle durability can be performed in its entirety, with both powertrain and chassis induced loads, on a test track with a drive profile that replicates the road surface and vehicle speed necessary for the intended geographical region. While vehicle durability testing on a test track offers the most realistic load cases, it often takes longer to complete and is dependant on the current ambient conditions only, not the specific conditions that are necessary. Simulated powertrain or vehicle structural durability, on the other hand, offers more repeatable test outcomes in an expeditious manner.

Component Durability

Many vehicle systems and components experience complex static, dynamic, and thermal loading conditions when operated. Data gathered from road load or vehicle durability results are used to simulate these load conditions in a lab where forces and ambient temperatures acting on the test subject can be controlled. Climatic chambers are used for specific control of ambient conditions including temperature and humidity while multi-axis shaker systems can control up to three axis of motion simultaneously and independently. For controlled component durability testing, where control of the inputs and the response of the test object are crucial, PCB® offers robust quartz accelerometers with high sensitivity and excellent resolution that are well-suited for this demanding application. For tests requiring tight control of inputs over large temperature variations, PCB® Series 339A low temperature coefficient triaxial ICP® accelerometers, ensure accurate representation.





DC Response Accelerometers for Durability Applications

PCB® Series 3741 DC response accelerometers are offered in a variety of full-scale ranges, from ± 2 to ± 200 g, to accommodate vehicle and component durability testing requirements. The units feature silicon MEMS sensing elements for uniform, repeatable performance. Gas damping, mechanical over range stops, and a low profile, hard-anodized, aluminum housing are utilized for added durability. Electrically, the units offer a differential output signal for common-mode noise rejection. PCB® Series 3711 (single axis) and 3713 (triaxial) DC response accelerometers are designed to measure low-frequency vibration and motion, and are offered in full-scale ranges from ± 3 to ± 200 g, to accommodate a variety of vehicle and component durability testing requirements. The units feature gas-damped, silicon MEMS sensing elements that provide performance, while hermetically sealed titanium housings provide protection from harsh contaminants. These units are inherently insensitive to base strain and transverse acceleration effects, and offer high frequency overload protection. Electrically, the units offer a single-ended output signal for each channel with power and ground leads.

DC Response Accelerometers for Durability Applications					
Series 3741		Sensitivity	Measurement Range (pk)	Frequency (± 10%)	Broadband Resolution (rms)
		10 mV/g	± 200 g	0 to 2000 Hz	5.1 mg
		20 mV/g	± 100 g	0 to 2000 Hz	4.5 mg
		40 mV/g	± 50 g	0 to 2000 Hz	2.5 mg
		66.7 mV/g	± 30 g	0 to 2000 Hz	2.5 mg
		200 mV/g	± 10 g	0 to 200 Hz	1.1 mg
		1000 mV/g	± 2 g	0 to 150 Hz	0.3 mg
Series 3711 and 3713					
		10 mV/g	± 200 g	0 to 1500 Hz	5.3 mg
		40 mV/g	± 50 g	0 to 1500 Hz	4.4 mg
		40 mV/g, 2.5 V offset	± 50 g	0 to 1500 Hz	4.4 mg
		100 mV/g	± 20 g	0 to 1500 Hz	3.6 mg
		100 mV/g, 2.5 V offset	± 20 g	0 to 1500 Hz	3.6 mg
		700 mV/g	± 3 g	0 to 150 Hz	1.1 mg
Model Number		3741 Single Axis	3711 Single Axis	3713 Triaxial	
Overload Limit (Shock)		± 5,000 g pk	± 5000 g pk	± 5000 g pk	
Temperature Range		-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54.0 to +121 °C	-65 to +250 °F -54 to +121 °C	
Excitation Voltage		6 to 30 VDC	5 to 30 VDC	5 to 30 VDC	
Housing Material		Anodized Aluminum	Titanium	Titanium	
Sealing		Epoxy	Hermetic	Hermetic	
Size		0.30 x 1.00 x 0.85 in 7.62 x 25.4 x 21.6 mm	0.45 x 0.85 x 0.85 in 11.4 x 21.6 x 21.6 mm	1.1 in Cube 28 mm Cube	
Weight	Connector style Integral cable style	— 10 gm	14 gm 78 gm	78 gm 169 gm	
Electrical Connector		10 ft. (3 m) Integral Cable	1/4-28 4-Pin or 10 ft. (3 m) Integral Cable	9-Pin or 10 ft. (3 m) Integral Cable	
Output Configuration		Differential	Single-Ended	Single-Ended	
Supplied Accessories					
Easy Mount Clip		—	080A152	—	
Adhesive Base		—	—	080A208	
Mounting Screws/Studs		081A103 M081A103	081A64 M081A64	081A05 M081A05	
Additional Accessories					
Triaxial Mounting Block		080A208	080A153	—	
Mounting Cable Connectors		—	AY	EN	
Recommended Cables		—	034	037	





Vehicle & Component Durability Sensors

Small, Lightweight, Single Axis, ICP® Accelerometers for Durability Applications

Specific vehicle and component durability application testing requires small, lightweight accelerometers for high-frequency response, low noise, minimal mass loading, and installation in space restricted locations. PCB® offers a line of ceramic shear ICP® accelerometers housed in lightweight aluminum or robust hermetically sealed titanium. By minimizing the mass of the sensor, mass loading effects are reduced, leading to improved measurement accuracy.

Small, Lightweight, Single Axis, ICP® Accelerometers for Durability Applications

					
Model Number	352C23	352A73	352A21	352B10	352A24
Sensitivity	5 mV/g	5 mV/g	10 mV/g	10 mV/g	100 mV/g
Measurement Range	1000 g pk	1000 g pk	500 g pk	500 g pk	50 g pk
Broadband Resolution	0.003 g rms	0.002 g rms	0.002 g rms	0.003 g rms	0.0002 g rms
Frequency Range (± 10%)	1.5 to 15k Hz	1.5 to 25k Hz	0.7 to 13k Hz	1 to 17k Hz	0.8 to 10k Hz
Temperature Range	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C
Electrical Connector	3-56 Coaxial Jack	Integral Cable	3-56 Coaxial Jack	Integral Cable	3-56 Coaxial Jack
Sealing	Epoxy	Hermetic	Epoxy	Hermetic	Epoxy
Housing Material	Anodized Aluminum	Titanium	Titanium	Titanium	Aluminum
Weight	0.2 gm	0.3 gm	0.5 gm	0.7 gm	0.8 gm
Size	0.11 x 0.34 x 0.16 in 2.8 x 8.6 x 4.1 mm	0.11 x 0.34 x 0.16 in 2.8 x 8.6 x 4.1 mm	0.14 x 0.45 x 0.25 in 3.6 x 11.4 x 6.4 mm	0.32 x 0.24 in 8.1 x 6.1 mm	0.19 x 0.48 x 0.28 in 4.8 x 12.2 x 7.1 mm
Mounting	Adhesive	Adhesive	Adhesive	Adhesive	Adhesive
Supplied Accessories					
Cable	030A10	—	030A10	—	030A10
Wax/Adhesive	080A109	080A109	080A109	080A109 080A90	080A109
Removal Tool	039A26	039A26	039A27	—	039A28
Additional Versions					
Alternate Housing Material	—	—	352C22 - Aluminum	—	—
Alternate Sensitivity	—	—	—	352B01 - 1 mV/g	—
Additional Accessories					
Connector Adaptor	070A02	070A02	070A02	070A02	070A02
Mating Cable Connectors	EK	AL	EK	AL	EK
Recommended Cables	030	—	030	—	030





Small, Lightweight, Single Axis, ICP® Accelerometers for Durability Applications

						
Model Number	352C65	352C68	352C41	352C42	352C03	352C33
Sensitivity	100 mV/g	100 mV/g	10 mV/g	100 mV/g	10 mV/g	100 mV/g
Measurement Range	50 g pk	50 g pk	500 g pk	50 g pk	500 g pk	50 g pk
Broadband Resolution	0.00016 g rms	0.00016 g rms	0.0008 g rms	0.0005 g rms	0.0005 g rms	0.00015 g rms
Frequency Range (± 10%)	0.3 to 12k Hz	0.3 to 12k Hz	0.3 to 15k Hz	0.5 to 10k Hz	0.3 to 15k Hz	0.3 to 15k Hz
Temperature Range	-65 +200 °F -54 to +93 °C	-65 +200 °F -54 to +93 °C	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C	-65 +200 °F -54 to +93 °C
Electrical Connector	5-44 Coaxial Jack	10-32 Coaxial Jack	10-32 Coaxial Jack	10-32 Coaxial Jack	10-32 Coaxial Jack	10-32 Coaxial Jack
Sealing	Hermetic	Hermetic	Hermetic	Hermetic	Hermetic	Hermetic
Housing Material	Titanium	Titanium	Titanium	Titanium	Titanium	Titanium
Weight	2.0 gm	2.0 gm	2.8 gm	2.8 gm	5.8 gm	5.8 gm
Size	5/16 x 0.33 in 5/16 in x 8.4 mm	9/32 x 0.64 in 9/32 in x 16.3 mm	3/8 x 0.38 in 3/8 in x 9.7 mm	3/8 x 0.38 in 3/8 in x 9.7 mm	7/16 x 0.62 in 7/16 in x 15.7 mm	7/16 x 0.62 in 7/16 in x 15.7 mm
Mounting	5-40 Stud	5-40 Stud	Adhesive	Adhesive	10-32 Thread	10-32 Thread
Supplied Accessories						
Wax/Adhesive	080A109	080A109	080A109 080A90	080A109 080A90	080A109	080A109
Adhesive Mounting Base	080A15	080A15	—	—	080A	080A
Mounting Stud/Screw	—	—	—	—	081B05 M081B05	081B05 M081B05
Additional Versions						
Alternate Connector Position	352C66 - Top	—	—	—	352C04 - Top	352C34 - Top
Alternate Electrical Connector	352C67 Integrated Cable	—	—	—	—	—
Alternate Temperature Range	—	—	—	HT352C44 High Temperature	—	—
Alternate Electrical Isolation	—	JM352C68 Metric Ground Isolated	352C43 Ground Isolated	352C44 Ground Isolated	—	J352C33 Ground Isolated
Alternate Mounting Thread	M352C65 - Metric	M352C68 - Metric	—	—	—	—
Additional Accessories						
Magnetic Mounting Base	080A30	080A30	—	—	080A27	080A27
Triaxial Mounting Adaptor	080B16 080A196	080B16 080A196	—	—	080B10	080B10
Mating Cable Connectors	AG	EB	EB	EB	EB	EB
Recommended Cables	018 Flexible 003 CE	002 Low Cost 003 CE	002 Low Cost 003 CE	002 Low Cost 003 CE	002 Low Cost 003 CE	002 Low Cost 003 CE





Low Temperature Coefficient, Triaxial, ICP® Accelerometers for Durability Applications

PCB® Series 339A Triaxial, ICP® accelerometers are designed with a low temperature coefficient, wide operating temperature range, and good broadband measurement resolution, making them ideal for any vibration measurement requiring tight control of amplitude sensitivity over a wide thermal gradient. With a temperature coefficient of less than 0.0125% / °F (0.02% / °C), these sensors provide precision amplitude data for test applications with large thermal shifts such as durability testing in a climatic chamber.



High Temperature, Triaxial, ICP® Accelerometers for Durability Applications

High temperature, ICP® accelerometers are specially designed and tested to survive temperature extremes beyond the range of standard ICP® accelerometers. These sensors are ideal for use in engine, turbo, exhaust and other high temperature vehicle and component durability testing environments.

Low Temperature Coefficient, Triaxial, ICP® Accelerometers

Model Number	339A30	339A31
Sensitivity	10 mV/g	
Measurement Range	± 500 g pk	
Broadband Resolution	0.008 g rms	
Frequency Range (± 5%)	2 to 10k Hz	
Temperature Range	-65 to +325 °F -54 to +163 °C	
Temperature Coefficient of Sensitivity	≤ 0.01% / °F ≤ 0.02% / °C	
Electrical Connector	8-36 4-Pin Jack	
Sealing	Hermetic	
Housing Material	Titanium	
Weight	4.0 gm	5.5 gm
Size	0.4 in Cube 10.2 mm Cube	0.55 x 0.4 x 0.4 in 14 x 10.2 x 10.2 mm
Mounting	Adhesive	5-40 Stud
Supplied Accessories		
Wax	080A109	080A109
Adhesive Mounting Base	—	080A
Mounting Studs/Screws	—	081A27 M081A27
Cable Assembly	034K10	034K10
Additional Accessories		
Removal Tool	039A08	039A08
Mating Cable Connectors	EH	EH
Recommended Cables	034	034

High Temperature, Triaxial, ICP® Accelerometers for Durability Applications

					
Model Number	320C15	320C18	320C03	320C04	320C33
Sensitivity	10 mV/g	10 mV/g	10 mV/g	10 mV/g	100 mV/g
Measurement Range	500 g pk	500 g pk	500 g pk	500 g pk	50 g pk
Broadband Resolution	0.005 g rms	0.005 g rms	0.005 g rms	0.005 g rms	0.0003 g rms
Frequency Range (± 10%)	1.5 to 18k Hz	1.5 to 18k Hz	0.7 to 9000 Hz	0.7 to 9000 Hz	0.7 to 6000 Hz
Temperature Range	-100 to +325 °F -73 to +163 °C	-100 to +325 °F -73 to +163 °C	-100 to +325 °F -73 to +163 °C	-100 to +325 °F -73 to +163 °C	-100 to +325 °F -73 to +163 °C
Electrical Connector	5-44 Coaxial Jack	10-32 Coaxial Jack	10-32 Coaxial Jack	10-32 Coaxial Jack	10-32 Coaxial Jack
Sealing	Hermetic	Hermetic	Hermetic	Hermetic	Hermetic
Housing Material	Titanium	Titanium	Titanium	Titanium	Titanium
Weight	2.0 gm	1.7 gm	10.5 gm	10.5 gm	20.0 gm
Size	5/16 x 0.43 in 5/16 in x 10.9 mm	9/32 x 0.74 in 9/32 in x 18.8 mm	1/2 x 0.81 in 1/2 in x 20.6 mm	1/2 x 1.14 in 1/2 in x 29.0 mm	3/4 x 0.85 in 3/4 in x 21.6 mm
Mounting	5-40 Stud	5-40 Stud	10-32 Thread	10-32 Thread	10-32 Thread
Supplied Accessories					
Wax/Adhesive	080A109	080A109	080A109	080A109	080A109
Adhesive Mounting Base	080A15	080A15	—	—	080A12
Mounting Stud/Screw	—	—	081B05 M081B05	081B05 M081B05	081B05 M081B05
Additional Versions					
Metric Mounting	M320C15	M320C18	—	—	—
Adhesive Mounting	A320C15	—	—	—	—
Ground Isolated	—	—	J320C03	—	—
Additional Accessories					
Magnetic Mounting Base	080A30	080A30	080A27	080A27	080A27
Triaxial Mounting Adaptor	080B16 080A196	080B16 080A196	080B10	080B10	080B11
Mating Cable Connectors	AG	EB	EB	EB	EB
Recommended Cables	002 Low Cost 003 CE	002 Low Cost 003 CE	002 Low Cost 003 CE	002 Low Cost 003 CE	002 Low Cost 003 CE



Quartz Shear, ICP® Accelerometers for Durability Applications

PCB® quartz sensing crystals offer the most stable operation over time with virtually no change in sensitivity and performance even after multiple overload events. Measurement accuracy is improved in vibration testing that incorporates thermal cycling due to the quartz crystal's low temperature coefficient properties. Titanium housings provide lightweight construction for maximum frequency range and to minimize mass loading, as well as provide excellent protection against many corrosives.

Quartz Shear, ICP® Accelerometers for Durability Applications

Model Number	353B12	353B77	353B18	353B11	353B15
Sensitivity	5 mV/g	2 mV/g	10 mV/g	5 mV/g	10 mV/g
Measurement Range	1000 g pk	2500 g pk	500 g pk	1000 g pk	500 g pk
Broadband Resolution	0.01 g rms	0.05 g rms	0.005 g rms	0.01 g rms	0.005 g rms
Frequency Range (± 10%)	0.7 to 20k Hz	0.7 to 20k Hz	0.7 to 18k Hz	0.7 to 18k Hz	0.7 to 18k Hz
Temperature Range	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C
Electrical Connector	5-44 Coaxial Jack	Integral Cable	10-32 Coaxial Jack	5-44 Coaxial Jack	5-44 Coaxial Jack
Sealing	Hermetic	Hermetic	Hermetic	Hermetic	Hermetic
Housing Material	Titanium	Titanium	Titanium	Titanium	Titanium
Weight	1.5 gm	1.7 gm	1.8 gm	2.0 gm	2.0 gm
Size	9/32 x 0.57 in 9/32 in x 14.5 mm	9/32 x 0.49 in 9/32 in x 12.4 mm	9/32 x 0.64 in 9/32 in x 16.3 mm	5/16 x 0.33 in 5/16 in x 8.4 mm	5/16 x 0.33 in 5/16 in x 8.4 mm
Mounting	5-40 Stud	5-40 Stud	5-40 Stud	5-40 Stud	5-40 Stud
Supplied Accessories					
Wax/Adhesive	080A109	080A109	080A109	080A109	080A109
Adhesive Mounting Base	080A15	080A15	080A15	080A15	080A15
Additional Versions					
Alternate Mounting Thread	M353B12 - Metric	M353B77 - Metric	M353B18 - Metric	M353B11 - Metric	M353B15 - Metric
Alternate Electrical Connector	353B13 Integral Cable	—	353B17 Integral Cable	—	—
Alternate Electrical Connector	353B14 10-32 Coaxial Jack	—	353B16 5-44 Coaxial Jack	—	—
Alternate Electrical Isolation	—	J353B77 Ground Isolated	J353B18 Ground Isolated	—	—
Alternate Electrical Isolation	—	—	JM353B18 Metric Ground Isolated	—	—
Additional Accessories					
Magnetic Mounting Base	080A30	080A30	080A30	080A30	080A30
Triaxial Mounting Adaptor	080B16 080A196	080B16 080A196	080B16 080A196	080B16 080A196	080B16 080A196
Mating Cable Connectors	AG	AL	EB	AG	AG
Recommended Cables	018 Flexible 003 CE	—	002 Low Cost 003 CE	018 Flexible 003 CE	018 Flexible 003 CE
Connector Adaptor	—	070A02	—	—	—



Vehicle & Component Durability Sensors

Quartz Shear, ICP® Accelerometers for Durability Applications



CE



CE



Model Number	353B01	353B03	353B31	353B33
Sensitivity	20 mV/g	10 mV/g	50 mV/g	100 mV/g
Measurement Range	250 g pk	500 g pk	100 g pk	50 g pk
Broadband Resolution	0.005 g rms	0.003 g rms	0.001 g rms	0.0005 g rms
Frequency Range (± 10%)	0.7 to 10k Hz	0.7 to 11k Hz	0.7 to 8000 Hz	0.7 to 6500 Hz
Temperature Range	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C
Electrical Connector	10-32 Coaxial Jack	10-32 Coaxial Jack	10-32 Coaxial Jack	10-32 Coaxial Jack
Sealing	Hermetic	Hermetic	Hermetic	Hermetic
Housing Material	Titanium	Titanium	Titanium	Titanium
Weight	10.0 gm	10.5 gm	20.0 gm	27.0 gm
Size	1/2 x 0.81 in 1/2 in x 20.6 mm	1/2 x 0.81 in 1/2 in x 20.6 mm	3/4 x 0.85 in 3/4 in x 21.6 mm	3/4 x 0.93 in 3/4 in x 23.6 mm
Mounting	10-32 Thread	10-32 Thread	10-32 Thread	10-32 Thread
Supplied Accessories				
Wax/Adhesive	080A109	080A109	080A109	080A109
Adhesive Mounting Base	080A	080A	080A12	080A12
Mounting Stud/Screw	081B05 M081B05	081B05 M081B05	081B05 M081B05	081B05 M081B05
Additional Versions				
Alternate Connector Position	353B02 - Top	353B04 - Top	353B32 - Top	353B34 - Top
Alternate Electrical Isolation	—	J353B03 Ground Isolated	—	J353B33 Ground Isolated
Additional Accessories				
Magnetic Mounting Base	080A27	080A27	080A27	080A27
Triaxial Mounting Adaptor	080B10	080B10	080B11	080B11
Mating Cable Connectors	EB	EB	EB	EB
Recommended Cables	002 Low Cost 003 CE	002 Low Cost 003 CE	002 Low Cost 003 CE	002 Low Cost 003 CE

Charge Output Accelerometers for Durability Applications



Model Number	357B11	357B03	357B04	357B21	357B22	357B61
Sensitivity	3.0 pC/g	10 pC/g	10 pC/g	30 pC/g	30 pC/g	10 pC/g
Measurement Range	± 2300 g pk	± 2000 g pk	± 2000 g pk	± 1500 g pk	± 1500 g pk	± 1000 g pk
Frequency Range (10%)	16 kHz	12 kHz	12 kHz	7500 Hz	7500 Hz	5000 Hz [2]
Temperature Range	-95 to +500 °F -71 to +260 °C	-95 to +500 °F -71 to +260 °C	-95 to +500 °F -71 to +260 °C	-95 to +500 °F -71 to +260 °C	-95 to +500 °F -71 to +260 °C	-65 to +900 °F -54 to +482 °C
Electrical Connector	5-44 Coaxial Jack	10-32 Coaxial Jack	10-32 Coaxial Jack	10-32 Coaxial Jack	10-32 Coaxial Jack	10-32 Coaxial Jack
Sealing	Hermetic	Hermetic	Hermetic	Hermetic	Hermetic	Hermetic
Housing Material	Titanium	Titanium	Titanium	Titanium	Titanium	Inconel
Weight	2 gm	11 gm	11 gm	21 gm	21 gm	30 gm
Size	5/16 x 0.33 in 5/16 in x 8.4 mm	1/2 x 0.81 in 1/2 in x 20.6 mm	1/2 x 1.19 in 1/2 in x 30.2 mm	5/8 x 0.85 in 5/8 in x 21.6 mm	5/8 x 1.16 in 5/8 in x 29.3 mm	5/8 x 1 in 5/8 in x 25.4 mm
Mounting	5-40 Stud	10-32 Thread	10-32 Thread	10-32 Thread	10-32 Thread	10-32 Thread
Supplied Accessories						
Cable Assembly	—	—	—	—	—	023A10
Wax/Adhesive	—	080A109	080A109	080A109	080A109	—
Mounting Stud/Screw	—	081B05 M081B05	081B05 M081B05	081B05 M081B05	081B05 M081B05	081A107 M081A107
Additional Accessories						
Adhesive Mounting Base	—	080A	080A	080A12	080A12	080A12
Magnetic Mounting Base	080A30	080A27	080A27	080A27	080A27	080A27
Triaxial Mounting Adaptor	080B16, 080A196	080B10	080B10	080B11	080B11	080B11
Mating Cable Connectors	AG	EB	EB	EB	EB	FZ
Recommended Cables	018 Flexible, 003	003	003	003	003	023

Notes

Broadband Resolution is dependent upon cable length and signal conditioner



Multi-purpose, ICP® Force Sensors for Durability Applications



Model Number	208C01	208C02	208C03	208C04	208C05
Measurement Range (Compression)	10 lb 0.04448 kN	100 lb 0.4448 kN	500 lb 2.224 kN	1000 lb 4.448 kN	5000 lb 22.24 kN
Sensitivity	500 mV/lb 112,410 mV/kN	50 mV/lb 11,241 mV/kN	10 mV/lb 2248 mV/kN	5 mV/lb 1124 mV/kN	1 mV/lb 224.82 mV/kN
Maximum Static Force (Compression)	60 lb 0.27 kN	600 lb 2.669 kN	3000 lb 13.5 kN	6000 lb 26.69 kN	8000 lb 35.59 kN
Broadband Resolution	0.0001 lb-rms	0.001 lb-rms	0.005 lb-rms	0.01 lb-rms	0.05 lb-rms
Low Frequency Response (-5 %)	0.01 Hz	0.001 Hz	0.0003 Hz	0.0003 Hz	0.0003 Hz
Temperature Range	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C
Electrical Connector	10-32 Coaxial Jack	10-32 Coaxial Jack	10-32 Coaxial Jack	10-32 Coaxial Jack	10-32 Coaxial Jack
Sealing	Hermetic	Hermetic	Hermetic	Hermetic	Hermetic
Housing Material	Stainless Steel	Stainless Steel	Stainless Steel	Stainless Steel	Stainless Steel
Weight	22.7 gm	22.7 gm	22.7 gm	22.7 gm	22.7 gm
Size	5/8 x 0.5 in 5/8 in x 12.7 mm	5/8 x 0.5 in 5/8 in x 12.7 mm	5/8 x 0.5 in 5/8 in x 12.7 mm	5/8 x 0.5 in 5/8 in x 12.7 mm	5/8 x 0.5 in 5/8 in x 12.7 mm
Mounting	10-32 Thread	10-32 Thread	10-32 Thread	10-32 Thread	10-32 Thread
Supplied Accessories					
Thread Locker	080A81	080A81	080A81	080A81	080A81
Mounting Studs	081B05 M081A62	081B05 M081A62	081B05 M081A62	081B05 M081A62	081B05 M081A62
Impact Cap	084A03	084A03	084A03	084A03	084A03

ICP® Force Sensor for Durability Applications



Model Number	221B01	221B02	221B03	221B04	221B05
Measurement Range	10 lb 0.04448 kN	100 lb 0.4448 kN	500 lb 2.224 kN	1000 lb 4.448 kN	5000 lb 22.24 kN
Sensitivity	500 mV/lb 112,404 mV/kN	50 mV/lb 11,241 mV/kN	10 mV/lb 2248.2 mV/kN	5 mV/lb 1124.1 mV/kN	1 mV/lb 224.82 mV/kN
Broadband Resolution	0.0002 lb-rms 0.0008896 N-rms	0.002 lb-rms 0.008896 N-rms	0.01 lb-rms 0.04448 N-rms	0.02 lb-rms 0.08896 N-rms	0.10 lb-rms 0.445 N-rms
Upper Frequency Limit [1]	15 kHz	15 kHz	15 kHz	15 kHz	15 kHz
Non-Linearity [2]	≤ 1 % FS	≤ 1 % FS	≤ 1 % FS	≤ 1 % FS	≤ 1 % FS
Temperature Range	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C
Temperature Coefficient of Sensitivity	≤ 0.03 %/ °F ≤ 0.054 %/ °C	≤ 0.03 %/ °F ≤ 0.054 %/ °C	≤ 0.03 %/ °F ≤ 0.054 %/ °C	≤ 0.03 %/ °F ≤ 0.054 %/ °C	≤ 0.03 %/ °F ≤ 0.054 %/ °C
Electrical Connector	10-32 Coaxial Jack	10-32 Coaxial Jack	10-32 Coaxial Jack	10-32 Coaxial Jack	10-32 Coaxial Jack
Sealing	Hermetic	Hermetic	Hermetic	Hermetic	Hermetic
Housing Material	Stainless Steel	Stainless Steel	Stainless Steel	Stainless Steel	Stainless Steel
Weight	31 gm	31 gm	31 gm	31 gm	31 gm
Size	0.65 x 1.25 in 16.51 x 31.75 mm	0.65 x 1.25 in 16.51 x 31.75 mm	0.65 x 1.25 in 16.51 x 31.75 mm	0.65 x 1.25 in 16.51 x 31.75 mm	0.65 x 1.25 in 16.51 x 31.75 mm
Mounting	1/4-28 Thread	1/4-28 Thread	1/4-28 Thread	1/4-28 Thread	1/4-28 Thread
Additional Accessories					
Mounting Stud	081A06	081A06	081A06	081A06	081A06
Notes					

[1] Estimated using rigid body dynamics calculations [2] Zero-based, least-squares, straight line method



Strain Gage Load Cells for Durability Applications

PCB® general purpose load cells are suitable for a wide range of routine static force measurement applications, including vehicle and component durability application testing. PCB® Series 1403 low profile load cells are rugged devices manufactured using premium heat-treated, fatigue-resistant steels and are ideal for component testing.

Strain Gage Load Cells for Durability Applications



Model Number	1403-03A	1403-04A	1403-05A	1404-02A	1404-03A
Sensitivity	1 mV/V	1.5 mV/V	1.5 mV/V	1.5 mV/V	1.5 mV/V
Measurement Range	1000 lb 4.448 kN	2500 lb 11.12 kN	5000 lb 22.24 kN	10,000 lb 44.5 kN	25,000 lb 111 kN
Overload Limit	2000 lb 8.896 kN	5000 lb 22.24 kN	10,000 lb 44.48 kN	20,000 lb 89 kN	50,000 lb 222.4 kN
Non-Linearity	≤ 0.05 % FS	≤ 0.05 % FS	≤ 0.05 % FS	≤ 0.05 % FS	≤ 0.05 % FS
Hysteresis	≤ 0.05 % FS	≤ 0.05 % FS	≤ 0.05 % FS	≤ 0.05 % FS	≤ 0.05 % FS
Non-Repeatability	≤ 0.02 % FS	≤ 0.02 % FS	≤ 0.02 % FS	≤ 0.02 % FS	≤ 0.02 % FS
Temperature Range	-65 to +200 °F -54 to +93 °C	-65 to +200 °F -54 to +93 °C	-65 to +200 °F -54 to +93 °C	-65 to +200 °F -54 to +93 °C	-65 to +200 °F -54 to +93 °C
Bridge Resistance	700 ohm	700 ohm	700 ohm	700 ohm	700 ohm
Excitation Voltage	10 VDC	10 VDC	10 VDC	10 VDC	10 VDC
Weight	1.31 kg	1.31 kg	1.31 kg	4.06 kg	4.06 kg
Size	4.12 x 1.37 in 104.6 x 34.8 mm	4.12 x 1.37 in 104.6 x 34.8 mm	4.12 x 1.37 in 104.6 x 34.8 mm	6.06 x 1.75 in 153.9 x 44.5 mm	6.06 x 1.75 in 153.9 x 44.5 mm
Mounting	5/8 - 18 Thread	5/8 - 18 Thread	5/8 - 18 Thread	1 1/4 - 12 Thread	1 1/4 - 12 Thread
Electrical Connector	PT02E-10-6P	PT02E-10-6P	PT02E-10-6P	PT02E-10-6P	PT02E-10-6P
Additional Version					
Alternate Electrical Connector	1403-03B PC04E-10-6P	1403-04B PC04E-10-6P	1403-05B PC04E-10-6P	1404-02B PC04E-10-6P	1404-03B PC04E-10-6P
Metric Mounting	M1403-03A M1403-03B	M1403-04A M1403-04B	M1403-05A M1403-05B	M1404-02A M1404-02B	M1404-03A M1404-03B
Additional Accessory					
Mounting Base	084A100 M084A100	084A100 M084A100	084A100 M084A100	084A101 M084A101	084A101 M084A101



Recommended General ICP® Signal Conditioners

		
Model 480B21	Model 480C02	Model 480E09
3-channel, battery powered, gain x1, x10, x100	Single-channel, battery powered, BNC input/output connectors	Single-channel, battery powered, gain x1, x10, x100, and BNC input/output connectors
		
Model 482C05	Model 482C16	Model 482C54
4-channel, line powered, unity gain, BNC input/output connectors	4-channel, line powered, incremental gain x0.1 to x200, digital control interface RS-232	4-channel, line powered charge, incremental gain, TEDS, digital control interface RS-232

Recommended ICP® Signal Conditioner for Load Cell Sensors

		
Series 8159	Series 8161	Series 8162
Operates from 115 or 230 VAC power, provides 5 or 10 VDC strain gage bridge excitation, delivers ± 10 VDC and 4 to 20 mA output signals, 4 programmable set points with LED status indicators, optional RS-232 output	DIN rail, 35 mm, operates from 12 to 28 VDC, provides 5 or 10 VDC strain gage bridge excitation, delivers ± 5 or ± 10 volts and 4 to 20 mA output signals. Adjustable zero and span with built-in shunt calibration.	IP66 (NEMA 4X) enclosure operates from 12 to 28 VDC, provides 5 or 10 VDC strain gage bridge excitation, delivers ± 5 or ± 10 volts and 4 to 20 mA output via screw terminal connections. Adjustable zero and span with built-in shunt calibration.





Vehicle & Component Durability Sensors

Recommended Signal Conditioner for Series 3741 DC Response Accelerometers

CE



Model 482C27

Four-channel, line powered, bridge, incremental gain, digital control interface, RS-232 and ethernet

Recommended Signal Conditioners for Series 3711 & 3713 DC Response Accelerometers

CE



Model 478A01

Single-channel unity gain (internal battery powered)

CE



Model 478B05

Three-channel unity gain 36 VDC power adaptor (optional external battery pack)

Recommended Signal Conditioners for Charge Output Accelerometers

CE



Model 422E

In-line charge converter, range from 0.1 mV/pC to 100 mV/pC

CE



Model 421A11/421A13

One- or three-channel versions available, three user selectable input ranges, rugged, surface mountable, sealed aluminum enclosures

CE



Model 421A25

Industrial charge amplifier with 13 selectable ranges and peak hold, 3 additional ranges with continuous gain adjustment





Driveability and Ride & Handling Sensors

Accelerometers, Force Sensors, Load Cells, Signal Conditioners, and Human Vibration Monitors





Driveability and Ride & Handling

Driveability is a vehicle's response to driver input through a series of drive cycles and is generally indicative of the degree of smoothness and steadiness of straight line acceleration and deceleration. Vehicle handling is also defined as a vehicle's response to driver input; however, the emphasis is on vehicle motion transverse to the primary direction of motion, particularly during cornering, lane change maneuvers and its ability to maintain the chosen path. The low frequency response of the vehicle to driver input defines the "character" of the vehicle and is the basis for the image and branding of particular vehicle types. Primary and secondary ride are important aspects of ride quality and development of their performance is often a compromise with vehicle handling attributes.

Although driveability and ride & handling are unique attributes, they share some commonality. Measurement for both attributes is conducted using low frequency measurement instrumentation. Primary ride is typically measured in the 0 to 3 Hz range, while secondary ride is higher, but typically less than 25 Hz. Driveability and vehicle handling require measurements down to DC, as changes in vehicle motion by driver input are the primary metrics. With advancements in engine and vehicle technologies, it is now common practice to collect not only vehicle motion data but also system information from the vehicle's CANBus, to monitor and adjust engine operating parameters, advanced combustion control (cylinder deactivation algorithms), stability control (brake and torque-based systems), and traction control, as these systems can play a significant role in driveability and ride & handling performance.

Driveability

Driveability can be a complex equation between driver expectation and how a vehicle actually performs over numerous maneuvers in a particular drive cycle. While parlaying objective measurements into subjective ratings is still very much under scrutiny, the process of collecting objective data is noncontroversial and plays a crucial role in the vehicle development process.



Typical test setups include measurement of driver input and low frequency vehicle response, including:

- Pedal force (brake, accelerator, and clutch)
- Longitudinal vehicle acceleration
- Vehicle pitch
- CANBus
 - Throttle position
 - Turbo boost pressure
 - Brake pressure
 - Transmission shift parameters

Calibration engineers routinely strike a balance between fuel economy, NVH, and driveability performance by optimizing engine combustion processes and transmission shift schedules.

Ride & Handling

Vehicle manufacturers strive to achieve optimal vehicle handling and to balance handling performance against other key attributes in chassis development, including ride comfort; road noise; and durability, in accordance with brand status. Vehicle handling is a complex interaction between driver and vehicle; actions and reactions of a driver, including acceleration/deceleration, brake or clutch operation, gear shift, and steering movements. Vehicle specifications and trim levels also play a role in handling, including vehicle weight distribution; suspension; tires and wheels; electronic stability control; and more. Numerous testing situations take into account different driving styles, from defensive to aggressive, as well as weather and road conditions. Track-based testing includes:

- Fishhook
- On-Center
- Step Steer
- Steering Pad



While these tests are performed for benchmarking against baseline targets, they are also used for gap analysis during the development stage, and occasionally performed to satisfy safety regulations prior to market release.

Vehicle handling tests lend themselves to be somewhat subjective. PCB® accelerometers and accessories can help achieve specific objective measurements to aid in vehicle handling analysis. PCB® sensors are small, lightweight, and hermetically sealed, making them waterproof to accommodate typical track environments.

PCB Piezotronics offers a complete line of sensors and instrumentation for vehicle driveability and ride & handling tests. Single axis and triaxial DC response accelerometers are designed to measure low-frequency vibration and motion. These units are inherently insensitive to base strain and transverse acceleration effects, and offer better thermal stability, higher overload protection, better signal-to-noise ratio, superior durability, and simpler test setups than strain gage-based DC sensors. Series 3711 and 3713 units are rugged by design; housed in titanium and hermetically sealed; and offer a single-ended output signal for each channel with power and ground leads. Series 3741 are precision units that offer a differential output signal for common-mode noise rejection. Model 356B41 triaxial, ICP® seat pad accelerometer measures whole body vibration influences associated with vehicle operation. The unit houses a triaxial accelerometer within a molded rubber pad that can be placed under a seated person or beneath a weighted test object. Model HVM100 human vibration meter utilizes accelerometer inputs to provide vibration severity measurements relative to human vibration exposure and is used with the seat pad accelerometer. Additional ICP®, triaxial accelerometers with high sensitivity, low frequency capability, and good resolution are available to aid in driveability and secondary ride measurement requirements. Series 1515-106 pedal effort force sensor is compact, lightweight, and designed to measure load applied to the brake, accelerator, and clutch pedals during acceleration, deceleration, and transmission shift events. Series 8161 and 8162 strain gage signal conditioners are used with the pedal effort force sensor. PCB® products are designed and manufactured in state-of-the-art facilities, and together with our global distribution network and Total Customer Satisfaction guarantee, you can rely on us to deliver products and solutions for your demanding requirements.



DC Response Accelerometers for Driveability and Ride & Handling Applications

Series 3741		Sensitivity	Measurement Range (pk)	Frequency (± 10%)	Broadband Resolution (rms)
		10 mV/g	± 200 g	0 to 2000 Hz	5.1 mg
		20 mV/g	± 100 g	0 to 2000 Hz	4.5 mg
		40 mV/g	± 50 g	0 to 2000 Hz	2.5 mg
		66.7 mV/g	± 30 g	0 to 2000 Hz	2.5 mg
		200 mV/g	± 10 g	0 to 200 Hz	1.1 mg
		1000 mV/g	± 2 g	0 to 150 Hz	0.3 mg
Series 3711 and 3713					
		10 mV/g	± 200 g	0 to 1500 Hz	5.3 mg
		40 mV/g	± 50 g	0 to 1500 Hz	4.4 mg
		40 mV/g, 2.5 V offset	± 50 g	0 to 1500 Hz	4.4 mg
		100 mV/g	± 20 g	0 to 1500 Hz	3.6 mg
		100 mV/g, 2.5 V offset	± 20 g	0 to 1500 Hz	3.6 mg
		700 mV/g	± 3 g	0 to 150 Hz	1.1 mg
Model Number		3741 Single Axis	3711 Single Axis	3713 Triaxial	
Overload Limit (Shock)		± 5,000 g pk	± 5000 g pk	± 5000 g pk	
Temperature Range		-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54.0 to +121 °C	-65 to +250 °F -54 to +121 °C	
Excitation Voltage		6 to 30 VDC	5 to 30 VDC	5 to 30 VDC	
Housing Material		Anodized Aluminum	Titanium	Titanium	
Sealing		Epoxy	Hermetic	Hermetic	
Size		0.30 x 1.00 x 0.85 in 7.62 x 25.4 x 21.6 mm	0.45 x 0.85 x 0.85 in 11.4 x 21.6 x 21.6 mm	1.1 in Cube 28 mm Cube	
Weight	Connector style Integral cable style	— 10 gm	14 gm 78 gm	78 gm 169 gm	
Electrical Connector		10 ft. (3 m) Integral Cable	1/4-28 4-Pin or 10 ft. (3 m) Integral Cable	9-Pin or 10 ft. (3 m) Integral Cable	
Output Configuration		Differential	Single-Ended	Single-Ended	
Supplied Accessories					
Easy Mount Clip		—	080A152	—	
Adhesive Base		—	—	080A208	
Mounting Screws/Studs		081A103 M081A103	081A64 M081A64	081A05 M081A05	
Additional Accessories					
Triaxial Mounting Block		080A208	080A153	—	
Mounting Cable Connectors		—	AY	EN	
Recommended Cables		—	034	037	

Triaxial, ICP® Seat Pad Accelerometer

	
Model Number	356B41
Sensitivity	100 mV/g
Measurement Range	± 10 g pk
Broadband Resolution	0.0002 g rms
Frequency Range ($\pm 5\%$)	0.5 to 1000 Hz
Temperature Range	+14 to +122 °F -10 to +50 °C
Supplied Accessory	010G05 Cable
Electrical Connector	Integral Cable
Sealing	Hermetic
Weight	272 gm
Size	7.87 x 0.472 in 200 x 12 mm

Recommended Human Vibration Monitor for Model 356B41 Seat Pad Accelerometer

Model HVM100 provides a portable, convenient way to collect and analyze data in accordance with ISO requirements for assessing steering wheel hand-arm and whole-body vibration exposure. This handheld instrument measures human exposure to vibration, performs relevant calculations, and provides overall metrics on its LCD display.

For more information on Model HVM100, please visit www.larsondavis.com





Driveability and Ride & Handling Sensors

Triaxial ICP® Accelerometers

			
Model Number	356A16	356A17	356B18
Sensitivity	100 mV/g	500 mV/g	1000 mV/g
Measurement Range	± 50 g pk	± 10 g pk	± 5 g pk
Broadband Resolution	0.0001 g rms	0.00006 g rms	0.00005 g rms
Frequency Range (± 10 %)	0.3 to 6000 Hz	0.3 to 4000 Hz	0.3 to 5000 Hz
Temperature Range	- 65 to +176 °F - 54 to +80 °C	- 65 to +176 °F - 54 to +80 °C	- 20 to +170 °F - 29 to +77 °C
Electrical Connector	1/4-28 4-Pin Jack	1/4-28 4-Pin Jack	1/4-28 4-Pin Jack
Sealing	Epoxy	Epoxy	Epoxy
Housing Material	Anodized Aluminum	Anodized Aluminum	Anodized Aluminum
Weight	7.4 gm	9.3 gm	25 gm
Size	0.55 in Cube 14 mm Cube	0.55 in Cube 14 mm Cube	0.80 in Cube 20.3 mm Cube
Mounting	10-32 Thread	5-40 Thread	10-32 Thread
Supplied Accessories			
Wax/Adhesive	080A109	080A109	080A109
Mounting Base	080A12	080A145	080A68
Mounting Stud	081B05 M081B05	081A27 M081A27	081B05 M081B05
Additional Accessories			
Magnetic Mounting Base	080A27	—	080A27
Removal Tool	039A10	039A10	—
Mating Cable Connectors	AY	AY	AY
Recommended Stock Cables	034	034	034

Pedal Effort Force Sensor

			
Model Number	1515-106-01A	1515-106-02A	1515-106-03A
Measurement Range	100 lb 0.44 kN	200 lb 0.89 kN	300 lb 1.33 kN
Overload Limit	500 lb 2.20 kN	1000 lb 4.40 kN	1500 lb 6.67 kN
Temperature Range	-65 to +200 °F -54 to +93 °C		
Size	2.63 x 1.19 in 66.80 x 30.23 mm		
Weight	0.49 kg		
Housing Material	Plated Steel		
Electrical Connector	Pigtail Ends		

Recommended Signal Conditioners for Series 1515-106 Pedal Effort Force Sensor



Series 8161

DIN rail, 35 mm, strain gage signal conditioner, operates from 12 to 28 VDC, provides 5 or 10 VDC bridge excitation, and delivers ± 5 or ± 10 volts and 4 to 20 mA output signals. Adjustable zero and span with built-in shunt calibration.



Series 8162

Strain gage signal conditioner in IP66 (NEMA 4X) enclosure operates from 12 to 28 VDC and provides 5 or 10 VDC bridge excitation, and delivers ± 5 or ± 10 volts and 4-20 mA output via screw terminal connections. Adjustable zero and span with built-in shunt calibration.

Recommended Signal Conditioner for Series 3741


Model 482C27
Four-channel, line powered, bridge, incremental gain, digital control interface, RS-232 and ethernet

Recommended Signal Conditioners for Series 3711 & 3713

	
Model 478A01	Model 478B05
Single-channel unity gain (internal battery powered)	Three-channel unity gain 36 VDC power adaptor (optional external battery pack)



Motorsport Sensors

Accelerometers; Force Sensors; Preamplifiers; Microphones; Torque Sensors; Pressure Sensors; Load Cells; Modally Tuned®, ICP®, Impact Hammers; and Signal Conditioners





Motorsport encompasses more than just Formula 1 and NASCAR automobiles vying for first place glory as they power around a track at speeds topping 220 mph. The Motorsport industry also entails the racing of motorcycles, trucks, water craft, snowmobiles, go carts, and even lawn mowers. Whatever it is that's racing, these vehicles are high performance, finely-tuned, engineering marvels designed to win. Drivers, and the owners of these vehicles, continually seek to better understand and improve materials, components, and systems, as well as to ensure safety. This is accomplished by engineers spending painstakingly long hours in the design labs and testing tracks around the world.

In an industry where fractions of a second can mean the difference between victory and defeat, every effort is taken to gain and maintain a competitive advantage. To this end, motorsport companies routinely test and analyze current and newly developed materials, components, systems, and technologies to get increased efficiency and the highest performance achievable. When seconds count, nothing should go into a vehicle unless it adds to its performance. In order to verify positive performance, motorsport companies typically conduct tests and studies including:

- Ride & handling
- Powertrain development
- Component & system performance
- Vehicle and powertrain NVH
- Modal analysis

PCB® Piezotronics offers a complete line of sensors and instrumentation for the motorsport industry. Models 3711A03 and 3711A05 single axis DC response accelerometers are designed exclusively for data acquisition systems commonly used in the motorsport industry. Titanium housed and hermetically sealed, these units offer a single-ended 2.5V offset output signal for each channel with power and ground leads, and are ideal for use in both lab and test track situations. New Series 5300D TORKDISC® in-line rotary torque sensor systems have high torsional stiffness, are compact and low weight, and are used in powertrain development where axial space is at a premium, as it is in most motorsport vehicles. New Series 339A, triaxial ICP® accelerometers, with a temperature coefficient of less than 0.0125% / °F (0.02% / °C), are titanium housed and hermetically sealed 10 mm cubes that have a 10 mV/g sensitivity, a measurement frequency to 10 kHz, and an operating temperature range from -65 to +325 °F (-54 to +163 °C). These sensors provide precision amplitude data for test applications with large thermal shifts such as powertrain vibration testing, powertrain NVH, certain vehicle systems NVH tests, road load data acquisition, and durability testing in climatic chambers. PCB® also offers an extensive range of single and triaxial ICP® accelerometers; prepolarized and externally-polarized microphones; ICP® preamplifiers and array microphones; ICP® force sensors; ICP® quartz force rings; instrumented impact hammers; and ICP® sensor signal conditioners for use in numerous additional motorsport measurement scenarios. PCB® products are designed and manufactured in our state-of-the-art facilities, and together with our global distribution network and Total Customer Satisfaction guarantee, you can rely on us to deliver products and solutions for your demanding requirements.





DC Response Accelerometers for Motorsport Applications

PCB® Series 3741 DC response accelerometers are offered in a variety of full-scale ranges, from ± 2 to ± 200 g, to accommodate many motorsport testing requirements. The units feature silicon MEMS sensing elements for uniform, repeatable performance. Gas damping, mechanical over range stops, and a low profile, hard-anodized, aluminum housing are utilized for added durability. Electrically, the units offer a differential output signal for common-mode noise rejection.

PCB® Series 3711 (single axis) and 3713 (triaxial) DC response accelerometers are designed to measure low-frequency vibration and motion, and are offered in full-scale ranges from ± 3 to ± 200 g, to accommodate a variety of motorsport testing requirements. The units feature gas-damped, silicon MEMS sensing elements that provide performance, while hermetically sealed titanium housings provide protection from harsh contaminants. These units are inherently insensitive to base strain and transverse acceleration effects, and offer high-frequency overload protection. Electrically, the units offer a single-ended output signal for each channel with power and ground leads.

PCB® Models 3711A03 and 3711A05 single axis DC response accelerometers are designed exclusively for data acquisition systems commonly used in the motorsport industry. Titanium housed and hermetically sealed, these units are ideal for use in both lab and test track situations.



DC Response Accelerometers for Motorsport Applications				
Series 3741	Sensitivity	Measurement Range (pk)	Frequency ($\pm 10\%$)	Broadband Resolution (rms)
	10 mV/g	± 200 g	0 to 2000 Hz	5.1 mg
	20 mV/g	± 100 g	0 to 2000 Hz	4.5 mg
	40 mV/g	± 50 g	0 to 2000 Hz	2.5 mg
	66.7 mV/g	± 30 g	0 to 2000 Hz	2.5 mg
	200 mV/g	± 10 g	0 to 200 Hz	1.1 mg
	1000 mV/g	± 2 g	0 to 150 Hz	0.3 mg
Series 3711 and 3713				
	10 mV/g	± 200 g	0 to 1500 Hz	5.3 mg
	40 mV/g	± 50 g	0 to 1500 Hz	4.4 mg
	40 mV/g, 2.5 V offset	± 50 g	0 to 1500 Hz	4.4 mg
	100 mV/g	± 20 g	0 to 1500 Hz	3.6 mg
	100 mV/g, 2.5 V offset	± 20 g	0 to 1500 Hz	3.6 mg
	700 mV/g	± 3 g	0 to 150 Hz	1.1 mg
Model Number	3741 Single Axis	3711 Single Axis	3713 Triaxial	
Overload Limit (Shock)	$\pm 5,000$ g pk	± 5000 g pk	± 5000 g pk	
Temperature Range	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54.0 to +121 °C	-65 to +250 °F -54 to +121 °C	
Excitation Voltage	6 to 30 VDC	5 to 30 VDC	5 to 30 VDC	
Housing Material	Anodized Aluminum	Titanium	Titanium	
Sealing	Epoxy	Hermetic	Hermetic	
Size	0.30 x 1.00 x 0.85 in 7.62 x 25.4 x 21.6 mm	0.45 x 0.85 x 0.85 in 11.4 x 21.6 x 21.6 mm	1.1 in Cube 28 mm Cube	
Weight	—	14 gm 78 gm	78 gm 169 gm	
Connector style	—	—	—	
Integral cable style	10 gm	—	—	
Electrical Connector	10 ft. (3 m) Integral Cable	1/4-28 4-Pin or 10 ft. (3 m) Integral Cable	9-Pin or 10 ft. (3 m) Integral Cable	
Output Configuration	Differential	Single-Ended	Single-Ended	
Supplied Accessories				
Easy Mount Clip	—	080A152	—	
Adhesive Base	—	—	080A208	
Mounting Screws/Studs	081A103 M081A103	081A64 M081A64	081A05 M081A05	
Additional Accessories				
Triaxial Mounting Block	080A208	080A153	—	
Mounting Cable Connectors	—	AY	EN	
Recommended Cables	—	034	037	

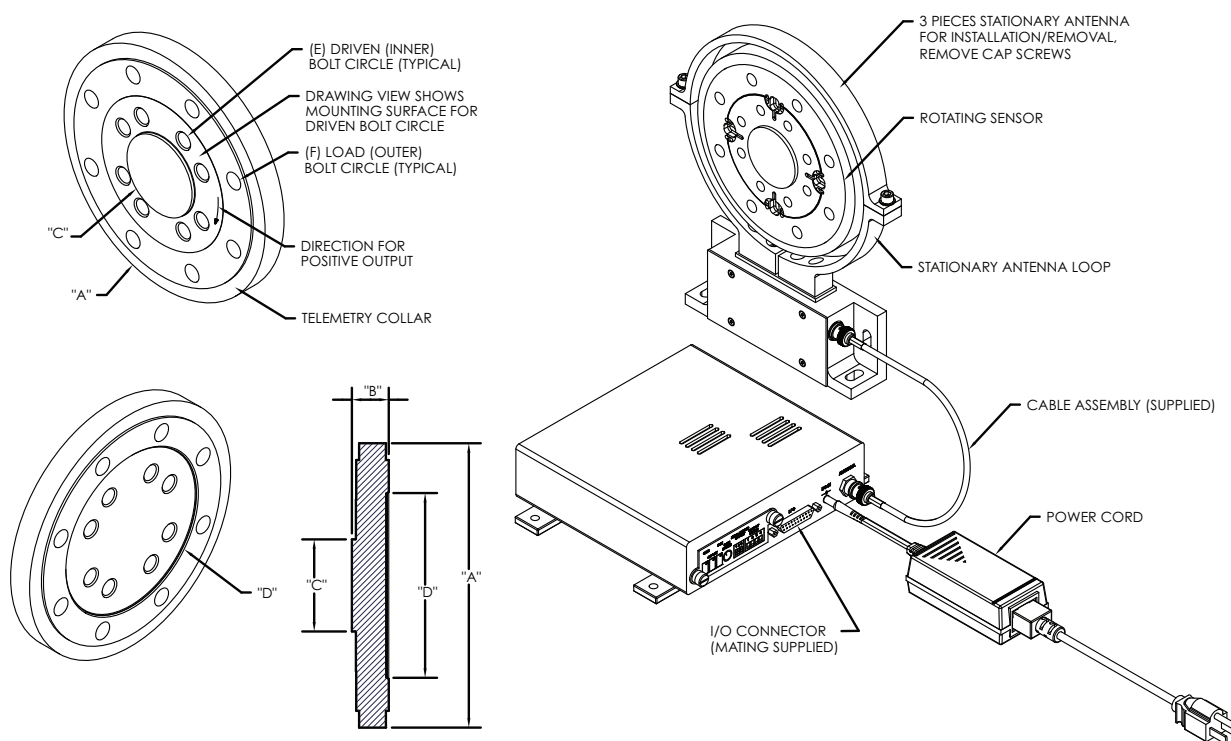


Series 5300D

TORKDISC® In-line Rotary Torque Sensor System for Motorsport Applications

PCB® Series 5300D sensors are designed for dynamometer and other test applications requiring a robust rotary torque transducer where axial space is at a premium. Onboard, the transducer is a field proven electronic module that converts the torque signals into a high-speed digital representation. Once in digital form, this data is transmitted to a non-contacting pick-up loop, with no risk of noise or data corruption. A remote receiver unit converts the digital data to a high-level analog output voltage, and a serial digital output.

Series 5300D incorporates dual high level analog outputs, AC and DC coupled, providing both static and dynamic torque measurement capability that can be recorded separately and independently scaled; which is particularly beneficial when high DC levels are present or when low levels of AC content is of particular interest. Series 5300D also features industry leading bandwidth, DC to 8500 Hz, resulting in increased dynamic response characteristics. The DC coupled output features an 8-pole low pass elliptical filter with user selectable frequencies for minimal roll off at each filter selection. A 2-pole Butterworth high pass filter with a wide range of user selectable cut off frequencies is included with the AC coupled output.



The TORKDISC® and receiver make up a complete system. No additional signal conditioning is required. The receiver box provides voltage and digital output via a 25-pin I/O connector.

TORKDISC® In-line Rotary Torque Sensor System Dimensions

	A	B	C	D	E	F
Series	O.D. - Outside Diameter (including telemetry collar)	Overall Thickness	Pilot	Pilot	Driven (inner) Bolt Circle	Load (outer) Bolt Circle
5302D	7.00 in 177.8 mm	1.10 in 27.9 mm	1.999 in 50.8 mm	4.375 in 111.1 mm	(8) 3/8-24 threaded holes, spaced on a 3.00 in (76.20 mm) B.C.	(8) 0.406 in (10.31 mm) dia. through holes equally spaced on a 5.00 in (127.0 mm) B.C.
5308D	8.49 in 215.5 mm	1.10 in 27.9 mm	2.748 in 69.9 mm	5.513 in 140.0 mm	(8) 5/8-11 threaded holes, spaced on a 3.75 in (95.25 mm) B.C.	(8) 0.531 in (13.49 mm) dia. through holes equally spaced on a 6.5 in (165.0 mm) B.C.
5309D	10.49 in 241.0 mm	1.64 in 41.7 mm	3.998 in 101.5 mm	7.500 in 190.5 mm	(12) 5/8-11 threaded holes, spaced on a 6.0 in (152.4 mm) B.C.	(16) 0.531 in (13.49 mm) dia. through holes equally spaced on a 8.5 in (215.9 mm) B.C.
5310D	17.98 in 456.7 mm	2.09 in 53.0 mm	5.499 in 139.7 mm	11.001 in 279.4 mm	(12) 7/8-14 threaded holes, spaced on a 9.0 in (228.6 mm) B.C.	(16) 0.780 in (19.8 mm) dia. through holes equally spaced on a 13.0 in (330.2 mm) B.C.

Notes [1] Extraneous load limits reflect the maximum axial load, lateral load, and bending moment that may be applied singularly without electrical or mechanical damage to the sensor. Where combined extraneous loads are applied, decrease loads proportionally. Request Application Note AP-1015 regarding the effects of extraneous loads on the torque sensor output



TORKDISC® Rotary Torque Sensor System

Model Number	Unit	5302D-05A	5302D-03A	5302D-01A	5302D-02A	5302D-04A	5308D-01A	5308D-02A
Continuous Rated Capacity	in-lb N-m	250 28	1000 113	2000 226	5000 565	6250 706	10k 1130	20k 2260
Bolt Joint Slip Torque	in-lb N-m	3300 373	3300 373	3300 373	10k 1130	10k 1130	35k 4000	35k 4000
Safe Overload	in-lb N-m	750 85	3000 339	6000 678	15k 1695	15k 1695	30k 3400	60k 6775
Failure Overload	in-lb N-m	1000 113	4000 452	8000 904	20k 2260	20k 2260	40k 4500	80k 9040
Torsional Stiffness	in-lb/rad N-m/rad	300k 34k	2.9M 328k	5.8M 655k	14.5M 1.6M	14.5M 1.6M	33.5M 3.8M	67M 7.6M
Torsional Angle @ Capacity	degrees	0.125	0.02	0.02	0.02	0.02	0.017	0.017
Rotating Inertia	in-lb sec ² N-m sec ²	0.030 0.003	0.056 0.006	0.056 0.006	0.117 0.013	0.117 0.013	0.24 0.027	0.24 0.027
Axial Load Limit [1]	lb N	62.5 278	250 1112	500 2224	1000 4448	1000 4448	1350 6000	2700 12k
Lateral Load Limit [1]	lb N	62.5 278	250 1112	500 2224	1000 4448	1000 4448	1650 7300	3375 15k
Bending Moment Limit [1]	in-lb N-m	125 14	750 85	1500 169	3000 339	3000 339	5000 565	7500 850
Maximum Speed	RPM	15k	15k	15k	15k	15k	10k	10k
Rotor Weight	lb kg	2 0.91	3.5 1.59	3.5 1.59	9 4.08	9 4.08	10 4.5	10 4.5
Rotor Material		Aluminum	Aluminum	Aluminum	Steel	Steel	Steel	Steel
Model Number	Unit	5308D-03A	5309D-01A	5309D-02A	5310D-03A	5310D-01A	5310D-02A	5310D-04A
Continuous Rated Capacity	in-lb N-m	30k 3400	50k 5650	100k 11.3k	120k 13.6k	180k 20.3k	200k 22.5k	225k 25.4k
Bolt Joint Slip Torque	in-lb N-m	35k 4000	85k 9600	110k 12.4k	268k 30.3k	268k 30.3k	268k 30.3k	268k 30.3k
Safe Overload	in-lb N-m	75k 8475	100k 11.3k	200k 22.6k	360k 40.7k	540k 61.0k	600k 67.8k	675k 76.3k
Failure Overload	in-lb N-m	100k 11.3k	125k 14k	250k 28.2k	480k 54.2k	720k 81.3k	800k 90.4k	900k 101.7k
Torsional Stiffness	in-lb/rad N-m/rad	100M 11.3M	115M 13M	230M 26M	730k 82.5k	1.1B 24M	1.2B 138M	1.35B 152.5M
Torsional Angle @ Capacity	degrees	0.017	0.017	0.017	0.01	0.01	0.01	0.01
Rotating Inertia	in-lb sec ² N-m sec ²	0.24 0.027	0.874 0.099	0.874 0.099	7.514 0.849	7.514 0.849	7.514 0.849	7.514 0.849
Axial Load Limit [1]	lb N	4000 17.8k	5000 22.2k	10k 44.5k	12k 53.4k	13.5k 60k	14k 62k	15k 66.7k
Lateral Load Limit [1]	lb N	5000 22.2k	5000 22.2k	10k 44.5k	12k 53.4k	13.5k 60k	14k 62k	15k 66.7k
Bending Moment Limit [1]	in-lb N-m	10k 1130	25k 2825	50k 5650	80k 9039	90k 10.2k	95k 10.7k	100k 11.3k
Maximum Speed	RPM	10k	10k	10k	4500	4500	4500	4500
Rotor Weight	lb kg	10 4.5	30 13.6	30 13.6	100 45	100 45	100 45	100 45
Rotor Material		Steel	Steel	Steel	Steel	Steel	Steel	Steel

Series 5300D Common Specifications

System Output		Temperature	
Voltage Output A	AC Coupled, 0 to ± 10 volt w/ independent coarse gain control (16 increments)	Rotor Temp. Range Compensated	+70 to +170 °F (+21 to +77 °C)
Voltage Output B	DC Coupled, 0 to ± 10 volt w/ independent fine and coarse gain control	System Temp. Effect on Output [2]	± 0.002% FS/°F (± 0.0036% FS/°C)
Digital Output:	QSPI	System Temp. Effect on Zero [2]	± 0.002% FS/°F (± 0.0036% FS/°C)
System Performance		Rotor/Stator Temp. Range Usable	+32 to +185 °F (0 to +85 °C)
Accuracy	Overall, 0.1% FS, combined effect of Non-Linearity, Hysteresis, & Repeatability	Rotor/Stator Optional Temp. Range Usable	+32 to +250 °F (0 to +121 °C)
Voltage Output A Filter (AC)	2-pole Butterworth high pass w/ selectable cutoff frequencies of 5, 10, 20, 200, 500, & 735 Hz, & 8-pole low pass determined by the DC coupled output cutoff frequency selection	Receiver Temp. Range Usable	0 to +122 °F (-17 to +50 °C)
Voltage Output B Filter (DC)	8-pole elliptical low pass w/selectable cutoff frequencies of > 8.5k, 5k, 2.5k, 1.25k, 625, 313, 10, & 1 Hz	Mechanical	
Bandwidth	DC to 8500 Hz anti-alias	Permissible Radial Float, Rotor to Stator	± 0.25 in (± 6.35 mm)
Digital resolution	16-bit	Permissible Axial Float, Rotor to Stator	± 0.25 in (± 6.35 mm)
Analog Resolution	0.030% FS (10 volts/32,768)	Dynamic Balance	ISO G 2.5
Digital Sample Rate	26,484 samples/sec	Sensor Positional Sensitivity	≅ 0.1% FS (180° rotation)
Group Delay	≅ 110 microseconds at 10 kHz	Power	
Noise	≤10 mV at 10 kHz	Power Requirements	9 to 18 VDC, 15 watts (90 to 240VAC 50-60 Hz, adaptor is supplied)
Noise Spectral Density	< 0.0005%FS per root Hz typical	Miscellaneous	
		Symmetry Adjustment	Factory and user adjustable ± 0.5% FS
		Supplied Cable, Stator to Receiver	24 ft. (7.3 m), RG 58/U (BNC plug/stator side, TNC plug/receiver side)
		Optional Cable, Stator to Receiver	80 ft. (24.4 m), RG 58/U (contact factory for longer lengths)
		Output Interface	DB-25 female connector (mating supplied w/backshell)
		Calibration	Unipolar shunt calibration, invoked from the receiver front panel
		Stator Assembly	Top half of loop is removable for easy installation over rotor
		Notes	
		[2] Within compensated range	



Microphones and Preamplifiers for Motorsport Applications

Series 130 ICP® Array Microphones provide a cost-effective method for large channel count sound pressure measurements such as beam forming holography and pressure mapping. Powered by standard ICP® sensor signal conditioners, these microphones are interchangeable with ICP® accelerometers and include an integrated preamplifier. Array kits are also available, complete with patch panel, cables, and signal conditioners.



Model 130D20
(BNC Connector)



Model 130D21
(10-32 Connector)



ICP® Array Microphones with Integral Preamplifier

Model Number	130D20	130D21
Microphone Diameter	1/4 in	1/4 in
Response	Free-Field	Free-Field
Sensitivity (± 3 dB at 250 Hz)	45 mV/Pa	45 mV/Pa
Frequency Response (± 1 dB)	100 to 4000 Hz	100 to 4000 Hz
Frequency Response ($-2, +5$ dB)	20 to 15k Hz	20 to 15k Hz
Dynamic Range (10 Hz to 10 kHz, ref. 20 μ Pa)	< 30 to > 122 dB	< 30 to > 122 dB
Polarization Voltage	0 V	0 V
Temperature Range	+14 to +122 °F -10 to +55 °C	+14 to +122 °F -10 to +55 °C
Connector	BNC Jack	10-32 Jack
TEDS IEEE P1451.4	Optional	Optional

Prepolarized (0V) Precision Condenser Microphone Cartridges

Model Number	377C01
Diameter	1/4 in
Response	Free-Field
Open Circuit Sensitivity (at 250 Hz)	2 mV/Pa
Frequency Range (± 2 dB)	5.4 to 80k Hz
Dynamic Range - 3% Distortion Limit [1]	165 dB
Dynamic Range - Cartridge Thermal Noise [1]	28 dB (A)
Temperature Range	-40 to +248 °F -40 to +120 °C
Notes	
[1] re 20 μ Pa	



Model 377C01



Model 426B03
1/4" ICP® Preamplifier



Preamplifiers

Model Number	426B03
Diameter	1/4 in
Gain (Attenuation) [1]	-0.08 dB
Frequency Response (± 0.1 dB)	5 to 126k Hz
Electrical Noise (A-weight) [1]	≤ 3.2 μ V
Electrical Noise (Linear) [1]	≤ 5.6 μ V
Output Voltage (Maximum)	± 8 V pk
Temperature Range	-40 to +158 °F -40 to +70 °C
Output Connector	10-32 Coaxial Jack
TEDS IEEE P1451.4	Yes
Notes	
[1] Measured with an 18 pF reference microphone	



Industry exclusive PCB® Model HT378B02 is the world's first IEC compliant microphone and preamplifier combination that has an operating capability to 120 °C (250 °F), perfect for acoustic measurements near high performance powertrain components, underhood, engine, manifold and other high temperature applications for the motorsport industry.



Model HT378B02

High Temperature Acoustic Measurement System

Model Number	HT378B02
Nominal Diameter	1/2 in 12.5 mm
Response Characteristic	Free-Field
Open Circuit Sensitivity at 250 Hz (± 1.7 dB)	50 mV/Pa
Frequency Range (± 1 dB)	5 to 10k Hz
Frequency Range (± 2 dB)	3.15 to 20k Hz
Lower Limiting Frequency (-3 dB Point)	1 to 2.4 Hz
Dynamic Range (3% Distortion Value)	146 dB [1]
Dynamic Range at Nominal Sensitivity	135 dB [1]
Noise Floor (Cartridge Thermal Noise)	17 dBA [1] [2]
Excitation Voltage	20 to 32 VDC
Polarization Voltage	0 Volts (Prepolarized Style)
Constant Current Excitation	2 to 10 mA, ICP® Sensor Power
Operating Temperature - System	-40 to +250 °F -40 to +120 °C
Connector	BNC Jack
Size (Diameter x Length, with Grid Cap)	0.52 x 3.88 in 13.2 x 98 mm
Microphone Component	377B20
Preamplifier Component	HT426E01
Notes	
[1] re 20 μ V [2] 4.9 Vrms, minimum 7 Vpk	



Single and Triaxial, ICP® Accelerometers for Motorsport Applications

PCB® offers a complete line of single and triaxial, ICP® accelerometers for motorsport applications ranging from highly sensitive and lightweight sensors for low level inputs and mild environments to units with high ranges, hermetically sealed connectors, and rugged titanium construction for severe inputs and environments. With a variety of packages, mounting, and output cabling options, these sensors can accommodate virtually any motorsport testing situation. Optional “TEDS” circuitry offers ‘smart sensing’ solutions for automating sensor performance bookkeeping and structure coordinate mapping.

PCB® Series 339A Triaxial, ICP® accelerometers are designed with a low temperature coefficient, wide operating temperature range, and good broadband measurement resolution, making them ideal for any vibration measurement requiring tight control of amplitude sensitivity over a wide thermal gradient. To alleviate the effects of high frequency overloads caused by metal-to-metal inputs, a low pass filter has been incorporated, ensuring accurate data in the frequency range of interest. These sensors provide precision amplitude data for test applications with large thermal shifts such as powertrain vibration testing, powertrain NVH, certain vehicle systems NVH tests, road load data acquisition, and durability testing in climatic chambers. Sensors are available in both stud and adhesive mounting configurations.



Single Axis and Triaxial, ICP® Accelerometers for Motorsport Applications

	Single Axis			Triaxial		
Model Number	352C23	352C22	356A01	339A30	339A31	356A15
Sensitivity	5 mV/g	10 mV/g	5 mV/g	10 mV/g	10 mV/g	100 mV/g
Measurement Range	± 1000 g pk	± 500 g pk	± 1000 g pk	± 500 g pk	± 500 g pk	± 50 g pk
Broadband Resolution	0.003 g rms	0.002 g rms	0.003 g rms	0.008 g rms	0.008 g rms	0.0002 g rms
Frequency Range (± 10%)	1.5 to 15k Hz	0.7 to 13k Hz	2 to 8000 Hz [1]	2 to 10k Hz [1]	2 to 10k Hz [1]	1.4 to 6500 Hz
Temperature Range	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C	-65 to +325 °F -54 to +163 °C	-65 to +325 °F -54 to +163 °C	-65 to +250 °F -54 to +121 °C
Temperature Coefficient	0.20%/ °F 0.11%/ °C	0.23%/ °F 0.13%/ °C	0.22%/ °F 0.12%/ °C	≤ 0.01 %/ °F ≤ 0.02 %/ °C	≤ 0.01 %/ °F ≤ 0.02 %/ °C	0.20%/ °F 0.11%/ °C
Electrical Connector	3-56 Coaxial Jack	3-56 Coaxial Jack	Integral Cable	8-36 4-Pin Jack	8-36 4-Pin Jack	1/4-28 4-Pin Jack
Sealing	Epoxy	Epoxy	Hermetic	Hermetic	Hermetic	Hermetic
Housing Material	Anodized Aluminum	Anodized Aluminum	Titanium	Titanium	Titanium	Titanium
Weight	0.2 gm	0.5 gm	1.0 gm	4.0 gm	5.5 gm	10.5 gm
Size	0.11 x 0.34 x 0.16 in 2.8 x 8.6 x 4.1 mm	0.14 x 0.45 x 0.25 in 3.6 x 11.4 x 6.4 mm	0.25 in Cube 6.35 mm Cube	0.4 in Cube 10.2 mm Cube	0.55 x 0.4 x 0.4 in 14.0 x 10.2 x 10.2 mm	0.55 in Cube 14.0 Cube
Mounting	Adhesive	Adhesive	Adhesive	Adhesive	5-40 Stud	10-32 Thread
Supplied Accessories						
Wax/Adhesive	080A109	080A109	080A109 080A90	080A109	080A109	080A109 080A90
Adhesive Mounting Base	—	—	—	—	080A	080A12
Removal Tool	039A26	039A27	—	—	—	—
Mounting Studs/Screws	—	—	—	—	081A27 M081A27 081A90	081B05 M081B05
Cable Assembly	030A10	030A10	034G05	034K10	034K10	—
Additional Versions						
Alternative Option	—	—	HT356A01 High Temperature	—	—	HT356A15 High Temperature
Additional Accessories						
Magnetic Mounting Base	—	—	—	—	—	080A27
Removal Tool	—	—	—	039A08	039A08	039A10
Connector Adaptor	070A02	070A02	—	—	—	—
Mating Cable Connectors	EK	EK	AY	EH	EH	AY
Recommended Cables	030	030	034	034	034	034
Notes						
[1] Range shown is ± 5%						



Pressure Transducers for Motorsport Applications

Manufactured with a unique thin-film process to "atomically fuse" sensitive resistive material behind a recessed diaphragm, PCB® Series 1500 Pressure Transducers achieve high accuracy repeatability, and the stability expected of today's measurement and control requirements. Series 1500 sensors are used for shock absorber, struts, and brake systems studies, as well as for DC line pressure with response time up to 1 msec, and intake manifold pressure.

Pressure Sensors for Motorsport Applications

		
Series Number	1501	1502
Output	0 to 5 VDC FS	0 to 10 VDC FS
Supply Voltage (Vs)	6.5 to 30 VDC	11.5 to 30 VDC
Pressure Ranges [1]	From 0 to 10 psi (69 kPa) FS up to 0 to 6000 psi (41,370 kPa) FS	
Accuracy [1][2]	≤ ±0.25% FS or ≤ ±0.5% FS	
Response Time	≤ 1 ms	
Burst Pressure	> 35x for ≤ 100 psi (≤ 670 kPa) > 20x for ≤ 1000 psi (≤ 6,890 kPa) > 5x for ≤ 6000 psi (≤ 41,370 kPa)	
Operating Temperature [1]	-40 to +260 °F -40 to +125 °C	
Compensated Temperature Range	-5 to +180 °F -20 to +80 °C	
Thermal Error over Compensated Range	≤ 2% FS	
Acceleration Sensitivity	≤ ±0.03% FS/g	
Vibration Survivability Rating	35 g peak sinusoidal (5 to 2000 Hz)	
Pressure Ports [1]	English, NPT, SI, and "M" Threads	
Materials: Wetted parts Housing	17-4 PJ SS 316/316L SS	
Electrical Connection [1]	Solder Tabs, Connector or Integral Cable	
Notes		
[1] Consult your PCB Piezotronics representative for specific ordering information and options		
[2] Accuracy is calculated as the square root of the sum of the squares of non-linearity, non-repeatability and hysteresis		

Modally Tuned®, ICP® Impact Hammers for Motorsport Applications

		
Model Number	086C03	086D05
Sensitivity	10 mV/lbf 2.25 mV/N	1 mV/lbf 0.23 mV/N
Measurement Range	500 lbf pk 2200 N pk	5000 lbf pk 22,000 N pk
Resonant Frequency	≥ 22 kHz	≥ 22 kHz
Hammer Mass	0.16 kg	0.32 kg
Tip Diameter	0.25 in 6.3 mm	0.25 in 6.3 mm
Hammer Length	8.5 in 215.9 mm	9.0 in 228.6 mm
Electrical Connection	BNC Jack	BNC Jack
Extender Mass Weight	75 gm	200 gm
Supplied Accessories		
Extender Mass	—	084A09
Mounting Studs	081B05	081B05
Aluminum Extender	084A08	—
Hard Tip	084B03	084B03
Medium Tip	084B04	084B04
Soft Tip	084C05	084C05
Super Soft Tip	084C11	084A50
Tip Cover	085A10	085A10

Modally Tuned®, ICP® Impact Hammers for Motorsport Applications

Modally Tuned®, ICP® Impact hammers are easy-to-use solutions for delivering impulse forces into automotive test structures. "Modal tuning" is a technology that ensures the structural characteristics of the hammer do not affect measurement results. This is accomplished by eliminating hammer resonances in the frequency range of interest from corrupting the test data, resulting in more accurate and consistent outcomes.

Modally Tuned®, ICP® impact hammers are also available in convenient kits which include the response accelerometers, signal conditioners, cables, and accessories needed for automotive component structural testing. Consult the PCB® web site at www.pcb.com for further details.



ICP® Quartz Force Ring for Motorsport Applications

				
Model Number	201B02	201B03	201B04	201B05
Measurement Range (Compression)	100 lb 0.4448 kN	500 lb 2.224 kN	1000 lb 4.448 kN	5000 lb 22.24 kN
Sensitivity	50 mV/lb 11,240 mV/kN	10 mV/lb 2248 mV/kN	5 mV/lb 1124 mV/kN	1 mV/lb 224.8 mV/kN
Maximum Static Force (Compression)	600 lb 2.67 kN	3000 lb 13.34 kN	6000 lb 26.69 kN	8000 lb 35.59 kN
Broadband Resolution	0.002 lb-rms	0.01 lb-rms	0.02 lb-rms	0.10 lb-rms
Low Frequency Response (-5 %)	0.001 Hz	0.0003 Hz	0.0003 Hz	0.0003 Hz
Temperature Range	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C
Electrical Connector	10-32 Coaxial Jack	10-32 Coaxial Jack	10-32 Coaxial Jack	10-32 Coaxial Jack
Sealing	Hermetic	Hermetic	Hermetic	Hermetic
Housing Material	Stainless Steel	Stainless Steel	Stainless Steel	Stainless Steel
Weight	10 gm	10 gm	10 gm	10 gm
Size (Diameter x Height x Through Hole Diameter)	0.65 x 0.31 x 0.25 in 16.5 x 7.9 x 6.0 mm	0.65 x 0.31 x 0.25 in 16.5 x 7.9 x 6.0 mm	0.65 x 0.31 x 0.25 in 16.5 x 7.9 x 6.0 mm	0.65 x 0.31 x 0.25 in 16.5 x 7.9 x 6.0 mm
Mounting	10-32 Stud	10-32 Stud	10-32 Stud	10-32 Stud
Supplied Accessories				
Assembly Lubricant	080A82	080A82	080A82	080A82
Mounting Studs	081A11 M081A11	081A11 M081A11	081A11 M081A11	081A11 M081A11
Anti-Friction Washer	082B01	082B01	082B01	082B01
Pilot Bushing	083B01	083B01	083B01	083B01
Additional Accessories				
Mating Cable Connectors	EB, EJ	EB, EJ	EB, EJ	EB, EJ
Recommended Cables	002 Low Cost, 003 CE	002 Low Cost, 003 CE	002 Low Cost, 003 CE	002 Low Cost, 003 CE

Multi-purpose, ICP® Force Sensors for Motorsport Applications

					
Model Number	208C01	208C02	208C03	208C04	208C05
Measurement Range (Compression)	10 lb 0.04448 kN	100 lb 0.4448 kN	500 lb 2.224 kN	1000 lb 4.448 kN	5000 lb 22.24 kN
Sensitivity	500 mV/lb 112,410 mV/kN	50 mV/lb 11,241 mV/kN	10 mV/lb 2248 mV/kN	5 mV/lb 1124 mV/kN	1 mV/lb 224.82 mV/kN
Maximum Static Force (Compression)	60 lb 0.27 kN	600 lb 2.669 kN	3000 lb 13.5 kN	6000 lb 26.69 kN	8000 lb 35.59 kN
Broadband Resolution	0.0001 lb-rms	0.001 lb-rms	0.005 lb-rms	0.01 lb-rms	0.05 lb-rms
Low Frequency Response (-5 %)	0.01 Hz	0.001 Hz	0.0003 Hz	0.0003 Hz	0.0003 Hz
Temperature Range	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C
Electrical Connector	10-32 Coaxial Jack	10-32 Coaxial Jack	10-32 Coaxial Jack	10-32 Coaxial Jack	10-32 Coaxial Jack
Sealing	Hermetic	Hermetic	Hermetic	Hermetic	Hermetic
Housing Material	Stainless Steel	Stainless Steel	Stainless Steel	Stainless Steel	Stainless Steel
Weight	22.7 gm	22.7 gm	22.7 gm	22.7 gm	22.7 gm
Size	5/8 x 0.5 in 5/8 in x 12.7 mm	5/8 x 0.5 in 5/8 in x 12.7 mm	5/8 x 0.5 in 5/8 in x 12.7 mm	5/8 x 0.5 in 5/8 in x 12.7 mm	5/8 x 0.5 in 5/8 in x 12.7 mm
Mounting	10-32 Thread	10-32 Thread	10-32 Thread	10-32 Thread	10-32 Thread
Supplied Accessories					
Thread Locker	080A81	080A81	080A81	080A81	080A81
Mounting Studs	081B05 M081A62	081B05 M081A62	081B05 M081A62	081B05 M081A62	081B05 M081A62
Impact Cap	084A03	084A03	084A03	084A03	084A03



Motorsport Sensors

Triaxial, ICP® Force Sensors for Motorsport Applications



CE



CE



CE



CE



Model Number	260A01	260A02	260A03	261A01
Measurement Range (z axis)	1000 lb 4.45 kN	1000 lb 4.45 kN	10,000 lb 44.48 kN	1000 lb 4.45 kN
Measurement Range (x or y axis)	500 lb 2.22 kN	1000 lb 4.45 kN	4000 lb 17.79 kN	500 lb 2.22 kN
Sensitivity (z axis)	2.5 mV/lb 0.56 mV/N	2.5 mV/lb 0.56 mV/N	0.25 mV/lb 0.06 mV/N	2.5 mV/lb 0.56 mV/N
Sensitivity (x or y axis)	10 mV/lb 2.25 mV/N	5 mV/lb 1.12 mV/N	1.25 mV/lb 0.28 mV/N	10 mV/lb 2.25 mV/N
Broadband Resolution (z axis)	0.006 lb-rms	0.006 lb-rms	0.05 lb-rms	0.006 lb-rms
Broadband Resolution (x or y axis)	0.002 lb-rms	0.006 lb-rms	0.01 lb-rms	0.002 lb-rms
Upper Frequency Limit	90 kHz	90 kHz	39 kHz	10 kHz
Non-Linearity	≤ 1 % FS	≤ 1 % FS	≤ 1 % FS	≤ 1 % FS
Temperature Range	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C
Housing Material	Stainless Steel	Stainless Steel	Stainless Steel	Stainless Steel
Sealing	Hermetic	Hermetic	Hermetic	Hermetic
Size	1.075 x 0.95 x 0.39 in 27.3 x 24.1 x 9.9 mm	1.35 x 1.25 x 0.39 in 34.3 x 31.8 x 9.9 mm	2.25 x 2.25 x 0.79 in 57.1 x 57.1 x 20.07 mm	1.66 x 1.66 x 1.96 in 42.04 x 42.04 x 41.96 mm
Weight	26 gm	45 gm	271 gm	386 gm

Supplied Accessories

Mounting Stud	081A70	081A74	081A71	—
Anti-Friction Washer	082B02	082M12	082B06	—
Pilot Bushing	083A10	083A13	083A11	—

Additional Accessories

Mating Cable Connectors	AY	AY	AY	AY
Recommended Cable	010	010	010	010

Notes

Charge mode versions of each of these models are also available



Series 1203

Low Profile Load Cell Sensors for Motorsport Applications

Model Number	1203-01A	1203-03A	1203-05A
Sensitivity	2 mV/V	2 mV/V	3 mV/V
Measurement Range	500 lb 2.224 kN	2000 lb 8.896 kN	10,000 lb 44.48 kN
Overload Limit	750 lb 3.336 kN	3000 lb 13.34 kN	15,000 lb 66.72 kN
Non-Linearity	≤ 0.05 % FS	≤ 0.05 % FS	≤ 0.05 % FS
Hysteresis	≤ 0.05 % FS	≤ 0.05 % FS	≤ 0.05 % FS
Non-Repeatability	≤ 0.02 % FS	≤ 0.02 % FS	≤ 0.02 % FS
Temperature Range	-65 to +200 °F -54 to +93 °C	-65 to +200 °F -54 to +93 °C	-65 to +200 °F -54 to +93 °C
Bridge Resistance	700 ohm	700 ohm	700 ohm
Excitation Voltage	10 VDC	10 VDC	10 VDC
Weight	1.31 kg	1.31 kg	1.31 kg
Size	4.12 x 1.37 in 104.6 x 34.8 mm	4.12 x 1.37 in 104.6 x 34.8 mm	4.12 x 1.37 in 104.6 x 34.8 mm
Mounting	5/8 - 18 Thread	5/8 - 18 Thread	5/8 - 18 Thread
Electrical Connector	PT02E-10-6P	PT02E-10-6P	PT02E-10-6P

Additional Versions

Alternate Electrical Connector	1203-01B PC04E-10-6P	1203-03B PC04E-10-6P	1203-05B PC04E-10-6P
Alternate Mounting	M1203-01A M1203-01B Metric	M1203-03A M1203-03B Metric	M1203-05A M1203-05B Metric

Additional Accessories

Mounting Base	084A100 M084A100	084A100 M084A100	084A100 M084A100
---------------	---------------------	---------------------	---------------------



Recommended Signal Conditioners for Motorsport Applications

PCB® provides the appropriate signal conditioning necessary for sensor excitation and to prepare measurement signals for readout, recording, analysis, or control. Available features can include gain, integration, filtering, alarm relays, zero clamping, and conversion to rms or peak values. Additionally, essential cables and accessories to support a successful installation are available.

Recommended Signal Conditioners for Strain Gage Load Cell Sensors

	
Series 8159 Provides 5 or 10 VDC strain gage bridge excitation which delivers ± 10 VDC and 4 to 20 mA output signals, and operates from 115 or 230 VAC power	Series 8162 In-line, IP66 enclosure, operates from 12 to 18 VDC, provides 10 VDC strain gage sensor excitation, delivers ± 10 V and 4 to 20 mA outputs

Recommended ICP® Signal Conditioner for Force Sensors


Model 484B06 Single-channel, line powered with AC/DC coupling and BNC input/output connection

Recommended General ICP® Signal Conditioners

			
Model 482C05 4-channel, line powered, unity gain, BNC input/output connector	Model 482C16 4-channel, line powered, incremental gain x0.1 to x200, digital control interface RS-232	Model 482C54 4-channel, line powered, charge, incremental gain, TEDS, digital control interface RS-232	Model 480C02 Single-channel, battery powered, BNC input/output connector
			
Series 481A 16-channel, line powered, can be configured with options including gain, filtering, switched outputs, integration, rms conversion, computer control, and more		Model 480B21 3-channel, battery powered, gain x1, x10, x100	Model 480E09 Single-channel, battery powered, gain x1, x10, x100, and BNC input/output connection

Recommended Signal Conditioner for Series 3741 DC Response Accelerometers


Model 482C27 Four-channel, line powered, bridge, incremental gain, digital control interface, RS-232 and ethernet

Recommended Signal Conditioners for Series 3711 & 3713 DC Response Accelerometers

	
Model 478A01 Single-channel with unity gain (internal battery powered)	Model 478B05 3-channel, unity gain, with 36 VDC power adaptor (optional external battery pack)



Product Specifications:

Electronics pg. 85



Accessories pg. 99



Cables & Adaptors pg. 111



Look to PCB® for all your test & measurement needs!



Electronics



Highlights:

- Battery Powered Signal Conditioners
- DC Powered Signal Conditioners
- Line Powered Signal Conditioners
- Multi-channel ICP® Sensor Signal Conditioners
- DC Coupled Signal Conditioners
- Modular Signal Conditioners
- In-line ICP® Powered Charge Converters
- Industrial Charge Amplifiers
- MEMS Sensor Signal Conditioners
- Strain Gage Signal Conditioners



Battery-Powered Signal Conditioners



Model Number	480C02	480E09	480B10	480B21
Channels	1	1	1	3
Sensor Input Type(s)	ICP®	ICP®	ICP®	ICP®
Gain	Unity	x1, x10, x100	Unity	x1, x10, x100
Integration	—	—	Accel., Vel., Disp.	—
Low Frequency Response (-5%)	0.05 Hz [1]	0.15 Hz [1]	0.07 (a), 8 (v), 15 (d) Hz [4]	0.15 Hz [1]
High Frequency Response (-5%) (Unity Gain)	500 kHz	100 kHz	100 (a), 10 (v), 1 (d) kHz	100 kHz
Temperature Range	+32 to +122 °F 0 to +50 °C	+32 to +122 °F 0 to +50 °C	+32 to +122 °F 0 to +50 °C	+32 to +122 °F 0 to +50 °C
Power Required (Internal Batteries)	(3) 9 VDC	(3) 9 VDC	(2) 9 VDC	(3) 9 VDC
Battery Like (Standard Alkaline)	100 hours	50 hours	≥ 30 hours	25-40 hours
Excitation Voltage	27 to 29 VDC	27 to 29 VDC	16 to 19 VDC	25 to 30 VDC
Constant Current Excitation	1.9 to 3.1 mA [2]	1.9 to 3.1 mA [2]	1.4 to 2.6 mA [2]	2.75 to 3.25 mA [2]
DC Offset	≤ 30 mV [1]	≤ 30 mV [1]	≤ 30 mV [1]	≤ 30 mV [1]
Broadband Electrical Noise (Gain x1)	≤ 3.25 µV rms [3]	≤ 3.25 µV rms [1]	—	3.54 µV rms [1]
Input/Output Connectors	BNC Jacks	BNC Jacks	BNC Jacks	BNC Jacks (i/o); 4-pin Jack (i) [5]
External DC Power Input	Yes	Yes	No	Yes
DC Power Input Connector	3.5mm dia. mini Jack	3.5mm dia. mini Jack	—	6-pin mini DIN
Size (Height x Width x Depth)	4 x 2.9 x 2.2 in 10 x 7.4 x 5.6 cm	4 x 2.9 x 2.4 in 10 x 7.4 x 6.1 cm	4 x 2.9 x 1.5 in 10 x 7.4 x 3.8 cm	7.5 x 5 x 2 in 19 x 13 x 5 cm
Weight	0.7 lb 300 gm	0.7 lb 300 gm	0.61 lb 276.4 gm	1.1 lb 500 gm
Additional Accessories				
AC Power Source	488A03 or F488A03	488A03 or F488A03	—	488A10
Battery Charger	488A02 or F488A02	488A02 or F488A02	488A02 or F488A02	—
9 VDC Ultralife Lithium Batteries (3)	400A81	400A81	—	400A81
Auto Lighter 12 VDC Power Adapter	—	—	—	488A12
Additional Versions				
Rechargeable [6]	R480C02	R480E09	R480B10	—
4 mA Constant Current	—	480M122	—	—
Notes				

[1] Specified into 1M ohm load [2] Through internal current limited diode [3] Typical [4] Achieved with accelerometer having a discharge time constant of >1 second and 1M ohm load impedance [5] Use BNC jacks or 4-pin jack, not both at once. Cover all unused connectors with black ESD protective caps [6] Supplied with 488A02 recharger and (3) 073A09 9 VDC NiCAD batteries



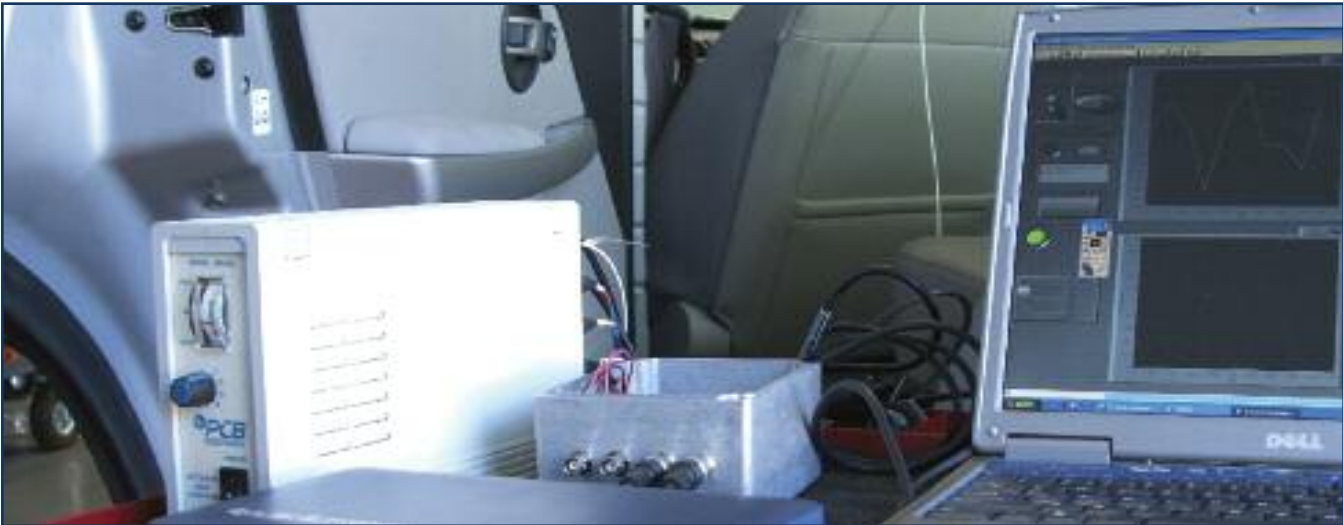


DC-Powered ICP® Sensor Signal Conditioners



Model Number	485B12	485B36
Channels	1	2
Sensor Input Type	ICP®	ICP®
Gain	Unity	Unity
Input Signal Range	± 5 V	± 5 V
Output Range	± 5 V	± 5 V
Low Frequency Response (-5%)	0.05 Hz [1]	1 Hz
High Frequency Response (-5%)	500 kHz [2]	50 kHz
Temperature Range	+32 to +122 °F 0 to +50 °C	+32 to +122 °F 0 to +50 °C
Excitation Voltage	Supply Voltage - 2 VDC	18.5 to 10.5 VDC
Constant Current Excitation	2 to 20 mA [3]	3.8 to 5.8 mA
DC Offset	<30 mV [1]	<80 mV
Broadband Electrical Noise (1 to 10,000 Hz) (Gain x1)	4 µV rms	6 µV rms
Input Connector	BNC Jack	BNC Jack
Output Connector	BNC Jack	3.5 mm Stereo Jack
External DC Power Connector	2 Banana Plugs	USB Connector
External Power Required	18 to 28 VDC	5 VDC from USB Port
Size (Height x Width x Depth)	1.44 x 2.95 x 0.7 in 3.7 x 7.5 x 1.8 cm	1.18 x 3.67 x 1.33 in 3.0 x 9.3 x 3.4 cm
Weight	1.4 oz 40 gm	2.5 oz 70 gm
Supplied Accessories		
Cables	—	(1) 009M130; (1) 009M131
Additional Versions		
10-32 Jack Input Connector	485B	—
Notes		
[1] With 1 Megohm or higher load [2] May be limited by sensor and cable length [3] User adjustable [4] Typical		





Line-Powered Signal Conditioners



CE



CE



Model Number	482A21	482B11	482C05
Channels	1	1	4
Sensor Input Type(s)	ICP®	ICP®	ICP®, Voltage
Gain	Unity	Unity	Unity
Output Range	± 10 V	± 10 V	± 10 V
Low Frequency Response (-5%)	<0.1 Hz	0.17 Hz	0.05 Hz [3]
High Frequency Response (-5%) (Unity Gain)	>1000 kHz	85 kHz	1000 kHz [3]
Fault/Bias Monitor	Meter	Meter	Open/Short/Overload LEDs
Temperature Range	+32 to +120 °F 0 to +50 °C	+30 to +130 °F -1 to +54 °C	+32 to +120 °F 0 to +50 °C
Power Required (for Supplied AC Power Adaptor)	100 to 240 VAC 47 to 63 Hz	—	100 to 240 VAC 47 to 63 Hz
Power Required (Direct Input to Unit)	+34 to +38 VDC	105 to 125 VAC/ 50 to 400 Hz	+34 to +38 VDC
Excitation Voltage	+26 VDC	+24 VDC	+26 VDC
Constant Current Excitation	2 to 20 mA [1]	2 to 20 mA [1]	0 to 20 mA [1]
DC Offset	≤ 20 mV	≤ 30 mV	≤ 20 mV
Broadband Electrical Noise (1 to 10,000 Hz) (Gain x1)	<3.5 µV rms [2]	<29 µV rms [2]	3.5 µV rms [2]
Input/Output Connectors	BNC Jacks	BNC Jacks	BNC Jacks
Electrical Connector (DC Power Input)	5-socket DIN	—	5-socket DIN
Size (Height x Width x Depth)	6.3 x 2.4 x 11 in 16 x 6.1 x 28 cm	4.3 x 1.8 x 6.0 in 10.9 x 4.6 x 15.2 cm	3.2 x 8.0 x 5.9 in 8.1 x 20 x 15 cm
Weight	1.51 lb 685 gm	2.00 lb 907.2 gm	2.25 lb 1.021 kg
Supplied Accessories			
Power Cord	(1) 017AXX	(1) 017AXX	(1) 017AXX
Universal Power Adaptor	(1) 488A04	—	(1) 488A04
Additional Accessories			
Auto Lighter Adapter	488A11	—	488A11
DC Power Pack	488B07	—	488B07
Additional Versions			
230 VAC Powered	—	F482B11	—
Internal Jumper Selectable Gain x1, x10, x100	—	—	482C15
Notes			

[1] User adjustable, factory set at 4 mA (± 0.5 mA). One control adjusts all channels [2] Typical [3] - 3dB point



Line-Powered Signal Conditioners



CE



CE



TEDS
MECHANICAL
INDICATOR

Model Number	482C16	482C54
Channels	4	4
Sensor Input Type(s)	ICP®, Voltage	ICP®, Voltage, Charge
Gain	x0.1 to x200	x0.1 to x200
Output Range	± 10 V	± 10 V
Low Frequency Response (-5%)	0.05 Hz	0.05 Hz
High Frequency Response (-5%) (Unity Gain)	100 kHz	100 kHz
Electrical Filter Corner Frequency (-3dB)	—	10 kHz [3]
Fault/Bias Monitor	Open/Short/Overload LEDs	Open/Short/Overload LEDs
Front Display/Keypad	Yes	Yes
Digital Control Interface	RS-232	RS-232
Temperature Range	+32 to +120 °F 0 to +50 °C	+32 to +120 °F 0 to +50 °C
Power Required (for Supplied AC Power Adaptor)	100 to 240 VAC/ 50 to 60 Hz	100 to 240 VAC/ 50 to 60 Hz
Power Required (Direct Input to Unit)	+9 to +18 VDC	+9 to +18 VDC
Excitation Voltage	+24 VDC	+24 VDC
Constant Current Excitation	0 to 20 mA [1]	0 to 20 mA [1]
DC Offset	≤ 50 mV	≤ 50 mV
Broadband Electrical Noise (1 to 10,000 Hz) (Gain x1)	10 µV rms [2]	50 µV rms [2]
Input/Output Connectors	BNC Jacks	BNC Jacks
Electrical Connector (DC Power Input)	6-socket mini DIN	6-socket mini DIN
Electrical Connector (Digital Control)	DB-9 Connector	DB-9 Connector
Size (Height x Width x Depth)	3.2 x 8.0 x 5.9 in 8.1 x 20 x 15 cm	3.2 x 8.0 x 5.9 in 8.1 x 20 x 15 cm
Weight	2.25 lb 1.021 kg	2.25 lb 1.021 kg
Supplied Accessories		
Power Cord	(1) 017AXX	(1) 017AXX
Universal Power Adaptor	(1) 488A14	(1) 488A14
Communication Cable	(1) 100-7103-50	(1) 100-7103-50
MCSC Control Software	(1) EE75	(1) EE75
Additional Accessories		
Auto Lighter Adapter	488A13	488A13
Additional Versions		
TEDS Sensor Support	482C26	—
Ethernet Control Interface	—	482C64
Notes		

[1] User adjustable, factory set at 4 mA (± 0.5 mA). One control adjusts all channels [2] Typical [3] Frequency tolerance is within ± 5% of the specified value





Multi-Channel, ICP® Sensor Signal Conditioners



Model Number	481A01	481A02	481A03
Channels	16	16	16
Sensor Input Type(s)	ICP®	ICP®	ICP®
Installed Series Options [1]	080	035, 080, 101, 102, 103	012, 020, 038, 080, 101, 102, 103, 157
Gain	Unity	x1, x10, x100	x0.0025 to x200
Output Range	10 V	10 V	10 V
Low Frequency Response (-5%)	0.5 Hz	0.5 Hz	0.5 Hz
High Frequency Response (-5%) (Unity Gain)	100 kHz	100 kHz	100 kHz
Filtering	—	—	Programmable Low Pass [4]
Internal/External Calibration Function	—	—	Yes
Programmable Overload Level	—	—	Yes
Front Display/Keypad	—	Yes	Yes
Fault/Bias Monitor	Open/Short/Overload LEDs	Open/Short/Overload LEDs	Open/Short/Overload LEDs
Digital Control Interface	—	RS-232	RS-232
Temperature Range	+32 to +120 °F 0 to +50 °C	+32 to +120 °F 0 to +50 °C	+32 to +120 °F 0 to +50 °C
Excitation Voltage	+24 ±1 VDC	+24 ±1 VDC	+24 ±1 VDC
Constant Current Excitation	3 to 20 mA [2]	3 to 20 mA [2]	3 to 20 mA [2]
DC Offset	50 mV	50 mV	50 mV
Broadband Electrical Noise (1 to 10,000 Hz) (Gain x1)	11 µV rms [3]	11 µV rms [3]	4 mV rms [3]
Input Connectors	(16) BNC Jacks, (1) DB50 Female	(16) BNC Jacks, (1) DB50 Female	(16) BNC Jacks, (1) DB50 Female
Output Connector	(16) BNC Jacks, (1) DB37 Female	(16) BNC Jacks, (1) DB37 Female	(16) BNC Jacks, (1) DB37 Female
Size (Height x Width x Depth)	3.5 x 19 x 16.25 in 8.9 x 48.3 x 41.3 cm	3.5 x 19 16.25 in 8.9 x 48.3 x 41.3 cm	3.5 x 19 x 16.25 in 8.9 x 48.3 x 41.3 cm
Weight	15 lb 6.82 kg	15 lb 6.82 kg	15 lb 6.82 kg
Supplied Accessories			
Power Cord	(1) 017AXX	(1) 017AXX	(1) 017AXX
Communication Cable	—	(1) 009N03	(1) 009N03
Ferrite Clamp	(1) 100-2973-30	(1) 100-2973-30	(1) 100-2973-30
MCSC Control Software	—	EE75	EE75
Additional Versions			
High Frequency version to 1 MHz	481A20	—	—
Base Configureable Model [1]	481A	481A	481A
8-channel	498A01	498A02	498A03
8-channel Dual Mode (ICP®, Charge) with 10k Hz LPF	—	—	498A30
8-channel Base Configureable Model [1]	498A	498A	498A
Notes			

[1] See 481A-498A Series brochure for more information on Series options [2] User adjustable, factory set at 4 mA (± 0.5 mA) [3] Typical

[4] Programmable 8th-order Elliptical low pass filter with >500 steps



DC-Coupled, ICP® Sensor Signal Conditioners



CE



CE



CE



Model Number	484B06	484B11	442B06	410B01
Channels	1	1	1	1
Gain	Unity	x1, x10, x100	x1, x10, x100	x0.5, x1, x2, x4, x8, x10, x16, x20
Low Frequency Response (-5%) AC, DC	0.05 Hz, 0 Hz	0.16 Hz, 0 Hz	0.05 Hz, 0 Hz	0.5 Hz, 0 Hz
High Frequency Response (-5%) (Unity Gain)	50 kHz	100 KHz	50 kHz	10 kHz
Temperature Range	+32 to +120 °F 0 to +50 °C	+32 to +120 °F 0 to +50 °C	+32 to +120 °F 0 to +50 °C	+60 to +110 °F +15 to +45 °C
Excitation Voltage	+24 ± 1.0 VDC	+24 ± 1.0 VDC	+24 ± 0.5 VDC	+18 VDC
Constant Current Excitation	2-20 mA [1]	2-20 mA [1]	1-20 mA	4 mA
DC Offset	<30 mV	<40 mV	<50 mV	<± 35 mV
Broadband Electrical Noise (Gain x1)	85 µV rms [2]	10 µV rms [2]	9.11 µV rms [2]	20 µV rms [2]
Input/Output Connectors	BNC Jacks	BNC Jacks	BNC Jacks	SMA Jacks, Screw Terminals
Peak Hold Reset Connector	—	—	—	Screw Terminals [3]
Size (Height x Width x Depth)	4.25 x 1.62 x 6.25 in 108 x 41 x 159 mm	4.3 x 1.8 x 6.0 in 109.2 x 45.7 x 152.4 mm	6.2 x 4.25 x 10.2 in 157.5 x 108 x 259.1 mm	4.39 x 0.88 x 3.63 in 111.5 x 22.4 x 92.2 mm
Weight	2 lb 907.2 gm	2 lb 907.2 gm	5.63 lb 2554 gm	0.25 lb 113.4 gm
Supplied Accessories				
Power Cord	(1) 017AXX	(1) 017AXX	(1) 017AXX	(1) 017AXX
Ferrite Clamp	—	—	(1) 100-2973-30	(1) 100-2973-30
Additional Versions				
Clamped Output, 120 VAC Powered	484B02	—	—	—
230 VAC Powered	F484B06	F484B11	—	—
Clamped Output, 230 VAC Powered	F484B02	—	—	—

Notes

[1] Unit supplied with current set at 4 +/-0.6 mA [2] Typical [3] Optically isolated contact closure





Modular-Style Signal Conditioners

				
Model Number	442B02	442C04	443B01	443B02
Style	ICP® Sensor	ICP® Sensor	Charge Mode and ICP® Sensor	Charge Mode and ICP® Sensor
Channels	1	4	1	1
Gain	x1, x10, x100	x1, x10, x100	x0.1 to x1000	x0.1 to x1000
Charge Sensitivity	—	—	0.0001 to 10 V/pC	0.0001 to 10 V/pC
Low Frequency Response (-5%)	0.05 Hz	0.05 Hz	0.2/2 Hz (-10%)	~DC to 2 Hz (-10%)
High Frequency Response (-5%) (Unity Gain)	100 kHz	100 kHz	>200 kHz	>200 kHz
Temperature Range	+32 to +120 °F 0 to +50 °C	+32 to +120 °F 0 to +50 °C	+32 to +120 °F 0 to +50 °C	+32 to +120 °F 0 to +50 °C
Excitation Voltage	+24 ±0.5 VDC	+25.5 ±1.5 VDC	+24 ±1.0 VDC	+24 ±1.0 VDC
Constant Current Excitation	1-20 mA [1]	0.5-20 mA [1]	0, 2, 4, 8, 12, or 20 mA [1]	0, 2, 4, 8, 12, or 20 mA [1]
Broadband Electrical Noise (Gain x1)	480 µV rms [2]	200 µV rms [2]	9 µV rms [2]	9 µV rms [2]
Input/Output Connectors	BNC Jacks	BNC Jacks	BNC Jacks	BNC Jacks
Size (Height x Width x Depth)	6.2 x 4.25 x 10.2 in 157.5 x 108 x 259.1 mm	6.2 x 4.25 x 10.2 in 157.5 x 108 x 259.1 mm	6.2 x 6.05 x 10.2 in 157.5 x 153.7 x 259.1 mm	6.2 x 6.05 x 10.2 in 157.5 x 153.7 x 259.1 mm
Weight	4.68 lb 2.12 kg	4.735 lb 2.15 kg	6.15 lb 2.79 kg	6.15 lb 2.79 kg
Supplied Accessories				
Power Cord	(1) 017AXX	(1) 017AXX	(1) 017AXX	(1) 017AXX
Ferrite Clamp	(1) 100-2973-30	(1) 100-2973-30	(1) 100-2973-30	(1) 100-2973-30
Ferrite Bead	—	—	(1) 100-7102-20	(1) 100-7102-20
RS-232 Cable	—	—	(1) 100-7103-50	(1) 100-7103-50
Additional Versions				
8-channel in 3-wide Chassis	—	442C05	—	—
Notes				
[1] Unit supplied with current set at 4 mA [2] Typical				



In-Line, ICP®-Powered Charge Converters



Model Number	422E51	422E52	422E53	422E55	422E54
Gain (Charge Conversion Sensitivity)	100 mV/pC $\pm 5\%$	10 mV/pC $\pm 2.5\%$	1 mV/pC $\pm 2.5\%$	0.5 mV/pC $\pm 2.5\%$	0.1 mV/pC $\pm 2.5\%$
Input Range	± 50 pC	± 500 pC	± 5000 pC	$\pm 10,000$ pC	$\pm 50,000$ pC
Output Voltage Range	± 5.0 V	± 5.0 V	± 5.0 V	± 5.0 V	± 5.0 V
Frequency Response (+/-5%)	5 to 100k Hz [1]	5 to 100k Hz [1]	5 to 100k Hz [1]	5 to 50k Hz [1]	5 to 50k Hz [1]
Broadband Electrical Noise	49 μ V rms [2]	33 μ V rms [2]	33 μ V rms [2]	33 μ V rms [2]	33 μ V rms [2]
Temperature Range	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C
Excitation Voltage	18 to 28 VDC	18 to 28 VDC	18 to 28 VDC	18 to 28 VDC	18 to 28 VDC
Constant Current Excitation	2 to 20 mA	2 to 20 mA	2 to 20 mA	2 to 20 mA	2 to 20 mA
Input Connector	10-32 Jack	10-32 Jack	10-32 Jack	10-32 Jack	10-32 Jack
Output Connector	BNC Jack	BNC Jack	BNC Jack	BNC Jack	BNC Jack
Size (Length x Diameter)	3.4 x 0.52 in 86 x 13 mm	3.4 x 0.52 in 86 x 13 mm	3.4 x 0.52 in 86 x 13 mm	3.4 x 0.52 in 86 x 13 mm	3.4 x 0.52 in 86 x 13 mm
Weight	1.15 oz 32.7 gm	1.15 oz 32.7 gm	1.15 oz 32.7 gm	1.15 oz 32.7 gm	1.15 oz 32.7 gm
Additional Versions					
0.5 Hz (-5%) Low Frequency, ± 2.5 V Output	422E01	422E02	422E03	422E05	422E04
Low Noise, ± 2.5 V Output	422E11	422E12	422E13	422E15	422E14
TEDS Addressable, ± 2.5 V Output	T422E11	T422E12	T422E13	T422E15	T422E14
Miniature Size, TEDS Addressable [3]	—	T422E93/A	T422E92/A	—	T422E91/A

Notes

[1] High frequency response may be limited by supply current and output cable length [2] Tested using voltage source and input capacitor equal to the feedback capacitor, to simulate a charge output sensor [3] Units are 1.6 in x 0.25 in (length x diameter) (40 mm x 6.4 mm) with 10-32 jack connectors





In-Line, ICP®-Powered Charge Converters



Model Number	422E36	422E35	422E38
Type	High Temp. Aps [1]	High Temp. Aps [1]	High Temp. Aps [1]
Gain (Charge Conversion Sensitivity)	10 mV/pC ±2%	1 mV/pC ±2%	0.1 mV/pC ±2%
Input Range	±250 pC	±2500 pC	±25,000 pC
Output Voltage Range	±2.5 V	±2.5 V	±2.5 V
Frequency Response (+/-5%)	5 to 100k Hz [2]	5 to 100k Hz [2]	5 to 100k Hz [2]
Broadband Electrical Noise	26 µV rms [3]	14 µV rms [3]	14 µV rms [3]
Temperature Range	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C	-65 to +250 °F -54 to +121 °C
Excitation Voltage	18 to 28 VDC	18 to 28 VDC	18 to 28 VDC
Constant Current Excitation	2.2 to 20 mA	2.2 to 20 mA	2.2 to 20 mA
Input Connector	10-32 Jack	10-32 Jack	10-32 Jack
Output Connector	BNC Jack	BNC Jack	BNC Jack
Size (Length x Diameter)	3.4 x 0.52 in 86 x 13 mm	3.4 x 0.52 in 86 x 13 mm	3.4 x 0.52 in 86 x 13 mm
Weight	1.1 oz 31 gm	1.1 oz 31 gm	1.1 oz 31 gm
Additional Versions			
TEDS Addressable, On-board EEPROM	T422E36	T422E35	—
Notes			

[1] Specifically designed for use with sensors operating in elevated temperatures >+400°F (+204°C) [2] High frequency response may be limited by supply current and output cable length [3] Tested using voltage source and input capacitor equal to the feedback capacitor, to simulate a charge output sensor



Industrial Charge Amplifiers



Model Number	421A11	421A13	421A25
Channels	1	3	1
Number of Measurement Ranges	3	3	13 Fixed, 3 Adjustable
Input Range	± 100 to 100,000 pC [1]	± 100 to 100,000 pC [1]	± 100 to 1,000,000 pC [1]
Sensitivity	5.00 to 0.05 mV/pC [1]	5.00 to 0.05 mV/pC [1]	100 to 0.01 mV/pC [1]
Output Voltage	± 5 V	± 5 V	± 10 V
Low Frequency Response	-0 Hz	-0 Hz	-0 Hz
High Frequency Response (-5%)	4 to 12 kHz [1]	4 to 12 kHz [1]	2 to 20 kHz [1] [4]
Broadband Electrical Noise (1 to 10k Hz)	11 μ V rms [2]	11 μ V rms [2]	<20 mVpp [5]
Drift	0.03 pC/s	0.03 pC/s	0.03 pC/s [6]
Temperature Range	+32 to +140 °F 0 to +60 °C	+32 to +140 °F 0 to +60 °C	+23 to +140 °F -5 to +60 °C
Power Required	15 to 30 VDC	15 to 30 VDC	15 to 35 VDC
Current Draw (Maximum)	19 mA	19 mA	70 mA
Input Connector(s)	BNC Jack	BNC Jack	BNC Jack
Output Connector	Screw Terminal [3]	Screw Terminal [3]	DB25 Male [7]
Size (Length x Width x Height)	4.89 x 2.52 x 1.50 in 124.2 x 64 x 38.1 mm	6.95 x 2.52 x 1.50 in 176.5 x 64 x 38.1 mm	3.9 x 3.1 x 1.35 in 98 x 79 x 34.4 mm
Weight	14.6 oz 415 gm	21.1 oz 598.7 gm	9.6 oz 272.2 gm
Supplied Accessories			
Ferrite Beads	(2) 100-2973-30	(4) 100-2973-30	—
Additional Versions			
2-Channel	421A12	421A12	—
200,000 pC Input	421A111	421A113	—

Notes

[1] Dependant on input range selected [2] Noise measurements performed at 10,000 pC to 100,000 pC range [3] Supplied with 10-ft multi-conductor cable and PG-9 cord grip [4] - 3dB [5] Measured 0.1 Hz to 100 kHz; <30 mVpp in 100 pC range [6] At room temperature. Scope: charge input open and screened, charge amplifier connected to operating voltage for minimum 30 minutes, in "operate" mode, lid tightly closed [7] Connector also used for setup control and power





MEMS Sensor Signal Conditioners

				
Model Number	478A01	478B05	478A16	482C27
Channels	1	3	16	4
Sensor Input Type(s)	Single-ended MEMS Capacitive	Single-ended MEMS Capacitive	Single-ended MEMS Capacitive	Diff./Single-ended MEMS/Bridge, ICP®/Voltage
Compatible Sensor Series	3711, 3713	3711, 3713	3711, 3713	350x, 360x, 371x, 374x, Load Cells
Gain	Unity	Unity	Unity	x0.1 to x2000; x0.1 to x200 [5]
Output Range	5 V	±5 V	±10 V	±10 V
Frequency Response (±5%)	DC to 10k Hz	DC to 2k Hz	DC to 70k Hz [3]	DC to 100k Hz (-3dB)
Temperature Range	+32 to +120 °F 0 to +50 °C	+32 to +120 °F 0 to +50 °C	+32 to +120 °F 0 to +50 °C	+32 to +122 °F 0 to +50 °C
Excitation Voltage	>16 VDC	17.3 ±10% VDC	18 VDC	0 to 12 VDC Unipolar or Bipolar [6]
Broadband Electrical Noise (1 to 100,000 Hz) (Gain x1)	8 µV rms [1]	5 µV rms	70 µV rms	—
Power Required	27 VDC	36 VDC [2]	100 to 240 VAC, 50 to 400 Hz	9 to 18 VDC [2]
Input Connectors	4-pin Jack	4-pin Jack	(16) 4-pin Jacks, (1) DB50 Female	(4) 8-socket Mini DIN, (4) BNC Jacks
Output Connectors	BNC Jacks	BNC Jacks	(16) BNC Jacks, (1) DB37 Female [4]	BNC Jacks
Size (Height x Width x Depth)	4.0 x 2.9 x 2.4 in 10.2 x 7.4 x 6.1 cm	6.3 x 2.4 x 11 in 16.0 x 6.1 x 28.0 cm	3.5 x 19 x 16.25 in 8.9 x 48.3 x 41.3 cm	3.2 x 8.0 x 5.9 in 8.1 x 20 x 15 cm
Weight	.69 lb 312 gm	1.67 lb 756 gm	8.5 lb 3.9 kg	2.25 lb 1.021kg
Supplied Accessories				
Power Cord	—	(1) 017AXX	(1) 017AXX	(1) 017AXX
Universal Power Adaptor	—	(1) 488A04	—	(1) 488A14
MCSC Control Software	—	—	—	(1) EE75
Additional Accessories				
AC Power Source	488A03 or F488A03	—	—	—
Battery Charger	488A02 or F488A02	—	—	—
9 VDC Ultralife Lithium Batteries (3)	400A81	—	—	—
DC Power Pack	—	488B07	—	—
Auto Lighter Adaptor	—	488A11	—	488A13
Input Mating Connector	AY	AY	AY, DB50 Male	8-pin Mini DIN, AC
Additional Versions				
Line Powered with Gain	445C01	—	—	—
Base Configurable Model with Selectable Options	—	—	478A17	—
8-channel	—	—	478A18	—
8-channel Base Configurable Model with Selectable Options	—	—	478A19	—
Screw Terminal Input Connector	—	478A05	—	—

Notes

[1] Noise measured from 0.1 Hz to 10k Hz [2] Supplied with 85 to 264 VAC, 47 to 400 Hz Universal Power Adaptor [3] ±1% DC to 40 kHz (minimum) [4] BNC jacks on both front and rear panels [5] Maximum gain for bridge/MEMS input is x2000 and for ICP®/voltage is X200 [6] In bipolar mode, +Vexc track each other. They are equal and opposite. User selectable in 0.1V increments



Strain Gage Signal Conditioners



Model Number	Series 8159	Series 8161	Series 8162
Channels	1	1	1
Frequency Range	0 to 1000 Hz [1]	0 to 1000 Hz	0 to 1000 Hz
Digital Resolution	1 Part in 19,999	--	--
Full Scale Input (Internal Switch Selectable)	1.5, 2.5, 3.5 mV/V	0.5 to 11 mV/V	0.5 to 11 mV/V
Non-Linearity	± 0.015% FS	± 0.01% FS	± 0.01% FS
Display Type	0.4 in (10.2 mm) LED	—	—
Display Range	± 99.999 (5 digits)	—	—
Shunt Calibration	Yes	Yes	Yes
Temperature Range	+14 to +122 °F -10 to +50 °C	+32 to +158 °F 0 to +70 °C	+32 to +158 °F 0 to +70 °C
Temperature Stability	± 0.56 µV/°F ± 1 µV/°C	Zero Coefficient 0.5mV/°F Span Coefficient 0.004%/°F	—
Humidity (Maximum)	Non-Condensing, 90%	Non-Condensing, 90%	—
Enclosure Rating	NEMA 4X (Front Panel)	—	NEMA 4X
Power Required	115 or 230 VAC 50 - 60 Hz	10 to 28 VDC	12 to 28 VDC
Excitation Voltage	5 or 10 VDC ± 0.5%	5 or 10 VDC	5 or 10 VDC
Input	Fully Differential (Bipolar)	Fully Differential (Bipolar)	0.5 to 11 mV/V
Analog Outputs	± 10 Volts and 4 to 20 mA	± 5 or ± 10 Volts and 4 to 20 mA	± 5 or ± 10 Volts and 4 to 20 mA
Mounting	Panel Mount (1/8 DIN)	35 mm DIN Rail	Flange
Electrical Connector	DB-9 Input, DB-15 Output	Screw Terminals	Screw Terminals
Size (Height x Width x Depth)	1.89 x 3.78 x 5.88 in 48 x 96 x 149 mm	3.53 x 0.69 x 2.27 in 89 x 18 x 58 mm	2.6 x 3.7 x 2.3 in 6.6 x 9.4 x 5.8 mm
Weight	16.3 oz 590 gm	2.4 oz 68 gm	4.8 oz 136 gm

Notes

[1] Upper frequency limited by single pole, low-pass filter





Additional Electronics

In-line TEDS Memory Modules

Models 070A70 and 070A71 are TEDS memory modules, which can be added in-line with standard ICP® sensors, to construct a sensor system with TEDS functionality.

Both units are identical except for their electrical connectors. Model 070A70 features a BNC jack input connector and a BNC plug output connector, whereas Model 070A71 features 10-32 coaxial jack input and output connectors.

ICP® sensor excitation is passed through the units to the sensor. Under reverse bias, the memory circuitry is activated for read and write capability per IEEE P1451.4.

TEDS functionally permits data storage within a non-volatile EEPROM memory circuit to store information such as model number, serial number, sensitivity, location, and orientation. The standard TEDS protocol complies with IEEE P1451.4, which facilitates automated bookkeeping and measurement system setup to speed testing and reduce errors.



Model 070A70



Model 070A71



ICP® Sensor Simulator

Model 492B ICP® sensor simulator installs in place of an ICP® sensor and serves to verify signal conditioning settings, cable integrity, and tune long lines for optimum system performance. By use of an internal oscillator, the unit delivers a 100 Hz sine or square wave at a selectable peak to peak voltage. External test signals from a function generator may also be inserted. This portable unit is battery operated.



ICP® Sensor Simulator

Model 401B04 ICP® sensor simulator installs in place of an ICP® sensor and accepts test signals from a voltage function generator. The unit serves to verify signal conditioning settings, cable integrity, and tune long lines for optimum system performance. This unit requires power from an ICP® sensor signal conditioner.



Step Function Generator

Model 492B03 generates a rapid charge or voltage step function from zero to a selected peak value between either 0 and 100,000 pC or 0 and 10 volts DC. The unit is useful for setting trigger points in recording equipment and verifying charge amplifier and data acquisition equipment setup. This unit is battery powered and portable.



Accessories



Single Axis and Triaxial Accelerometer Accessories:

- Adhesive Mounting Bases
- Mounting Pads
- Easy-mount Clips
- Adhesives
- Tools
- Magnetic Mounting Bases
- Mounting Studs and Screws
- Triaxial Mounting Adaptors
- Calibration & Testing Services

Acoustics Accessories:

- Adaptors
- Cables
- Calibration Equipment
- Environmental Protection
- Holders
- Stands & Mounts

Load Cell Accessories:

- Mounting Bases
- Cable Assemblies
- Rod Ends
- Load Buttons
- Mating Connectors

Pressure Sensor Accessories:

- Mounting Adaptors



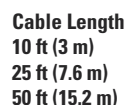
Adhesive mounting bases are utilized to facilitate adhesively mounting an accelerometer to a test surface. The base is secured to the test object with a suitable adhesive such as epoxy, glue or wax. The accelerometer is then stud mounted to the adhesive mounting base. The use of the adhesive mounting base eliminates the adhesive from being in direct contact with the sensor and potentially clogging its tapped mounting hole. Accelerometers may be easily moved to multiple bases installed in various locations. All bases are machined of lightweight aluminum with a grooved side for applying the adhesive and a hardcoat finish which provides electrical isolation between the test object and the accelerometer. For proper mounting, match the hex size on the accelerometer to the hex size on the adhesive base. Use the next larger adhesive base hex size if a match is not available.

Model 080A19

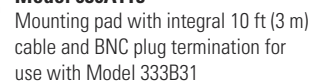
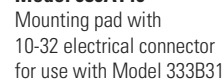
Model Number	Hex size	Thickness	Mounting	Material
080A14	5/16 in	0.32 in (8.1 mm)	10-32 Thread	Hardcoat Aluminum
M080A14	5/16 in	0.32 in (8.1 mm)	M5 x 0.8 Thread	Hardcoat Aluminum
080A15	5/16 in	0.125 in (3.18 mm)	5-40 Thread	Hardcoat Aluminum
M080A15	5/16 in	0.125 in (3.18 mm)	M3 x 0.50 Thread	Hardcoat Aluminum
080A04	3/8 in	0.200 in (5.08 mm)	10-32 Thread	Hardcoat Aluminum
M080A04	3/8 in	0.200 in (5.08 mm)	M6 x 0.75 Thread	Hardcoat Aluminum
080A25	7/16 in	0.125 in (3.18 mm)	5-40 Thread	Hardcoat Aluminum
M080A25	7/16 in	0.125 in (3.18 mm)	M3 x 0.50 Thread	Hardcoat Aluminum
080A178	1/2 in	0.120 in (3.05 mm)	10-32 Stud	Hardcoat Aluminum
080A	1/2 in	0.187 in (4.75 mm)	10-32 Thread	Hardcoat Aluminum
M080A	1/2 in	0.187 in (4.75 mm)	M6 x 0.75 Thread	Hardcoat Aluminum
080A145	3/4 in	0.200 in (5.08 mm)	5-40 Thread	Hardcoat Aluminum
080A12	3/4 in	0.200 in (5.08 mm)	10-32 Thread	Hardcoat Aluminum
M080A12	3/4 in	0.200 in (5.08 mm)	M6 x 0.75 Thread	Hardcoat Aluminum
080A13	3/4 in	0.200 in (5.08 mm)	1/4-28 Thread	Hardcoat Aluminum
080A19*	3/4 in	0.375 in (9.53 mm)	10-32 Thread	Hardcoat Aluminum
080A68	7/8 in	0.200 in (5.08 mm)	10-32 Thread	Hardcoat Aluminum
M080A68	7/8 in	0.200 in (5.08 mm)	M6 x 0.75 Thread	Hardcoat Aluminum
080A147	7/8 in	0.274 in (6.96 mm)	(2) M3 x 0.5 Thread	Hardcoat Aluminum
080A170	1.0 in	0.350 in (8.89 mm)	(2) 6-32 Thread	Hardcoat Aluminum
080A190	1.25 in	0.250 in (6.35 mm)	10-32 Thread	Stainless Steel
080M227*	1.25 in	0.625 in (15.9 mm)	10-32 Thread	Ceramic

* Suitable for use as a stud mounted, electrical isolation base with a 10-32 accelerometer mounting stud inserted into each end.

Specially designed mounting pads are for use with array accelerometers that incorporate their electrical connection within their mounting surface.



Mounting pad with 3-socket adhesive base with integral cable that terminates with a 3-socket IDC connector for use with Model 333B (available with BNC plug termination by specifying suffix /AC to model number, e.g., 080B40/AC)





Easy-mount Clips

Easy-Mount Clip



**Models 080A160, 080A172,
080A173**



Shown with sensor
(sensor not included)

Model Number	080A172	080A173	080A160
Compatible Cube Size	0.40 in 10.2 mm	0.45 in 11.4 mm	0.55 in 14.0 mm
Size (Length x Width x Height)	0.55 x 0.55 x 0.25 in 14 x 14 x 6.4 mm	0.6 x 0.6 x 0.25 in 15.2 x 15.2 x 6.4 mm	0.81 x 0.81 x 0.32 in 20.6 x 20.6 x 8.1 mm
Weight	0.5 gm	0.6 gm	1.4 gm
Frequency Limit ($\pm 5\%$) (Grease Mount)	2000 Hz	2000 Hz	2000 Hz
Frequency Limit ($\pm 10\%$) (Grease Mount)	4000 Hz	3000 Hz	2500 Hz
Frequency Limit ($\pm 5\%$) (Dry Mount)	1000 Hz	1000 Hz	1000 Hz
Frequency Limit ($\pm 10\%$) (Dry Mount)	1300 Hz	1300 Hz	1300 Hz
Temperature Range (Continuous)	-65 to +125 °F -54 to +52 °C	-65 to +125 °F -54 to +52 °C	-65 to +125 °F -54 to +52 °C
High Temperature Limit (Short Term Exposure)	+175 °F +79 °C	+175 °F +79 °C	+175 °F +79 °C
Compatible Accelerometers	333B32, 333B33, 356B11, 356B21	333B42, 333B53, 356A12, 356A22	356A02, 356A15, 356A16, 356A17

Ordering Information

100-Piece Bag of Easy-Mount Clips	080A181	080A183	080A185
-----------------------------------	---------	---------	---------

Notes

Actual attainable frequency limits may be higher than specified, particularly for lower weight accelerometers, and may differ depending on axis of motion. An interface of silicone grease between clip and accelerometer aids in mechanical coupling to improve attainable frequency range.

Easy-Mount Clips offer practical and economical installation techniques for accelerometers in multi-channel vibration measurement applications.

The clips can be attached to the test structure via double sided tape or adhesive. Once the clips are installed, accelerometers are simply snapped into the clips and are ready to take vibration measurements.

More measurement points and orientations can be accommodated with fewer sensors by installing clips at all desired points and populating them with as many sensors as necessary. Sensors are then moved to remaining clip locations until all measurements are accomplished. Triaxial measurements can be made with single axis, cubic shaped accelerometers by changing axis orientation for successive measurements.

Swivel-style clips permit sensors installed on curved or sloped surfaces to be aligned along the desired plane and axis. These clips rotate and pivot to provide full flexibility in alignment.

Easy-Mount Swivel Clip



**Models 080B174, 080B176,
080B177**



Shown with sensor
(sensor not included)

Model Number	080B174	080B176	080B177
Compatible Cube Size	0.40 in 10.2 mm	0.45 in 11.4 mm	0.55 in 14.0 mm
Size (Base Diameter x Maximum Height)	0.5 x 1.22 in 12.7 x 31.0 mm	0.5 x 1.22 in 12.7 x 31.0 mm	0.75 x 1.39 in 19.1 x 35.2 mm
Weight	3.6 gm	3.6 gm	5.5 gm
Frequency Limit ($\pm 10\%$) (Grease Mount)	1000 Hz	1000 Hz	1000 Hz
Temperature Range (Continuous)	-65 to +125 °F -54 to +52 °C	-65 to +125 °F -54 to +52 °C	-65 to +125 °F -54 to +52 °C
High Temperature Limit (Short Term Exposure)	+175 °F +79 °C	+175 °F +79 °C	+175 °F +79 °C
Compatible Accelerometers	333B32, 333B33, 356B11, 356B21	333B42, 333B53, 356A12, 356A22	356A02, 356A15, 356A16, 356A17

Ordering Information

25-Piece Bag of Easy-Mount Swivel Clips	080B182	080B184	080B186
---	---------	---------	---------

Notes

Actual attainable frequency limits may be higher than specified, particularly for lower weight accelerometers, and may differ depending on axis of motion. An interface of silicone grease between clip and accelerometer aids in mechanical coupling to improve attainable frequency range.



Adhesives

Many adhesives have been successfully used for securing adhesive mounting bases to test objects. These include epoxies, waxes, glues, gels, and dental cement. Some provide more permanent attachment than others. Stiffer adhesives provide better transmission of high frequencies. Adhesives should be selected which perform adequately for the required application and environmental conditions. PCB® offers petro wax and quick bonding gel.



Model 080A90
Quick Bonding Gel



Model 080A109
Petro Wax

Adhesive

Model Number	Description	Quantity Provided
080A24	Petro Wax	4 Squares, 1 x 1 x 0.25 in ea.
080A109	Petro Wax	1 Squares, 1 x 1 x 0.25 in
080A47	Petro Wax	175 gm Box
080A90	Quick Bonding Gel	1 Tube, 0.10 oz (3 gm)

Tips from Techs

Adhesive Mount Removal (other than wax)

A debonder should always be used to avoid sensor damage.

To avoid damaging the accelerometer, a debonding agent must be applied to the adhesive prior to sensor removal. With so many adhesives in use (glues, dental cement, epoxies, etc.), there is no universal debonder available. The debonder for the Loctite 454 adhesive that PCB® offers is Acetone. If you are using anything other than Loctite 454, you will have to check with the individual manufacturers for their debonding recommendations. The debonding agent must be allowed to penetrate the surface in order to properly react with the adhesive, so it is advisable to wait a few minutes after applying before removing the sensor.

Tools

Removal tools help avoid sensor damage and assist with the removal of adhesively mounted “teardrop”-style accelerometers. The shear force applied, snaps the bond of most glues and epoxies.

Probe tips install onto accelerometers to enable their use as handheld vibration sensors. This technique is useful if installation space is severely limited or for determining installation locations where vibration is most prevalent.



Model 080A09
Probe Tip with 10-32
tapped hole



Model 076A22
BNC connector tool
Helps grip BNC's for
connection to crowded panels



**Removal tool for
cube shaped
accelerometers**



Removal tool for miniature teardrop accelerometers

Tools

Model Number	Applicable Sensor
039A27	352A21, 352C22, 357A09, 357C10
039A26	352C23
039A28	352A24
039A29	357A08
039A07	740B02
039A31	352A56
039A32	352A71
039A08	0.4 in (10.2 mm) Cube Shaped Accelerometers
039A09	0.45 in (11.4 mm) Cube Shaped Accelerometers
039A10	0.55 in (14 mm) Cube Shaped Accelerometers
039A12	0.8 in (20.3 mm) Cube Shaped Accelerometers



Magnetic Mounting Bases

Magnetic mounting bases allow a convenient, temporary method of installing accelerometers to ferrous, magnetic surfaces. Select a magnetic base with a larger diameter than the accelerometer base.

Tips from Techs

Always exercise caution when using a magnetic base, as the attractive installation forces can cause excessive shock to the sensor. It is recommended to install the magnet to the test object on an edge and then "roll" the assembly gently into position, or install the magnet to the test object first, and then attach the sensor to the base.

Magnetic Mounting Bases

							
Model 080A30	Model 080A27	Model 080A179	Model 080A130	Model 080A54			
Model Number	Diameter	Thickness		Mounting	Force		Uses
080A30	3/8 in hex	0.23 in	5.84 mm	5-40 Thread	2.5 lb	11 N	Miniature, 2 gm Accelerometers
M080A30	3/8 in hex	0.2 in	5.08 mm	M3 x 0.5 Thread	2.5 lb	11 N	Miniature, 2 gm Accelerometers
080A27	3/4 in hex	0.27 in	6.86 mm	10-32 Stud	12 lb	54 N	General Purpose
080A179	0.75 in	0.42 in	10.7 mm	10-32 Thread	12 lb	54 N	General Purpose
080A54	1-3/8 in hex	0.49 in	12.45 mm	1/4-28 Stud	50 lb	225 N	Industrial Accelerometers
080A130	0.75 in	0.72 in	18.29 mm	1/4-28 Stud	15 lb	68 N	Curved Surfaces
080A26	0.75 in	0.37 in	9.4 mm	Adhesive	—	—	Mounting Pad to Mate with Magnet
080A131	1.1 in	1.02 in	25.9 mm	1/4-28 Thread	35 lb	158 N	For Curved Surfaces
080A132	1.5 in	1.25 in	31.8 mm	1/4-28 Thread	55 lb	225 N	For Curved Surfaces

Mounting Studs and Screws

Mounting studs are used to secure the accelerometer to the test object. To ensure accurate measurements, always mount the accelerometer with the recommended mounting torque and avoid bottoming the stud into the test object's or accelerometer's tapped mounting hole. The use of a stud with

a shoulder will usually avoid bottoming, however, ensure that the base of the sensor is counter-bored to accept the shoulder. Once installed, the accelerometer's base should be in close contact with the test object surface.

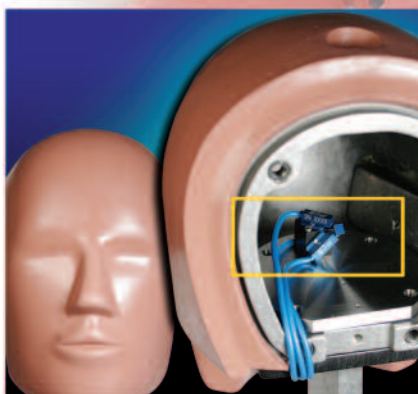
Mounting Studs & Screws

					
Model 081A08	Model 081B05	Model 081B45	Model 081A21	Model 080A149	
Model Number	Mounting			Comment	Style
081A27	5-40 Stud	to	5-40 Stud	BeCu, For Some Triaxial Accelerometers	B
081A90	5-40 Stud	to	10-32 Stud	Adaptor Stud, BeCu	A
080A149	5-40 Thread	to	10-32 Stud	Adaptor Plate, 0.5" Dia. with 7/16" Flats	E
080A84	5-40 Thread	to	10-32 Stud	Adaptor Plate, 0.75" Dia. with Knurl	E
M080A149	M3 x 0.5 Thread	to	10-32 Stud	Adaptor Plate, 0.5" Dia. with 7/16" Flats	E
080A85	M3 x 0.5 Thread	to	10-32 Stud	Adaptor Plate, 0.75" Dia. with Knurl	E
080M260	6-32 Thread	to	10-32 Stud	Adaptor Plate, 0.75" Dia., Knurled with 5/8" Flats	E
081B05	10-32 Stud	to	10-32 Stud	with Shoulder, BeCu, For Most Accelerometers	B
081A10	10-32 Stud	to	10-32 Stud	with Shoulder, Stainless Steel	B
081A21	10-32 Stud	to	10-32 Stud	Electrical Isolation Mounting Pad/Stud, 0.75" Hex	D
081C21	10-32 Stud	to	10-32 Stud	Electrical Isolation Mounting Pad/Longer Stud, 0.75" Hex	D
M081B23	10-32 Stud	to	M5 x 0.8 Stud	Adaptor Stud, BeCu	A
M081B05	10-32 Stud	to	M6 x 0.75 Stud	Adaptor Stud, with Shoulder, BeCu	A
M081A18	10-32 Stud	to	M6 x 1 Stud	Adaptor Stud, with Shoulder, Stainless Steel	A
081A08	10-32 Stud	to	1/4-28 Stud	Adaptor Stud, BeCu	A
081B20	1/4-28 Stud	to	1/4-28 Stud	with Shoulder, BeCu	B
081A96	1/4-28 Stud	to	1/4-28 Stud	Stainless Stl. for Model 350B96 Shock Accelerometer	B
M081B20	1/4-28 Stud	to	M6 x 0.75 Stud	Adaptor Stud, with Shoulder, BeCu	A
081B45	6-32 thd x 0.625 inch length			Cap Screw for Series 355 Ring Shaped Accelerometers	C
M081B45	M3 x 0.5 thd x 16 mm length			Cap Screw for Series 355 Ring Shaped Accelerometers	C
081B36	2-56 thd x 0.375 inch length			Cap Screw for 355B12 & 357A06	C
M081B36	M2 x 0.4 thd x 0.37 inch length			Cap Screw for 355B12 & 357A06	C
081B60	10-32 thd x 0.62 inch length			Cap Screw for 354C02 & 354C03	C



Triaxial Mounting Adaptors

Adapts three standard, uni-axial accelerometers for monitoring vibration in three orthogonal axes. Hex size listed represents the maximum allowable hex size for the installed uni-axial accelerometers.



Triaxial Mounting Bases



Style "A"



Style "B"



Style "C"

Model Number	Dimensions	Material	Mounting via	Accel. Fasteners	Max. hex	Style
080B16	0.37 in (9.4 mm) Cube	Anodized Aluminum	10-32 Thread	5-40 Thread	5/16 in	A
M080B16	0.37 in (9.4 mm) Cube	Anodized Aluminum	10-32 Thread	M3 x 0.5 Thread	5/16 in	A
080A196	0.44 in (11.18 mm) Cube	Anodized Aluminum	10-32 Thread	5-40 Thread	3/8 in	A
080A17	0.812 in (20.62 mm) Cube	Stainless Steel	10-32 Screws	10-32 Thread	3/8 in	B
M080A17	0.812 in (20.62 mm) Cube	Stainless Steel	M5 x 0.8 Screws	M5 x 0.8 Thread	3/8 in	B
080B10	0.866 in (22 mm) Cube	Stainless Steel	8-36 Screws	10-32 Thread	1/2 in	B
M080B10	0.866 in (22 mm) Cube	Stainless Steel	M4 x 0.7 Screws	M6 x 0.75 Thread	1/2 in	B
080C10	0.866 in (22 mm) Cube	Anodized Aluminum	8-36 Screws	10-32 Thread	1/2 in	B
080A187	0.875 x 0.875 x 0.665 in (22.23 x 22.23 x 16.89 mm)	Anodized Aluminum	4-40 Screws	6-32 Thread	For Ring Type	C
080A180	1.00 in (25.4 mm) Cube	Titanium	10-32 Screws	1/4-28 Thread	7/8 in	C
M080A180	1.00 in (25.4 mm) Cube	Titanium	M5 x 0.8 Screws	M6 x 0.75 Thread	7/8 in	C
080B11	1.24 in (31.5 mm) Cube	Anodized Aluminum	10-32 Screws	10-32 Screws	7/8 in	B
M080B11	1.24 in (31.5 mm) Cube	Anodized Aluminum	M5 x 0.8 Screws	10-32 Screws	7/8 in	B
080A62	1.23 in (31.2 mm) Cube	Stainless Steel	10-32 Screws	1/4-28 Screws	7/8 in	B
080A204	1.23 in (31.2 mm) Cube	Anodized Aluminum	10-32 Screws	10-32 Thread	1.0 in (25.4 mm) dia	B
080A57	1.48 in (37.6 mm) Cube	Stainless Steel	10-32 Screws	1/4-28 Screws	1-1/4 in	B
M080A57	1.48 in (37.6 mm) Cube	Stainless Steel	M5 x 0.8 Screws	1/4-28 Screws	1-1/4 in	B
Model	Dimensions	Material	Mounting via	Accel. Fasteners	Note	
080A194	0.28 in (7.11 mm) Cube	Anodized Aluminum	Adhesive	Adhesive	For Teardrop Accelerometers	
080A114	0.90 in (22.86 mm) Cube	Aluminum	10-32 Thread	10-32 Electrical Jack	Use Only with Models 333A31, 333A41 or 333A51	
080A153	1.265 in (32.13 mm) Cube	Acetal	10-32 Thread	4-40 Screws	Use with Series 3711	
080A208	1.01 in (25.65 mm) Cube	Anodized Aluminum	6-32 Screws	4-40 Screws	Use with Series 3741	
080A213	0.6 x 0.8 0.36 in (15.2 x 20.3 x 9.1 mm)	Titanium	8-32 Screws	4-40 Screws	Use with Series 3991	



Calibration & Testing Services

Calibration and Testing

Calibration of an accelerometer typically involves a series of tests which are intended to verify its performance and adherence to its specifications. Results of this testing are provided on a report or "Calibration Certificate".

Routine calibration of PCB® accelerometers includes an amplitude response test from 10 Hz to the specified 5% upper frequency range (ACS-1), a transverse sensitivity test and a test to determine the unit's discharge time constant. The PCB® calibration laboratory is accredited by A2LA to ISO 17025. To insure testing accuracy, PCB® calibrations are accredited by A2LA, are traceable to NIST and conducted in accordance with ISO standards and industry procedures. It is important to note that PCB® maintains traceability to NIST for 44 discrete frequency points for the primary standards used for reference acceleration comparison. PCB® also maintains traceability to NIST for all test instrumentation utilized during calibration.

The following is a partial list of calibration and testing services that are available for your existing PCB® accelerometers or to complement the testing supplied with a new sensor. Calibration services for piezoelectric accelerometers not manufactured by PCB® are also available.



Calibration and Testing Services

Code	Description
ACS-1	Single axis amplitude response calibration from 10 Hz to upper 5% frequency range, NIST traceable
ACS-1T	Triaxial amplitude response calibration from 10 Hz to upper 5% frequency range, NIST traceable
ACS-2	Single axis one point @ 100 Hz amplitude response calibration, NIST traceable
ACS-2T	Triaxial one point @ 100 Hz amplitude response calibration, NIST traceable
ACS-3	Single axis phase calibration from 10 Hz to upper 5% frequency range
ACS-3T	Triaxial phase calibration from 10 Hz to upper 5% frequency range
ACS-4	Single axis, low frequency phase and amplitude response calibration from 0.5 to 10 Hz
ACS-4T	Triaxial, low frequency phase and amplitude response calibration from 0.5 to 10 Hz
ACS-5	Single axis, extended frequency, amplitude response cal. from upper 5% frequency to 15 kHz, NIST traceable
ACS-5T	Triaxial, extended frequency, amplitude response cal. from upper 5% frequency to 15 kHz, NIST traceable
ACS-11	Single axis, low frequency, amplitude response calibration on long stroke shaker from 0.5 Hz to upper 5% frequency (max 1000 Hz, min 50 mV/g sensitivity)
ACS-11T	Triaxial, low-frequency, amplitude response calibration on long stroke shaker from 0.5 Hz to upper 5% frequency (max 1000 Hz, min 50 mV/g sensitivity)
ACS-14	High G shock accelerometer calibration using Hopkinson bar, to 100,000 g
ACS-109	Primary laser calibration on long stroke shaker, 0.5 Hz to 10 Hz
ACS-110	Primary laser calibration on mid range shaker, 5 Hz to 15 kHz
ATS-1	Single axis sensitivity deviation vs temperature test. Provides sensitivity data at two selected temperatures from -300 to +550 °F (-184 to +288 °C)
ATS-1A	Additional temperature test point for ATS-1
ATS-6	Hydrostatic pressure test — cable/sensor assembly verified in pressurized water environment
ATS-7	360° transverse sensitivity test with polar plot



Acoustic Accessories



Adaptors

ADP043 – 1/4" Microphone to 1/2" Preamplifier Adaptor

ADP009 – 1/2" Microphone to 1/4" Preamplifier Adaptor

ADP008 – 1" Microphone to 1/2" Preamplifier Adaptor

079A24 – Tripod Stand Adaptor to Convert 5/8" Stud to 1/4" For Mic Holder

079A27 – Right Angle Adaptor, 1/4" Mic to 1/4" Preamplifier

079A28 – Right Angle Adaptor, 1/4" Mic to 1/2" Preamplifier

079A29 – Swivel Head, Stand to Holder Adaptor



Cables

EXA010 – 10 Foot Cable with 7 Pin LEMO 01B Connectors
(Additional Lengths Available)

003C10 – 10 Foot Coaxial Cable with 10-32 Plug and BNC Plug
(Additional Lengths Available)

003D10 – 10 Foot Coaxial Cable with BNC Plugs
(Additional Lengths Available)

003U10 – 10 Foot Coaxial Cable with SMB Plugs
(Additional Lengths Available)

003V10 – 10 Foot Coaxial Cable with SMB Plug and BNC Plug
(Additional Lengths Available)



Calibration Equipment

CAL200 – 1 kHz, 94 and 114 dB, Calibrator

ADP024 – CAL200 to 1/4" Microphone Adaptor

CAL250 – 250 Hz, 94 dB Calibrator

ADP021 – CAL250 to 1/4" Microphone Adaptor

079A31 – 8-Channel Coupler for the CAL250 Calibrator

394A40 – 250 Hz, 94 dB Pistonphone Calibrator

079A30 – Pistonphone to 1" Microphone Adaptor



079A07



079A06



079B21



EPS2106



EPS2108



079A10



079A11



079B23



079A32



079A15



079A16



079A17



079A18



379A01

Environmental Protection

079A07 – 3-1/2" Windscreen for 1/4" Microphone

079A06 – 3-1/2" Windscreen for 1/2" Microphone

079B20 – Nose Cone for 1/4" Microphone

079B21 – Nose Cone for 1/2" Microphone

EPS2106 – Short Term Outdoor Protection, 3/4" Mount

EPS2108 – Short Term Outdoor Protection, 1/4" Side Exit Mount

Holders

079A10 – Holder for 1/4" Microphone

079A11 – Holder for 1/2" Microphone

079B23 – Holder for Both 1/4" and 1/2" Microphone

079A32 – Clip Holder for 1/4" Microphone

Stands and Mounts

079A15 – Tripod Stand with Boom Arm

079A16 – Miniature Tripod Stand with Adjustable Legs

079A17 – Camera Tripod Stand

079A18 – Adjustable Clamp

379A01 – Array Stand and Holders





Load Cell Accessories

To assist in load cell integration requirements, PCB® offers a range of popular accessories for the test engineer. These include load cell mounting bases, mating connectors, rod ends, load buttons, and ready made cable assemblies for quick setup.



Cable Assemblies



Mounting Base
084A100
084A101

(Metric versions also available)



Series A-20357



Series C-20099



181-012A/B
6-socket PT Connector & Back Shell



181-025A/B
6-socket PC Connector & Back Shell

Pressure Sensor Accessories

Mounting Adaptors

What are mounting adaptors?

Most quartz pressure probes are designed for precision installation in restricted locations. When minimum dimensions are not required, mounting adaptors provide a convenient sensor installation method. For example, it is less complicated to drill and tap a 3/8-24 or M10x1.0 port for an adaptor than it is to machine a precision sensor mounting port.

Why use mounting adaptors?

When space permits, mounting adaptors offer several advantages. First, the use of an adaptor reduces the need for precision machining in sensor installations. In locations where necessary machining steps are impossible, impractical, or simply inconvenient, the adaptor can be mounted with a few simple steps. The sensor can be electrically isolated in many adaptors to minimize interference from ground loop noise involved with operation on electrical machinery. Special adaptor materials, sensor coatings and insulating seals can be factory installed to isolate the sensor from noise.

Water-cooled adaptors provide for sensor installation in high temperature applications for dynamic measurements on exhaust manifolds, turbines, rocket motors, heat exchangers or other high temperature

applications. Water-cooled adaptors allow ICP® and charge output pressure sensors to operate well above their maximum rated temperature range. For example, an ICP® sensor, rated to 275 °F (135 °C) will remain below 150 °F (65 °C) when operating in Series 064B water-cooled adaptors on a 1000 °F (535 °C) exhaust manifold.

Most mounting adaptors are made of high-strength 17-4 PH stainless steel. Care should be exercised to observe maximum pressure when using adaptors made of lesser-strength materials. For example, Acetal, a type of plastic used to provide sensor ground isolation, should not be used above 500 psi (3450 kPa).

In sensor applications involving exposure to flash temperatures, an ablative diaphragm coating is beneficial. To captivate the ablative, the sensor may be slightly recessed in an adaptor, and the recess filled with ablative coating such as the PCB® 'CA' option.

Our most popular adaptors are summarized on the following tables. Many standard and special adaptors can be supplied to fit specific mounting ports or material requirements, so please visit www.pcb.com, or please contact a PCB® application engineer to discuss your unique needs.



Pressure Sensor Mounting Adaptors

		Benefits	Limitations
Sensor		Series 111, 112, 113 probe-style sensor, with supplied 5/16-24 or M7x0.75 thread, may be directly mounted using the floating clamp nut. Used when there is limited space available to install a sensor or a flush diaphragm mount is desired.	Requires precision machining tools and dimensions.
	Straight Threads  061A01 3/8-24 or 061A10 M10x1.0 install in common mounting ports. Both made in 17-4 PH stainless steel	Simplified installation by drilling and tapping standard size mounting port. Eliminates precision machining required for probe-style sensors. Adapts Series 111, 112, 113 to thin-walled applications.	Limited to thin-wall or thick, counter-bored walls to install. Requires more area to prepare mounting port than probe-style sensor alone.
	Electrical Isolation  061A59 3/8-24 thread, made from Acetal material	Electrically isolates the sensor from ground.	Lower strength of Acetal limits use to lower pressure applications <500 psi (<3450 kPa).
	NPT Tapered Threads  062A01 1/8" NPT thread, made from 17-4 PH stainless steel	1/8" NPT thread conveniently adapts Series 111, 112, 113 to common hydraulic, pneumatic, and process mounting ports.	Since the tapered pipe thread seals on the thread itself, it is more difficult to achieve a flush mount of the sensor diaphragm. Requires more area to prepare mounting port than probe-style sensor alone.
	Water-cooled Adaptors  064B01 recessed mount isolates the sensor from environment. 064B02 flush mount for better high frequency response. Both feature 1/2-20 mounting thread and are made from 17-4 PH stainless steel	Adapts Series 111, 112, 113 to high temperature environments.	Requires greater mounting area. Recessed sensor: reduced frequency capabilities. Flush sensor: diaphragm is susceptible to flash thermal effects.

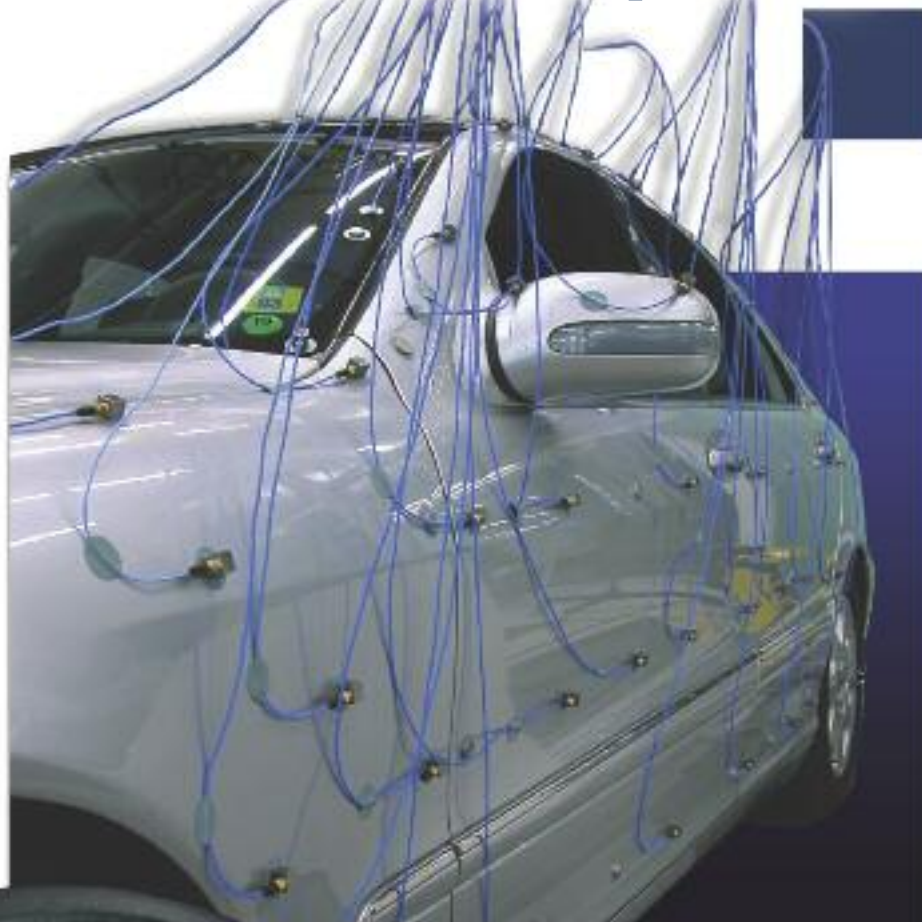


Pressure Sensor Mounting Adaptors

		Benefits	Limitations
Adaptor Type	Sensor 	Models 106B, 116B and 116B03 probe-style sensors, with supplied 5/16-24 or M14x1.25 thread may be directly mounted using the floating clamp nut. Used when there is limited space available to install a sensor or a flush diaphragm mount is desired.	Requires precision machining tools and dimensions.
	Straight Threads  061A60 3/14-16 installs in common mounting ports. Both made in 17-4 PH stainless steel	Simplified installation by drilling and tapping standard size mounting port. Eliminates precision machining required for probe-style sensors. Adapts Models 106B, 116B and 116B03 to thin-walled applications.	Limited to thin-wall or thick, counter-bored walls to install. Requires more area to prepare mounting port than probe-style sensor alone.
	Electrical Isolation  061A61 3/14-16 thread, made from Acetal material	Electrically isolates the sensor from ground.	Lower strength of Acetal limits use to lower pressure applications <500 psi (<3450 kPa).
	NPT Tapered Threads  062A06 1/2" NPT thread, made from 17-4 PH stainless steel	1/2" NPT thread conveniently adapts Models 106B, 116B and 116B03 to common hydraulic, pneumatic, and process mounting ports.	Since the tapered pipe thread seals on the thread itself, it is more difficult to achieve a flush mount of the sensor diaphragm. Requires more area to prepare mounting port than probe-style sensor alone.
Adaptor Type	Water-cooled Adaptors  064B06 recessed mount isolates the sensor from environment. 1/2-20 thread, made from 17-4 PH stainless steel.	Adapts Models 106B, 116B and 116B03 to high temperature environments.	Requires greater mounting area. Recessed sensor: reduced frequency capabilities.



Cables & Adaptors



Highlights:

- Stock Cable Assemblies
- Custom Cable Assemblies
- Multi-conductor Cables
- Patch Panels
- Connector Adaptors



Common Coaxial Cable Assemblies

Common Coaxial Cable Assemblies

Base Model	1 ft (0.3 m)	3 ft (0.9 m)	5 ft (1.5 m)	10 ft (3.0 m)	20 ft (6.1 m)	30 ft (9.1 m)	50 ft (15.2 m)	Construct cable assembly model by combining base model with desired length, e.g., 002C10.	
030A		03	05	10	20	30	50	FEP, Low Noise, Miniature	3-56 Plug to 10-32 Plug
030C			05	10	20	30	50	FEP, Low Noise, Miniature	3-56 Plug to BNC Plug
018G		03	05	10	20	30		PVC, Miniature	5-44 Plug to 10-32 Plug
003G		03	05	10	20	30		TFE, Low Noise, CE	5-44 Plug to 10-32 Plug
002P		03	05	10	20	30		FEP	5-44 Plug to BNC Plug
003P		03	05	10	20	30		TFE, Low Noise, CE	5-44 Plug to BNC Plug
018C		03	05	10	20	30		PVC, Miniature	5-44 Plug to BNC Plug
030B			05	10	20			FEP, Low Noise, Miniature	M3 Plug to 10-32 Plug
003R			05	10	20			TFE, Low Noise, CE	M3 Plug to 10-32 Plug
002A		03	05	10	20	30	50	FEP	10-32 Plug to 10-32 Plug
003A	01	03	05	10	20	30	50	TFE, Low Noise, CE	10-32 Plug to 10-32 Plug
023A				10				Hardline	10-32 Plug to 10-32 Jack
002C		03	05	10	20	30	50	FEP	10-32 Plug to BNC Plug
003C		03	05	10	20	30	50	TFE, Low Noise, CE	10-32 Plug to BNC Plug
002B	01	03						FEP	10-32 Plug to BNC Jack
003B	01	03						TFE, Low Noise, CE	10-32 Plug to BNC Jack
003U				10				TFE, Low Noise, CE	SMB Female Plug to SMB Female Plug
003V				10				TFE, Low Noise, CE	SMB Female Plug to BNC Plug
002T		03	05	10	20	30		FEP	BNC Plug to BNC Plug
003D		03		10	20			TFE, Low Noise, CE	BNC Plug to BNC Plug
012A		03	05	10	20	30	50	PVC, RG58/U	BNC Plug to BNC Plug
012E				10	20		50	PVC, RG58/U	2-Socket Env. Sealed to BNC Plug
012R				10	20		50	PVC, RG58/U	2-Socket MIL to BNC Plug



3-56 Plug



5-44 Plug



10-32 Plug



10-32 Jack



BNC Plug



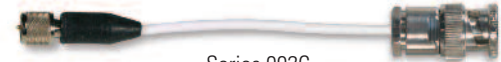
BNC Jack



Series 018C



Model 023A10



Series 002C



Series 012A



Series 003A

Common Coaxial Cable Specifications

Model	002	003	012	018	030
Cable Style	General Purpose	Low Noise	General Purpose	General Purpose	Low Noise
Temperature Range	-130 to +400 °F -90 to +204 °C	-320 to +500 °F -196 to +260 °C	-40 to +176 °F -40 to +80 °C	-22 to +221 °F -30 to +105 °C	-130 to +500 °F -90 to +260 °C
Impedance	50 ohm	50 ohm	52 ohm	32 ohm	50 ohm
Capacitance	29 pF/ft 95 pF/m	30 pF/ft 98 pF/m	29 pF/ft 95 pF/m	55 pF/ft 180 pF/m	30 pF/ft 98 pF/m
Cable Jacket Material	FEP	TFE	PVC	PVC	FEP
Cable Jacket Diameter	0.075 in 1.9 mm	0.079 in 2.01 mm	0.193 in 4.9 mm	0.054 in 1.37 mm	0.042 in 1.09 mm

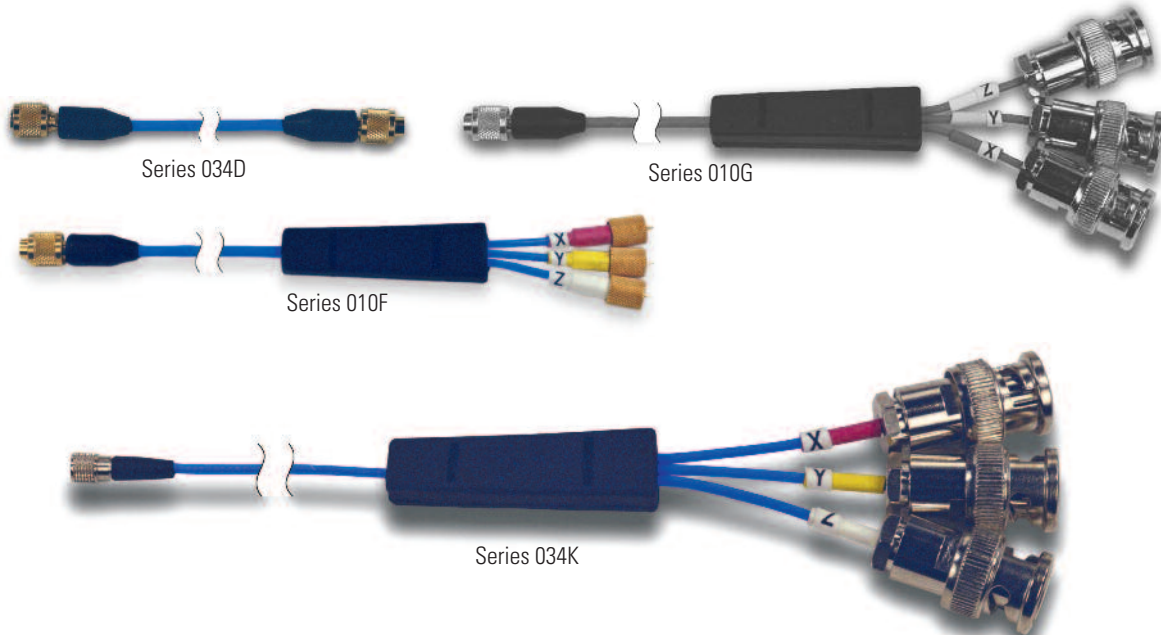
Other Coaxial Cable Specifications

Model	005	006	023	038	098
Cable Style	Ruggedized	Low Noise Ruggedized	Hardline	Low Noise	Low Noise
Temperature Range	-67 to +275 °F -55 to +135 °C	-67 to +275 °F -55 to +135 °C	-300 to +1200 °F -184 to +650 °C	-58 to +250 °F -50 to +121 °C	-130 to +500 °F -90 to +260 °C
Impedance	50 ohm	50 ohm	—	50 ohm	50 ohm
Capacitance	29 pF/ft 95 pF/m	30 pF/ft 98 pF/m	100 pF/ft 328 pF/m	30 pF/ft 100 pF/m	35 pF/ft 115 pF/m
Cable Jacket Material	Polyolefin over Steel Braid	Polyolefin over Steel Braid	Stainless Steel	Polyurethane	TFE
Cable Jacket Diameter	0.200 in 5.08 mm	0.200 in 5.08 mm	0.059 in 1.5 mm	0.119 in 3.02 mm	0.079 in 2.01 mm



4-Conductor Cable Assemblies

4-Conductor Cable Assemblies									
Base Model	5 ft (1.5 m)	10 ft (3.0 m)	15 ft (4.6 m)	20 ft (6.1 m)	25 ft (7.6 m)	30 ft (9.1 m)	50 ft (15.2 m)	Construct cable assembly model by combining base model with desired length, e.g., 034G20.	
034H	05	10		20		30	50	FEP, Lightweight	Mini 4-Socket Plug to (3) 10-32 Plugs
034K	05	10		20		30	50	FEP, Lightweight	Mini 4-Socket Plug to (3) BNC Plugs
019B	05	10	15	20		30		Silicone, Flexible, Lightweight	Mini 4-Socket Plug to (3) BNC Plugs
010P	05	10		20		30	50	FEP, General Purpose	4-Socket Plug to Pigtails
034A	05	10		20		30	50	FEP, Lightweight	4-Socket Plug to Pigtails
010D	05	10	15	20	25	30		FEP, General Purpose	4-Socket Plug to 4-Socket Plug
034D	05	10		20		30	50	FEP, Lightweight	4-Socket Plug to 4-Socket Plug
078D	05	10		20		30	50	Polyurethane, Flexible	4-Socket Plug to 4-Socket Plug
010F	05	10	15	20	25	30	50	FEP, General Purpose	4-Socket Plug to (3) 10-32 Plugs
034F	05	10		20		30	50	FEP, Lightweight	4-Socket Plug to (3) 10-32 Plugs
078F		10	15		25			Polyurethane, Flexible	4-Socket Plug to (3) 10-32 Plugs
010G	05	10	15	20	25	30	50	FEP, General Purpose	4-Socket Plug to (3) BNC Plugs
034G	05	10	15	20	25	30	50	FEP, Lightweight	4-Socket Plug to (3) BNC Plugs
036G	05	10	15	20	25	30		Silicone, Flexible	4-Socket Plug to (3) BNC Plugs
078G	05	10	15	20	25	30	50	Polyurethane, Flexible	4-Socket Plug to (3) BNC Plugs



4-Conductor Cable Specifications					
Model	010	034	019	036	078
Cable Style	General Purpose	Low Noise	Flexible Lightweight	Flexible	Flexible
Temperature Range	-130 to +392 °F -90 to +200 °C	-130 to +392 °F -90 to +200 °C	-76 to +500 °F -60 to +260 °C	-76 to +392 °F -60 to +200 °C	-58 to +185 °F -50 to +85 °C
Capacitance	16 pF/ft 52.4 pF/m	14 pF/ft 46 pF/m	15 pF/ft 49.2 pF/m	15 pF/ft 48 pF/m	25 pF/ft 81 pF/m
Cable Jacket Material	FEP	FEP	Silicone	Silicone	Polyurethane
Cable Jacket Diameter	0.1 in 2.54 mm	0.077 in 1.96 mm	0.068 in 1.73 mm	0.104 in 2.64 mm	0.119 in 3.02 mm



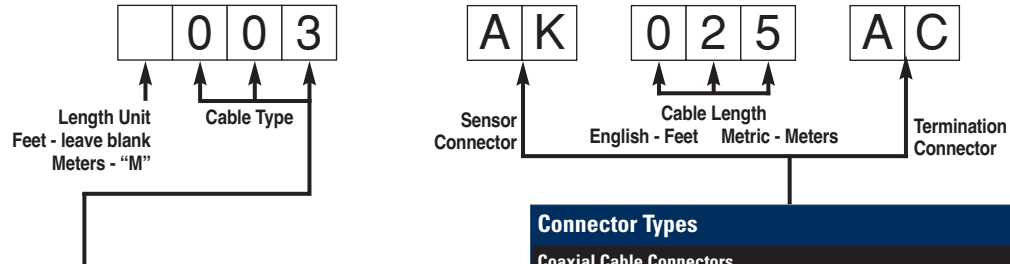
Custom Cable Assemblies

How to Configure Custom Cable Models:

1. Choose the cable length format desired, either English (ft) or Metric (m) unit lengths.
2. Choose the desired raw cable type.
3. Choose desired sensor connector type.
4. Determine the cable length required in English (ft) or Metric (m) unit lengths.
5. Choose desired termination connector type.

Example:

Model 003AK025AC defines a 25 ft, low-noise cable with right angle 10-32 plug sensor connector, BNC plug termination connector.



Raw Cable Type

Coaxial Cables			Diameter		Max. Temp.	
002	General Purpose, White PTFE Jacket	CE	0.075 in	1.9 mm	400°F	204°C
003	Low Noise, Blue PTFE Jacket	CE	0.079 in	2.0 mm	500°F	260°C
005	Ruggedized 002 Type, General Purpose	CE	0.2 in	5.08 mm	275°F	135°C
006	Ruggedized 003 Type, Low Noise	CE	0.2 in	5.08 mm	275°F	135°C
012	RG-58/U, Black Vinyl Jacket	CE	0.193 in	4.90 mm	176°F	80°C
018	Lightweight, Black PVC Jacket		0.054 in	1.37 mm	221°F	105°C
030	Low Noise, Mini, PTFE Jacket	CE	0.043 in	1.1 mm	500°F	260°C
038	Low Noise, Blue Polyurethane Jacket	CE	0.119 in	3.02 mm	250°F	121°C
098	Flexible, Low Noise, Green PTFE Jacket	CE	0.079 in	2.06 mm	500°F	260°C
Twisted/Shielded Pair Cable						
024	General Purpose, Black Polyurethane Jacket	CE	0.250 in	6.35 mm	250°F	121°C
032	Lightweight, FEP Jacket		0.085 in	2.16 mm	392°F	200°C
045	High Temperature, Red PFA Jacket	CE	0.204 in	5.18 mm	250°F	121°C
053	High Temperature, Red FEP Jacket	CE	0.157 in	3.99 mm	392°F	200°C
Shielded 4-Conductor Cable						
010	General Purpose, FEP Jacket	CE	0.1 in	2.54 mm	392°F	200°C
034	Lightweight, FEP Jacket	CE	0.077 in	1.96 mm	392°F	200°C
019	Lightweight, Blue Silicon Jacket	CE	0.068 in	1.73 mm	500°F	260°C
036	General Purpose, Blue Silicon Jacket	CE	0.104 in	2.64 mm	392°F	200°C
078	General Purpose, Blue Polyurethane Jacket	CE	0.119 in	3.02 mm	185°F	85°C
Hardline Cable						
013	Hardline, 2-conductor, Inconel Jacket		0.125 in	3.20 mm	1200 °F	650 °C
023	Hardline, Coaxial, 304L Stainless Steel Jacket		0.059 in	1.5 mm	1200 °F	650 °C
Miscellaneous Cable						
031	Red/White Twisted Pair, PTFE Jacket		0.03 in*	0.8 mm*	392°F	200°C
037	10-cond. Shielded, Black Poly Jacket		0.024 in	0.61 mm	250°F	121°C

* diameter of each conductor
The combination of cables and connectors listed are only recommended configurations; other configurations may be available. Consult PCB® before ordering.
CE designates that cable maintains CE conformance

Connector Types

Coaxial Cable Connectors

EB	10-32 Plug
EJ	10-32 Plug (Spring Loaded)
AH	10-32 Plug (Hex)
AK	10-32 Plug (Right-Angle)
AW	10-32 Plug (Solder Adaptor)
FZ	10-32 Plug (for 023 Hardline Cabling)
AL	10-32 Jack
GA	10-32 Jack (for 023 Hardline Cabling)
AG	5-44 Plug
AF	5-44 Plug (Right-Angle)
EK	3-56 Plug
EP	M3 Plug
LM	M4 Plug
AC	BNC Plug
AB	BNC Jack
FW	SMB Plug
FX	SMB Jack

Multi-Lead Connectors (For Triaxial Sensors)

AY	4-Socket Plug
CA	4-Pin Jack
EH	4-Socket Miniature Plug
HJ	4-Pin Miniature Jack
EN	9-Socket Plug
GJ	9-Pin Plug
JY	Splice Assembly to (3) EB Connectors
LA	Splice Assembly to (3) EJ Connectors
JZ	Splice Assembly to (3) AL Connectors
JW	Splice Assembly to (3) AC Connectors
JX	Splice Assembly to (3) AB Connectors
JS	Splice Assembly to (3) AY Connectors

Miscellaneous Connectors

AE	2-Socket Plug MS3106 5/8-24 thd (with Environmental Boot)
AP	2-Socket Plug MS3106 5/8-24 thd (with Strain Relief)
BP	2-Socket Plug MS3106 5/8-24 thd (High Temperature)
ET	2-Socket Plug MIL 7/16-27 thd (High Temperature)
GN	2-Socket Plug MIL 7/16-27 thd (for 013 Hardline Cabling)
GP	2-Pin Jack MIL 7/16-27 thd (for 013 Hardline Cabling)
LN	8-Pin Mini DIN (for 4-Wire Bridge)
BZ	Blunt Cut
DZ	Pigtail (Leads Stripped and Tinned for 3711/3713 Series)
JJ	Pigtail (Leads Stripped and Tinned for 3741 Series)
AD	Pigtail (Leads Stripped and Tinned for all Others)



- AB BNC Jack**
Max Temp 212 °F (100 °C) 
- AC BNC Plug**
Max Temp 212 °F (100 °C) 
- AD Pigtail** (leads stripped and tinned)
Max Temp 490 °F (254 °C)* 
- AE 2-Socket MS3106 Plug** (with environmental boot)
Max Temp 325 °F (163 °C) 
- AF 5-44 Coaxial Plug** (right angle)
Max Temp 325 °F (163 °C) 
- AG 5-44 Coaxial Plug** (straight)
Max Temp 490 °F (254 °C) 
- AH 10-32 Coaxial Plug** (straight, with wire locking hex)
Max Temp 490 °F (254 °C) 
- AK 10-32 Coaxial Plug** (right angle)
Max Temp 490 °F (254 °C) 
- AL 10-32 Coaxial Jack** (straight)
Max Temp 325 °F (163 °C) 
- AP 2-Socket MS3106 Plug** (with strain relief)
Max Temp 325 °F (163 °C) 
- AW 10-32 Coaxial Plug / Solder Adaptor** (user repairable)
Max Temp 490 °F (254 °C)* 
- AY 4-Socket Plug, 1/4-28 Thread** (for triaxial sensors)
Max Temp 325 °F (163 °C) 

- CA 4-Pin Jack, 1/4-28 Thread** (for triaxial sensors)
Max Temp 350 °F (177 °C) 
- EB 10-32 Coaxial Plug** (straight)
Max Temp 490 °F (254 °C) 
- EH 4-Socket Mini Plug, 8-36 Thread** (for triaxial sensors)
Max Temp 490 °F (254 °C) 
- EJ 10-32 Coaxial Plug** (straight, o-ring seal, spring loaded)
Max Temp 490 °F (254 °C) 
- EK 3-56 Coaxial Plug**
Max Temp 350 °F (177 °C) 
- EN 9-Socket Plug** (for triaxial capacitive accelerometers)
Max Temp 325 °F (163 °C) 
- EP M3 Coaxial Plug**
Max Temp 490 °F (254 °C) 
- ET 2-Socket Plug, 7/16-27 Thread**
Max Temp 325 °F (163 °C) 
- FZ 10-32 Coaxial Plug** (for hardline cable)
Max Temp 900 °F (482 °C) 
- GA 10-32 Coaxial Jack** (for hardline cable)
Max Temp 500 °F (260 °C) 
- GN 2-Socket Plug, 7/16-27 Thread** (high temperature)
Max Temp 900 °F (482 °C) 
- GP 2-Pin Jack, 7/16-27 Thread** (high temperature)
Max Temp 900 °F (482 °C) 

*Max Temp may be less depending upon cable application.



Custom Cable Assemblies

PCB® offers many standard cable assemblies, however, in the event that a standard cable assembly will not fulfill the requirements of the application, the ability to configure a custom cable assembly is offered. Start by ensuring compatibility of the connector type with the cable type desired from the chart below, and then configure the custom cable model number from the steps on the next page.

Cable - Connector Compatibility Matrix

The following table provides compatibility information for cables and cable connectors. A "✓" denotes compatibility of the connector type shown in the rows going down the table with the cable type of the intersecting column going across the table.

Coax Custom Cable Assemblies

Cable	002	003	005	006	012	013	018	023	024	030	031	032	038	045	053	098
Connector																
AB	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	✓	✓	✓	✓
AC	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	✓	✓	✓	✓
AD	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	✓	✓	✓	✓
AE		✓			✓				✓						✓	
AF	✓	✓	✓	✓			✓			✓						✓
AG	✓	✓	✓	✓			✓			✓	✓	✓	✓			✓
AH	✓	✓	✓	✓			✓			✓		✓				✓
AK	✓	✓	✓	✓			✓			✓		✓	✓			✓
AL	✓	✓	✓	✓			✓			✓	✓	✓				✓
AP	✓	✓	✓	✓	✓				✓			✓	✓	✓	✓	✓
AW											✓					
BP	✓	✓		✓									✓	✓	✓	
BZ	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	✓	✓	✓	✓
EB	✓	✓	✓	✓			✓			✓	✓	✓	✓			✓
EJ	✓	✓	✓	✓			✓			✓		✓	✓			✓
EK										✓						
EP	✓	✓	✓	✓			✓			✓						✓
ET														✓	✓	
FW	✓	✓	✓	✓			✓			✓						✓
FX	✓	✓														✓
FZ								✓								
GA								✓								
GN						✓										
GP						✓										

Multi-conductor Custom Cable Assemblies

Cable	010	019	034	036	037	078
Connector						
AD	✓	✓	✓	✓	✓	✓
AY	✓	✓	✓	✓		✓
BZ	✓	✓	✓	✓	✓	✓
CA	✓	✓	✓	✓		✓
EH		✓	✓			
EN					✓	
GF	✓		✓		✓	
HJ			✓			
JJ	✓					
JS					✓	
JW	✓	✓	✓	✓		✓
JX	✓	✓	✓	✓		✓
JY	✓	✓	✓	✓		✓
JZ	✓	✓	✓	✓		✓
LA	✓	✓	✓	✓		✓



Multi-conductor Cables

Multi-conductor cables minimize tangles and reduce overall cable costs. They also offer the user numerous cable/termination variations to suit a particular transmission requirement, as well as the ability to consolidate several cables into one.



Model 009F "xx"
Flat ribbon cable
DB50 female to DB50 male
Specify "xx" length in feet



Model 009H "xx"
Shielded ribbon cable
DB50 female to DB50 male
Specify "xx" length in feet



Model 009L05
Multi-conductor cable
VXI to 4 BNC plugs
5 ft (1.5 m) length



Model 009S05
Multi-conductor cable
VXI to VXI
5 ft (1.5 m) length



Model 009B "xx"
Ruggedized
Shielded multi-conductor cable
DB50 female to DB50 male
Specify "xx" length in feet



Model 009A "xx"
Ruggedized
Multi-conductor cable
DB50 female to 16 BNC Plugs
Specify "xx" length in feet

Patch Panels

Input patch panels serve as a central collection point for individual sensor cables installed in multi-channel measurement arrays. The sensor signal paths are then consolidated and transmission to readout or data acquisition equipment is accomplished by a single, multi-conductor cable.

Output patch panels connect via multi-conductor cables to the output connectors on high density rack or modular signal conditioners. The sensor signal paths are then expanded to individual BNC's for each channel for subsequent connection to data acquisition equipment.



Model 070C21
16-channel input patch panel
16 IDC pin inputs
DB50 male output



Model 070C29
16-channel input patch panel
16 BNC jack and
16 IDC pin inputs
DB50 male output



Model 070A33
32-channel input patch panel
32 BNC jack and 32 IDC pin inputs
2 DB50 male outputs
Rack mount



Model 070A34
32-channel output patch panel
2 DB37 male inputs
4 DB37 female servo inputs
4 DB50 male HP outputs
32 BNC jack outputs
Rack mount



Connector Adaptors



070A01

Scope Input T Connector

BNC plug to two 10-32 coaxial jacks. Used for splitting low-impedance signals.



070A05

10-32 Coaxial

Coupler 10-32 coaxial jack to 10-32 coaxial jack. Joins two cables terminating in 10-32 coaxial plugs.



070A11

BNC T Connector

BNC plug to two BNC jacks. Used as a cable splitter.



1/4 in max
wall thickness
5/16 in mtg thd

070A14

10-32 Hermetic Feed-thru

10-32 coaxial jack to 10-32 coaxial jack. Tapped 5/16-32.



Model "EB" 10-32 Coaxial Connector

10-32 crimp-on style coaxial connector. Requires tool contained in 076C31 kit.

Model 076C31 10-32 Coaxial Crimp-on Connector Kit

Includes 1 pin insertion tool, 1 sleeve-crimping tool, and 20 Model "EB" connectors with cable strain reliefs. (Wire stripper and soldering iron not included).



Crimping tool

Pin tool



070A02

Scope Input Adaptor

10-32 coaxial jack to BNC plug. For adapting BNC connectors for use with 10-32 coaxial plugs.



070A08

Cable Adaptor

10-32 coaxial jack to BNC jack. Joins cables terminating in a BNC plug and a 10-32 coaxial plug.



070A12

BNC Coupler

BNC jack to BNC jack. Joins two cables terminating in BNC plugs.



070A20

10-32 Coaxial Right Angle Connector Adaptor

10-32 coaxial jack to 10-32 coaxial plug. For use in confined locations. For ICP® sensors only.



076A25

076A05 10-32 Coaxial Plug

Microdot connector, screw-on type.

076A25 Connector Tool

Used to install 076A05 screw-on type microdot connector.

Model 076A30 Microdot Screw-on Connector Kit

One Model 076A25 Tool and 20 Model 076A05 10-32 coaxial connectors for emergency repair of 002-type cables.



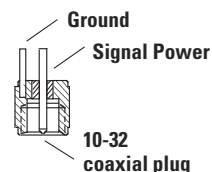
070A03

Connector Adaptor

10-32 coaxial plug to BNC jack. Converts 10-32 connectors for use with BNC plugs. Do not use on sensor connectors.



070B09



Solder Connector Adaptor

10-32 coaxial plug to solder terminals. Excellent for high-shock applications. User-repairable.

1/8 in max
wall thickness
1/2 in mtg thd



070A13

Feed-thru Adaptor

10-32 coaxial jack to BNC jack. Bulkhead connects BNC plug to 10-32 coaxial jack.



085A18

Plastic Protective Cap

Provides strain relief for solder connector adaptors, as well as protects 10-32 cable ends.



085A40

10-32 Coaxial Shorting Cap

Used to short charge output sensor connectors during storage and transportation.



Custom Sensors & Options for PCB® Products

PCB® designs and manufactures thousands of custom product variations. These range from minor modifications of sensitivity or mounting configuration, all the way to complex projects built from the ground-up based on customer specifications for the most demanding applications. PCB® also provides a simplified format for ordering many custom versions of our stock and standard products through the use of prefixes. What follows is a list of the most popular prefixes and a brief explanation of their function. Please contact PCB to see if the prefix of interest can be combined with the model in which you are interested. At that time price and delivery can also be provided.

Option “A” — Adhesive Mount (e.g., A353B18)

This option designates the removal of the integral stud so that the sensor has a smooth and flat bottom for direct adhesive mounting. Note that the frequency response will not be as high as with stud mounting and that higher frequency response will be achieved with stiffer adhesives.

Option “HT” — High Temperature Operation (e.g., HT356A02)

An adjustment to the built-in microelectronic circuitry permits sensor operation to temperatures that exceed the standard specified temperature range. Typically, the low frequency range will be somewhat compromised. The published Specification sheet for the base model will indicate the extent low frequency response is compromised.

Option “J” — Ground Isolation (e.g., J353B01)

The ground isolation option provides an electrical isolation of $> 10^8$ ohms between the accelerometer and the test structure. Isolating the sensor from the test object reduces noise induced by electrical ground loops. Attaching the ground isolation base to the accelerometer reduces the upper frequency range slightly. The “J” option need only be specified when ground isolation is required and the sensor is being stud mounted. If adhesively mounting, the base model will include an adhesive base to provide ground isolation. Physical dimensions will change but the change may not be clear on the specification sheet. Please call a PCB® Applications Engineer for detailed information.

Option “M” — Metric Mounting Thread (e.g., M353B15)

This option is used for applications requiring a metric thread for installation. On models for which a separate mounting stud is provided, this option supplies an adaptor stud with a metric installation thread. For models that incorporate an integral mounting stud, the optional unit includes an integral metric threaded stud. Models that have through-hole mounting are furnished with appropriately sized, metric-threaded cap screws. There are no compromises to any specification when installing with a metric thread. Note: many models are supplied with both SAE and Metric mounting hardware.

Option “P” — Positive Polarity Element (e.g., P357B03)

When the phase of the output signal is important, especially for timing and multi-channel applications, it may be necessary to reverse the polarity of the output signal to correspond to the inverting characteristics of the signal conditioner being used. Most charge

amplifiers invert the measurement signal and would typically be used with charge mode accelerometers having a negative signal polarity. In cases where the signal conditioner is a non-inverting device, it may be desirable to use a positive polarity sensor. This option provides a positive polarity charge mode sensor without compromise to any other specification.

Option “Q” — Extended Low Frequency (e.g., Q353B01)

Accurate measurements below 1 Hz can often be achieved by factory modification of the internal microelectronics of the sensor. For most sensors the DTC is extended to 10 seconds, which provides -5% @ 0.05 Hz. For some smaller sensors the DTC is extended to 5 seconds, which provides -5% @ 0.1 Hz. For accurate low-frequency measurements, be certain the signal conditioner is DC coupled. For practical reasons, lower sensitivity sensors (≤ 50 mV/g) with extended low frequency are recommended only for long-duration shock pulse measurements associated with package or drop testing.

Option “T” — Transducer Electronic Data Sheet (TEDS) (e.g., T333B32)

The “TEDS” option provides an accelerometer with an on-board digital memory. This memory stores valuable information such as sensor model number, serial number, sensitivity value, last calibration date, etc. Via command from an appropriately outfitted signal conditioner, the sensor is digitally addressed and the information in the memory is downloaded. The information is then utilized by the data acquisition system to aid in automating such tasks as coordinate mapping and data bookkeeping. This plug-and-play capability is in accordance with the international standard defined by IEEE P1451.4 Users should verify with their analyzer / software vendor to see what versions and templates are supported in order to select the proper PCB “TEDS” option.

Option “TLA” — TEDS LMS International - Free Format (e.g., TLA333B32)

Option “TLB” — TEDS with LMS International - Automotive Format (e.g., TLB333B32)

Option “TLD” — TEDS Capable of Digital Memory and Communication Compliant with IEEE 1451.4 (e.g., TLD333B32)

Option “W” — Water Resistant Connection (e.g., W353B01/002C10)

The water resistant option provides a cable directly attached and sealed to the sensor's electrical connector with o-rings and heat-shrink tubing. This sealing process guards against contamination from dirt and fluids and permits short-term underwater use. The model number is constructed by placing the letter “W” as a prefix to the model number, then adding a slash (/) after the model number, followed by the type of cable, length, and appropriate connectors. (See cables/accessories section for a description of cables and connectors). As an example, a W353B01/002C03 designates a water resistant sealing of a 002C03 cable to a 353B01 accelerometer. Metric lengths can be defined by adding a “M” in front of the cable type, e.g., W353B01/M002C03 designates a 3-meter cable length.



Services and Qualifications

Lifetime Warranty Plus — PCB® Piezotronics, Inc. guarantees Total Customer Satisfaction. If any stock or standard PCB® product ever fails, PCB® will repair, replace or exchange the product at no charge. As a further benefit under the PCB® Lifetime Warranty Plus, PCB® will, for a one (1) year period following the delivery date of any stock or standard PCB® product, refund 100% of the purchase price for any PCB® stock or standard product with which the original purchaser is not completely satisfied.

Toll-Free Customer Service — PCB® offers a direct, toll-free telephone numbers for customer use - 888-684-0014. Customer Service Representatives and Application Engineers are available to assist with requests for product literature, price quotations, discuss application requirements, orders, order status, expedited delivery, troubleshooting equipment, or arranging for returns. Our general fax number is: 248-478-2094. We look forward to hearing from you.

24-hour SensorLineSM — PCB® offers to all customers, at no charge, 24-hour emergency product or application support, day or night, seven days per week, anywhere in the world. To reach a PCB® SensorLineSM Customer Service Representative, call 716-684-0001.

Web site - www.pcb.com/auto — Visit us online at www.pcb.com/auto to view our full selection of products, newly released products, complete product specifications, product drawings, technical information, and literature.

AS9100 and ISO 9001 Certifications — PCB® is registered by the Underwriters Laboratory, Inc. as an AS9100 and ISO 9001 facility and maintains a quality assurance system dedicated to resolving any concern to ensure total customer satisfaction. PCB® also conforms to the former MIL-STD-45662 and MIL-Q-9858.

A2LA Accredited Calibration Facility — PCB Piezotronics microphones, accelerometers, pressure and force transducers are calibrated with full traceability to NIST (National Institute of Standards & Technology) to ensure conformance to published specifications. Certificates of calibration are furnished which include actual measured data. Calibration systems utilized are kept in full compliance with ISO 9001:2000 standards. Calibration methods are accredited in accordance with the recognized International Standard ISO/IEC 17025:2005 General Requirements for the Competence of Testing and Calibration Laboratories, as well as AS9100 and ISO 10012-1 standards. PCB® also meets requirements of ANSI/NCCL Z540-1-1994 and any additional program requirements in the field of calibration.

Delivery Policy — PCB® is committed to making every effort possible to accommodate all delivery requests. Our extensive in-house production capabilities permit us to manufacture most products to order in a timely fashion. In the event that a specific model is unavailable in the time frame that you need, we can usually offer a comparable unit, for sale or loan, to satisfy your urgent requirements. Many products are available from stock for immediate shipment. Standard cable assemblies and accessory hardware items are always stocked for immediate shipment and PCB® never requires a minimum order amount. If you have urgent requirements, call a factory representative and every effort will be made to fulfill your needs.

Custom Products — PCB® prides itself on being able to respond to customers' needs. Heavy investment in machinery, capabilities, and personnel allow us to design, test, and manufacture products for specialized applications. Please contact us to discuss your special needs.

CE Marking  — Many PCB® products are designed, tested, and qualified to bear CE marking in accordance with European Union EMC Directive. Products that have earned this qualification are so indicated by the  logo.

Hazardous Area Use (ATEX Logo, CSA-US Logo) — Certain equipment is available with ATEX and/or CSA certifications to enable use in hazardous environments. Contact PCB® for detailed specifications, which will identify the specific approved environments for any particular model.

Accuracy of Information — PCB® has made a reasonable effort to ensure that the specifications contained in this catalog were correct at the time of printing. In the interest of continuous product improvement, PCB® reserves the right to change product specifications without notice at any time. Dimensions and specifications in this catalog may be approximate and for reference purposes only. Before installing sensors, machining any surfaces, or tapping any holes, contact a PCB® Application Engineer to obtain a current installation drawing and the latest product specifications.

Routine Modification of Standard Models — In addition to the product options noted in our catalogs, customers from all business sectors regularly request adjustments for their specific implementation and measurement needs. PCB® has accommodated customers by making numerous standard adjustments to thousands of sensors, as well as to associated electronics. These adjustments to sensitivity, range, frequency response, resolution, grounding issues, mounting, cabling, and electrical requirements can often be made for a certain premium over the base model.

Stock Products — For the added convenience of our customers, PCB® offers a wide selection of sensors and instrumentation as stock products, available in-house and off the shelf, competitively priced with expedited delivery. These products have been identified and stocked based upon customer demand, with models that offer reliability and versatility across multiple application environments. We also manufacture custom products made to your requirements. We invite our customers to work with our Applications Engineers in evaluating your application first, to see if we might have a stock product alternative that fits your requirements with a short delivery time.

PCB® Contact Guide

USA Toll-Free Customer Service:
888-684-0014

International Customers:
716-684-0001

Fax:
248-478-2094

E-mail:
automotivesales@pcb.com

Web Site:
www.pcb.com/auto

24-Hour SensorLineSM:
716-684-0001



PCB Piezotronics corporate headquarters,
located at 3425 Walden Avenue, Depew, NY, USA



With more than 40 years of products, innovation and customer service, PCB Piezotronics is a global leader in the design and manufacture of force, torque, load, strain, pressure, acoustic, shock and vibration sensors, as well as the pioneer of ICP® technology. Core competencies include ICP® and charge output piezoelectric, piezoresistive, strain gage, MEMS and capacitive sensors and instrumentation.

To address the growing need for sensors and related instrumentation in the target market areas of test & measurement, industrial vibration, automotive, aerospace & defense, environmental noise monitoring and industrial hygiene, PCB® has established a series of focused divisions, with dedicated sales, marketing, engineering, and customer service resource support tailored to the needs of customers in these very specific areas. PCB® divisions and their core competencies include:



PCB® Aerospace & Defense specializes in products and programs developed exclusively for the global aerospace, civil and military aviation, defense, homeland security, nuclear, power generation, and test and measurement markets. Products include space-rated high temperature and high-g shock accelerometers; space-qualified hardware; sensors and instrumentation for Health and Usage Monitoring Systems (HUMS), for UAV's, helicopters, fixed wing aircraft and ground vehicles; system electronics; combustion monitoring pressure sensors; high temperature engine vibration monitoring sensors; launch and separation shock sensors; Active Noise Cancellation products; and aircraft hydraulic pressure sensors, among others. Typical applications include vibration and fatigue testing; qualification testing; aircraft and engine ground, flutter and flight testing; blast pressure and hydraulic system pressure measurements; structural dynamics; engine vibration monitoring; launch and separation shock studies; pressure, wind tunnel and aerodynamic studies; aircraft and ground vehicle prognostics; and noise cancellation applications. Toll-free in the USA 1-866-816-8892; email: aerosales@pcb.com.



PCB® Automotive Sensors is a dedicated sales and technical support group, located in Novi, Michigan, devoted to the testing and instrumentation needs of the global automotive test market. This team is focused on development and application of sensors and related instrumentation technologies for specific vehicle development test programs, in the areas of modal and structural analysis, vehicle and component NVH characterization, powertrain testing, vehicle and component durability, vehicle dynamics, safety and regulatory testing, component and system level performance, driveability, road load, and crash, among others. PCB® designs and manufactures sensors for automotive testing, including vibration, acoustic, pressure, force, load, dynamic strain and torque sensing technologies. These robust sensors are designed to excel in a variety of automotive applications. Toll-free in the USA 1-888-684-0014; email: automotivesales@pcb.com; www.pcb.com/auto.



IMI Sensors designs and manufactures a full line of accelerometers, sensors, vibration switches, vibration transmitters, cables and accessories for predictive maintenance, continuous vibration monitoring, and machinery and equipment protection. Products include rugged industrial ICP® accelerometers; 4-20 mA industrial vibration sensors and transmitters for 24/7 monitoring; electronic and mechanical vibration switches; the patented Bearing Fault Detector, for early warning of rolling element bearing faults; high temperature accelerometers to +900 °F (+482 °C); 2-wire Smart Vibration Switch, with MAVT™ technology, which automatically sets trip level; and the patented Reciprocating Machinery Protector, which outperforms conventional impact transmitters. CE approved and intrinsically safe versions are available for most products. Toll-free 1-800-959-4464; email: imi@pcb.com; www.imi-sensors.com.



Larson Davis Environmental Noise Monitoring and Industrial Hygiene offers a full line of Noise and Vibration measurement instrumentation, including Type 1 sound level meters, personal noise dosimeters, octave band, audiometric calibration systems, microphones and preamplifiers, hearing conservation software, and Human Vibration Exposure Monitor for Hand-Arm/Whole Body Vibration for evaluating human exposures to ISO 2631 and 5349, as well as to help ensure compliance with a number of ANSI and OSHA and other related industrial hygiene standards, as well as for measurement of building acoustics, community and environmental noise monitoring, as well as supporting various automotive, aerospace and industrial applications. Toll-free 1-888-258-3222; email: sales@larsondavis.com; www.larsondavis.com.



PCB Piezotronics Test & Measurement Products supports the application of traditional sensor technologies of acoustics, pressure, force, load, strain, torque, acceleration, shock, vibration, electronics and signal conditioning within product design and development, consumer product testing, quality assurance, civil structure monitoring, research and development, education and engineering application areas.

Visit www.pcb.com for more details.



The Modal Shop, Inc. (www.modalshop.com) specializes in multi-channel sound and vibration sensing systems for lab measurements and industrial process monitoring, including calibration systems and test and measurement equipment rental. Also, smart sensing systems applied to parts quality NDT analysis, process monitoring and machinery gauging. Toll-free in USA: 800-860-4867, Phone: 513-351-9919



Automotive Sensors & Instrumentation



PCB® Automotive Sensors is a dedicated technical sales and support group, located in Novi, Michigan, USA, devoted to the testing needs of the global transportation market. This team is focused on development and application of sensors and related instrumentation for specific vehicle development test programs, including modal analysis; driveability; ride & handling; component & system performance; durability; road load data acquisition; vehicle and powertrain NVH; legislative testing; quality control; powertrain development; and motorsport. PCB® offers exceptional customer service, 24-hour technical assistance, and a **Lifetime Warranty Plus** guarantee.

AUTOMOTIVE SENSORS A PCB PIEZOTRONICS DIV.

40000 Grand River Avenue, Suite 201, Novi, MI 48375

Toll-Free in USA 888-684-0014

Fax 248-478-2094 E-mail automotivesales@pcb.com

www.pcb.com/auto

The Global Leader in Sensors and Instrumentation For All Your Applications

AEROSPACE & DEFENSE
A PCB PIEZOTRONICS DIV.

Toll-Free in USA 866-816-8892
E-mail aerosales@pcb.com

IMI SENSORS
A PCB PIEZOTRONICS DIV.

Toll-Free in USA 800-959-4464
E-mail imi@pcb.com

PCB PIEZOTRONICS
TEST & MEASUREMENT PRODUCTS

Toll-Free in USA 800-828-8840
E-mail info@pcb.com

LARSON DAVIS
A PCB PIEZOTRONICS DIV.

Toll-Free in USA 888-258-3222
E-mail sales@larsondavis.com

THE MODAL SHOP INC.
A PCB GROUP CO.

Toll-Free in USA 800-860-4867
E-mail info@modalshop.com

PCB PIEZOTRONICS INC.
A PCB GROUP COMPANY

Corporate Headquarters

3425 Walden Avenue, Depew, NY 14043-2495 USA

Toll-Free in USA 800-828-8840

24-hour SensorLineSM 716-684-0001

Fax 716-684-0987 E-mail info@pcb.com

www.pcb.com

AS9100 CERTIFIED ■ ISO 9001 CERTIFIED ■ A2LA ACCREDITED to ISO 17025

© 2012 PCB Group, Inc. In the interest of constant product improvement, specifications are subject to change without notice. PCB, ICP, Modally Tuned, Spindler, Swiveler and TORKDISC are registered trademarks of PCB Group. SoundTrack LXT, Spark and Blaze are registered trademarks of PCB Piezotronics. SensorLine is a service mark of PCB Group. All other trademarks are property of their respective owners.

AUTO-S&CAT-0812

Printed in U.S.A.

Visit **www.pcb.com**
for a complete list
of global sales offices



Mixed Sources
Product group from well managed
forests, controlled sources and
recycled wood or fiber
www.fsc.org Cert no.
© 1996 Forest Stewardship Council

