SENSORS FOR AUTOMOTIVE MODAL ANALYSIS

PCB PIEZOTRONICS
AN AMPHENOL COMPANY

pcb.com | 800 828 8840

MODAL ANALYSIS FOR AUTOMOTIVE DESIGN

Modal analysis is the process of identifying dynamic characteristics of a vibrating system using measured force inputs and vibratory responses. Insights obtained from scaled mode shapes are invaluable to automotive design, enabling engineers to pinpoint areas of weakness and devise structural enhancements for improved performance and safety. While increased computing power and advances in finite element analysis (FEA) techniques have significantly enhanced the precision of today's automotive models, modal testing provides vital empirical data to validate these computational predictions. Together, FEA's theoretical insights and modal analysis's real-world measurements form a robust foundation for automotive engineering, ensuring designs are both innovative and grounded in practical reality.

Common applications include:

- Modal alignment
- Analytical model correlation
- Force response simulation
- Structural testing
- Vibration absorption

PCB® specializes in producing accelerometers, dynamic force sensors, instrumented impact hammers, electrodynamic modal shakers, and related accessories tailored for modal analysis applications. Our commitment to fulfilling your specific needs is at the core of our business. Through strategic investments in advanced machinery, technological capabilities, and skilled personnel, we're equipped to design, test, and manufacture products suited for specialized applications. Please contact one of our highly trained representatives to explore solutions tailored to your unique requirements.

CHOOSING AN ACCELEROMETER

Overall, the optimal accelerometer for automotive modal analysis is one that has high sensitivity with excellent resolution, a wide frequency range, and small mass. When choosing a sensor, keep in mind that size has an influence on performance characteristics: larger inertial mass enhances resolution and sensitivity, but tends to limit the frequency range it can effectively measure. 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. For larger structures, such as body-in-white, a larger accelerometer with better resolution and higher sensitivity is optimal. While accelerometers used for classical and operational modal analysis tests are similar, the environments and conditions under which measurements are made can differ significantly. An operational modal test is performed in a structure's ambient environment, which can be quite harsh, requiring hermetically sealed connectors and high temperature resilience. The operating inputs can also be quite severe, requiring sensors with a wide amplitude range and a robust construction.

ACCELEROMETERS FOR MULTI-POINT MODAL TESTING

PCB offers a wide variety of single-axis and triaxial ICP® accelerometers for automotive modal analysis, spanning from ultrasensitive, lightweight sensors for low-level inputs and mild environments, to robust models featuring high ranges, hermetically sealed connectors, and rugged titanium construction for severe inputs and environments. These sensors are available in a variety of packages, with a range of mounting options and output cabling. Optional TEDS circuitry streamlines the management of sensor performance data and mapping of structure coordinates when paired with compatible systems.

SMALL, LIGHTWEIGHT, ICP® ACCELEROMETERS

SERIES 333 ICP® ACCELEROMETER
MODEL 333A22

- Sensitivity: 10 mV/g
- Measurement Range: ±500 g pk
- Frequency Range: 1 to 6k Hz (±5%)
- TEDS included

SERIES 333 ICP® ACCELEROMETER
MODEL 333B30

- Sensitivity: 100 mV/g
- Measurement Range: ±50 g pk
- Frequency Range: 0.5 to 3k Hz (±5%)
- TEDS version: TLD333B30

SERIES 333 ICP® ACCELEROMETER
MODEL 333B32

- Sensitivity: 100 mV/g
- Measurement Range: ±50 g pk
- Frequency Range: 0.5 to 3k Hz (±5%)
- TEDS version: TLD333B32

SERIES 333 ICP® ACCELEROMETER
MODEL 333B40

- Sensitivity: 500 mV/g
- Measurement Range: ±10 g pk
- Frequency Range: 0.5 to 3k Hz (±5%)
- TEDS version: TLD333B40

SERIES 333 ICP® ACCELEROMETER
MODEL 333B45

- Sensitivity: 500 mV/g
- Measurement Range: ±10 g pk
- Frequency Range: 0.5 to 3k Hz (±5%)
- TEDS version: TLD333B45

SERIES 333 ICP® ACCELEROMETER
MODEL 333B50

- Sensitivity: 1000 mV/g
- Measurement Range: ±5 g pk
- Frequency Range: 0.5 to 3k Hz (±5%)
- TEDS version: TLD333B50

TRIAXIAL ICP® ACCELEROMETERS

LIGHTWEIGHT TRIAXIAL ICP® ACCELEROMETER
MODEL TLD356A03

- Sensitivity: 10 mV/g
- Measurement Range: ±500 g pk
- Frequency Range: 2 to 5k Hz (±5%)
- Weight: 0.04 oz (1.0 gm)
- TEDS included

LIGHTWEIGHT TRIAXIAL ICP® ACCELEROMETER
MODEL 356A09

- Sensitivity: 10 mV/g
- Measurement Range: ±500 g pk
- Frequency Range: 2 to 5k Hz (±5%)
- Weight: 0.04 oz (1.0 gm)

CASE ISOLATED TRIAXIAL ICP® ACCELEROMETER
MODEL 354B05

- Sensitivity: 100 mV/g
- Measurement Range: ±50 g pk
- Frequency Range: 0.4 to 10k Hz (±5%)
- Weight: 0.51 oz (14.5 gm)
- TEDS included

LIGHTWEIGHT TRIAXIAL ICP® ACCELEROMETER
MODEL 356A43

- Sensitivity: 10 mV/g
- Measurement Range: ±500 g pk
- Frequency Range: 0.4 to 10k Hz (±10%)
- Weight: 0.15 oz (4.2 gm)
- TEDS included

LIGHTWEIGHT TRIAXIAL ICP® ACCELEROMETER
MODEL 356A44

- Sensitivity: 50 mV/g
- Measurement Range: ±100 g pk
- Frequency Range: 0.4 to 10k Hz (±10%)
- Weight: 0.15 oz (4.2 gm)
- TEDS included

LIGHTWEIGHT TRIAXIAL ICP® ACCELEROMETER
MODEL 356A45

- Sensitivity: 100 mV/g
- Measurement Range: ±50 g pk
- Frequency Range: 0.4 to 10k Hz (±10%)
- Weight: 0.15 oz (4.2 gm)
- TEDS included

HIGH SENSITIVITY ICP® TRIAXIAL ACCELEROMETER
MODEL TLD356A15

- Sensitivity: 100 mV/g
- Measurement Range: ±50 g pk
- Frequency Range: 1.4 to 6.5k Hz (±10%)
- Weight: 0.37 oz (10.5 gm)
- TEDS included

HIGH SENSITIVITY ICP® TRIAXIAL ACCELEROMETER
MODEL TLD356A16

- Sensitivity: 100 mV/g
- Measurement Range: ±50 g pk
- Frequency Range: 0.3 to 6k Hz (±10%)
- Weight: 0.26 oz (7.4 gm)
- TEDS included

HIGH SENSITIVITY ICP® TRIAXIAL ACCELEROMETER
MODEL TLD356A17

- Sensitivity: 500 mV/g
- Measurement Range: ±10 g pk
- Frequency Range: 0.4 to 4k Hz (±10%)
- Weight: 0.33 oz (9.3 gm)
- TEDS included

TEARDROP, RING, AND GROUND ISOLATED ICP® ACCELEROMETERS

TEARDROP ICP® ACCELEROMETER
MODEL 352A21

- Sensitivity: 10 mV/g
- Measurement Range: ±500 g pk
- Frequency Range: 1 to 10k Hz (±5%)
- Weight: 0.02 oz (0.6 gm)

TEARDROP ICP® ACCELEROMETER
MODEL 352A24

- Sensitivity: 100 mV/g
- Measurement Range: ±50 g pk
- Frequency Range: 1 to 10k Hz (±5%)
- Weight: 0.03 oz (0.9 gm)

TEARDROP ICP® ACCELEROMETER WITH TEDS
MODEL 352A59

- Sensitivity: 10 mV/g
- Measurement Range: ±500 g pk
- Frequency Range: 1 to 10k Hz (±5%)
- Weight: 0.03 oz (0.9 gm)

MINIATURE ICP® ACCELEROMETER
MODEL 352C68

- Sensitivity: 100 mV/g
- Measurement Range: ±50 g pk
- Frequency Range: 1 to 10k Hz (±5%)
- Weight: 0.07 oz (2.0 gm)

RING ICP® ACCELEROMETER
MODEL 320C52

- Sensitivity: 10 mV/g
- Measurement Range: ±500 g pk
- Frequency Range: 1 to 10k Hz (±5%)
- Weight: 0.07 oz (2.0 gm)

RING ICP® ACCELEROMETER
MODEL 355B02

- Sensitivity: 10 mV/g
- Measurement Range: ±500 g pk
- Frequency Range: 1 to 10k Hz (±5%)
- Weight: 0.35 oz (10.0 gm)

GROUND ISOLATED ICP® ACCELEROMETER
MODEL 352A58

- Sensitivity: 10 mV/g
- Measurement Range: ±500 g pk
- Frequency Range: 1 to 10k Hz (±5%)
- Weight: 0.03 oz (0.9 gm)

GROUND ISOLATED ICP® ACCELEROMETER
MODEL J320C18

- Sensitivity: 10 mV/g
- Measurement Range: ±500 g pk
- Frequency Range: 1 to 10k Hz (±5%)
- Weight: 0.06 oz (1.7 gm)

GROUND ISOLATED ICP® ACCELEROMETER
MODEL JTLD352C33

- Sensitivity: 100 mV/g
- Measurement Range: ±50 g pk
- Frequency Range: 1 to 10k Hz (±5%)
- Weight: 0.02 oz (5.8 gm)

INSTRUMENTED IMPACT HAMMERS FOR MODAL ANALYSIS

Modally Tuned® ICP® impact hammers are an easy-to-use solution 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 preventing hammer resonance in the frequency range of interest from corrupting the test data, resulting in more accurate and consistent outcomes.

Models are also available with TEDS capabilities. Explore a full range of options at pcb.com.

ICP® IMPACT HAMMER: 50 lbf

MODEL 086E80

- Sensitivity: 100 mV/lbf
- Measurement Range: ±50 lbf pk
- Hammer Mass: 2.4 lb (38.4 oz)
- Ideal for use on rearview mirrors and printed circuit boards for ECMs

ICP® IMPACT HAMMER: 500 lbf

MODEL 086C03, TLD086C03

- Sensitivity: 10 mV/lbf
- Measurement Range: ±500 lbf pk
- Hammer Mass: 0.34 lb (2.6 oz)
- Ideal for use on lightly damped door panels

ICP® IMPACT HAMMER: 5,000 lbf

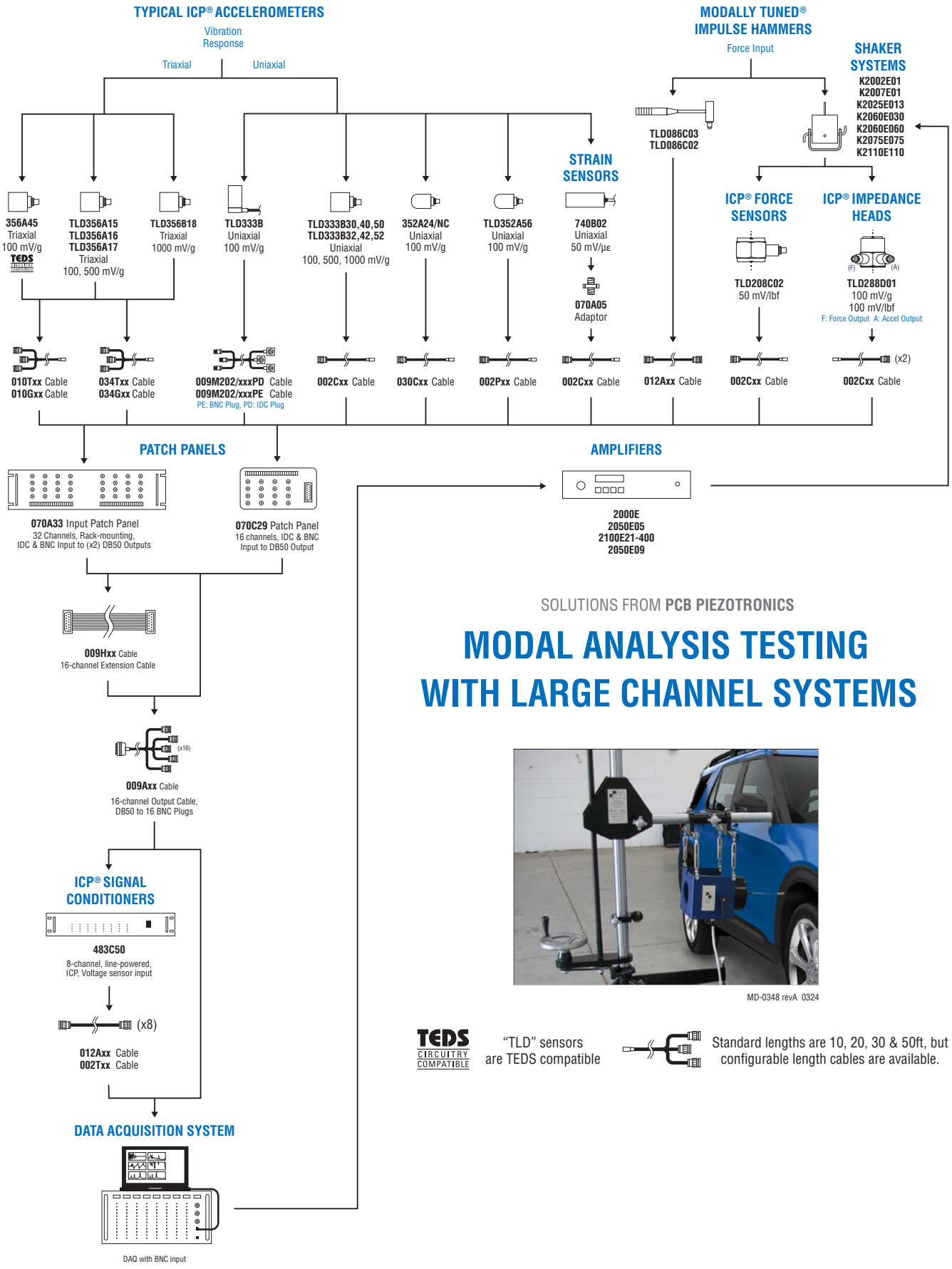
MODEL 086D05, TLD086D05

- Sensitivity: 1 mV/lbf
- Measurement Range: ±5000 lbf pk
- Hammer Mass: 0.7 lb (7.0 oz)
- Ideal for use on light-duty truck fames, engines, and exhaust systems

ICP® IMPACT HAMMER: 5,000 lbf

MODEL 086D20, TLD086D20

- Sensitivity: 1 mV/lbf
- Measurement Range: ±5000 lbf pk
- Hammer Mass: 2.4 lb (38.4 oz)
- Ideal for use on heavy-duty truck frames, suspensions, and bus structures



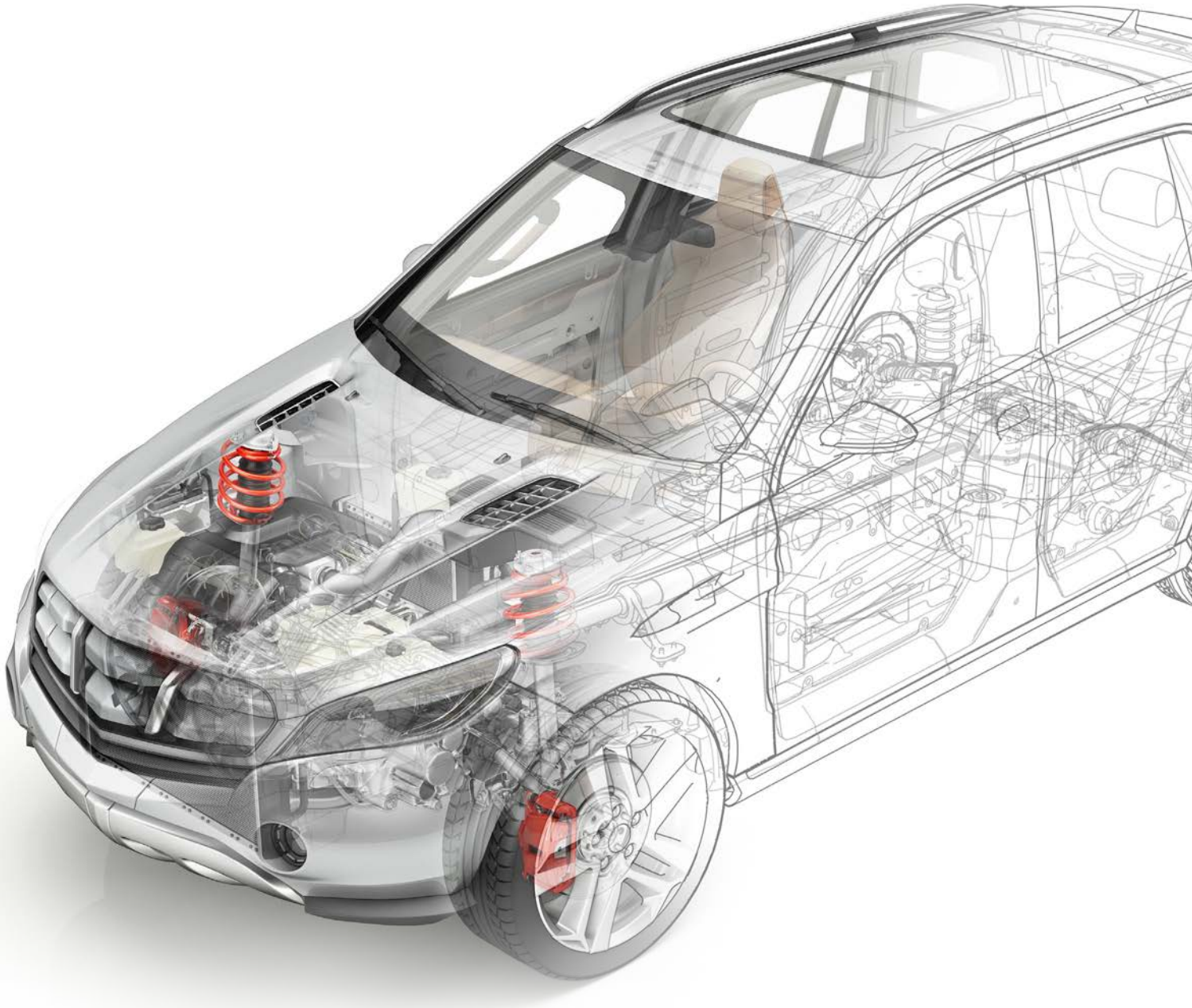
SOLUTIONS FROM **PCB PIEZOTRONICS**

MODAL ANALYSIS TESTING WITH LARGE CHANNEL SYSTEMS

MD-0348 revA 0324

TEDS CIRCUITRY COMPATIBLE "TLD" sensors are TEDS compatible

Standard lengths are 10, 20, 30 & 50ft, but configurable length cables are available.



PCB PIEZOTRONICS
AN AMPHENOL COMPANY

3425 Walden Avenue, Depew, NY 14043 USA

pcb.com | info@pcb.com | 800 828 8840 | +1 716 684 0001

© 2025 PCB Piezotronics - all rights reserved. PCB Piezotronics is a wholly-owned subsidiary of Amphenol Corporation. Endevco is an assumed name of PCB Piezotronics of North Carolina, Inc., which is a wholly-owned subsidiary of PCB Piezotronics, Inc. Accumetrics, Inc. and The Modal Shop, Inc. are wholly-owned subsidiaries of PCB Piezotronics, Inc. IMI Sensors and Larson Davis are Divisions of PCB Piezotronics, Inc. Except for any third party marks for which attribution is provided herein, the company names and product names used in this document may be the registered trademarks or unregistered trademarks of PCB Piezotronics, Inc., PCB Piezotronics of North Carolina, Inc. (d/b/a Endevco), The Modal Shop, Inc. or Accumetrics, Inc. Detailed trademark ownership information is available at www.pcb.com/trademarkownership.

AUTO-Modal-0825