KISTLER

measure. analyze. innovate.

Measuring Equipment for Demanding T&M Applications

Test & Measurement

Sensors and Signal Conditioning Overview

About Kistler.

A Tradition of Innovation
When Kistler was first founded in 1959, it was founded on curiosity and a passion for technology. With the pioneering invention of the charge amplifier and the series production of the first quartz pressure sensors, Walter P. Kistler and Hans Conrad Sonderegger undoubtedly contributed to the global breakthrough of piezoelectric measuring technology. The rise of piezoelectric technology worldwide is inextricably linked with the success of our family-owned business, which has its roots in both Switzerland and the USA.
The passion of the two Kistler pioneers still influences the company's DNA right up to the present day. A unique culture of innovation allows room for new ideas and provides the essential foundation for true success. Using patented technology to give both improved sensitivity and greater temperature stability, the company grows its own crystals, allowing us to deliver reliable results even in the most demanding applications. Today, Kistler is more than a synonym for dynamic measuring technology, it has also made a name for itself in piezoresistive, optical, and strain gage measuring technology. As a result, we can always offer the best solution available for any given application. In addition to general measurement products, Kistler supplies complete turnkey solutions for specific applications, such as engine development, plastics processing, and assembly engineering.

Kistler is still a pioneer of measuring technology, and the company's physicists and engineers have the same passion for technology today that has made the company what it is. Many long-term customer relationships testify to the high standard of performance and service of which Kistler is rightly proud.

For detailed facts and figures see **www.kistler.com/facts.**

Test & Measurement.

Measuring Equipment for Demanding T&M Applications
Drawing on a wealth of experience, Kistler supplies pressure, acceleration, force, strain, and torque sensors with corresponding signal conditioning solutions for the T&M market. In addition to reliable, high-quality sensors, we provide engineers, researchers, measurement technicians, and students in a wide range of fields.

Today, Kistler is the global market leader in piezoelectric measuring technology and the largest supplier of piezoelectric sensors. Complementing this piezoelectric portfolio are our high-quality piezoresistive, capacitive, and strain gage sensors. Allowing us to provide laboratories all over the world with solutions for demanding application in all aspects of measurement, testing plus research & development.

Read on to discover Kistler's wide range of Test & Measurement solutions. This brochure provides a complete overview of our range – detailed information about individual measuring chains and products can be found on our website and in our product catalogs (more information on page 11).

Don't hesitate to contact our T&M sales team – our local representatives will be happy to assist you.

Industries
- Aviation and Aerospace
- Transport and Traffic
- Automotive Engineering
- Shipbuilding and Maritime
- Energy and Environmental Engineering
- Oil and Gas
- Chemical and Pharmaceutical
- Semiconductors and Electronics
- Paper and Cellulose
- Food and Beverage
- Civil Engineering and Mining
- Medical Technology
- Machine Building
- University Research

Pressure.

Kistler's portfolio includes a variety of piezoelectric and piezoresistive sensors to measure pressure – so we can offer the right solution for many applications.

Due to their high natural frequencies, piezoelectric pressure sensors can be used for a variety of applications where dynamic pressures need to be measured. Another unique characteristic of piezoelectric pressure sensors is their ability to measure small pressure fluctuations at high static pressure levels.

By contrast, piezoresistive pressure sensors are the right choice when measuring static pressure curves.

Piezoelectric Pressure Sensors

- Measurement of highly dynamic, dynamic and quasi-static pressure curves
- Small pressure fluctuations (pressure pulsations) can be measured at high static pressure levels
- One pressure sensor can cover extensive measurement ranges, from mbar (mPSI) to 10 kbar (145 kPSI)
- Very short rise times (1 µs) resp. very high natural frequencies (500 kHz)
- Very wide temperature range, from cryogenic to 350 °C (660 °F)
- Ultra-compact sensor dimensions
- Charge (PE) and voltage output (IEPE)

Piezoresistive Pressure Sensors

- High-precision static and quasi-static pressure measurements
- Wide temperature range, from –40 to 200 °C (–40 to 390 °F)
- Small sensor dimensions (e.g. M5)
- Available with integrated signal amplifiers
- Optional ATEX certification
- Voltage (mV or V) and current output (mA)

Acceleration.

Kistler accelerometers provide reliable results in the most demanding applications. These include modal and durability testing, environmental simulations with vibration and shock, noise, vibration and harshness investigations (NVH) for automotive, in-flight flutter testing for aircraft wings, vibration monitoring for railways or ultra-low frequency structural vibration monitoring for large civil engineering structures such as bridges.

Kistler offers a wide spectrum of sensors for measuring from static to highly dynamic applications such as acoustic emissions. Additionally, PiezoStar® crystals outperform standard quartz with high thermal stability and a higher voltage sensitivity which allows for miniaturization.

Piezoelectric Accelerometers

- Single axis and triaxial solutions with charge (PE) and voltage (IEPE) output
- Some triaxial accelerometers can be stud-mounted in any of the three orthogonal directions
- Ceramic based:
  - Charge output solution for high temperature applications up to 250 °C (480 °F)
  - High output IEPE solutions for very low noise
- Quartz or PiezoStar crystal based:
  - High thermal stability with PiezoStar crystals for dynamic temperature applications from –196 to 165 °C (–320 to 330 °F)
  - Wide frequency ranges thanks to high rigidity and resonance frequencies
  - Long-term stability

Variable MEMS Capacitance Accelerometers

- Single and triaxial solutions
- Measurements from 0 Hz (DC) to 1 kHz
- Uni- or bipolar, single-ended or differential outputs
- Thermal and long-term stability
- Servo capacitive solution for microvibration measurements

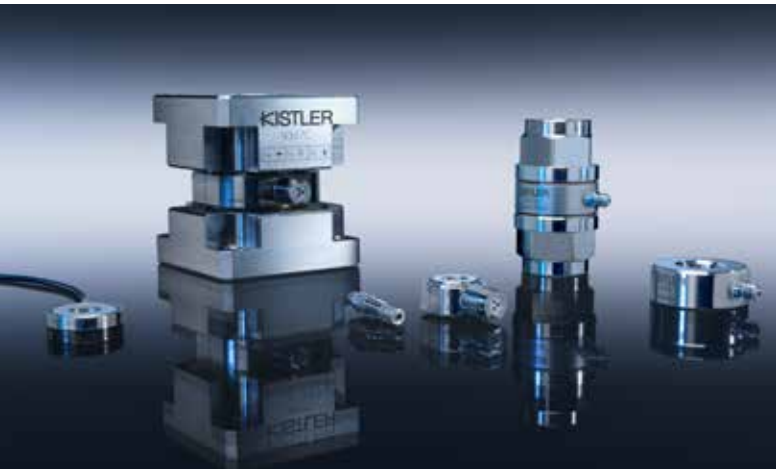
Acoustic Emission Measuring Chain

- Measurement of high energy surface waves from 50 to 900 kHz
- Dedicated to non destructive testing and permanent online monitoring
- Usage up to 165 °C (330 °F)
- ATEX certification option available for use in hazardous environments

Others

- Impedance heads and impact hammers for modal analysis
- Rotational accelerometers for measurements on an oscillating specimen
- Reference standard accelerometers for calibration

Force.



High rigidity, high natural frequency, wide measuring range over several decades – these are just a few of the advantages which describe Kistler's piezoelectric force sensors and dynamometers.

They are ideal for dynamic and quasi-static force measurements of one or three components in the field of research and development, and also for very small forces under high static initial loads.

Since the type of installation is decisive when measuring force, the components are available in a variety of designs: force sensors are extremely compact and are installed by the customer using a preloading set, whereas force links – already preloaded and calibrated – are ready to operate immediately.

1-Component Force Sensors
- Ideally suited in case of limited space
- Compact size and high rigidity
- Sensor size depending on maximum force
- Force ranges F_z from 2.5 to 1 200 kN (incl. preload)
- Preloading set available for installation
- Calibration after installation

1-Component Force Links
- Ideally suited for simple installation and immediate measurements
- Preloaded and precalibrated force sensor
- Force ranges F_z from 2.5 to 700 kN
- High sensitivity versions for force ranges F_z from 50 to 500 N

3-Component Force Sensors
- Ideally suited in case of limited space
- Measures all three force components simultaneously (F_x, F_y, F_z)
- Compact size and high rigidity
- Force ranges $F_{x,y}$ from 1.5 to 75 kN
- Force ranges F_z from 3 to 150 kN (incl. preload)
- Output with easy-to-use 3-pin connector
- Preloading set available for installation
- Calibration after installation
- Some sensors are available with PiezoStar crystals for substantially higher sensitivity

3-Component Force Links
- Ideally suited for simple installation and immediate measurements
- Measures all three force components simultaneously (F_x, F_y, F_z)
- Preloaded and precalibrated force sensor
- Force ranges $F_{x,y}$ from 0.5 to 75 kN (depending on bending moment)
- Force ranges F_z from 3 to 150 kN
- Output with easy-to-use 3-pin connector
- 4 force links can be combined to create a dynamometer for torque measurements (application-specific calibration needed)
- Some sensors are available with PiezoStar crystals for substantially higher sensitivity

Dynamometers
- Ideally suited for simple installation and immediate measurements
- Consists of four preloaded 3-component force sensors mounted to a top and base plate
- Precalibrated, ready to measure with high accuracy
- Measures all three force components simultaneously (F_x, F_y, F_z)
- Optional 6-component measurements (forces and moments) possible
- IP67 sealed, suitable for harsh environments

Strain.

The high rigidity of the piezoelectric measuring crystal makes it ideal for strain measurements in large structures. Kistler's piezoelectric strain sensors are simple to install and have an extremely wide measuring range. One strain sensor covers the complete measuring range from με fractions to destruction of the structure.

Due to their mechanical properties, it is almost impossible to damage a piezoelectric strain sensor with overload.

Surface Strain Sensors
- Simple mounting on surface of structure with one screw
- Ideal for industrial applications
- Strain range from 20 to 800 με

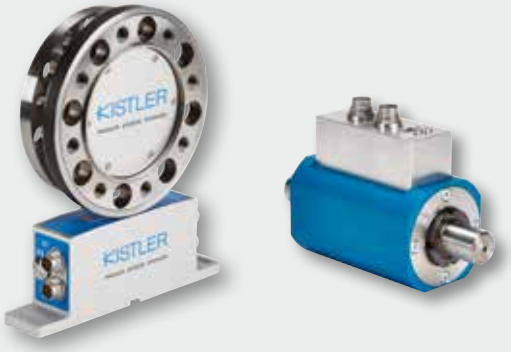
Strain Measuring Pins
- Mounting in blind hole
- Strain measurement parallel to or at right angles to mounting bore
- Ideal for research applications
- Strain range up to 1 500 με

Torque.

With two different technologies for torque measurement, Kistler offers the right solution for a wide range of applications.

Rotating strain gage sensors guarantee the highest accuracy in dynamic and static measurements. They are available as torque measuring flanges or torque sensors with a shaft connection, and are suitable for a wide range of applications such as efficiency determination for pumps, gear trains, electric motors, etc.

The stationary piezoelectric reaction torque sensors are predestined for research and development applications where installation space is restricted, and are used whenever a large measuring range is required.



Rotating Torque Sensors

- Torque ranges from 0.2 to 20 000 N·m and speed up to 50 000 1/min
- Highest accuracy <0.05 %
- Maintenance free and solid due to contactless data and energy transmission
- For product testing and analysis in production and reasearch & development
- Used for efficiency and friction testing at combustion and electric drives, transmissions, drive shafts and pumps

Reaction Torque Sensors

- Stationary, piezoelectric torque sensors for quasi-static and dynamic torque measurements
- Suitable for extremely small torque shifts
- Robust due to high overload capacity
- Calibrated and simple to install
- Torque ranges from 1 to 1 000 N·m

Signal Conditioning.

A high-grade signal conditioning solution ensures the sensor signals are available with the best possible quality and this is the key to producing the desired high-precision measurement results.

Kistler offers the matching signal conditioning solution for each sensor. A charge amplifier is required for piezoelectric sensors (PE), whereas piezoelectric sensors with integrated electronics (IEPE) are fed by Piezotron couplers.

In addition to analog amplifier solutions, Kistler also offers devices with integrated data acquisition. High-precision calibration equipment rounds off the offer.

Charge Amplifiers
- Charge ranges from 2 to 2 200 000 pC
- Frequency ranges from ≈0 to 200 000 Hz
- Devices with integrated data acquisition
- Dual-mode amplifiers (compatible with PE and IEPE sensors)
- Single- and multi-channel solutions

Piezotron® Couplers (IEPE)
- From battery-operated single channel devices to line-powered multi-channel systems
- IEPE solutions with TEDS support

Amplifier for Piezoresistive Pressure Sensors
- PiezoSmart® sensor identification
- Support of digital compensation for maximum measuring accuracy

Power Supplies for MEMS Capacitive Accelerometers
- Powering up to 15 single axis and up to five triaxial K-Beam® accelerometers

Calibration Devices
- Fully automated calibration of charge amplifiers and other signal conditioning devices
- Portable signal conditioning system for the calibration of piezoelectric sensors

Service Worldwide.

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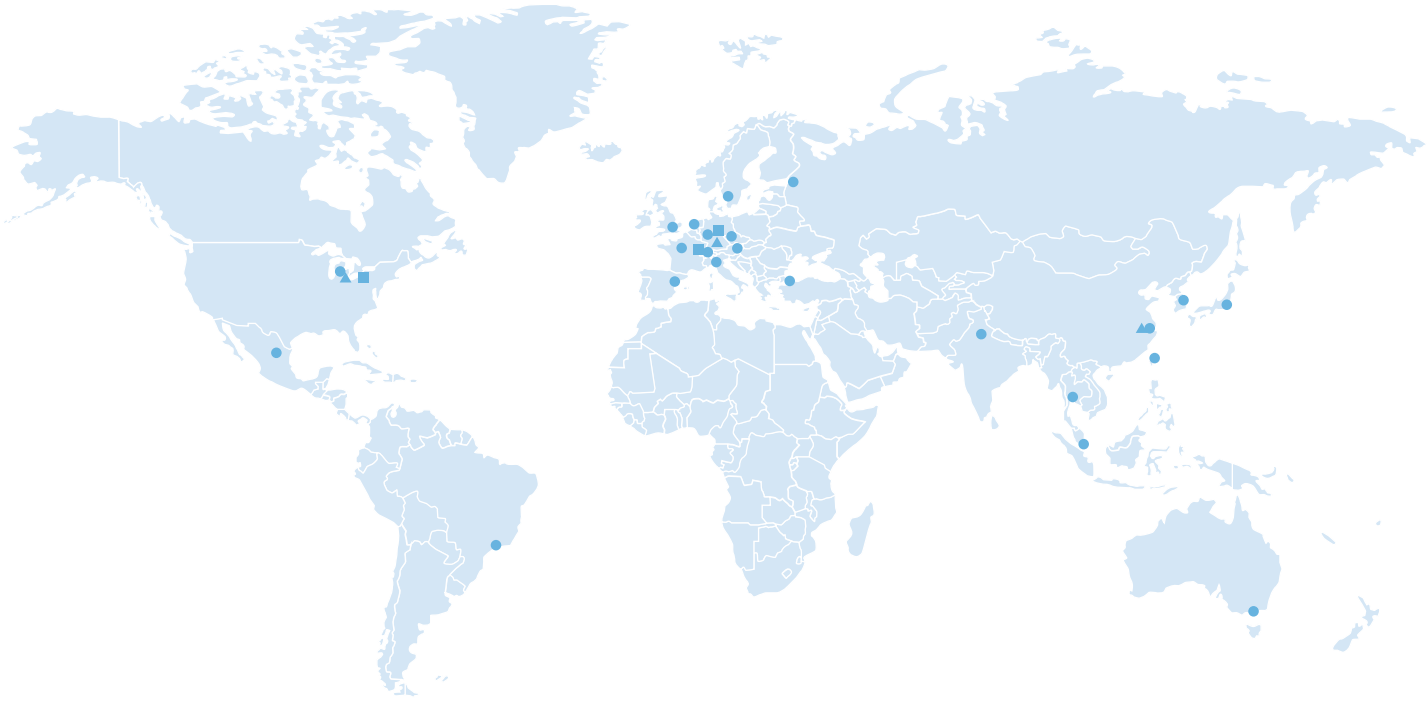


- Sales Center
- Tech Center
- Production Center

Kistler aims to offer all customers personal and professional support. Thanks to 30 Sales Centers around the globe and a large network of local distributors, we are close to our customers. Our experts are happy to offer help and advice.

Expert advice and practical assistance for technical implementation is provided by our local Sales Centers or Sales Offices. For standardized calibration services, repairs to/with original parts, and product modifications, please contact your regional Tech Center.

To help you make the most effective use of Kistler measurement technologies, Kistler offers tailor-made training for all its products and systems – either at your own premises or at one of our Sales Centers.

Simply go to www.kistler.com/t&m and click on to the section you are interested in to find the contact details of the relevant sales representative. Contact us today – we're here to help.

Information Overview.

Test & Measurement Online
On our website, you will find more information about the range of Test & Measurement solutions from Kistler, including various measurands, sensor technologies, and signal conditioning solutions for general measurement purposes in research & development or test laboratories.

www.kistler.com/t&m

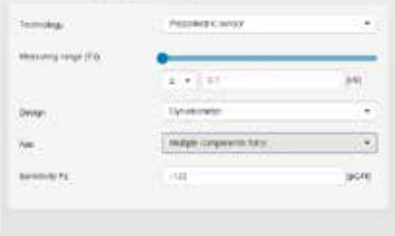
Catalogs and Data Sheets
Detailed information about individual products is available in our product catalogs and data sheets, which are free to download from our website.

Sales Representatives
Whether you need one-to-one advice or assistance with installation, you can quickly and easily find the contact details of your local contact on our website by clicking on the measurand you are interested in.

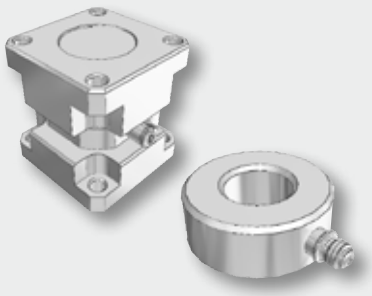
www.kistler.com/t&m

Component Finder
Our interactive online component finder with search filters makes it easy to find generic sensors and signal conditioning solutions.

www.kistler.com/t&m/componentfinder



CAD Data
Various Kistler 3D CAD models are available free of charge to help you integrate our products directly in your CAD designs. You can download the appropriate file format for every CAD system from our website.



Application Solutions
In addition to generic sensors and signal conditioning solutions, Kistler offers a wide range of made-to-measure solutions for specific applications:

- Cylinder Pressure Measurement
- High Speed Dynamics (Ballistics)
- Plastics Injection Molding
- Cutting Force Measurement
- Vehicle Safety
- Industrial Process Monitoring
- Weigh-In-Motion
- Biomechanics

For more information, visit www.kistler.com

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