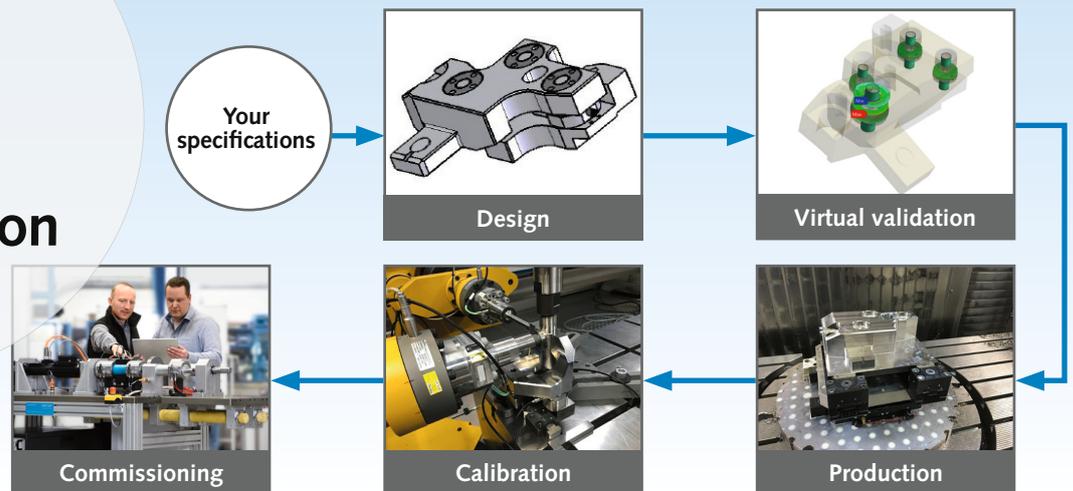


## Tailored solution for your application



# Customized force measurement for NVH testing of electric vehicles and powertrains

With increasing electric vehicle development, accurate measurement of the forces exchanged by components on the powertrain and chassis is key to optimize overall NVH performance. These applications impose specific packaging spaces and operating loads, which often cannot be covered by standard force sensor solutions.

To fulfill your technical requirements and ensure the highest accuracy, Kistler can customize the design of force measurement solutions, offering 60 years of experience in piezoelectric sensor design.

### Applications

A customized force measurement solution allows measuring up to 6 components (3 forces and 3 torques). Unlimited design possibilities are offered by a broad sensor portfolio from Kistler. Of high relevance for electric vehicle testing, the piezoelectric technology allows reaching high frequencies, thanks to the higher stiffness with respect to strain gage load cells. Moreover, the wide measuring range guarantees performance under the most demanding loading conditions.

Typical applications requiring accurate force measurement cover:

- Noise and vibration control
- Dynamic or maximum load measurement
- Mounting design and structural optimization
- Blocked force measurement and Transfer Path Analysis (TPA)
- High-fidelity force inputs for simulation processes

Either on vehicle or on the test bench, each application imposes a unique set of technical and geometrical specifications and requires a customized measurement solution to ensure the most accurate and reliable measuring performance.

### Sensor know-how supported by virtual validation

In the initial phase of the customization process, Kistler Engineers will identify the optimal piezoelectric sensor design based on your

technical specifications and available packaging space. Our virtual validation process supports the whole design and includes Finite Element Analysis to verify the performance under dynamic and static conditions.

### Production and calibration

The production of piezoelectric sensors and its housing requires the finest manufacturing accuracy. Therefore, these components will be manufactured by Kistler under state-of-the-art quality controls. Accuracy is guaranteed by our calibration service, which is traceable to national standards and can be performed on-site or in one of the Kistler laboratories around the World.

### Installation, commissioning, service

After production and calibration, Kistler Engineers will install and commission the force measurement solution at your site, guaranteeing that the device is ready to measure. Moreover, to ensure the measuring environment and operation conditions do not influence the accuracy of the measurement device, re-calibration service is also available and is complemented by assistance in dismantling, shipment and re-installation as well.

### Sensors and measuring systems

Kistler can also provide you with complementary products that complete the measuring chain. A wide selection of charge amplifiers is available and can be combined with high-insulation cables to ensure the most accurate measurement.

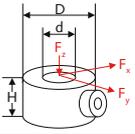
### Benefits at a glance

- Kistler's expertise available for you
- Turnkey solution: from design to commissioning
- High performance: wide measuring range, broad frequency range, overload-protection
- Unlimited design and application possibilities

### Standard 3-component force sensors

The product line to measure 3-component loads from Kistler covers a wide variety of sizes and measuring ranges (see a selection below).

Additionally, 1-component force sensors, pre-loaded piezoelectric sensors, dynamometers and strain sensors are also available as standard products.

Technical data		Type	9017C / 9018C*	9027C / 9028C*	9047C / 9048C*	9067C / 9068C*
						
Measuring ranges	F <sub>x</sub> ,F <sub>y</sub>	kN	-1.5 ... 1.5	-4 ... 4	-15 ... 15	-30 ... 30
	F <sub>z</sub>	kN	-3 ... 3	-8 ... 8	-30 ... 30	-60 ... 60
Preloading		kN	9.5	20	70	140
Sensitivity	F <sub>x</sub> ,F <sub>y</sub>	pC/N	≈-25	≈-7.8	≈-8.1	≈-8.1
	F <sub>z</sub>	pC/N	≈-11	≈-3.8	≈-3.7	≈-3.9
Dimensions	D	mm	19	28	45	65
	d	mm	6.5	8.1	14.1	26.5
	H	mm	10	12	14	21

\* The types are identical, but they have rotated coordinate system (see data sheet).

### Amplifiers

For the most demanding, high-accuracy measurement, Type 5080A... is a high-end, modular and multi-channel charge amplifier, up to eight modules with charge input and featuring an analog 6-component summing calculator.

Types 5165A... and 5167A... are ideal when flexibility and compactness are required. All settings are configured in a standard web browser through the graphical interface.

Technical data		Type	5080A...	5165A...	5167A...
					
Main features			<ul style="list-style-type: none"> <li>- Analog output</li> <li>- Low noise</li> <li>- Wide charge measuring range</li> <li>- Broad frequency range</li> <li>- Summing calculator</li> <li>- Fischer connector option</li> </ul>	<ul style="list-style-type: none"> <li>- Compact and flexible</li> <li>- Digital or analog output</li> <li>- Charge and IEPE sensors</li> <li>- Web interface</li> <li>- Ethernet connection</li> <li>- Virtual channels option for summing calculator</li> </ul>	<ul style="list-style-type: none"> <li>- Compact and flexible</li> <li>- Digital or analog output</li> <li>- Web interface</li> <li>- Ethernet connection</li> <li>- Virtual channels option for summing calculator</li> <li>- Fischer connector option</li> </ul>
Preferred application			Dynamic and quasi-static signals	Dynamic signals	Dynamic and quasi-static signals
Number of channels	-		1 ... 8	1/4	4/8
Inputs	-		Charge	Charge, IEPE and voltage	Charge
Resolution	bit		-	24	24
Sampling frequency	max kSps/channel		-	200	100
Frequency range (-3 dB)	Hz		≈0 ... 200,000	0.1 ... 100,000 (voltage: 0 ... 100,000)	≈0 ... >45,000 (≤195,000 pC)
Measuring range	pC		±2 ... 2,200,000	±100 ... 1,000,000	±100 ... 1,000,000
Analog output	-		1 ... 8	1/4	4/8

### Accessories, services and more

The Kistler force sensor portfolio covers a much wider variety of products, including cables and accessories, and allows addressing the most demanding measurement configurations. Additionally, Kistler offers its customers a comprehensive calibration service throughout the world. The service ensures that Kistler sensors and systems are – and will remain – fully functional for the entire

service lifetime of the equipment: the basis for precise and reliable measurement results.

To discover which product from Kistler suits best your application, get in touch with your Kistler sales representative or visit our website [www.kistler.com](http://www.kistler.com)

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