PACELine Piezo technology
Secure results for your measurement and testing tasks
For your quality and process monitoring

Under control

PACEline from HBM are products used in force and strain measurement technology, and based on the piezoelectric effect. PACEline also has the appropriate solution for your application in all areas of quality or process monitoring. The use of PACEline offers numerous advantages for test engineering, assembly monitoring, function testing or test bench engineering.

Tests and trials
- Numerous flexible test tasks with one sensor type
- Highly dynamic applications due to sensors with high natural frequencies
- Simple integration of charge amplifier through standardized hardware and software interfaces

Assembly monitoring
- Miniaturization of the systems due to compact sensors
- Low-deformation constructions even under load due to stiff sensors
- Utilization of large sensors even for smaller forces due to sensitivity being independent of the measuring range

Function tests
- Measuring range from less than 1 N up to 700 kN with just one sensor
- Documented quality through proven evaluation methods: 100 % control of components
- High application diversity due to scalable digital amplifier technology for any measuring ranges
PACEl ine piezo technology

All clear. Crystal clear.
It all comes down to the crystal. PACEl ine makes no compromises when it comes to quality.

HBM uses quartz in the PACEl ine products. They even use gallium phosphate (GaPO4) for sensors with nominal (rated) force of 5 kN and 20 kN. Both crystals have impressive long-term stability and optimum measuring properties.

In addition to the extraordinary temperature stability, gallium phosphate guarantees high output signals and low-drift measurement, even of smaller forces.

Everything under control
Wherever frequently recurring procedures occur in your processes, PACEl ine sensors guarantee the best reproducibility and therefore the highest level of security. Regardless of what requirements your production poses. In order to optimally resolve your measurement task, you are provided with perfectly matched electronics and software solutions in addition to the sensors. From fast charge amplifiers with simple monitoring functions right up to complete systems for test bench and assembly monitoring. All sensors and charge amplifiers in the PACEl ine series are delivered with calibration certificates.

"The perfectly matched components in the HBM piezoelectric measurement chain helped us to design our test procedures more efficiently and securely in the shortest possible time."

Mr. Soufflet, Mr. Moenne Loccoz and Mr. Graveline, engineers at Valeo
PACEline at a glance – the calibrated piezoelectric force measurement chain

Complete piezo solutions for your products

PACEline keeps pace at all times, even with the most challenging tasks in your process monitoring. Because PACEline is not just a transducer, it is a measuring chain. Simply put it into operation with the Plug & Measure principle.

You can add other high-performance HBM components to expand the CMC measuring chain – and create your own monitoring system designed specifically for your production lines. A suitable configuration enables peak overload stability.

“We discussed and compared possible measurement technology solutions based on piezo and SG systems with HBM and came to the conclusion that the CFW sensors in the PACEline series are predestined for this application. We were initially skeptical as we have in the past used piezoelectric sensors from other manufacturers without achieving satisfactory results.”

Hans Georg Conrady, Managing Director of Artis

Utilization in a machine tool
Powerful transducers
Profit from the performance of HBM’s piezoelectric sensors. Stainless materials, symmetrical construction, small displacement and extraordinarily compact dimensions. Our sensors can be easily integrated and perform reliably in your application.

Simply connect
Profit from our experience. In addition to sensor technology, we offer practical accessories. Cables for particularly rough ambient conditions, summing boxes or even mounting aids for piezoelectric force washers. All accessories fit perfectly into the complete piezoelectric solution from HBM. With the usual high quality.

Precise measurement
Assembly without isolation. Charge amplifiers and summing boxes have electrical isolation so that isolated assembly is not required. Metal housings, robust plugs and a high degree of protection provide security even in rugged measurement environments.

Secure evaluation
Your measurement data are in safe hands. You can rely on our hardware and software solutions for data acquisition and process monitoring. Irrespective of whether you need solutions for production or tests, get in touch with us.
### HBM piezo technology: The facts

PACEline piezo-technology offers you secure results for your measurement and test tasks.

The most important technical data at a glance:

<table>
<thead>
<tr>
<th>Calibrated force transducers</th>
<th>Calibrated measuring chains</th>
<th>Force washers</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CFT series</strong></td>
<td><strong>CMC series</strong></td>
<td><strong>CFW series</strong></td>
</tr>
<tr>
<td>Order No.</td>
<td>Nominal (rated) force</td>
<td>Order No.</td>
</tr>
<tr>
<td>1-CFT/5kN</td>
<td>5 kN</td>
<td>1-CMC/5kN</td>
</tr>
<tr>
<td>1-CFT/20kN</td>
<td>20 kN</td>
<td>1-CMC/20kN</td>
</tr>
<tr>
<td>1-CFT/50kN</td>
<td>50 kN</td>
<td>1-CMC/50kN</td>
</tr>
<tr>
<td>1-CFT/70kN</td>
<td>70 kN</td>
<td>1-CMC/70kN</td>
</tr>
<tr>
<td>1-CFT/120kN</td>
<td>120 kN</td>
<td>1-CMC/120kN</td>
</tr>
<tr>
<td>1-CFW/330kN</td>
<td>330 kN</td>
<td>1-CLP/62kN-0.5m</td>
</tr>
<tr>
<td>1-CFW/700kN</td>
<td>700 kN</td>
<td></td>
</tr>
</tbody>
</table>

### Main features

- Low displacement
- Calibrated in two force ranges (100% and 20%)
- Can be used immediately without calibration
- Can be mounted with flange screw fitting
- Stainless materials
- Output signal independent of maximum capacity
- High cut-off frequency through peak stiffness
- Compatible with market standards
- Sensors in CFT series and analog charge amplifiers with 0…10 V output
- Charge amplifier and sensor with two calibrated force ranges
- With manufacturing certificate for force \(\rightarrow\) output voltage correlation
- High economic efficiency
- Stainless materials
- Increased linearity through symmetrical design
- Low displacement, high resonance frequency
- Rugged charging cable connection and plug protection
- Centering sleeve and cable protection in scope of delivery
- Simple mounting with pre-stressing sets (option)
- Compact ring force sensor
- Ultra-compact
- Integrated charge cable
- Very high resonance frequency
Strain transducers

<table>
<thead>
<tr>
<th>CST series</th>
</tr>
</thead>
<tbody>
<tr>
<td>Order No.</td>
</tr>
<tr>
<td>1-CST/300</td>
</tr>
</tbody>
</table>

- Low noise
- Robust
- Temperature stable up to 120° Celsius

- Simple mounting using a screw
- Peak sensitivity of 55 pC/μm/m for stiff objects
- Force measurement possible after calibration

Cables

<table>
<thead>
<tr>
<th>KAB143</th>
</tr>
</thead>
<tbody>
<tr>
<td>Order No.</td>
</tr>
<tr>
<td>1-KAB143-2</td>
</tr>
<tr>
<td>1-KAB143-3</td>
</tr>
<tr>
<td>1-KAB143-7</td>
</tr>
<tr>
<td>1-KAB176-2</td>
</tr>
<tr>
<td>1-KAB176-3</td>
</tr>
<tr>
<td>1-KAB145-3</td>
</tr>
</tbody>
</table>

- Simple parallel connection of four sensors
- Galvanic isolation between cable shields and housing
- Direct integration in systems without insulation washers

Adapters

<table>
<thead>
<tr>
<th>CCO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Order No.</td>
</tr>
<tr>
<td>1-CCO</td>
</tr>
</tbody>
</table>

- Stainless
- Hardened
- Takes into account suitable bolt pitches

Summing boxes

<table>
<thead>
<tr>
<th>CSB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Order No.</td>
</tr>
<tr>
<td>1-CSB4/1</td>
</tr>
</tbody>
</table>

- Stainless
- Increased linearity through symmetrical design
- Low displacement, high resonance frequency
- Rugged charging cable connection and plug protection
- Centering sleeve and cable protection in scope of delivery
- Simple mounting with pre-stressing sets (option)
- Compact ring force sensor
- Ultra-compact
- Integrated charge cable
- Very high resonance frequency
- Simple mounting using a screw
- Peak sensitivity of 55 pC/μm/m for stiff objects
- Force measurement possible after calibration

Pre-stressing sets

<table>
<thead>
<tr>
<th>CPS series</th>
</tr>
</thead>
<tbody>
<tr>
<td>Order No.</td>
</tr>
<tr>
<td>1-CPS/20 kN</td>
</tr>
<tr>
<td>1-CPS/50 kN</td>
</tr>
<tr>
<td>1-CPS/100 kN</td>
</tr>
<tr>
<td>1-CPS/140 kN</td>
</tr>
<tr>
<td>1-CPS/190 kN</td>
</tr>
<tr>
<td>1-CPS/330 kN</td>
</tr>
<tr>
<td>1-CPS/700 kN</td>
</tr>
</tbody>
</table>

- Simple mounting using a screw
- Peak sensitivity of 55 pC/μm/m for stiff objects
- Force measurement possible after calibration

Main features

- Low noise
- Robust
- Temperature stable up to 120° Celsius

- Simple integration through flexible connection

- Simple parallel connection of four sensors
- Galvanic isolation between cable shields and housing
- Direct integration in systems without insulation washers

- Stainless
- Hardened
- Takes into account suitable bolt pitches
### Compact charge amplifier

**CMA series**

<table>
<thead>
<tr>
<th>Order No.</th>
<th>1st measuring range</th>
<th>2nd measuring range</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-CMA1</td>
<td>1,000 pC</td>
<td>100 pC</td>
</tr>
<tr>
<td>1-CMA2</td>
<td>2,000 pC</td>
<td>200 pC</td>
</tr>
<tr>
<td>1-CMA5</td>
<td>5,000 pC</td>
<td>500 pC</td>
</tr>
<tr>
<td>1-CMA20</td>
<td>20,000 pC</td>
<td>2,000 pC</td>
</tr>
<tr>
<td>1-CMA39</td>
<td>39,000 pC</td>
<td>3,900 pC</td>
</tr>
<tr>
<td>1-CMA158</td>
<td>158,000 pC</td>
<td>15,800 pC</td>
</tr>
<tr>
<td>1-CMA210</td>
<td>210,000 pC</td>
<td>21,000 pC</td>
</tr>
<tr>
<td>1-CMA287</td>
<td>287,000 pC</td>
<td>28,700 pC</td>
</tr>
<tr>
<td>1-CMA482</td>
<td>482,000 pC</td>
<td>48,200 pC</td>
</tr>
<tr>
<td>1-CMA2000</td>
<td>2,000,000 pC</td>
<td>20,000 pC</td>
</tr>
<tr>
<td>1-CMA5000/2 (*)</td>
<td>5,000,000 pC</td>
<td>50,000 pC</td>
</tr>
</tbody>
</table>

- Linearity deviation: +/- 1% of full scale value
-Signal output: +/- 10 VDC, measuring bandwidth (-3 dB) 10 kHz
-Sensor connection: 10/32-UNF male
-Degree of protection: IP65 in rugged metal housing for mounting in the field

### Universal charge amplifier

**CMD series**

<table>
<thead>
<tr>
<th>Order No.</th>
<th>Measuring range</th>
<th>Degree of protection</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-CMD600</td>
<td>50 ... 600,000 pC</td>
<td>IP60</td>
</tr>
<tr>
<td>1-CMD600/P</td>
<td>50 ... 600,000 pC</td>
<td>IP65</td>
</tr>
</tbody>
</table>

- Linearity deviation: +/- 0.5% of full scale value
- Signal output (analog) +/- 10 VDC, measuring bandwidth (-3 dB) 30 kHz
- Signal output (digital) Ethernet (TCP/IP), measuring bandwidth 1 kHz
- Peak values: 3 (min/max/peak-peak)
- Limits values: 2
- Digital inputs/outputs: 1 / 2
- Sensor connection: BNC socket (CMD600), 10/32-UNF male (CMD600-P)

### Main features

- Calibration certificate available for each measuring range
- Freely configurable charge amplifier for flexible applications (measuring range, limit values, digital inputs/outputs, peak value acquisition, filter and diagnostic functions)
- Two internal independent parameter sets/measurement programs for time-synchronous measurement of different tasks
- Includes parameterization software for comprehensive functions (strip chart, data logging and parameter/device backups)
- Software integration through command library and LabVIEW driver
- Galvanic isolation between supply voltage and measurement signal
- Low-noise, interference-immune measurement signal for rugged environments
- Degree of protection: IP60/IP65 in rugged metal housing for mounting in the field

(*) The CMA5000 has 2 sensor inputs connected in parallel for the measurement of larger forces
The right product for your application

You can find more comprehensive product information and the complete technical documentation available for download at www.hbm.com/paceline. Simply request an offer with a click of the mouse or order your required product directly in our online shop:

www.hbm.com/HBMshop