

 PUBLIC

PRESSURE PULSE CALIBRATION @KISTLER

MaritimeMET Workshop

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16.04.2026

KISTLER AT A GLANCE



Founding year
Headquarter Winterthur (Switzerland)

1959

Private Ownership

2nd G.

Sales in mCHF
(by 2025)

424

Employees worldwide

~2000

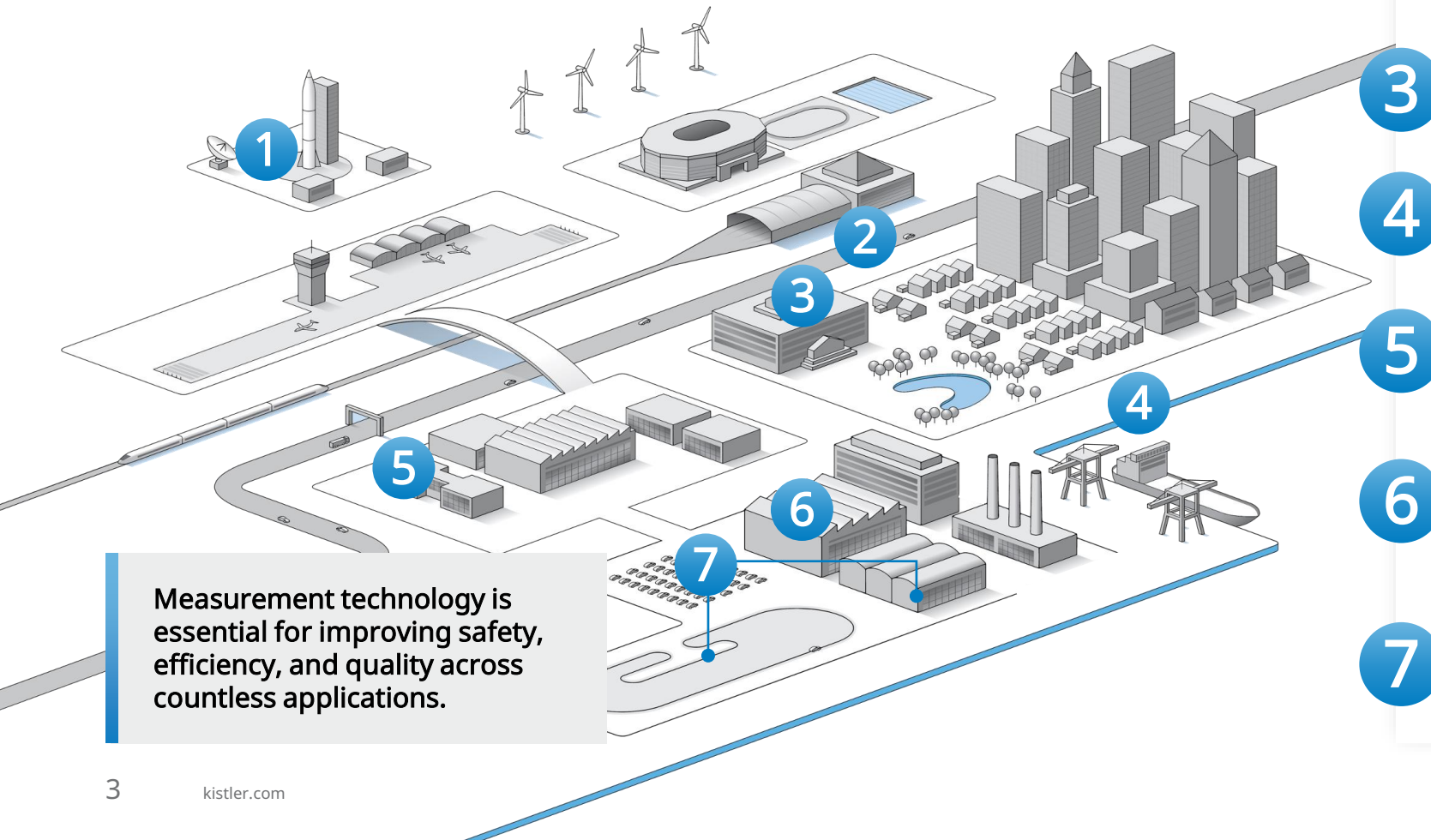
Investment in R&D
(as a % of sales)

9%

Patents

>860

CUSTOMER INDUSTRIES



1 Aerospace

- Rocket & satellite testing
- Aircraft testing

2 Traffic and infrastructure

- Weigh In Motion
- Structural Health Monitoring
- Speed Enforcement

3 Medtech

- Monitoring of injection molding processes
- Assembly process monitoring and control

4 Maritime

- Closed-loop combustion control
- Engine diagnostics

5 Semiconductors

- Intelligent process control and monitoring
- Seamless process traceability and transparency

6 Automotive production

- Assembly process control
- Spot welding process monitoring
- Analysis of fastening technology

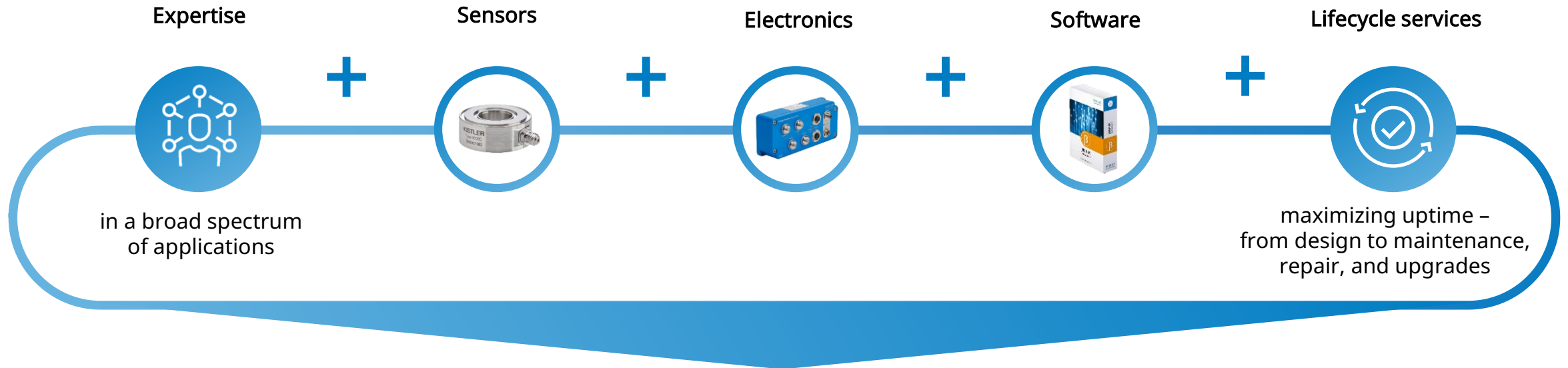
7 Automotive research and development

- Electric motor testing and combustion analysis
- Passive safety on board
- Vehicle performance testing

Measurement technology is essential for improving safety, efficiency, and quality across countless applications.

WHAT WE DO

Our offering



By combining these components effectively, we drive transparency in your processes and boost your performance and quality.

PIEZOELECTRIC PRESSURE SENSORS

PE or IEPE sensors at Kistler for dynamic measurements

601C

Miniature pressure sensors with high sensitivity, ideal for measuring very small pressure pulsations

Main features / advantages

- Pressure ranges up to 250 bar (3626 psi)
- Very wide operating temperature range
- Membrane optimized for high thermal shocks
- Short rise time and high natural frequency
- Small sensor size (~ 40 mm)
- Charge (PE) or voltage (IEPE) output



603C

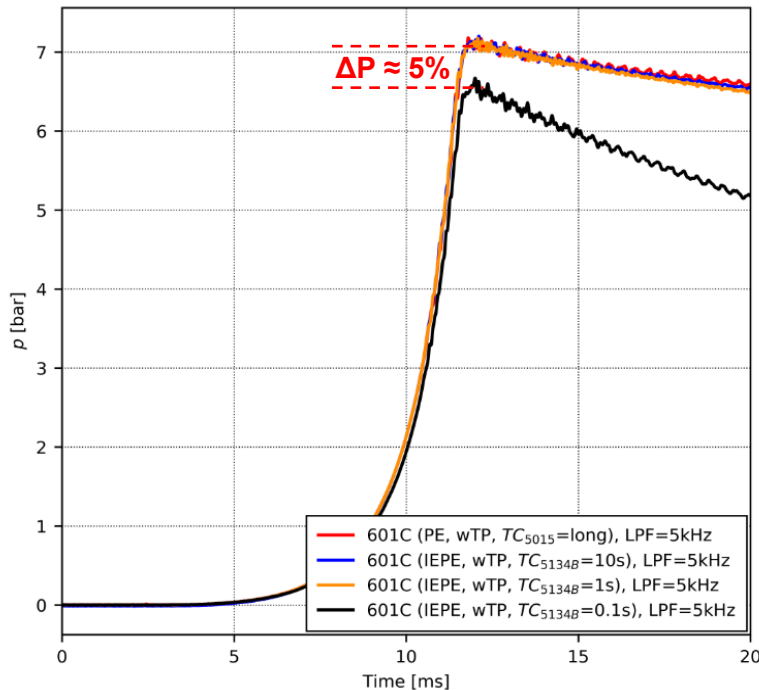
Miniature pressure sensors with very high natural frequency and acceleration compensation, ideal for measuring highly dynamic pressure transients—even under strong vibrations

Main features / advantages

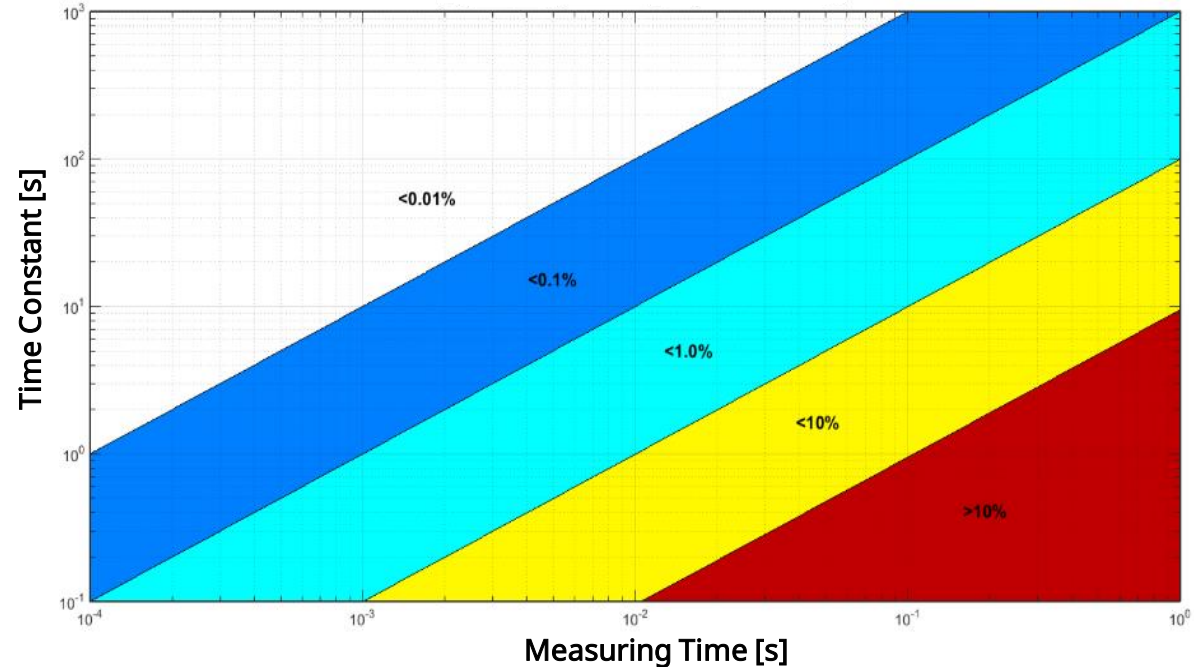
- Pressure ranges up to 1000 bar (15000 psi)
- Wide operating temperature range
- Acceleration compensated sensor design
- Very short rise time and very high natural frequency
- Small sensor size (~ 40 mm)
- Charge (PE) or voltage (IEPE) output

PEAK PRESSURE VS. TIME CONSTANT

Calibration of IEPE Sensors



- Short time constants can cause **underestimation** of dynamic peak pressures
- The **slower** the pressure rise, the **larger** the error
- For **<0.1% error**, the pressure pulse must be **$\sim 1000\times$ shorter** than the time constant



PRESSURE PULSE GENERATOR

6959B1

- Hydraulic pressure generator for calibrating piezoelectric pressure sensors with short pressure pulses
- Suited for IEPE sensors with a short time constant
- Ideal for testing sensors used in explosive and pulsating applications
- Automated pressure application, low mechanical noise
- Specifically designed for calibration of 601C/603C sensors
- Simultaneous calibration of three sensors possible

Technical data

Pressure range	0.5 ... 250 bar
Pulse duration	2 ... 10 ms
Reference sensor	601CAA, -37 pC/bar
UUT	601C, 603C



PRESSURE PULSE GENERATOR

6960A

Technical data

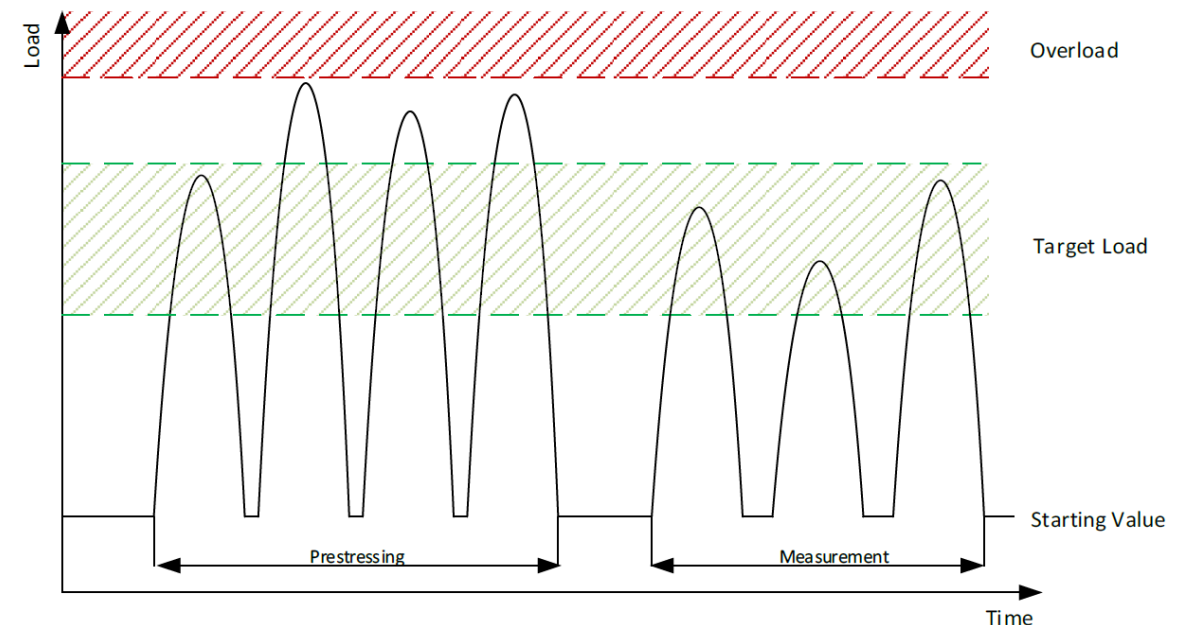
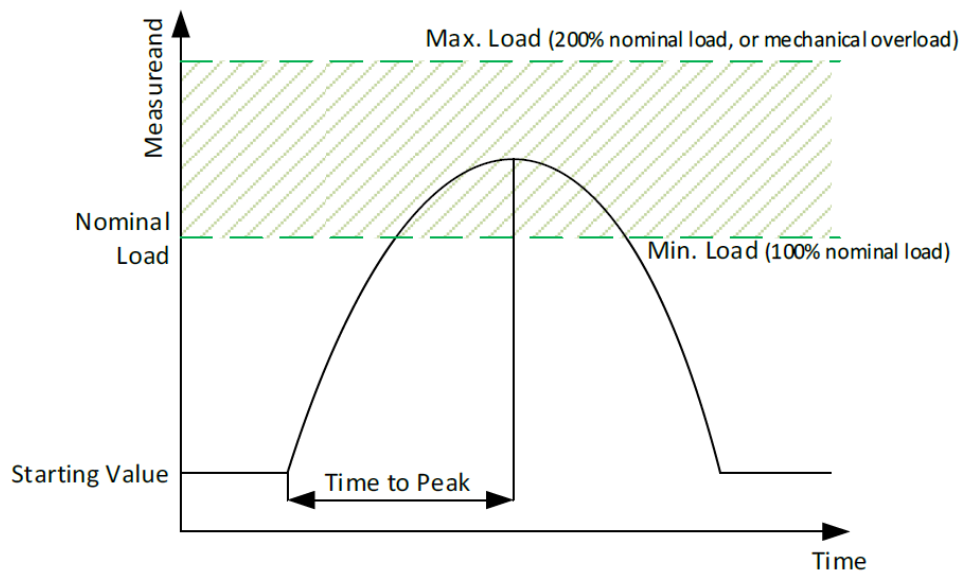
Pressure range	70 ... 1000 bar
Pulse duration	2 ... 10 ms
Reference sensor	603CAA, -4.5 pC/bar
UUT	603C



PRESSURE PULSE CALIBRATION

Load Profile

- Time to peak should be $< 1/1000$ of the time constant of the measurement chain to minimize error of peak pressure
 - IEPE sensors 601C/603C have a time constant of 2-3 s
- Load cycles: 4x pre-stressing and 3x measurement cycles
 - Pulse duration and max. load may vary by a few percent for each cycle, but the effect on the sensitivity and the linearity is very small

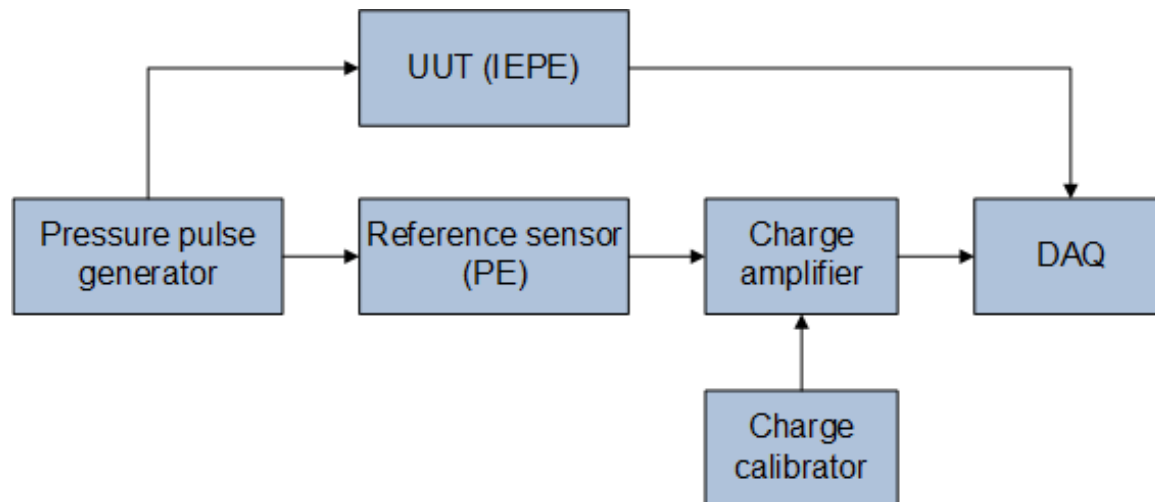


PRESSURE PULSE CALIBRATION

Measurement chain Setup

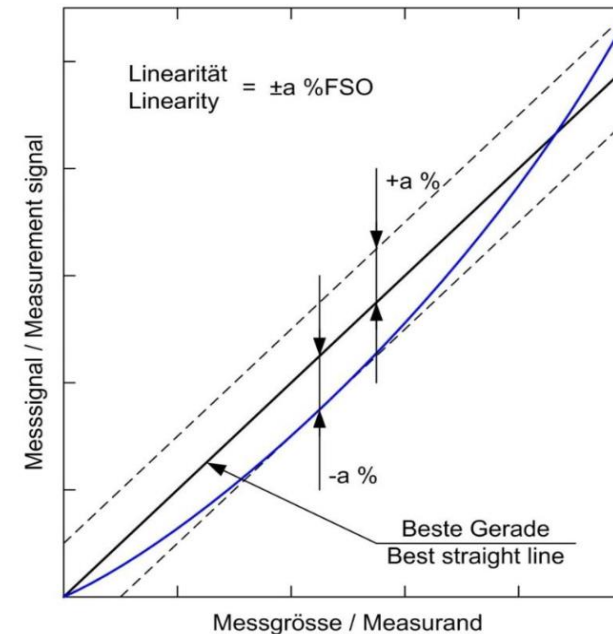
Signal Conditioning:

- Low-pass filter: 60 kHz
- High sampling rate: 400 kHz



Reference:

- Applied load is measured with a reference sensor (comparison method)



PRESSURE PULSE CALIBRATION

Calibration Certificate

Reference Equipment

Reference Equipment	Type	Serial No.
Working Standard	Kistler 601CAA250	5463669
Precision Calibrator	Kistler 5395B	5905639

Ambient Conditions

Ambient Temperature	Relative Humidity
23.4 °C	39.7 %

Results of Measurement

Nominal Range bar	Calibrated Range bar	Sensitivity mV / bar	Linearity ±%FSO
0 ... 35	0 ... 45.56	145.4	0.12

- Mean value of the three measurement cycles
 - Calibrated range (effective)
 - Sensitivity
 - Linearity

PRESSURE PULSE CALIBRATION @KISTLER

Summary

- Short pressure pulses are critical for reliable IEPE sensor calibration
- Kistler pressure pulse generators make this possible
- Calibration under realistic dynamic conditions
- Enables precise peak pressure measurement in demanding applications

Thank you!

Questions & discussion

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