

Piezoelectric pressure sensor for Test & Measurement applications

Type 603C...

The miniature pressure sensors of the Type 603C series are, due to their high natural frequency, suited for a variety of applications where highly dynamic pressure transients need to be measured. The acceleration compensation ensures reliable measurements even under highly vibrating conditions.

- Pressure range up to 1 000 bar (15 000 psi)
- Acceleration compensated
- Small sensor size
- Short rise time & high natural frequency
- Wide operating temperature range
- Charge (PE) or Voltage (IEPE) output

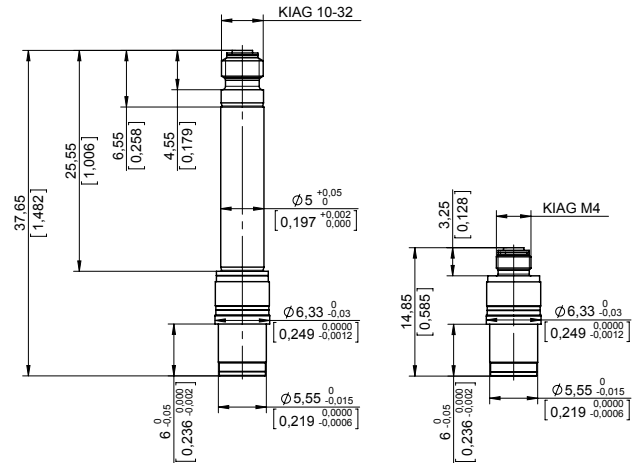
Description

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 that are superimposed on top of high static pressures with exceptional resolution. By contrast, piezoresistive pressure sensors are the right choice when measuring static pressure curves.

At the core of the all-welded, hermetically sealed 603C series there is a Quartz crystal. The pressure to be measured acts on the sensor's diaphragm and compresses the Quartz crystal. The compressed crystal produces a charge which is proportional to the pressure. Finally, the charge signal needs to be converted, by a charge amplifier, into a voltage which can then be read.

Typical applications

- High pressure measurements on hydraulic and pneumatic systems, etc.
- Highly dynamic pressure measurements on shock tubes, blast tests, etc.



Charge (PE) vs. Voltage (IEPE) output

One of the most important selection criteria for piezoelectric pressure sensors is the output signal. Two variants of the sensor are available, charge output (PE) and voltage output (IEPE) resp. Piezotron.

Piezoelectric pressure sensors are connected to an electronic circuit which converts the charge generated by the sensor into a proportional voltage. If the electronic circuit is integrated into the sensor housing, it is referred to as an IEPE sensor. If the electronics is an external device (charge amplifier), it is referred to as a PE sensor. Depending on the application, PE or IEPE sensors may be better suitable.

IEPE sensors are the ideal solution for the long-term measurement of small pressure pulsations (without any static pressure content) or the measurement of dynamic pressure profiles (up to a few tenths of a millisecond only). IEPE sensors will however, due to the built-in electronics, only work at moderate temperatures and come with a fixed measuring range.

PE sensors on the other hand are the right solution for the long-term measurement of small pressure pulsations (without any static pressure content), quasi-static or dynamic pressure profiles (up to a few minutes). PE sensors will, due to the external charge amplifier, operate at extreme temperatures too and allow for adjustable measuring ranges.

The instruction manual and pressure catalogue provides further details on PE and IEPE sensors, measuring chains as well as applications each technology is best suited for.

603C_003-288e-10.20

Technical data – PE sensors¹⁾**Type 603CA...**

Output signal	pC	Charge (PE)
Pressure range	bar	0 ... 1 000
	psi	0 ... 15 000
Calibrated partial range	%	10; 100
Overload	bar	1 100
	psi	15 950
Sensitivity (nom.)	pC/bar	-5.0
	pC/psi	-0.35
Linearity (typ.)	%FSO	±0.4
	(max.) %FSO	±1.0
Operating temperature range	°C	-196 ... +200
	°F	-321 ... +392
Rise time (10 ... 90%)	µs	<0.4
Natural frequency ²⁾	kHz	>500

Temp. coefficient of sensitivity	25°C ... 200°C	%/°C	≈-0.027
	77°F ... 392°F	%/°F	≈-0.015
	25°C ... -196°C	%/°C	≈+0.027
Acceleration sensitivity (axial)	77°F ... -321°F	%/°F	≈+0.015
		bar/g	≤0.00014
Acceleration sensitivity (radial)		psi/g	≤0.00200
		bar/g	≤0.00001
Insulation resistance		psi/g	≤0.00015
		Ω	≥10 ¹³
Weight	Type 603CAA / 603CAB	gram	4.8 / 2.2
Housing and diaphragm material			17-4 S.S.

Technical data – IEPE sensors¹⁾**Type 603CBA...**

		00014.0	00035.0	00070.0	00350.0	00690.0	01000.0
Output signal	V	Voltage (IEPE)					
Pressure range	bar	14	35	70	350	690	1 000
	psi	200	500	1 000	5 000	10 000	15 000
Maximum pressure	bar	1 000					
	psi	15 000					
Overload	bar	1 100					
	psi	15 950					
Sensitivity (nom.)	mV/bar	357	143	71	14	7	5
	mV/psi	25	10	5	1	0.5	0.3
Linearity	%FSO	±1.0					
Operating temperature range	°C	-55 ... +120					
	°F	-67 ... +248					
Rise time (10 ... 90%)	µs	<0.4					
Natural frequency ²⁾	kHz	>500					
Time constant (nom.)	s	2	3				
Low frequency response -3 dB	Hz	0.080	0.053				
	-5%	0.242	0.161				
Temp. coefficient of sensitivity	25 ... 120°C	% / °C ≈-0.027					
	77 ... 248°F	% / °F ≈-0.015					
	25 ... -55°C	% / °C ≈+0.027					
	77 ... -67°F	% / °F ≈+0.015					
Acceleration sensitivity (axial)	bar/g	≤0.00014					
	psi/g	≤0.00200					
Acceleration sensitivity (radial)	bar/g	≤0.00001					
	psi/g	≤0.00015					
Supply voltage (by IEPE-Coupler)	VDC	22 ... 30					
Supply current (by IEPE-Coupler)	mA	2 ... 20					
Output bias voltage (nom.)	VDC	11					
Output voltage FSO	V	±5					
Weight	grams	4.0					
Housing and diaphragm material	-	17-4 S.S.					

¹⁾ Indications are valid for 23°C / 73°F (if not specified otherwise)²⁾ Calculated from rise time

Mounting (sensors with standard housing)

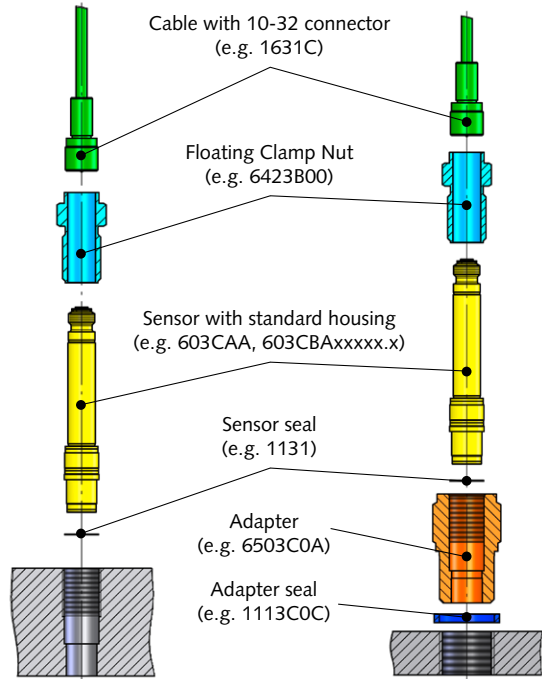
Sensors with charge output (PE) and voltage output (IEPE) are available with standard housing. Sensors with a standard housing can either be installed directly or with an adapter.

Direct Mounting

When the mounting location space is restricted, the sensor can be located in an appropriately dimensioned mounting bore, and then held in place with a floating clamp nut. Please note that for a reliable and accurate pressure measurement a precise machining of the mounting hole with special reamers and taps is required. For details on mounting hole fabrication please check the manual.

Adapter Mounting

Fitting sensors into a mounting adapter greatly simplifies the installation process (when space and wall thickness are not a premium). Use of a Kistler mounting adapter will eliminate the need to provide a precise mounting configuration and allow the installer to provide only a threaded hole of the size and depth required for the adapter selected. Special reamers or taps are not required when using an adapter. For details on mounting thread fabrication please check the manual. All sensors and adapters are available for download as 3D CAD files from Kistler's webpage.



Direct Mounting

- Flush mounting
- Complex drilling with special tool
- Min. structural influences on pressure measurement (mechanical decoupling)
- Ideal for close matrix alignment of sensors

Type 6503CxA Adapter

- M10 and 3/8-24 UNF
- Stainless steel (1.4542+AT)
- Flush mounting
- Max. Pressure 1 000 bar (14 500 psi)

Type 6503CxD Adapter

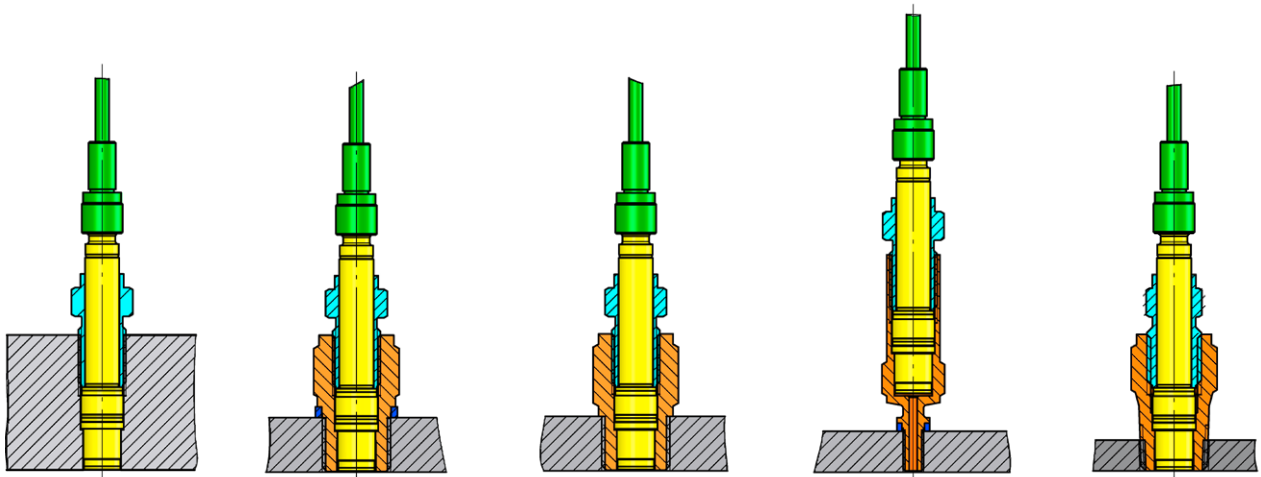
- M10 and 3/8-24 UNF
- Ground Isolating
- PEEK GF30 (glass fiber reinforced high performance plastic)
- Max. Pressure 100 bar (1 450 psi)
- Max. temperature 100°C (212°F)

Type 6507BxA Adapter

- M3 and 5-40 UNC
- Stainless steel (1.4542+AT)
- Recessed mounting
- Max. Pressure 300 bar (4 350 psi)

Type 6503C3A Adapter

- 1/8-27 NPTF
- Stainless steel (1.4542+AT)
- Almost flush mounting
- Max. Pressure 1 000 bar (14 500 psi)



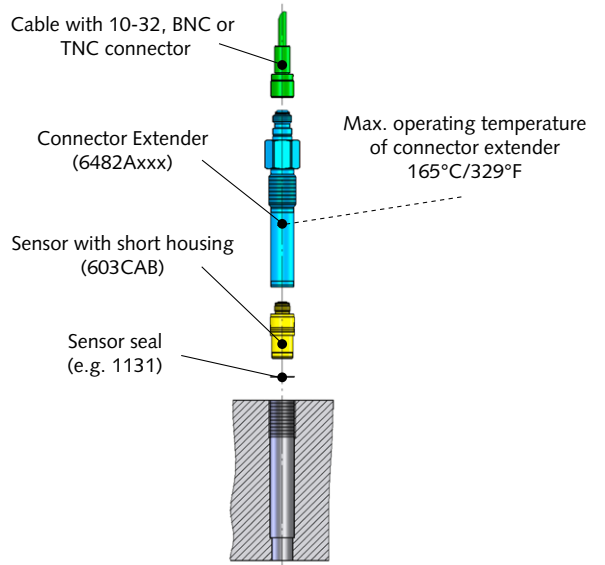
603C_003-288e-10.20

Mounting (sensors with short housing)

Sensors with charge output (PE) are also available with short housing. For the mounting of these sensors a connector extender of Type 6482A is required. This mounting form is mostly only used where mechanical structures cannot be weakened.

Connector extenders are made to order and are therefore not stock items (unlike floating clamp nuts of Type 6423B). Customers can choose between three different connectors, two different threads and a variable length (see ordering key).

Please note that for a reliable and accurate pressure measurement a precise machining of the mounting hole with special reamers and taps is required (same as for direct mounting, see previous datasheet page). For details on mounting hole fabrication please check the manual. All connector extenders are available for download as 3D CAD files from Kistler's webpage.



10-32 connector

Small coaxial 10-32 connectors are widely used in the sensor industry and therefore comes with a wide range of high impedance cable options. The small size further allows for sealing the sensor connector with thermo shrink sleeves. Attention needs to be paid to cleanliness of these small connectors.

BNC connector

The BNC connector (bayonet lock) is much bigger and therefore sturdier and less sensitive to contaminations than the widely used 10-32 connector. Its large dimensions and big mass as well the difficulty to be sealed might however be a criterion for exclusion in some applications.

TNC connector

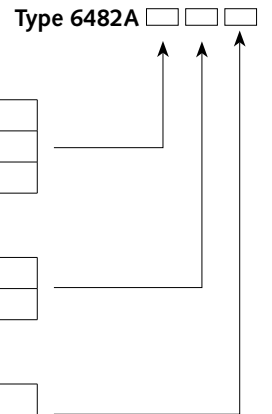
The TNC connector (thread lock) has about the same size, and offers the same advantages and disadvantages, as the BNC connector. Thanks to the thread lock a good sealing against exterior influences is achieved and is therefore the preferred choice when conducting tests outside a laboratory environment.

Ordering key (connector extender)

Connector type	
BNC	0
TNC	1
10-32	2

Mounting thread	
M7x0.75	0
5/16-24 UNF	1

Length (in mm)	
010	SP
013 ... 200	SP



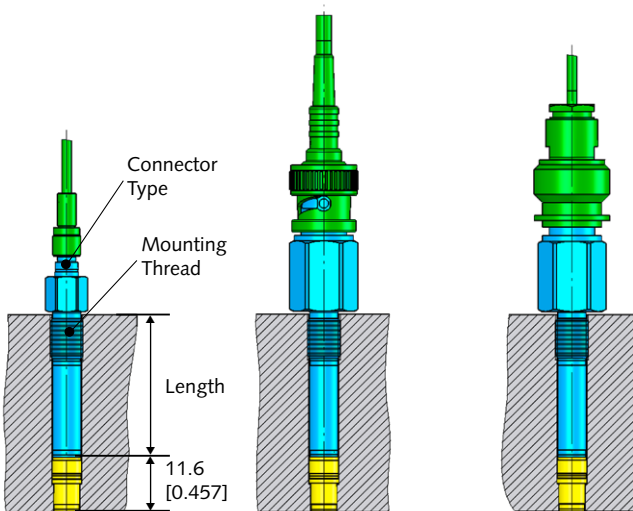
Ordering example

- 6482A with BNC, M7 thread, 10 mm length
- 6482A with TNC, M7 thread, 15 mm length
- 6482A with 10-32, UNF thread, 125 mm length

Type

- 6482A00SP010
- 6482A10SP015
- 6482A21SP125

603C_003-288e-10.20

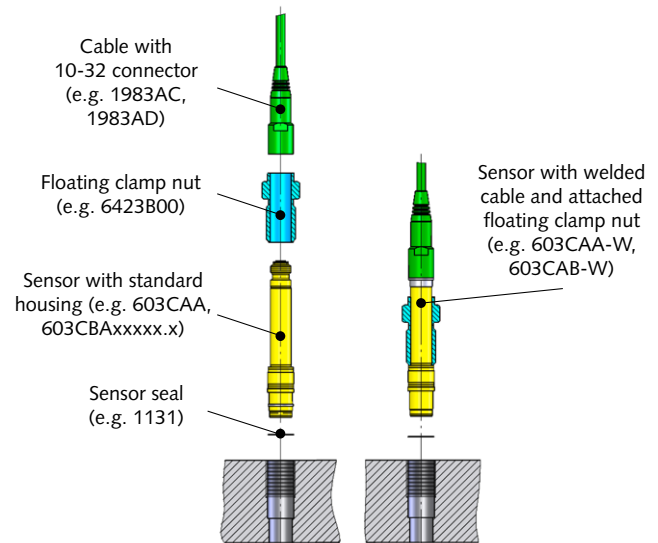


Waterproof solution (IP68)

For pressure sensors subject to water splashes or even used under water the IP68 rated cable Type 1983A shall be used. The Type 1983A cable, made of FKM rubber, comes with a vulcanized 10-32 connector and is only compatible to pressure sensors with a standard housing.

The Type 1983A cable can be screwed like any other standard cable, or optionally even be welded, to the pressure sensor. Welding, instead of screwing, the cable connector to the sensor offers protection against detachment of the cable in case of strong vibrations. Requirements to weld the connector to the sensor need to be stated at the time of order (see below ordering keys).

Both, screwed and welded, solutions have successfully been qualified for IP68 rating in water with pressures ranging from vacuum to 16 bar.



Ordering key (PE sensor with welded 1983A cable)

Type 603CAA-W

Floating clamp nut Type

6423B00	A
6423B11	B

Cable Type

1983AD (with BNC pos. connector)	A
1983AC (with 10-32 pos. int. connector)	B

Cable length (in m)

1 m (for 1983AC cable only)	1,0
2 m (for 1983AC and 1983AD cable)	2,0
3 m (for 1983AC cable only)	3,0
5 m (for 1983AD cable only)	5,0
Customized cable length (0.1 to 30.0 m)	SP

Ordering example

603CAA with 6423B00 and 2 m 1983AD cable
603CAA with 6423B00 and 6 m 1983AD cable
603CAA with 6423B11 and 0.5 m 1983AC cable

Type

603CAA-WAA2,0
603CAA-WAASP6,0
603CAA-WBBSPO,5

Ordering key (IEPE sensor with welded 1983A cable)

Type 603CBA-W -

IEPE pressure range

14 bar / 200 psi	00014.0
35 bar / 500 psi	00035.0
70 bar / 1 000 psi	00070.0
350 bar / 5 000 psi	00350.0
690 bar / 10 000 psi	00690.0
1 000 bar / 15 000 psi	01000.0

Floating clamp nut Type

6423B00	A
6423B11	B

Cable Type

1983AD (with BNC pos. connector)	A
1983AC (with 10-32 pos. int. connector)	B

Cable length (in m)

1 m (for 1983AC cable only)	1,0
2 m (for 1983AC and 1983A cable)	2,0
3 m (for 1983AC cable only)	3,0
5 m (for 1983AD cable only)	5,0
Customized cable length (0.1 to 30.0 m)	SP

Ordering example

603CB00014.0 with 6423B00 and 2 m 1983AD cable
603CB00070.0 with 6423B00 and 6 m 1983AD cable
603CB00350.0 with 6423B11 and 7 m 1983AC cable

Type

603CBA-W00014.0-AA2,0
603CBA-W00070.0-AASP6,0
603CBA-W00350.0-BBSP7,0

Accessories (included)

- Sensor seal copper (5 pcs.)

Type/Art.-No.

1131

Accessories (optional)

- Sensor seal nickel (1 pcs)
- Floating clamp nut M7x0.75
- Floating clamp nut 5/16-24-UNF
- Adapter M10x1¹⁾
- Adapter seal (S.S. / 25 pcs) for 6503C0A
- Adapter seal (Cu / 25 pcs) for 6503C0A
- Adapter 3/8-24-UNF¹⁾
- Adapter seal (S.S. / 25 pcs) for 6503C1A
- Adapter seal (Cu / 25 pcs) for 6503C1A
- Adapter M3x0.5¹⁾
- Adapter 5-40 UNC¹⁾
- Adapter seal for 6507BxA
- Lubrication Grease (Adapter)
- Adapter M10x1 (ground isolated)
- Adapter 3/8-24 UNF (ground isolated)
- Adapter 1/8-27 NPTF
- Connector extender (configurable product)
- Dummy sensor (standard housing)
- Dummy sensor (short housing)
- Step reamer (SC H7 Ø6.35/Ø5.58)

Type/Art.-No.

1131A
6423B00
6423B11
6503C0A
1113C0B
1113C0C
6503C1A
1113C1B
1113C1C
6507B0A
6507B1A
1117B0C
1063
6503C0D
6503C1D
6503C3A
6482A
6487AA
6487AB
1331C

Ordering key (sensor)**Output signal**

Charge (PE)	A
Voltage (IEPE)	B

Housing

Standard housing (PE and IEPE)	A
Short housing (only PE)	B

Pressure range (only IEPE)

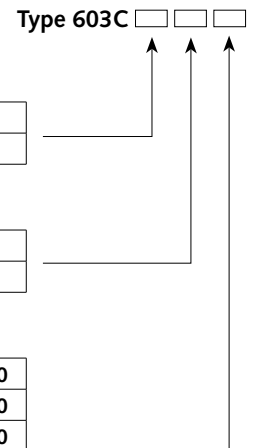
14 bar / 200 psi	00014.0
35 bar / 500 psi	00035.0
70 bar / 1 000 psi	00070.0
350 bar / 5 000 psi	00350.0
690 bar / 10 000 psi	00690.0
1000 bar / 15 000 psi	01000.0

Ordering example

PE sensor with standard housing
PE sensor with short housing
IEPE sensor (350 bar / 5 000 psi)

Type

603CAA
603CAB
603CBA00350.0



¹⁾ All of the adapters are delivered with 1 pc. of each adapter seal type and 1 pc. lubrication grease Type 1063 (except adapters Type 6503C0D, 6503C1D, 6503C3A).