

3-Component Force Sensor

Diameter 100 mm up to 100 kN

Type 9077B, 9078B,
9076B4

Quartz force sensor for measuring the three orthogonal components of a dynamic or quasistatic force acting in an arbitrary direction.

- Measures the 3 components of a force
- Compact, despite large measuring range
- High rigidity
- Minimal cross talk
- Multipole connector

Description

The force sensor contains 3 quartz rings which are mounted between two steel plates in the sensor housing.

Two quartz rings are sensitive to shear and measure the force components F_x and F_y , while one quartz plug is sensitive to pressure measures the component F_z of a force acting on the sensor. The electrical charges proportional to the different components are led via electrodes to the corresponding connectors.

Thanks to their high rigidity they cover a wide frequency range. The quartz packet is protected by the stainless, tightly welded sensor housing.

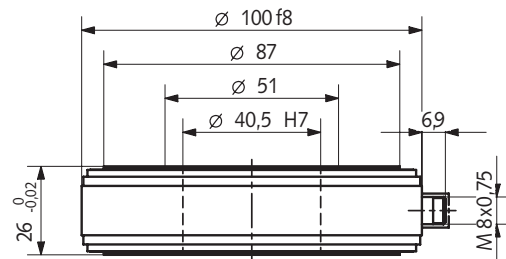
The mounting surfaces are mounted ground-isolated. This largely eliminates ground loop problems.

Application

The quartz force sensors can measure the 3 orthogonal force components easily, directly and precisely, because these sensors feature an inherently low cross talk.

Application examples

- Cutting forces
- Impact forces
- Reaction forces in rockets
- Dynamic forces on shakers
- Determination of coefficients of friction



Technical Data

Range	$F_x, F_y (F_z \geq 0)$	kN	-60 ... 60 ¹⁾
	F_z	kN	-100 ... 100 ¹⁾
	F_z	kN	0 ... 500 ²⁾
Overload	F_x, F_y	kN	-66/66 ¹⁾
	F_z	kN	-200/200 ¹⁾
	F_z	kN	600 ²⁾
Calibrated range	F_x, F_y	kN	0 ... 60 ¹⁾
	F_z	kN	0 ... 100 ¹⁾
	F_z	kN	0 ... 500 ²⁾
Threshold		N	<1
Sensitivity	F_x, F_y	pC/N	$\approx 4,2$ ¹⁾
	F_z	pC/N	$\approx 2,0$ ¹⁾
Linearity, each axis		%FSO	$\leq \pm 1$
Hysteresis, each axis		%FSO	≤ 1
Cross talk	$F_z \rightarrow F_x, F_y$	%	$\leq \pm 1$ ¹⁾
	$F_x \leftrightarrow F_y$	%	$\leq \pm 2$ ¹⁾
	$F_x, F_y \rightarrow F_z$	%	$\leq \pm 3$ ¹⁾
Rigidity	C_x, C_y	N/ μ m	≈ 2000
	C_z	N/ μ m	≈ 9000
Max. Moments	$M_x, M_y (F_z \leq 0)$	Nm	± 2600 ¹⁾
Operating temperature range		$^{\circ}$ C	-50 ... 120
Insulation resistance		Ω	$> 10^{13}$
Ground insulation		Ω	$> 10^8$
Capacitance, each channel		pF	≈ 1000
Connector			3 pole M8x0,75
Weight		g	1020

¹⁾ Standard mounting with preload 300 kN

²⁾ without preload

Other Descriptions

Types 9077B and 9078B

The sensors Types 9077B and 9078B differ only in the position of the coordinate system relative to the sensor case (see Fig. 1). The technical data of both types are identical.

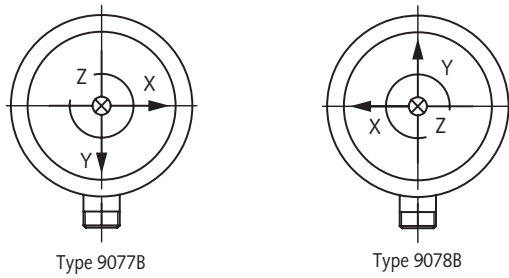


Fig. 1: 3-Component Force Sensor Type 9077B and Type 9078B

Type 9076B4

Sets consisting of four selected 3-Component force Sensors

These sets, Type 9076B4, consist of four selected three-component force sensors two of each Type 9077B and Type 9078B. Commonly ground to the same thickness, they are used for mounting into multicomponent dynamometers and force plates.

All connectors of the four sensors are oriented toward the inside, (see Fig. 2). The four force sensors are selected in a way to possess optimal specifications of constant sensitivity and minimal cross talk when they are mounted into a dynamometer.

This configuration permits a very compact mounting, e.g. in a dynamometer.

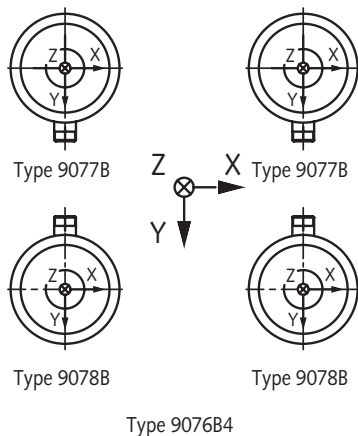


Fig. 2: Set consisting of 3-Component Force Sensors, two of each Type 9077B and 9078B

Mounting

The force sensor must be mounted under preload because the shear forces F_x and F_y are to be transmitted through static friction from the base and cover plate to the faces of the force sensor. The necessary preload depends on the shear forces to be transmitted.

The measuring ranges indicated in the technical data are valid for the standard preload of 300 kN.

The sensor is preloaded with a centered preloading bolt. The cable outlet serves to orient the sensor.

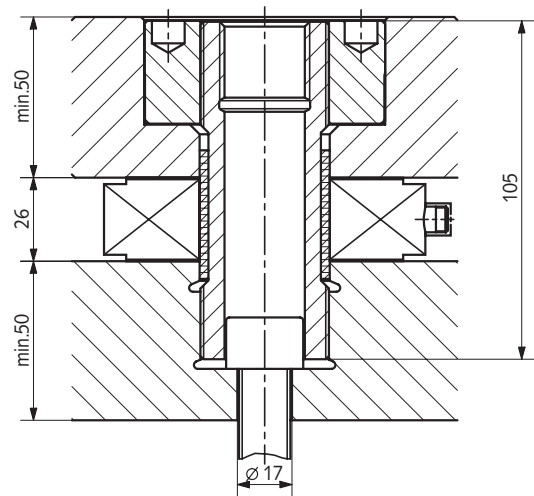


Fig. 3: Standard preloading with preloading set Type 9455

This preloading method allows a very compact mounting of dynamometers. A minimum overall height is obtained by recessed mounting of the ring nut.

Further information see data sheet of Type 9455 (000-195).

000-119e-08.04 (DB06.9077Bm)

Force Link

The force sensors Types 9077B and 9078B are available already mounted and calibrated in the form of a force link see data sheet of Type 9377B (000-171).

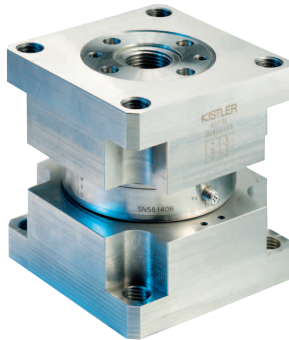


Fig. 4: Force Links Type 9377B, 9378B

Parallel Switching

Several quartz sensors of identical sensitivities can be paralleled directly. The charge amplifier connected then gives an output voltage which corresponds to the sum of all forces acting. This is a great advantage when building force plates and dynamometers with which only the 3 components of the resulting force must be measured.

Electronics

Besides the force sensors, a 3-component force measuring system also requires 3 charge amplifiers, which convert the electrical charge signals of the sensor into voltages exactly proportional to the three components F_x , F_y and F_z of the acting force. In order to construct multicomponent dynamometers for measuring three forces and three moments, special multichannel charge amplifiers are available.

Systems for Multicomponent Measurements

Information concerning cable concept see supplement for data sheet of Systems for Multicomponent Measurements (000-183).

Accessories Included

The preloading elements are not included in the delivery; they must be ordered separately. See data sheet of Type 9455 (000-195).

Optional Accessories

• Preloading set	Type 9455
• Wrench adapter	9473
• Connecting cable	1693A...
• Connecting cable	1694A...
• Connecting cable	1695A...

Ordering Key

3-Component Force Sensor

- 3-Component Force Sensor with standard coordinate system (see Fig. 1).

3-Component Force Sensor

- 3-Component Force Sensor like Type 9077B, but with coordinate system rotated 180° about z-axis (see Fig. 1).

Set of 3-Component Force Sensors

- Set of four matched 3-Component Force Sensors ground together, two of each Type 9077B and 9078B (see Fig. 2).

Type

9455
9473
1693A...
1694A...
1695A...

Type

9077B

9078B

9076B4