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# MiniDyn

Type 9256C...

## Multicomponent Dynamometer up to 250 N

Multicomponent dynamometer for measuring the three orthogonal components of a force. Its very low threshold allows measuring extremely small forces.

- For cutting force measurements in ultra precise machining
- Small design
- High sensitivity and natural frequency
- Small temperature error
- Top plate made of titanium



Type 9256C2

### Description

The dynamometer consists of four 3-component force sensors mounted under high preload between the cover plate and the two lateral base plates.

A low temperature error is obtained by this special mounting of the sensors. Each force sensor contains three crystal rings, of which one is sensitive to pressure in the y-direction and the two others to shear in the x- and z-directions. The forces are measured practically without displacement.

The outputs of the four mounted force sensors are fed to the 7-pole flanged socket. There are also multicomponent force-moment measurements possible.

The four sensors are fitted so that they are ground-isolated. This largely eliminates ground loop problems.

The dynamometer is corrosion-resistant and protected against penetration by splashing water or cutting fluid. The dynamometer including connecting cable Type 1696A5 or Type 1697A5 meets the degree of protection IP67.

### Examples of Application

- Cutting force measurement in precision machining such as:
  - cutting wafers
  - grinding hard-disk read heads
  - diamond turning
  - high speed machining
  - micromachining
- Ultra-high precision machining of brittle hard materials
- Multicomponent force measurement of small forces
- Force measurement in confined spaces

### Technical Data

| Measuring range | $F_x$, $F_y$, $F_z$ | N | –250 … 250 |
|---|---|---|---|
| Type 9256C1 | $M_x$, $M_z$ | N·m | –8 … 8 |
| Type 9256C2 | $M_x$, $M_z$ | N·m | –11 … 11 |
| Calibrated measuring range | | | |
| 100 % | $F_x$, $F_y$, $F_z$ | N | 0 … 250 |
| 10 % | $F_x$, $F_y$, $F_z$ | N | 0 … 25 |
| Overload | $F_x$, $F_y$, $F_z$ | N | –300/300 |
| Threshold | | N | <0,002 |
| Sensitivity | $F_x$, $F_z$ | pC/N | ≈–26 |
| | $F_y$ | pC/N | ≈–13 |
| Linearity, all ranges | | %FSO | ≤±0,4 |
| Hysteresis, all ranges | | %FSO | ≤0,5 |
| Crosstalk | | % | ≤±2 |
| Rigidity | $c_x$, $c_z$ | N/µm | >250 |
| | $c_y$ | N/µm | >300 |
| Natural frequency (mounted on rigid base) | | | |
| Type 9256C1 | $f_n$ (x) | kHz | ≈5,1 |
| | $f_n$ (y) | kHz | ≈5,5 |
| | $f_n$ (z) | kHz | ≈5,6 |
| Type 9256C2 | $f_n$ (x) | kHz | ≈4,0 |
| | $f_n$ (y) | kHz | ≈4,8 |
| | $f_n$ (z) | kHz | ≈4,6 |
| Operating temperature range | | °C | 0 … 70 |
| Insulation resistance | | Ω | >$10^{13}$ |
| Ground isolation | | Ω | >$10^8$ |
| Degree of protection EN60529 (with connecting cable Type 1696A5/1697A5) | | | IP67 |
| Weight | | | |
| Dynamometer | Type 9256C1/C2 | kg | 0,75/0,87 |
| Top plate | Type 9256C1/C2 | kg | 0,24/0,36 |
| Clamping area | | | |
| Type 9256C1 | | mm | 39x80 |
| Type 9256C2 | | mm | 55x80 |

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## Dimensions MiniDyn Type 9256C…
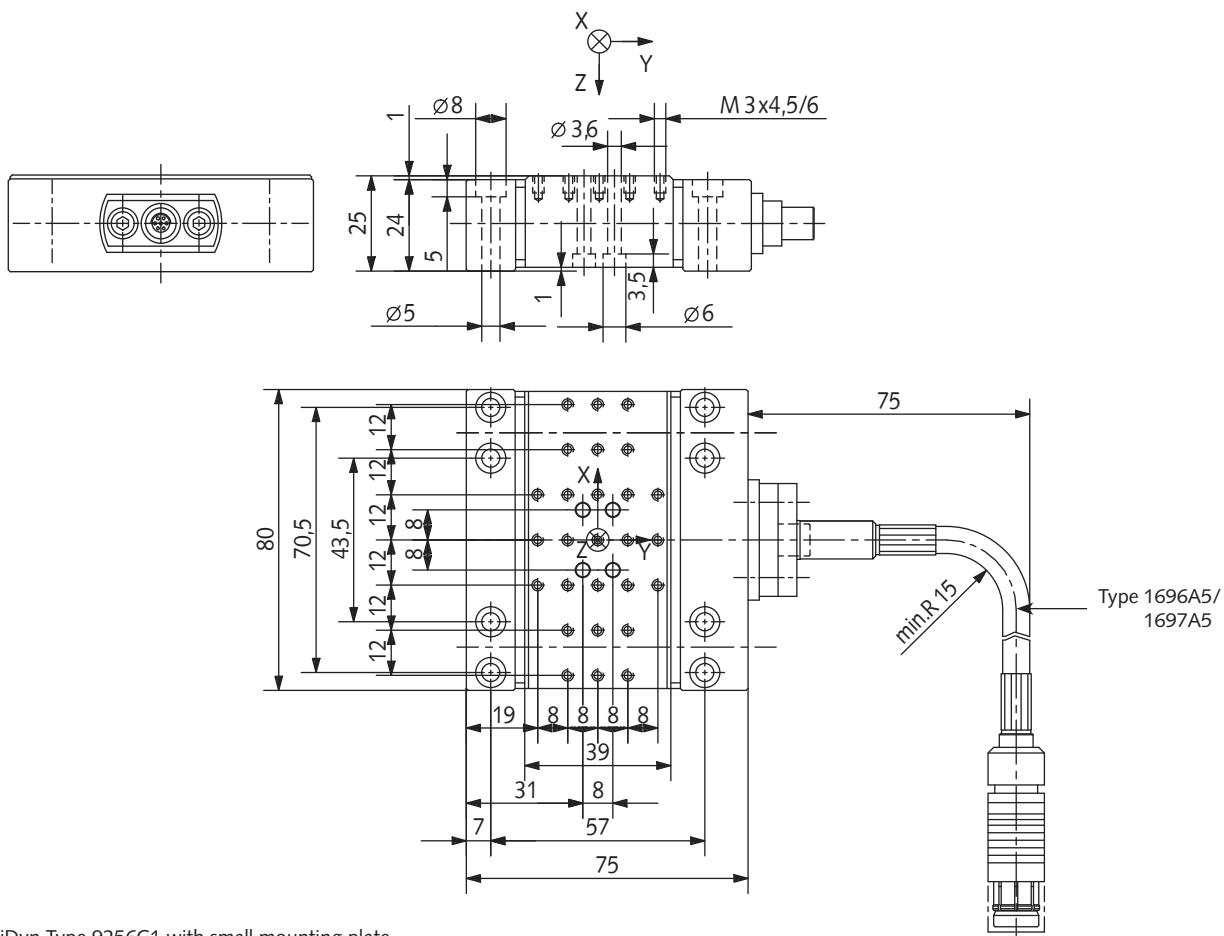


Fig. 1: MiniDyn Type 9256C1 with small mounting plate
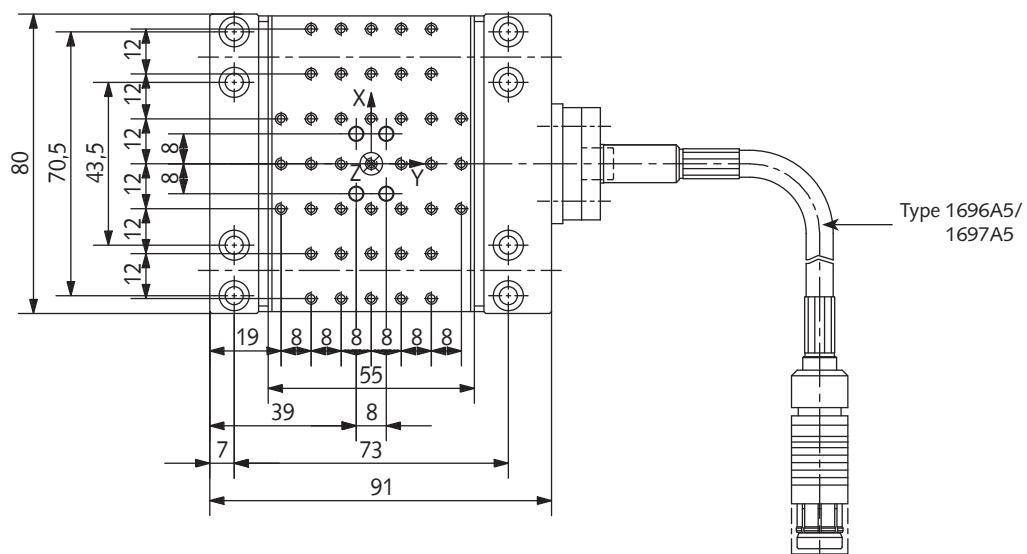


Fig. 2: MiniDyn Type 9256C2 with large mounting plate

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This information corresponds to the current state of knowledge. Kistler reserves the right to make technical changes. Liability for consequential damage resulting from the use of Kistler products is excluded.

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## Mounting

The dynamometer can be mounted with screws or clamps to any face-ground, clean mounting surface such as on a machine tool table. The measuring instrument can also be mounted on a magnetic plate. It must be noted that uneven contact surfaces may cause internal distortions, placing additional heavy stresses on the individual measuring elements and increasing the cross talk.

There are M3 tapped blind holes in the mounting plate for clamping the force-introducing components such as workpieces or toolholder. The contact surfaces of the force-introducing parts must be surface ground to achieve good mechanical coupling to the mounting plate.

## Electronics

A 3-component force measuring system requires, in addition to the dynamometer, a charge amplifier, which convert the charge signals of the dynamometer into output voltages, which are proportional to the forces occurring.
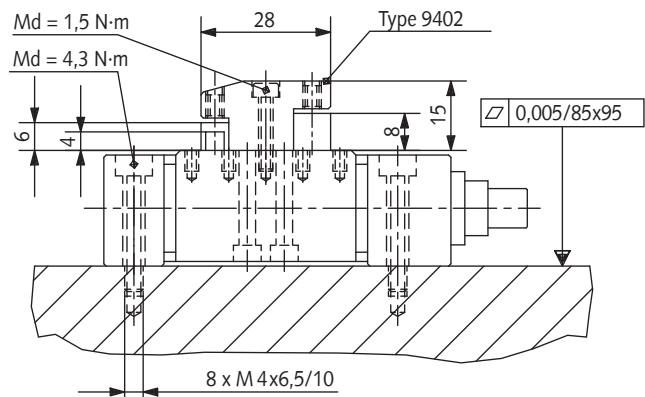
Fig. 3: Mounting the dynamometer

## Measuring System for 3-Component Measurement $F_x$, $F_y$, $F_z$

**MiniDyn** Type 9256C…

**Connecting Cable** Type 1697A5

Length = 5 m

**Multichannel Charge Amplifier** Type 5080Axx3x001

Output ±10 V

Ch1  $F_x$
Ch2  $F_y$
Ch3  $F_z$

IP67         IP65         IP40
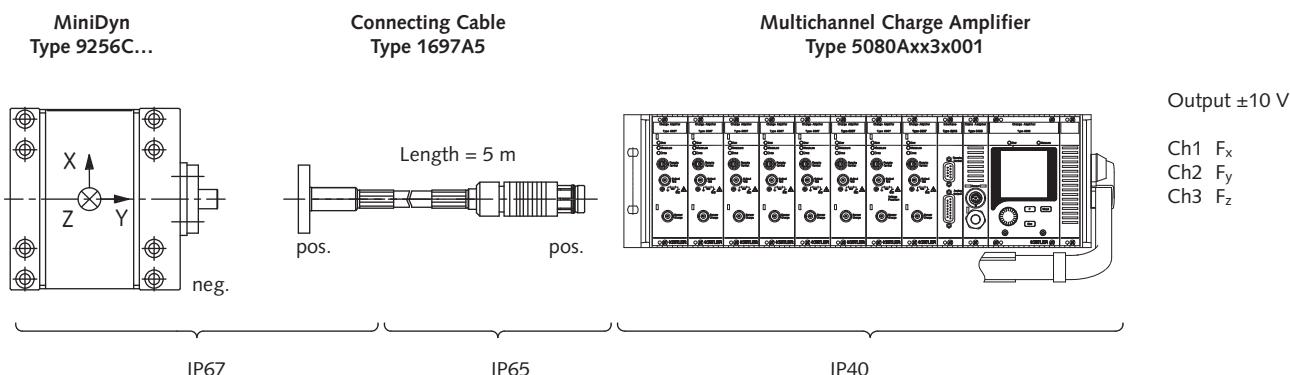
Degree of protection EN60529

Fig. 4: Measuring system for 3-component measurement $F_x$, $F_y$, $F_z$
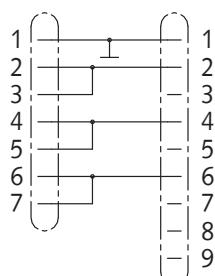
| Input Signals | Pin No. |
|---------------|---------|
| Ground | 1 |
| X1 + 2 | 2 |
| X3 + 4 | 3 |
| Y1 + 4 | 4 |
| Y2 + 3 | 5 |
| Z1 + 2 | 6 |
| Z3 + 4 | 7 |

| Pin No. | Output Signals |
|---------|----------------|
| 1 | Ground |
| 2 | Fx |
| 3 | – |
| 4 | Fy |
| 5 | – |
| 6 | Fz |
| 7 | – |
| 8 | – |
| 9 | – |

Fig. 5: Cable diagram connecting cable Type 1697A5

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## Measuring System for 5-Component Measurement $F_x$, $F_y$, $F_z$, $M_x$, $M_z$

| **MiniDyn** | **Connecting Cable** | **Multichannel Charge Amplifier** |
|---|---|---|
| **Type 9256C...** | **Type 1696A5/1696Asp** | **Type 5080Axx6x003** |

Length = 5 m
sp = specify cable length with order
($L_{min}$ = 1 m/$L_{max}$ = 5 m)

Output ±10 V
Ch1  $F_{x1+2}$
Ch2  $F_{x3+4}$
Ch3  $F_{y1+4}$
Ch4  $F_{y2+3}$
Ch5  $F_{z1+2}$
Ch6  $F_{z3+4}$

IP67                IP65                IP40
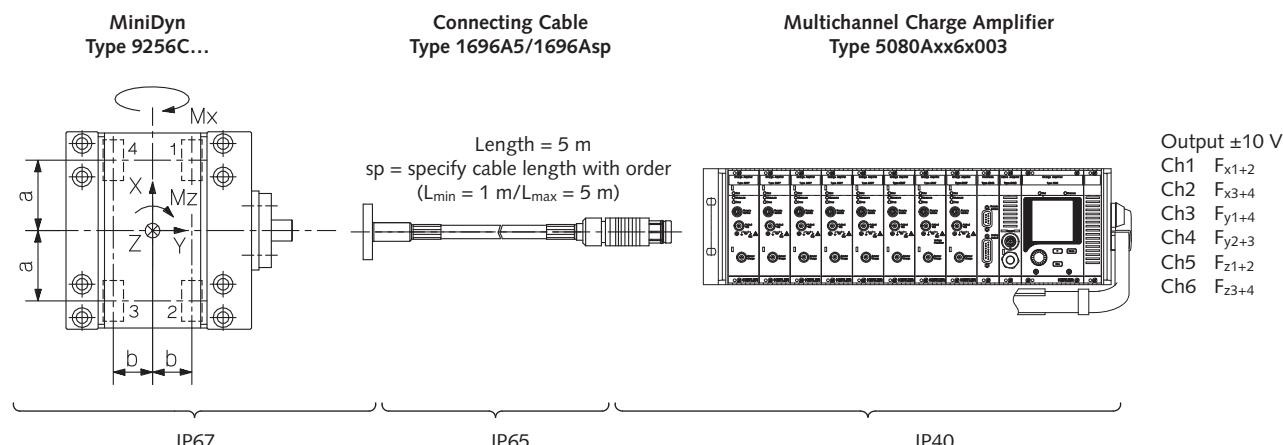
Degree of protection EN60529

Fig. 6: Measuring system for 5-component measurement $F_x$, $F_y$, $F_z$, $M_x$, $M_z$
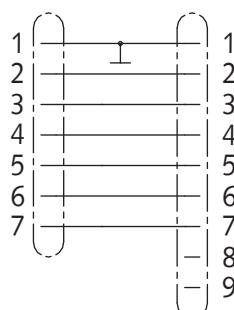
| Input Signals | Pin No. |
|---|---|
| Ground | 1 |
| X1 + 2 | 2 |
| X3 + 4 | 3 |
| Y1 + 4 | 4 |
| Y2 + 3 | 5 |
| Z1 + 2 | 6 |
| Z3 + 4 | 7 |

| Pin No. | Output Signals |
|---|---|
| 1 | Ground |
| 2 | Fx 1+2 |
| 3 | Fx 3+4 |
| 4 | Fy 1+4 |
| 5 | Fy 2+3 |
| 6 | Fz 1+2 |
| 7 | Fz 3+4 |
| 8 | – |
| 9 | – |

Fig. 7: Cable diagram connecting cable Type 1696A5

### Calculations

$$F_x = F_{x1+2} + F_{x3+4}$$
$$F_y = F_{y1+4} + F_{y2+3}$$
$$F_z = F_{z1+2} + F_{z3+4}$$
$$M_x = b \cdot (F_{z1+2} - F_{z3+4})$$
$$M_z = b \cdot (-F_{x1+2} + F_{x3+4}) + a \cdot (F_{y1+4} - F_{y2+3})$$

a = Distance of the sensor axes from the y-axis
  Type 9256C1 a = 28,5 mm
  Type 9256C2 a = 28,5 mm
b = Distance of the sensor axes from the x-axis
  Type 9256C1 b = 15,5 mm
  Type 9256C2 b = 23,5 mm

| Included Accessories | Art. No. |
|---|---|
| • Mounting screws (8 pieces M4x25) | 6.120.015 |

**Optional Accessories**
**for 3-Component Force Measurement $F_x$, $F_y$, $F_z$**

| | Type |
|---|---|
| • Connecting cable, 3 wires, l = 5 m | 1697A5 |
| • Toolholder | 9402 |
| • Charge amplifier | 5080A... |

**For 4/5-Component Force and Moment**
**Measurement $F_x$, $F_y$, $F_z$, $M_x$, $M_z$**

| | |
|---|---|
| • Connecting cable, 6 wires, l = 5 m | 1696A5 |
| • Charge amplifier | 5080A... |

### Ordering Key

Type 9256C ☐

| | |
|---|---|
| Dimensions 80x75 mm | 1 |
| Dimensions 80x91 mm | 2 |

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