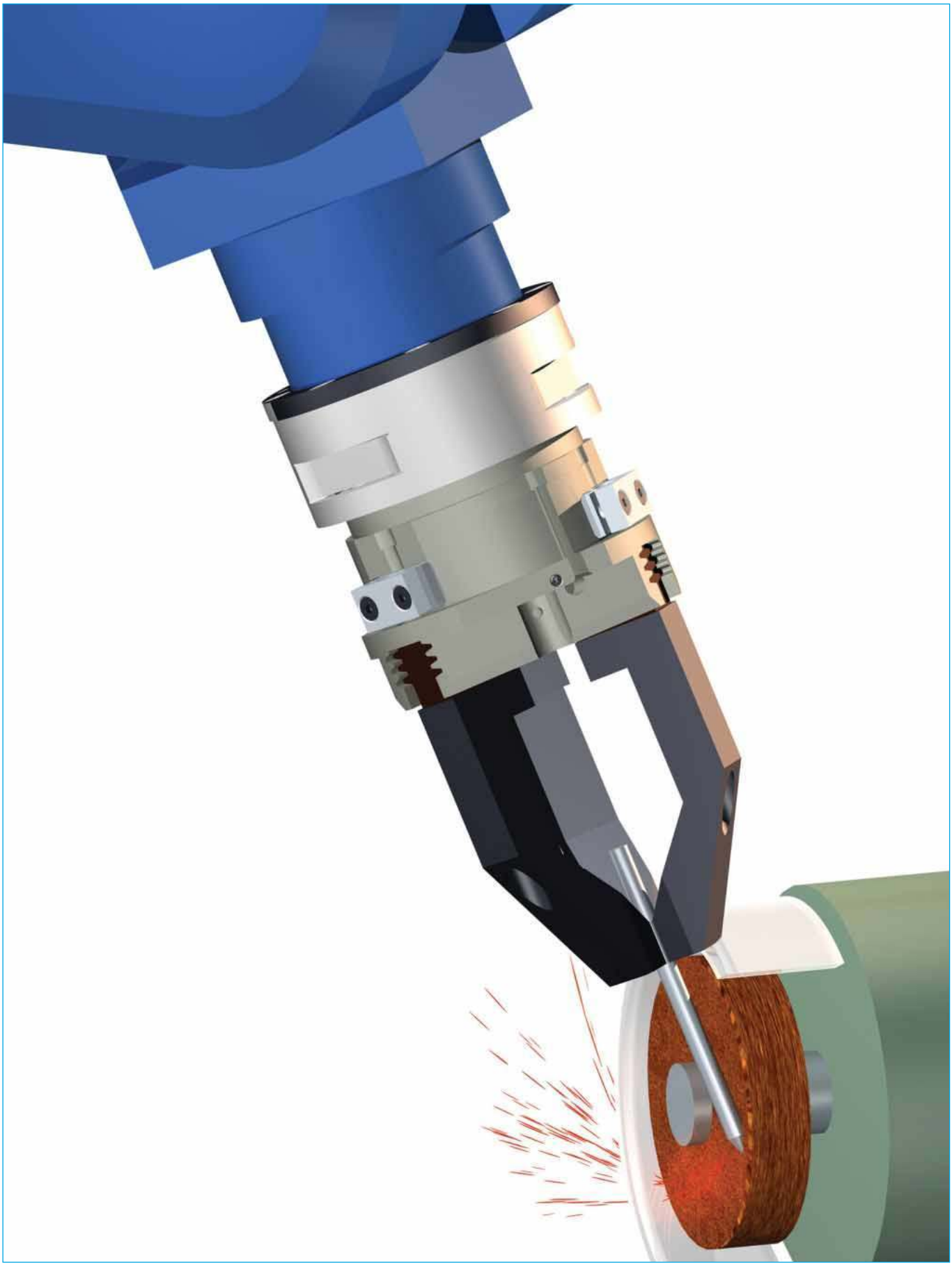
Description

6-axis force torque sensor



Product picture

Figure: FTD-Gamma

Benefits

- Precise measurement of forces and torques in all 3 planes
- Sizes with different ranges of measurement available
- High measured value resolution
- High overload capacity
- Rotation and translation of the system of coordinates in all 3 planes
- Robust design and easy to use
- Warranty: 12 months

Technical data

Sensor element

Method of functioning:
Monolithic element with three measuring phases with an angle of 120°. Each phase has two semiconductor strain measuring bridges which record deformation in the micrometer range.

Overload protection:
Overloads up to the values specified above are permissible in all 6 axes without having to recalibrate the sensor. Additional overload bolts protect the sensor against mechanical damage.

Material:
Aluminium, stainless steel

Operating temperature:
0 °C to 43 °C, calibrated at 22 °C

Measurement accuracy:
Absolute accuracy < 1% of the final range of measurement value at 22 °C

Temperature compensation:
Hardware side as standard

Splash protection:
IP 65 on request

DAQ F/T system FTD

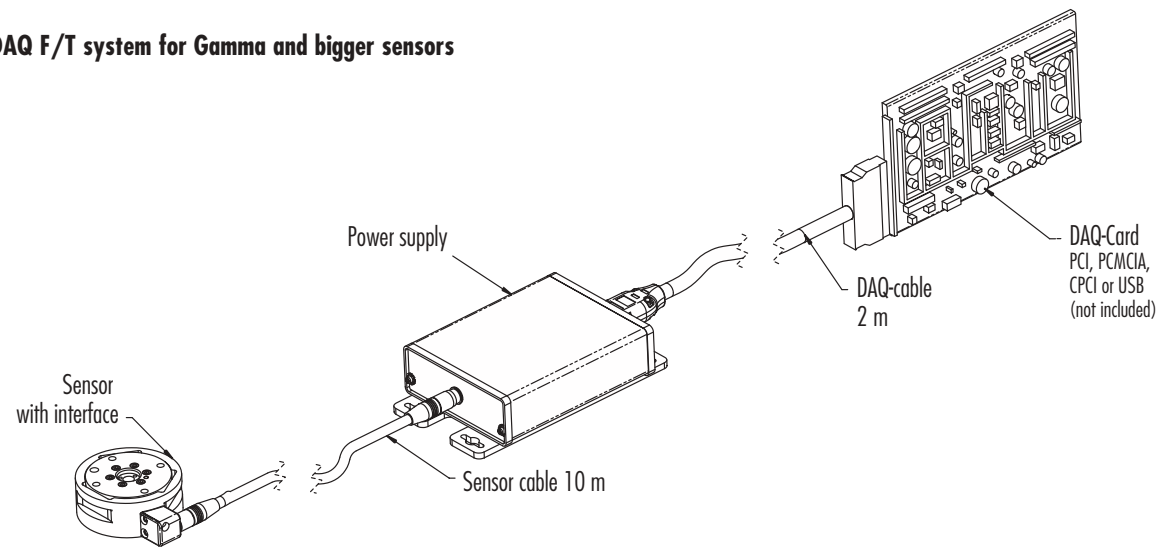
The 6 axis force-moment sensor FTD is available in 2 different configurations, depending on the size of the sensor:

- Sensor with integrated interface board
  Delivered as standard: Sensor with interface board (from Gamma size)
  Sensor cable (10 m)
  Voltage supply box
  Connecting cable to the PC (2 m)
- Sensor with external interface board
  Delivered as standard: Sensor without interface board (Nano and Mini)
  Sensor cable (1.8 m)
  Voltage supply box with integrated interface board
  Connecting cable to the PC (5 m)

Description of the individual components:

- Transducer:
  The transducer senses applied loading with six degrees of freedom (Fx, Fy, Fz, Tx, Ty, and Tz). Gamma and larger transducer models have the interface board inside the transducer while Nano and Mini transducer models require the interface board to be housed in Interface Power Supply Box (IFPS).
  Output is uncalibrated. ATI Software must be used to produce calibrated output.
- Transducer Cable:
  For our Nano and Mini transducer models, the transducer cable is integral to the transducer. For other transducers the transducer cable is attached with a connector. The transducer cable is a long-life flexible cable specially designed for noise immunity. This durable cable protects the transducer signals from electrical fields and mechanical stress.
- Interface Board:
  The interface board electronics receive transducer strain gauge signals and convert them to readable DAQ card signals using noise immunity technology.
  Each interface board is calibrated to work with a specific transducer. The interface board is mounted in the Gamma and larger transducer models and is located in the Interface Power Supply Box (IFPS) for the Nano and Mini transducer models. Output is uncalibrated. ATI software must be used to produce calibrated output.
- Power Supply:
  The power supply converts readily available five volt (275mA) power from the PC through the DAQ card connection to clean power used by the transducer.
  The power supply is mounted in a small box that connects to the transducer cable on one end and to the data acquisition card on the other.
  When not mounted on the transducer, the interface board electronics are included with the power supply.
- Power Supply Cable:
  The power supply cable conducts five volt power to the power supply box or interface power supply box and transmits the transducer signals to the data acquisition card. The cable has a flexible long-life design with special noise immunity features.
- Data Acquisition (DAQ) Card:
  The data acquisition card plugs into your PC, receives the analog transducer signals via the power supply cable and (with ATI software on your computer) converts them into data to be used by computer programs. Our data acquisition cards are available in a wide variety of configurations and supply power to the F/T system. In many cases, you can use an existing data acquisition card.

DAQ F/T system for Gamma and bigger sensors



DAQ Cards

Our DAQ F/T System works with our DAQ cards shown below or with differentially ended or single-ended analog inputs on your DAQ hardware; however, differentially ended inputs are preferred for the best noise immunity.

Available DAQ-Cards

Id.-No.	Type	Resolution	Bus	max. Throughput*
322 002	FTD-DAQ-N1PCI	16-bit	PCI	28.5 K Datasets/second
322 005	FTD-DAQ-N1CPCI	16-bit	cPCI	14.2 K Datasets/second
322 006	FTD-DAQ-N2CPCI	12-bit	cPCI	28.5 K Datasets/second
322 003	FTD-DAQ-N1PCMCIA	16-bit	PCMCIA	28.5 K Datasets/second
322 004	FTD-DAQ-N2PCMCIA	12-bit	PCMCIA	28.5 K Datasets/second
322 008	FTD-DAQ-N2USB	12-bit	USB	14.2 K Datasets/second

*Maximum Throughput is dependent on the overall speed of the computer system.

NOTE:
The DAQ F/T outputs amplified, conditioned strain gauge signals to a data acquisition card – not force or torque data. ATI software (included) running on the host computer performs computations to convert the strain gauge voltage data into force/torque data.
You must acquire all six strain gauge channels in order to calculate any of the forces and torques.

DAQ-Software:

ATI provides DAQ F/T software components that you can use to build your application as well as a sample application program.
The software components are optimized for high speed data transfer and include an Automation Server and C library as described below.

Software Component Features:

The Automation Server ATIDAQFT is a Windows ActiveX component that performs the core operations of the DAQ F/T system including:

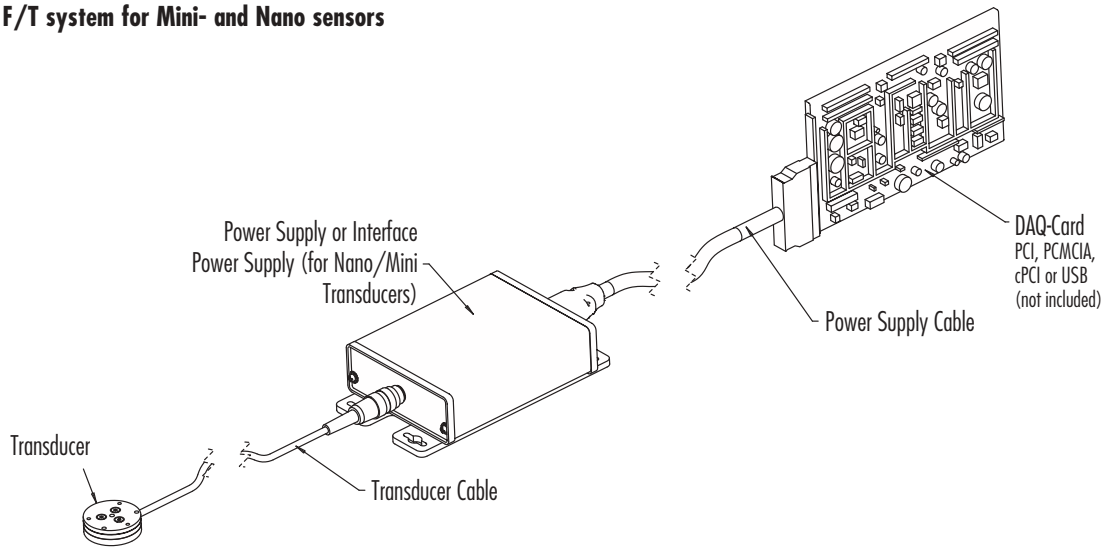
- reading calibration files
- configuring the transducer system
- converting transducer signals from any data acquisition system into force and torques
- performing tool transformations

ATIDAQFT can be used in development platforms that support ActiveX or Automation containment, including:
LabVIEW™, Microsoft ® Visual Basic™, Visual Basic for Applications, and Visual C++™.
For non-Windows operating systems, ATI also provides a C Library with the same features.

Application Program:

The Windows DAQ F/T application program displays graphical and numerical force and torque output for Windows 95 and later Windows operating systems.
Visual Basic 6.0 source code is provided as an aid in creating additional

DAQ F/T system for Mini- and Nano sensors



Stand Alone Controller version FTS

The 6 axis force-moment sensor FTS is available in 2 different configurations, depending on the size of the sensor:

- Sensor with integrated MULTIPLEX board
  Delivered as standard: Sensor without MULTIPLEX board (Nano and Mini)
  Sensor cable
  MULTIPLEX box
  MULTIPLEX cable
  Stand alone controller
  Network cable

- Sensor with external MULTIPLEX board
  Delivered as standard: Sensor without MULTIPLEX board (Nano and Mini)
  Sensor cable
  MULTIPLEX box
  MULTIPLEX cable
  Stand alone controller
  Network cable

Description of the individual components:

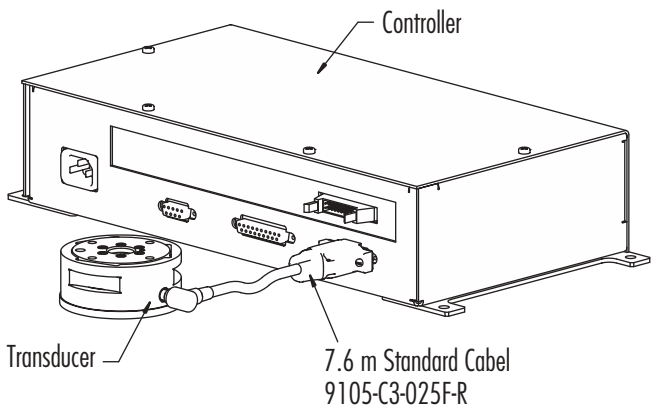
- Transducer:
  The transducer force and torques applied in six degrees of freedom (Fx, Fy, Fz, Tx, Ty, and Tz). Gamma and larger models have on-board electronics (known as the mux board) and Nano and Mini models require these electronics to be in a separate housing (known as the mux box).

- Transducer Cable:
  For our smaller transducers (Nano and Mini series) the transducer cable is integral to the transducer. For other transducers, the cable is integrated into a connector. This durable, long-life, flexible cable protects the transducer signals from electrical fields and mechanical stress.

- MUX Board:
  The mux board electronics connect directly to the transducer's sensing elements and provide high-level output signals.
  Each board is calibrated to work with a specific transducer. The board is mounted in the transducer when possible.
  When not possible, as in the Nano and Mini transducers, the board is located in the mux box.

- Controller:
  The controller interfaces with the transducer or mux box to process the transducer data into useable force and torque data and to provide high-level functions like tool-transformations and threshold detection. The controller is powered by standard 115VAC/230VAC power.
  This intelligent controller communicates over an RS-232 serial port and can also output loads via analog voltages. Its optically isolated discrete I/O port connects easily into many industrial applications and responds to user-programmed threshold conditions.

FTS-System



How to select an transducer

1. **Calculate expected moment and forces**
   Moment capacity is usually the determining factor in choosing the best transducer model for your application.
   The end-effector attached to the transducer as well as the tasks being performed will generate forces on the transducer, which will result in a moment.
   The moment is the applied force (dynamic and static together) multiplied by the distance from the transducer origin to the point at which the force is applied.
   It is important to also consider overload conditions beyond the normal operating forces and moments the transducer will experience.

2. **Identify transducer strength**
   Use the Quick-Selection Guide on page 3 to compare the measuring ranges of the transducer models available.

3. **Verify resolution**
   Next, the required resolution should be considered. A fine resolution requirement can conflict with a transducer chosen based on moment capacity.
   Transducers with larger ranges have coarser resolutions.

Example:
The expected maximum measured load is 98 N (10 Kg) of force and the end-effector is 25 cm long. The moment generated would be 24.5 Nm.

The best F/T would be a Delta/SI-330-30 (330 N, 30 Nm) which can handle the 24.5 Nm moment. The maximum single-axis moment rating (Txy) of this model is 230 Nm, which should be sufficient for overload situations.

Note:
The published payloads of robots are typically the maximum load the robot can handle at published positional resolution. The robot can actually handle much larger loads, but with some loss of positional repeatability. During a crash both inertia and the sudden deceleration can generate large loads. Robots are typically overpowered for an application, and the robot is capable of exerting loads many times its rated loads. You may decide to select a transducer with a lower payload with the understanding that this will increase the chances of damaging the transducer during a crash. We highly recommend the use of a robotic crash protection or breakaway device such as ATI's Protector as an added measure of F/T transducer protection in all robotic applications.

Quick-Selection Guide

Description	Nano 17	Nano 25	Nano 43	Mini 40	Mini 45	Gamma	Delta	Theta	Omega 160	Omega 190	Omega 250	Omega 331
Max. Fxy (±N)	50	250	36	80	580	130	660	2500	2500	7200	16000	40000
Max. Mxy (± Nm)	0.5	6	0.5	4	20	10	60	400	400	1400	2000	6000
Weight (kg)	0.01	0.07	0.04	0.05	0.09	0.25	0.91	4.99	2.72	6.35	30.0	43.0
Diameter (mm)	17	25	43	40	45	75.4	94.5	155	156	190	254	254
Height in (mm)	14.5	21.6	11.5	12.3	15.7	33.3	33.3	61.1	55.9	55.9	95	107

FT-Nano 43

Nano 43

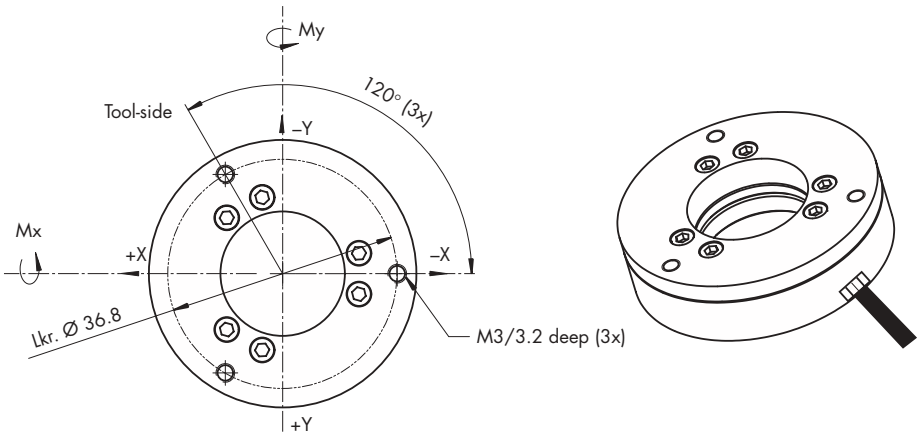
The transducer is made of hardened stainless steel, with integral interface plates made from high-strength aircraft aluminum

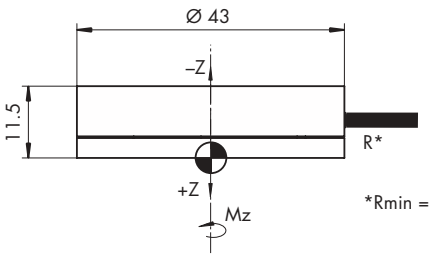
Product advantages

- **One of the smallest 6-axis sensors of the world**
  fits into restricted spaces of research applications and allows linkages and cables to pass through its center hole.
- **Extremely high-strength**
  – EDM wire-cut from high yield-strength stainless steel
  – Maximum allowable single-axis overload values are 6.7 to 14.8 times rated capacities
- **High signal-to-noise-ratio**
  Silicon strain gauges provide a signal 75 times stronger than conventional foil gauges.
  This signal is amplified, resulting in near-zero noise distortion.
- **Typical applications**
  – Telerobotics
  – Robotic surgery
  – Robotic hand research
  – Finger-force research

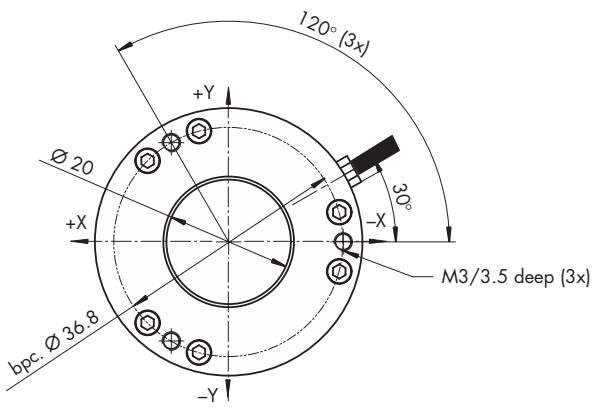
Main view Nano 43

Dimensions FT-Nano 43





*Rmin = 10 x Ø3.5



FT-Nano 43

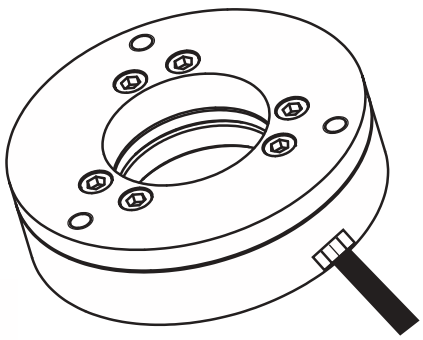
Range of measurement

Range of measurement	Nano 43 SI-18-0.25		Nano 43 SI-36-0.5	
Fx, Fy (± N)	18		36	
Fz (± N)	18		36	
Mx, My (± Nm)	0.25		0.5	
Mz (± Nm)	0.25		0.5	
Id.-No.	322 040	322 520	322 041	322 521
Resolution	Stand Alone	DAQ	Stand Alone	DAQ
Fx, Fy (± N)	1/64	1/1024	1/32	1/512
Fz (± N)	1/64	1/1024	1/32	1/512
Mx, My (± Nm)	1/5000	1/80000	1/2500	1/40000
Mz (± Nm)	1/5000	1/80000	1/2500	1/40000

Overload and Rigidity

Overload		Rigidity		
Fxy	± 300 N	Force	X-Y-axis (K_{Fx}, K_{Fy})	5.2 x 10^6 N/m
Fz	± 400 N		Z-axis (K_{Fz})	5.2 x 10^6 N/m
Txy	± 3.4 Nm	Torque	X-Y-axis (K_{Mx}, K_{My})	770 Nm/rad
Tz	± 5.4 Nm		Z-axis (K_{Mz})	1100 Nm/rad

Physical parameters	
Weight	39 g
Diameter	43 / 19 mm
Height	11.5 mm



Note

Please note that the life span of these units can be reduced considerably if they are used in extreme conditions (e.g. where coolant is used or dust from casting or grinding processes is present). We cannot be held responsible in such cases. Solutions do exist for many problems – please contact us to find out more.