



Multi-Axis Force/Torque Sensor
F/T

Product Description

The Force/Torque (F/T) sensor system measures the full six components of force and torque (Fx, Fy, Fz, Tx, Ty, Tz) using a monolithic instrumented transducer. The F/T transducer uses silicon strain gauges for excellent noise immunity. The use of silicon gauges allows the F/T transducer to have high stiffness and increased overload protection. All transducer models are available with either DAQ F/T or Controller F/T interfaces.

The DAQ F/T allows the transducer to connect to an analog Data Acquisition (DAQ) card chosen for your computer bus (PCI, USB, PCMCIA, etc.) making it easy to read sensor data with your PC or robot controller. The F/T strain gauge signals are conditioned and transmitted to the DAQ card. Next, the ATI DAQ software works with your computer to convert strain gauge data into force/torque data. The DAQ F/T consists of a transducer, an interface board, a power supply board, a DAQ card, software and long-life flexible cables designed to shield against outside electrical noise.

The Controller F/T processes the F/T strain gauge information and outputs serial and analog force/torque data. Controller functions provide tool transformations, peak capture, biasing and discrete I/O.

Future Development

Net F/T: ATI is developing an output interface that provides both DeviceNet™ and EtherNet/IP™ communication interfaces and is compatible with standard Ethernet. See page 6 or contact ATI for more information.



Multi-Axis Force/Torque Transducers

Product Advantages

Overload protection: The F/T transducer is extremely rugged and durable. The transducer's factor-of-safety can be as high as 4080%, depending on model and calibration.

High signal-to-noise ratio: Silicon gages provide a signal 75 times stronger than conventional foil gages. This signal is amplified resulting in near-zero noise distortion.

High-speed output: F/T systems are available with update rates as high as 28.5kHz. This speed exceeds requirements of most robotic and data collection applications.

Software Tool Transformations: Tool transformations can translate and rotate the F/T reference frame.

Versatile Outputs: PCI, Analog, USB, PCMCIA, Discrete I/O, Compact PCI, and more are available.

Temperature Compensation: Each F/T transducer features hardware temperature compensation to stabilize its sensitivity over temperature. This compensation method optimizes the transducer's accuracy over a range approximately $\pm 25^\circ$ C from room temperature.

"ATI's products and knowledgeable staff were instrumental in allowing us to rapidly prototype our latest surgical robotic platform. Because of their off-the-shelf solutions for miniature force and torque sensing, we were able to go from concept to working prototype in months instead of years."

Patrick Jensen, Ph.D.
Assistant Professor of Ophthalmology
Johns Hopkins University

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“When Lear Corporation partnered with KUKA Robotics to develop the OccubotVI seat testing system, we envisioned a robot that allowed for simultaneous load and position control. The critical component to achieving true load control was a sensor that could interface in real time with the robot kernel and receive commands directly while maintaining full robustness and accuracy necessary to duplicate exact human loading with sufficient repeatability. ATI Industrial Automation was the only choice, not just for the Theta transducer, which handily met all our demands, but primarily because of the excellent support from their technical and sales staff. Their partnership in the project was a key factor in its success.”

Terry O’Bannon,
 Sr. Engineer, Biomechanics and Robotics
 Lear Technologies, LLC

Quick-View Specification Table

Description	Nano17	Nano25	Nano43	Mini40	Mini45	Gamma
Max Fxy ±lb (±N)	12 (50)	50 (250)	8 (36)	20 (80)	120 (580)	30 (130)
Max Txy ±lbf-in (±N-m)	4 (0.5)	50 (6)	4 (0.5)	40 (4)	160 (20)	100 (10)
Weight* lb (kg)	0.02 (0.01)	0.14 (0.07)	.09 (0.04)	0.11 (0.05)	0.20 (0.09)	0.56 (0.25)
Diameter* in (mm)	0.67 (17)	0.99 (25)	1.69 (43)	1.57 (40)	1.77 (45)	2.97 (75.4)
Height* in (mm)	0.57 (14.5)	0.85 (21.6)	0.45 (11.5)	0.48 (12.3)	0.62 (15.7)	1.31 (33.3)

Description	Delta	Theta	Omega160	Omega190	Omega250	Omega331
Max Fxy ±lb (±N)	150 (660)	600 (2500)	600 (2500)	1600 (7200)	3600 (16000)	9000 (40000)
Max Txy ±in-lb (±N-m)	600 (60)	3600 (400)	3600 (400)	12000 (1400)	18000 (2000)	52000 (6000)
Weight* lb (kg)	2.0 (0.91)	11.0 (4.99)	6.0 (2.72)	14.0 (6.35)	66.0 (30.0)	104 (47.0)
Diameter* in (mm)	3.72 (94.5)	6.10 (155)	6.14 (156)	7.48 (190)	10.0 (254)	13.0 (330)
Height* in (mm)	1.31 (33.3)	2.41 (61.1)	2.20 (55.9)	2.20 (55.9)	3.74 (95.0)	4.29 (110.0)

*Specifications include standard interface plates.

Configurations

DAQ F/T Systems come in one of two configurations depending on the size of the transducer.

Internal Interface Board Configuration: Transducer with internal interface board electronics (Gamma and larger), transducer cable, power supply box, power supply cable, data acquisition board, and user computer.

External Interface Board Configuration: Transducer without electronics (Nano and Mini Series), interface power supply box, power supply cable, data acquisition board, and user computer.

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 an 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 gauge signals and convert them to readable DAQ card signals using noise immunity technology. Each interface board is calibrated to mate to a specific transducer. The interface board is mounted within the Gamma and larger transducer models and is located in the interface power supply box (IFPS) for the Nano and Mini transducer models. Since transducer output is uncalibrated, ATI software must be used to produce calibrated output.

Power Supply: The power supply converts readily available 5 volt (275mA) power from the PC through the DAQ card connection to regulated 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 is mated directly to the power supply.

Power Supply Cable: The power supply cable conducts 5 volt power to the power supply box or interface power supply box and transmits the transducer signals to the data acquisition card. The cable is 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 some cases, you can use an existing data acquisition system.

DAQ Multiple Transducer IFPS Box (optional): This multiple transducer version of our standard Interface Power Supply Box provides power for the transducers as well as grouping all of the transducer outputs on connectors that are easily connected to DAQ cards which can support multiple transducers. The box is a standard 19" rack-mount enclosure.

DAQ FT Dual Gain (optional): A transducer may have two calibrations which allows switching between higher-resolution calibration and a larger-range calibration. The larger-range calibration must be exactly twice the higher-resolution calibration. Switching calibrations is as easy as just loading the other calibration.

Note:

ATI DAQ systems perform best when used with the cabling and data acquisition hardware we supply. The demanding nature of precision analog signals makes it likely that other configurations will not perform optimally. The use of breakout boxes, unshielded cables and wires that are not twisted pair is discouraged as their use will result in increased noise.

DAQ Cards

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

Note:

The DAQ F/T outputs amplified, conditioned strain gauge signals to a data acquisition card—not the resolved force and 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.

ATI Supports the Following Bus-Types:

- PCI
- CPCI
- PCMCIA
- USB

Contact ATI regarding other bus-types. Most bus-types are available in 16-bit resolution.

Note:

Most laptop computers and PCMCIA peripherals do not have provisions for proper signal grounding. External grounding may be necessary to reduce some of the resulting additional noise.

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 include an ActiveX server, a C library and a .NET Assembly described below.

Software Component Features

The **.NET Assembly** ATICombinedDAQFT is a Windows .NET Assembly that performs the core operations of the DAQ F/T system, including:

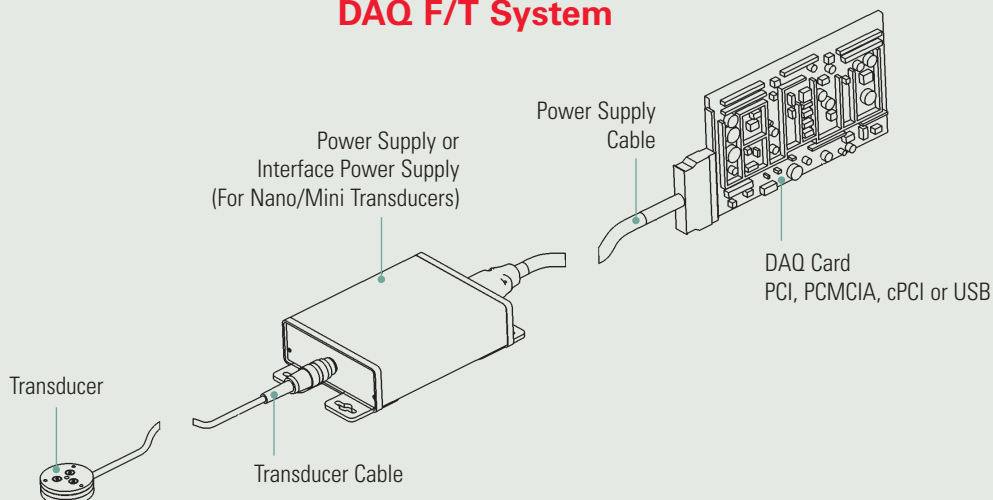
- loading calibration files.
- configuring the transducer system, including tool transformations.
- reading and converting transducer signals from NI-DAQmx-compatible DAQ systems into forces and torques.

ATICombinedDAQFT can be used in any development environment that supports .NET. For non-Windows operating systems, and DAQ cards not supported by NI-DAQmx, ATI provides a **C library** and **ActiveX Server** which perform system configuration, and calculate F/T values from voltages read from your DAQ system.

Application Program

The Windows DAQ F/T application program displays graphical and numerical force and torque output for Windows 2000 and later Windows™ operating systems. Visual Studio 2003 source code is provided as an aid in creating additional application programs. This program only works with NI-DAQmx-compatible boards.

DAQ F/T System



Net F/T

The Network Force/Torque (Net F/T) sensor system measures six components of force and torque (Fx, Fy, Fz, Tx, Ty, Tz) using a monolithic instrumented transducer. The Net F/T provides both DeviceNet™ and EtherNet/IP™ communication interfaces and is compatible with standard Ethernet.

Product Features

- Fully ODVA-compliant.
- Easy field-replaceable user configurations.
- Sealed to IP65 (water splash proof) or IP68 (under fresh water environments to a maximum depth of 10 meters).
- Powered by Power over Ethernet (PoE), DeviceNet or an external power supply.

Product Advantages

Multiple Interfaces: Ethernet, EtherNet/IP and DeviceNet, to support the widest possible range of automation and research applications.

LAN Connectivity: The Net F/T can be easily connected to your Local Area Network (LAN) allowing for easy remote operation and monitoring.

Web Server: The Net F/T has the ability to serve web pages, allowing the user to view and change system settings. An easily accessible Java™ demonstration application provides graphic depiction of loads.

High-speed output: Output rates up to 8000 Hz for 6 axes of measurement over Ethernet.

Simultaneous Operation: Both the Ethernet and DeviceNet ports can be used at the same time to allow monitoring and setup of DeviceNet configurations via Ethernet.

Built-in Status Indicators: LEDs inside an indicator window in the connector block alert the user to connection and load saturation status.

Portable User Settings: User settings, such as monitor conditions and tool transformations, are stored in a removable memory device, which allows the user to easily transfer settings from one sensor to another.



Overload protection: The F/T transducer is extremely rugged and durable. The transducer's factor of safety can be as high as 2000%, depending on model and calibration.

Software Tool Transformations: Tool transformations can translate and rotate the F/T point of origin.

Temperature Compensation: Each F/T transducer features hardware temperature compensation to stabilize its sensitivity over temperature. This compensation method optimizes the transducer's accuracy over a range approximately $\pm 25^{\circ}$ C from room temperature.

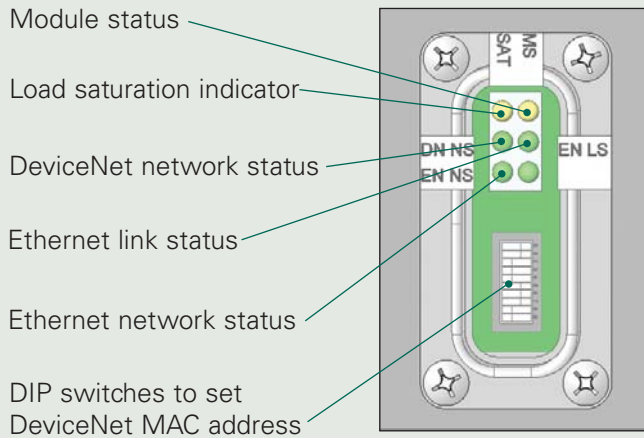
Internal Calibration Settings: All factory data used to generate calibrated sensor output resides in the sensor.

High signal-to-noise ratio: Silicon strain gages provide a signal 75 times stronger than conventional foil gages. This signal is amplified resulting in near-zero noise distortion.

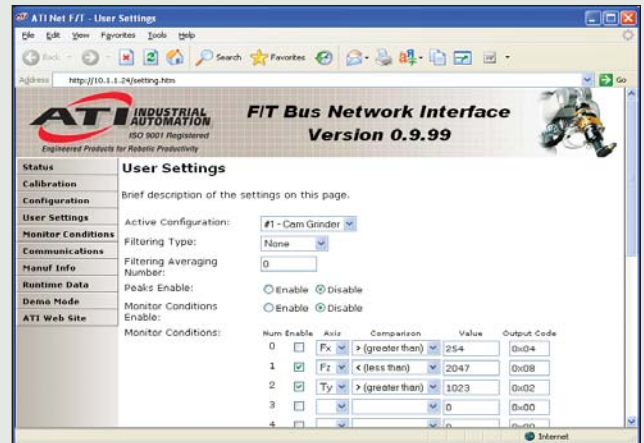
User Interface Overview

Conventional DeviceNet sensor setup and status monitoring can be done through the status LEDs and DIP switches or via an internet browser. Advanced functions and the demonstration application are also available via a browser.

Indicator Window Functions

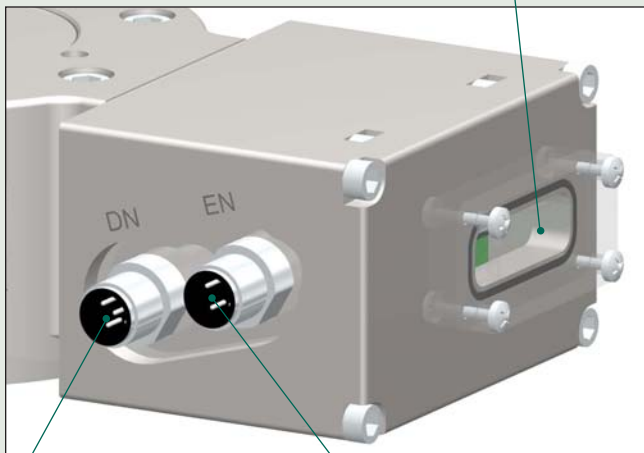


Easily-Accessible Configuration Settings



User I/O

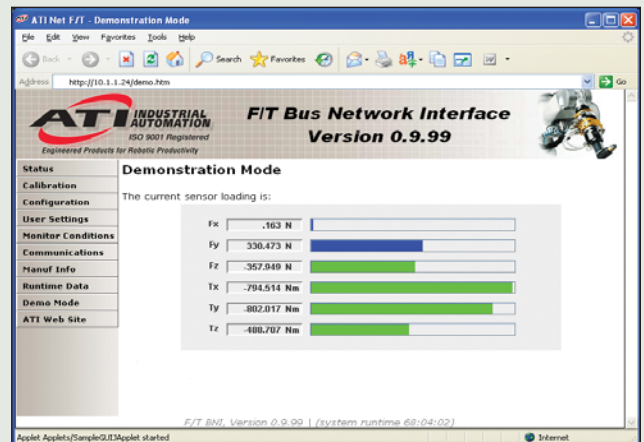
DIP switch and status indicator window



DeviceNet 5-pin 12 mm sealed Micro (Euro) connector

EtherNet/IP 4-pin 12 mm sealed Micro (Euro) connector (RJ45 adapter is included)

Self-Contained Demonstration Application



Note:

As of the date of the printing of this catalog, the Net F/T has not been released. Please contact ATI Industrial Automation for availability information.

CONTROLLER F/T SYSTEM

Configurations

The Controller F/T system comes in one of two configurations depending on the size of the transducer.

Internal Mux Board Configuration: Transducer with internal mux board electronics (Gamma and larger), transducer cable, and controller.

External Mux Board Configuration: Transducer without electronics (Nano and Mini), mux box, mux cable, and controller.

Components

Transducer: The transducer senses forces 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) while 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 attached to the transducer with a connector. This durable, long-life, flexible cable protects the transducer signals from electrical fields and can withstand 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.

Mux Cable: Systems with a mux box will also require a mux cable. The mux cable is a highly flexible long-life cable. This durable cable protects the transducer's signals from electrical fields and mechanical stress.

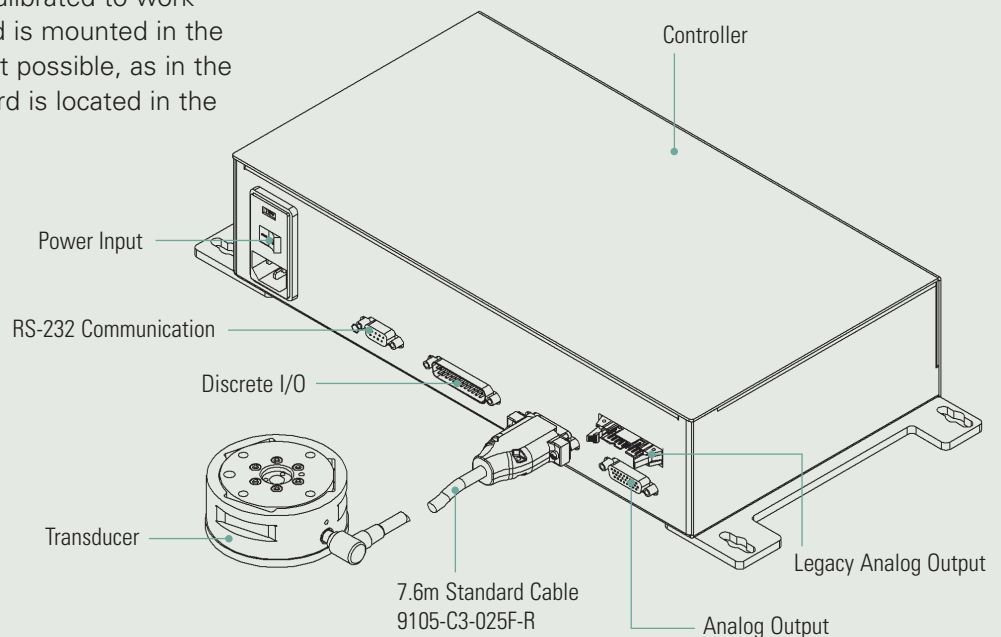
Controller: The controller interfaces with the transducer to process the transducer data into usable force and torque data and to provide high-level functions like tool-transformations and threshold detection. The controller is powered by standard AC power. This intelligent controller communicates over 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 to respond to user-programmed threshold conditions.

EuroCard Controller: This small card provides all the functions of our regular Controller in a small package, ideal for integration into systems where space is limited. All signals to and from the card are available on the industry standard 96-pin connector that uses a custom signal assignment. To use this card, it must be plugged into a mating connector that provides regulated DC voltages and connections to an ATI mux transducer.

Controller F/T System

Note:

A Mux box is added between the transducer and controller for Nano and Mini models.



How to Select an F/T 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.

4. Inspect other transducer specifications

Compare the detailed specifications of the chosen transducer to those of your application requirements to be certain the chosen transducer is appropriate for your application.

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 (T_{xy}) of this model is 110 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 forces many times its rated load.

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 collision sensor or breakaway device such as ATI's Collision Sensor as an added measure of F/T transducer protection in all robotic applications.

Options

While our standard systems provide all the necessary components for measuring force and torque, we also have available options which may aid in interfacing the F/T sensor system with special applications.

Interface Plates: All F/T transducers come with standard interface plates. Some models have threaded hole patterns machined into both sides that are used for attaching to the customer's equipment. Others have a threaded hole pattern on the tool side and a blank plate on the mounting side. The blank plate is machined by the customer to accommodate specific mounting requirements. For exact specifications for the various transducer models, refer to the product drawings in this catalog.

Custom Interface: ATI can help you design and fabricate interface plates needed for a nominal price. Please contact an ATI salesperson for additional information.

Dual-Calibration for Controller F/T System: With this option, one transducer can use two calibrations. For Controller Systems, a manually-operated switch allows the selection of either of two gain settings. Each gain setting is paired with unique calibration information that the user can load. This allows the use of one calibration for a low payload with high resolution, and the other calibration for a larger payload with a lower resolution.

Environmental Protection: Several models of transducers are available with IP60, IP65 and IP68 (10m) protection. An IP60 version is for use in dusty environments. The IP65 version of the transducer provides protection against water spray. The IP68 version is for underwater environments to a maximum depth of 10 meters in fresh water. Contact ATI Industrial Automation for drawings and more information.

HOW TO ORDER

9105-[Xducer]-[Cable]-□-□-□-□ →

Exit

CONTROLLER F/T - SENSOR SYSTEM

□: Line cord
A - Australia **D** - Denmark **I** - India
Y - Italy **N** - North America **U** - United Kingdom
T - Unterminated **E** - European

□: Controller
CTL 16 bit F/T controller
CON - F/T controller in compatibility mode
CTE - 16 bit F/T controller, Euro card version

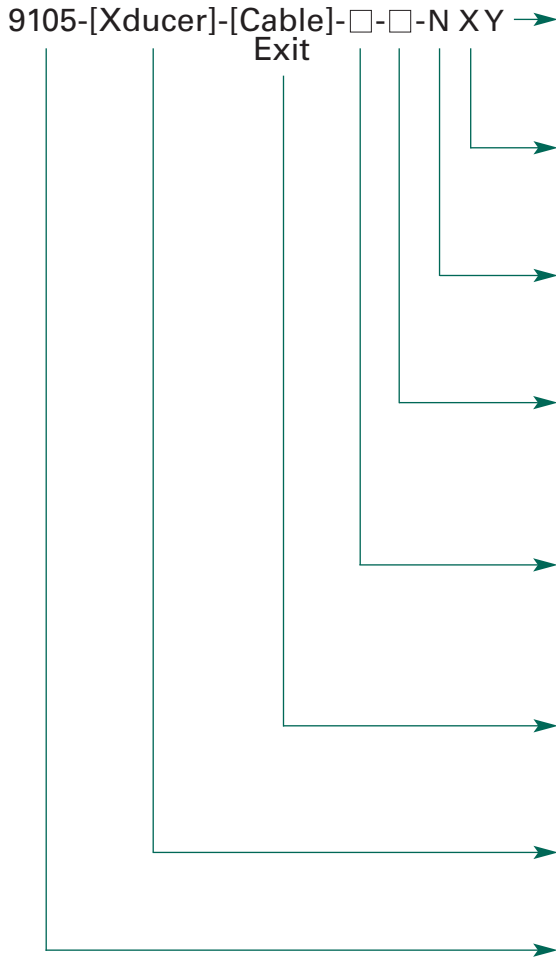
□: Mux cable length
 Standard length is **7.6m**
 If no mux box, enter **0**

□: Transducer cable length
 Large Sensors - Standard length is **7.6m**, right angle connector
 Nano/Mini Sensors - Standard length is **1.8m**

[Cable Exit]
R: Radial cable entrance available for all transducers
A: Axial cable entrance for Nano17, Nano25, Mini40 and Mini45 only

Nano17, Nano25, Nano43, Mini40, Mini45, Gamma, Delta, Theta, Omega160, Omega190, Omega250 or Omega331

Designates F/T series



DAQ F/T - SENSOR SYSTEM	
Y: DAQ Board Type PCI, CPCI, PCMCIA, PMC OR <input type="checkbox"/> USB □ = N (North America), U (United Kingdom), E (Europe) or J (Japan)	
X: Version 1 (16-bit ADC) 2 (12-bit ADC)	
NO : No DAQ Board N : National Instrument E-series M : National Instrument M-series	
<input type="checkbox"/> : Cable length from Power Supply or Interface-Power Supply box to the DAQ card Standard length is 2m M = M-series cable plus length	
<input type="checkbox"/> : Cable length from the transducer to Power Supply or Interface-Power Supply box. Large Sensors - Standard length is 10m Nano/Mini Sensors - Standard length is 1.8m	
[Cable Exit] R : Radial cable entrance available for all transducers A : Axial cable entrance for Nano17, Nano25, Mini40 and Mini45 only	
Nano17, Nano25, Nano43, Mini40, Mini45, Gamma, Delta, Theta, Omega160, Omega190, Omega250 or Omega331	
Designates F/T series	

Product Advantages

One of the Smallest 6-axis Sensors in the World:

The Nano17 fits into restricted spaces of research applications.

Extremely High Strength:

- EDM wire-cut from high yield-strength stainless steel.
- Maximum allowable single-axis overload values are 4.4 to 19.5 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.



The Nano17 F/T transducer

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

Typical Applications

- Dental research
- Robotic surgery
- Robotic hand research
- Finger-force research

ENGLISH CALIBRATIONS	SENSING RANGES		Calibrations											
	Axes		US-3-1		US-6-2		US-12-4							
	Fx, Fy (\pm lbf)		3		6		12							
	Fz (\pm lbf)		4.25		8.5		17							
	Tx, Ty (\pm lbf-in)		1		2		4							
	Tz (\pm lbf-in)		1		2		4							
	RESOLUTION		System Type*											
	Axes		CON		DAQ		CON		DAQ					
	Fx, Fy (lbf)		1/640		1/5120		1/320		1/2560		1/160		1/1280	
	Fz (lbf)		1/640		1/5120		1/320		1/2560		1/160		1/1280	
Tx, Ty (lbf-in)		1/4000		1/32000		1/2000		1/16000		1/1000		1/8000		
Tz (lbf-in)		1/4000		1/32000		1/2000		1/16000		1/1000		1/8000		

METRIC CALIBRATIONS	SENSING RANGES		Calibrations											
	Axes		SI-12-0.12		SI-25-0.25		SI-50-0.5							
	Fx, Fy (\pm N)		12		25		50							
	Fz (\pm N)		17		35		70							
	Tx, Ty (\pm Nmm)		120		250		500							
	Tz (\pm Nmm)		120		250		500							
	RESOLUTION		System Type*											
	Axes		CON		DAQ		CON		DAQ					
	Fx, Fy (N)		1/160		1/1280		1/80		1/640		1/40		1/320	
	Fz (N)		1/160		1/1280		1/80		1/640		1/40		1/320	
Tx, Ty (Nmm)		1/32		1/256		1/16		1/128		1/8		1/64		
Tz (Nmm)		1/32		1/256		1/16		1/128		1/8		1/64		

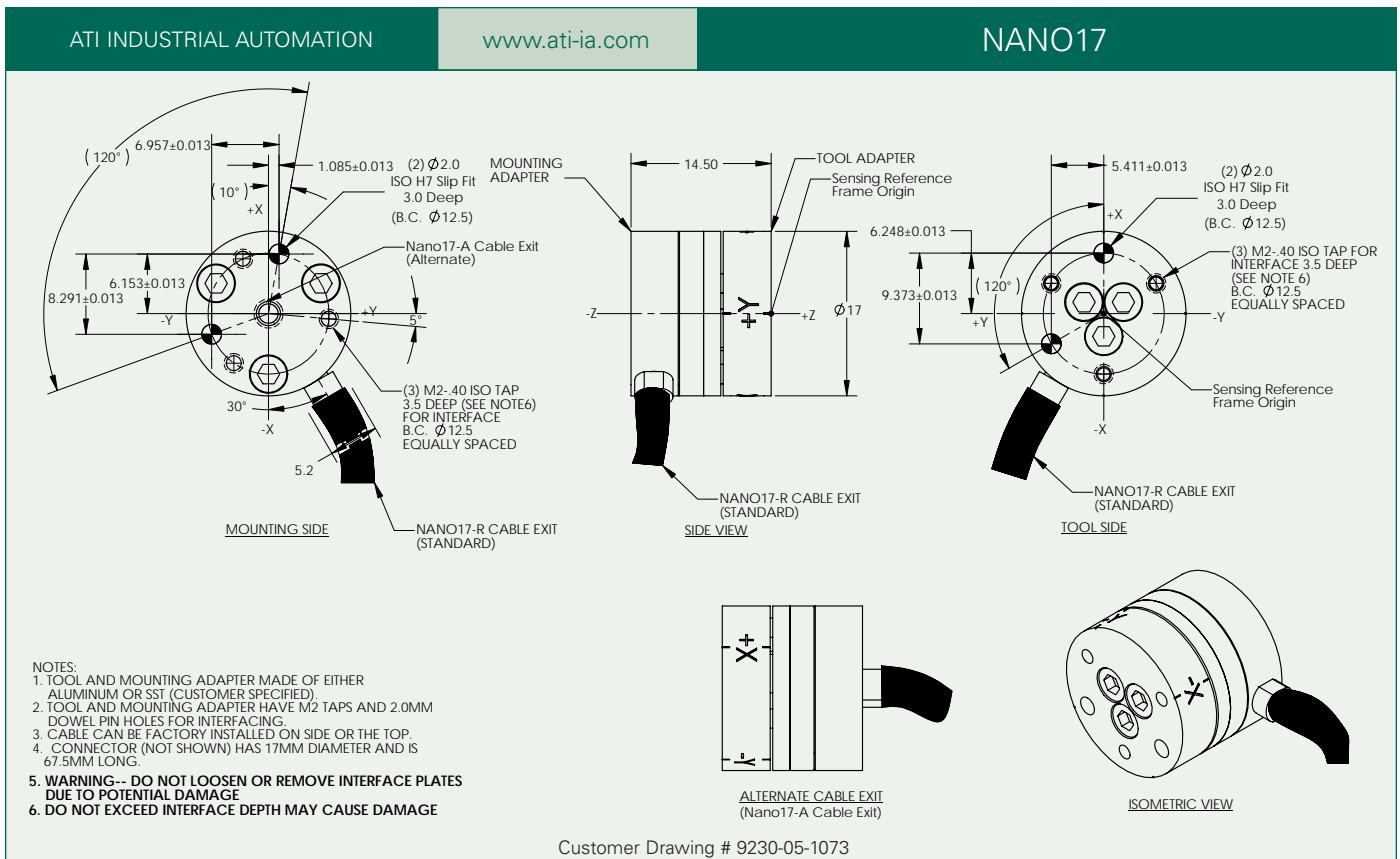
Contact ATI for complex loading information. Resolutions are typical. All Sensors calibrated by ATI. *CON: Controller F/T System, DAQ: 16-bit DAQ F/T System

Single-Axis Overload	English	Metric
Fxy	±79 lbf	±350 N
Fz	±156 lbf	±690 N
Txy	±20 lbf-in	±2.3 Nm
Tz	±26 lbf-in	±2.9 Nm
Stiffness (Calculated)	English	Metric
X-axis & Y-axis force (Kx, Ky)	47x10 ³ lb/in	8.2x10 ⁶ N/m
Z-axis force (Kz)	65x10 ³ lb/in	11x10 ⁶ N/m
X-axis & Y-axis torque (Ktx, Kty)	2.1x10 ³ lbf-in/rad	240 Nm/rad
Z-axis torque (Ktz)	3.4x10 ³ lbf-in/rad	380 Nm/rad
Resonant Frequency (Measured)		
Fx, Fy, Tz	7200 Hz	
Fz, Tx, Ty	7200 Hz	
Physical Specifications	English	Metric
Weight*	0.020 lb	9.1 g
Diameter*	0.669 in	17 mm
Height*	0.571 in	14.5 mm

*Specifications include standard interface plates.

"I used the Nano17 in a recent design application. The support I received from ATI for my special application was excellent. The documentation was well-written, the installation and set-up was easy and the sensor proved to be robust and highly accurate for my application."

Peter W. Johnson, PhD,
President
Ergonomic Research and Consulting, Inc.



Product Advantages

One of the Smallest 6-axis Sensors in the World: The Nano25 fits into restricted spaces of research applications.

Extremely High Strength:

- EDM wire-cut from high yield-strength stainless steel.
- Maximum allowable single-axis overload values are 7.5 to 15.1 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.

IP65 Version Available: The IP65 version of the transducer is available for use in wet environments. Contact ATI Industrial Automation for drawings and more information.

Typical Applications

- Telerobotics
- Robotic surgery
- Robotic hand research
- Finger-force research



The Nano25 F/T transducer

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

ENGLISH CALIBRATIONS	SENSING RANGES		Calibrations			
	Axes		US-25-25		US-50-50	
	Fx, Fy (\pm lbf)		25		50	
	Fz (\pm lbf)		100		200	
	Tx, Ty (\pm lbf-in)		25		50	
	Tz (\pm lbf-in)		25		30	
	RESOLUTION		System Type*			
	Axes		CON		DAQ	
	Fx, Fy (lbf)		1/112		1/896	
	Fz (lbf)		3/112		3/896	
Tx, Ty (lbf-in)		1/80		1/640		
Tz (lbf-in)		1/160		1/1280		

METRIC CALIBRATIONS	SENSING RANGES		Calibrations			
	Axes		SI-125-3		SI-250-6	
	Fx, Fy (\pm N)		125		250	
	Fz (\pm N)		500		1000	
	Tx, Ty (\pm Nm)		3		6	
	Tz (\pm Nm)		3		3.4	
	RESOLUTION		System Type*			
	Axes		CON		DAQ	
	Fx, Fy (N)		1/24		1/192	
	Fz (N)		1/8		1/64	
Tx, Ty (Nm)		1/660		1/5280		
Tz (Nm)		1/1320		1/10560		

Contact ATI for complex loading information. Resolutions are typical. All Sensors calibrated by ATI.
 *CON: Controller F/T System, DAQ: 16-bit DAQ F/T System

Single-Axis Overload	English	Metric
F _{xy}	±524 lbf	±2300 N
F _z	±1643 lbf	±7300 N
T _{xy}	±378 lbf-in	±43 Nm
T _z	±556 lbf-in	±63 Nm
Stiffness (Calculated)	English	Metric
X-axis & Y-axis force (K _x , K _y)	300x10 ³ lb/in	53x10 ⁶ N/m
Z-axis force (K _z)	630x10 ³ lb/in	110x10 ⁶ N/m
X-axis & Y-axis torque (K _{tx} , K _{ty})	57x10 ³ lbf-in/rad	6.5x10 ³ Nm/rad
Z-axis torque (K _{tz})	81x10 ³ lbf-in/rad	9.2x10 ³ Nm/rad
Resonant Frequency (Non-IP rates, Measured)		
F _x , F _y , T _z	3600 Hz	
F _z , T _x , T _y	3800 Hz	
Physical Specifications	English	Metric
Weight*	0.14 lb	63 g
Diameter*	0.984 in	25 mm
Height*	0.85 in	21.6 mm

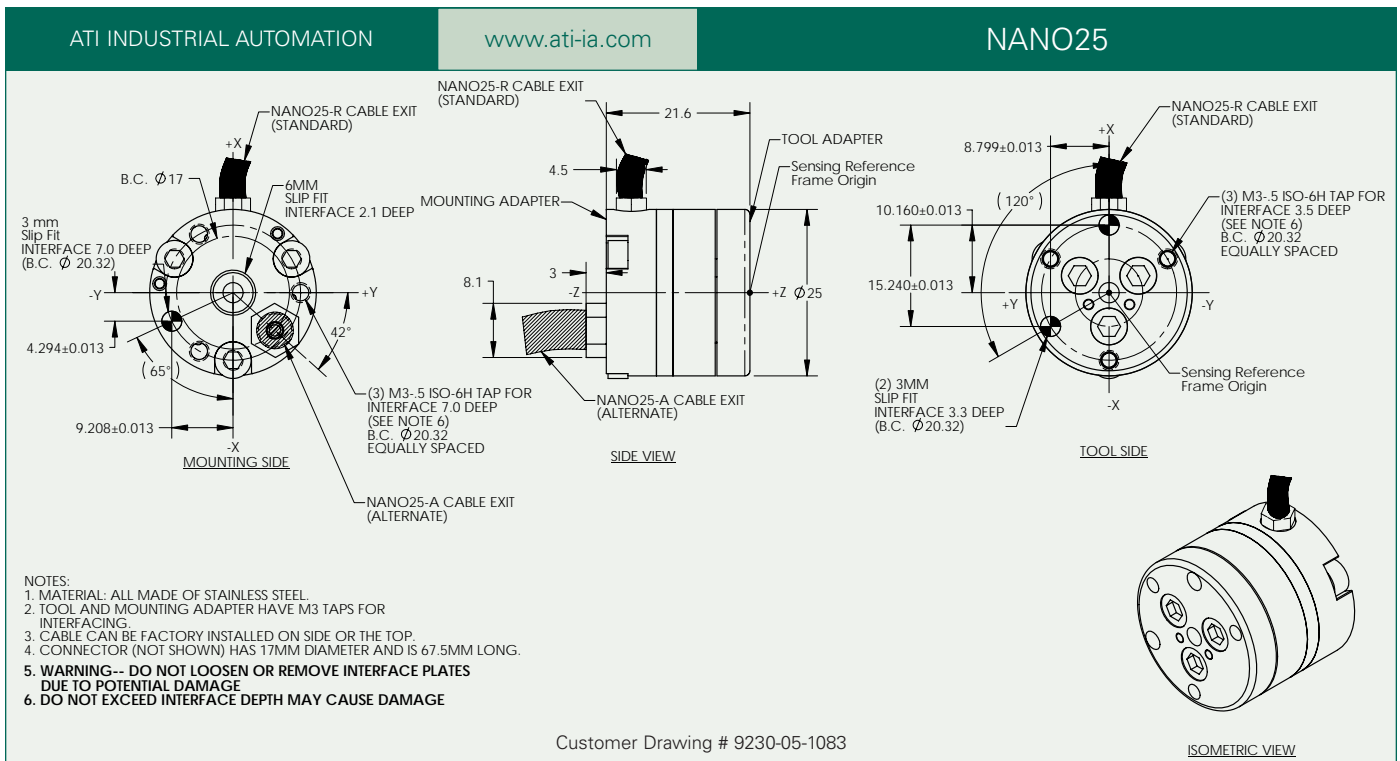
*Specifications include standard interface plates and are for non-IP rated models.

“The forcetorque systems from ATI are ideal in our study of human grip force coordination and production. They are as close to a turn-key system as we have found.”

Professor Jay L. Alberts
Dept. of Exercise Science
and Physical Education
Arizona State University

Note:

Applying moments beyond ±30 lbf-in (±3.4 Nm) in T_z can cause hysteresis and permanent zero-point change in the Nano25.



Product Advantages

One of the Smallest 6-axis Sensors in the World: The Nano43 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 6.6 to 14.7 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



The Nano43 F/T transducer

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

ENGLISH CALIBRATIONS	SENSING RANGES		Calibrations			
	Axes		US-4-2		US-8-4	
	Fx, Fy (\pm lbf)		4		8	
	Fz (\pm lbf)		4		8	
	Tx, Ty (\pm lbf-in)		2		4	
	Tz (\pm lbf-in)		2		4	
	RESOLUTION		System Type*			
	Axes		CON	DAQ	CON	DAQ
	Fx, Fy (lbf)		1/580	1/4640	1/290	1/2320
	Fz (lbf)		1/580	1/4640	1/290	1/2320
Tx, Ty (lbf-in)		1/1160	1/9280	1/580	1/4640	
Tz (lbf-in)		1/1160	1/9280	1/580	1/4640	

METRIC CALIBRATIONS	SENSING RANGES		Calibrations			
	Axes		SI-18-0.25		SI-36-0.5	
	Fx, Fy (\pm N)		18		36	
	Fz (\pm N)		18		36	
	Tx, Ty (\pm Nmm)		250		500	
	Tz (\pm Nmm)		250		500	
	RESOLUTION		System Type*			
	Axes		CON	DAQ	CON	DAQ
	Fx, Fy (N)		1/128	1/1024	1/64	1/512
	Fz (N)		1/128	1/1024	1/64	1/512
Tx, Ty (Nmm)		1/10	1/80	1/5	1/40	
Tz (Nmm)		1/10	1/80	1/5	1/40	

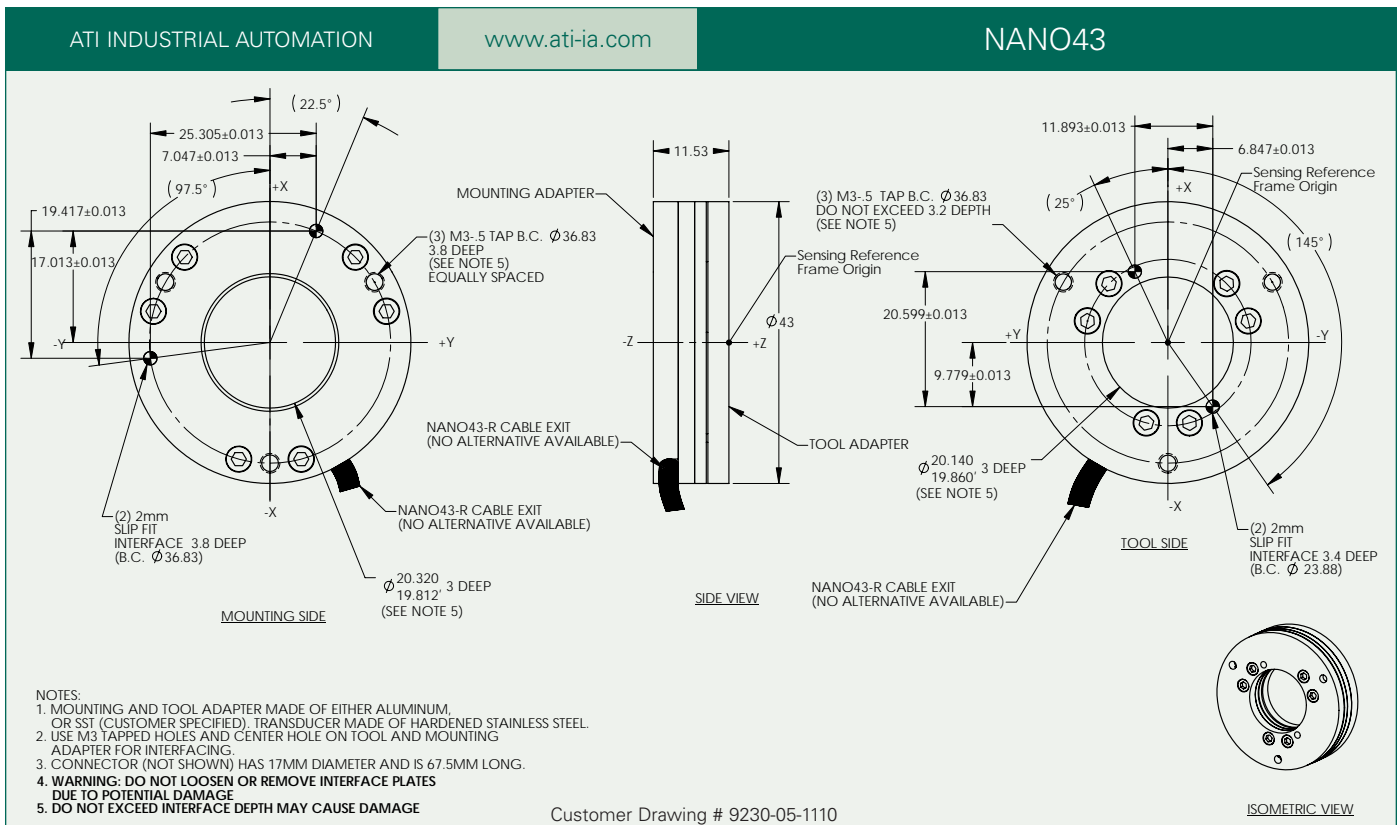
Contact ATI for complex loading information. Resolutions are typical. All Sensors calibrated by ATI.
 *CON: Controller F/T System, DAQ: 16-bit DAQ F/T System

Single-Axis Overload	English	Metric
F _{xy}	±68 lbf	±300 N
F _z	±89 lbf	±400 N
T _{xy}	±30 lbf-in	±3.4 Nm
T _z	±47 lbf-in	±5.3 Nm
Stiffness (Calculated)	English	Metric
X-axis & Y-axis force (K _x , K _y)	29x10 ³ lb/in	5.2x10 ⁶ N/m
Z-axis force (K _z)	29x10 ³ lb/in	5.2x10 ⁶ N/m
X-axis & Y-axis torque (K _{tx} , K _{ty})	6.8x10 ³ lbf-in/rad	770 Nm/rad
Z-axis torque (K _{tz})	10x10 ³ lbf-in/rad	1.1x10 ³ Nm/rad
Physical Specifications	English	Metric
Weight*	0.085 lb	39 g
Diameter (OD/ID)*	1.69 in/0.78 in	43 mm/19.9 mm
Height*	0.454 in	11.5 mm

*Specifications include standard interface plates.

“For high-resolution miniature 6 DOF force sensors, we’ve found ATI’s products to be the best commercially available.”

Peter Berkelman, PhD
Center for Computer-Integrated
Surgical Systems and Technology
Johns Hopkins University



Product Advantages

One of the Smallest 6-axis Sensors in the World:

The Mini40 has a compact, low-profile design.

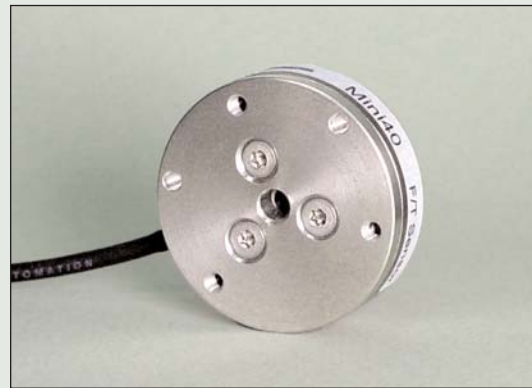
Extremely High Strength:

- EDM wire-cut from high yield-strength stainless steel.
- Maximum allowable single-axis overload values are 4.2 to 18.9 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



The Mini40 F/T transducer

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

ENGLISH CALIBRATIONS	SENSING RANGES		Calibrations					
	Axes		US-5-10		US-10-20		US-20-40	
	Fx, Fy (\pm lbf)		5		10		20	
	Fz (\pm lbf)		15		30		60	
	Tx, Ty (\pm lbf-in)		10		20		40	
	Tz (\pm lbf-in)		10		20		40	
	RESOLUTION		System Type*					
	Axes		CON	DAQ	CON	DAQ	CON	DAQ
	Fx, Fy (lbf)		1/400	1/3200	1/200	1/1600	1/100	1/800
	Fz (lbf)		1/200	1/1600	1/100	1/800	1/50	1/400
Tx, Ty (lbf-in)		1/400	1/3200	1/200	1/1600	1/100	1/800	
Tz (lbf-in)		1/400	1/3200	1/200	1/1600	1/100	1/800	

METRIC CALIBRATIONS	SENSING RANGES		Calibrations					
	Axes		SI-20-1		SI-40-2		SI-80-4	
	Fx, Fy (\pm N)		20		40		80	
	Fz (\pm N)		60		120		240	
	Tx, Ty (\pm Nm)		1		2		4	
	Tz (\pm Nm)		1		2		4	
	RESOLUTION		System Type*					
	Axes		CON	DAQ	CON	DAQ	CON	DAQ
	Fx, Fy (N)		1/100	1/800	1/50	1/400	1/25	1/200
	Fz (N)		1/50	1/400	1/25	1/200	2/25	1/100
Tx, Ty (Nm)		1/4000	1/32000	1/2000	1/16000	1/1000	1/8000	
Tz (Nm)		1/4000	1/32000	1/2000	1/16000	1/1000	1/8000	

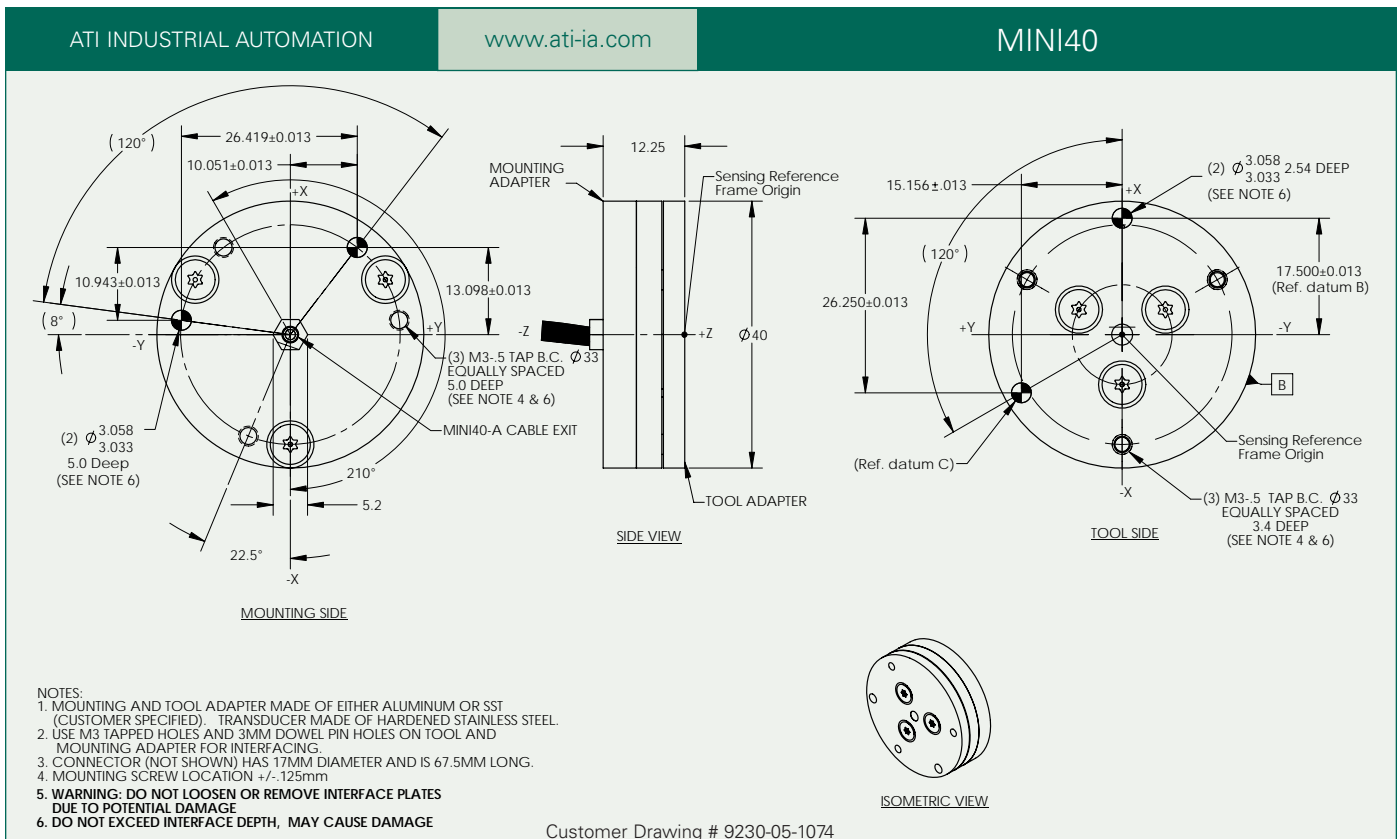
Contact ATI for complex loading information. Resolutions are typical. All Sensors calibrated by ATI. *CON: Controller F/T System, DAQ: 16-bit DAQ F/T System

Single-Axis Overload	English	Metric
F _{xy}	±183 lbf	±810 N
F _z	±532 lbf	±2400 N
T _{xy}	±168 lbf-in	±19 Nm
T _z	±176 lbf-in	±20 Nm
Stiffness (Calculated)	English	Metric
X-axis & Y-axis force (K _x , K _y)	61x10 ³ lb/in	11x10 ⁶ N/m
Z-axis force (K _z)	120x10 ³ lb/in	20x10 ⁶ N/m
X-axis & Y-axis torque (K _{tx} , K _{ty})	25x10 ³ lbf-in/rad	2.8x10 ³ Nm/rad
Z-axis torque (K _{tz})	36x10 ³ lbf-in/rad	4.0x10 ³ Nm/rad
Resonant Frequency (Measured)		
F _x , F _y , T _z	3200 Hz	
F _z , T _x , T _y	4900 Hz	
Physical Specifications	English	Metric
Weight*	0.11 lb	50 g
Diameter*	1.57 in	40 mm
Height*	0.482 in	12.2 mm

*Specifications include standard interface plates.

“ATI’s force transducers have given us high accuracy and easy to use tools that integrate perfectly with our research needs.”

Dr. Douglas Weeks
Dept. of Physical Therapy
Regis University



Product Advantages

One of the Smallest 6-axis Sensors in the World:

The Mini45 has a compact, low-profile design with a through-hole to allow passage of linkages or cables.

Extremely High Strength:

- EDM wire-cut from high yield-strength stainless steel.
- Maximum allowable single-axis overload values are 5.7 to 25.3 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



The Mini45 F/T transducer

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

ENGLISH CALIBRATIONS	SENSING RANGES		Calibrations					
	Axes		US-30-40		US-60-80		US-120-160	
	Fx, Fy (\pm lbf)		30		60		120	
	Fz (\pm lbf)		60		120		240	
	Tx, Ty (\pm lbf-in)		40		80		160	
	Tz (\pm lbf-in)		40		80		160	
	RESOLUTION		System Type*					
	Axes		CON	DAQ	CON	DAQ	CON	DAQ
	Fx, Fy (lbf)		1/40	1/320	1/20	1/160	1/20	1/160
	Fz (lbf)		1/40	1/320	1/20	1/160	1/10	1/80
Tx, Ty (lbf-in)		1/44	1/352	1/44	1/352	1/22	1/176	
Tz (lbf-in)		1/88	1/704	1/44	1/352	1/22	1/176	

METRIC CALIBRATIONS	SENSING RANGES		Calibrations					
	Axes		SI-145-5		SI-290-10		SI-580-20	
	Fx, Fy (\pm N)		145		290		580	
	Fz (\pm N)		290		580		1160	
	Tx, Ty (\pm Nm)		5		10		20	
	Tz (\pm Nm)		5		10		20	
	RESOLUTION		System Type*					
	Axes		CON	DAQ	CON	DAQ	CON	DAQ
	Fx, Fy (N)		1/8	1/64	1/4	1/32	1/2	1/16
	Fz (N)		1/8	1/64	1/4	1/32	1/2	1/16
Tx, Ty (Nm)		1/376	1/3008	1/188	1/1504	1/94	1/752	
Tz (Nm)		1/752	1/6016	1/376	1/3008	1/188	1/1504	

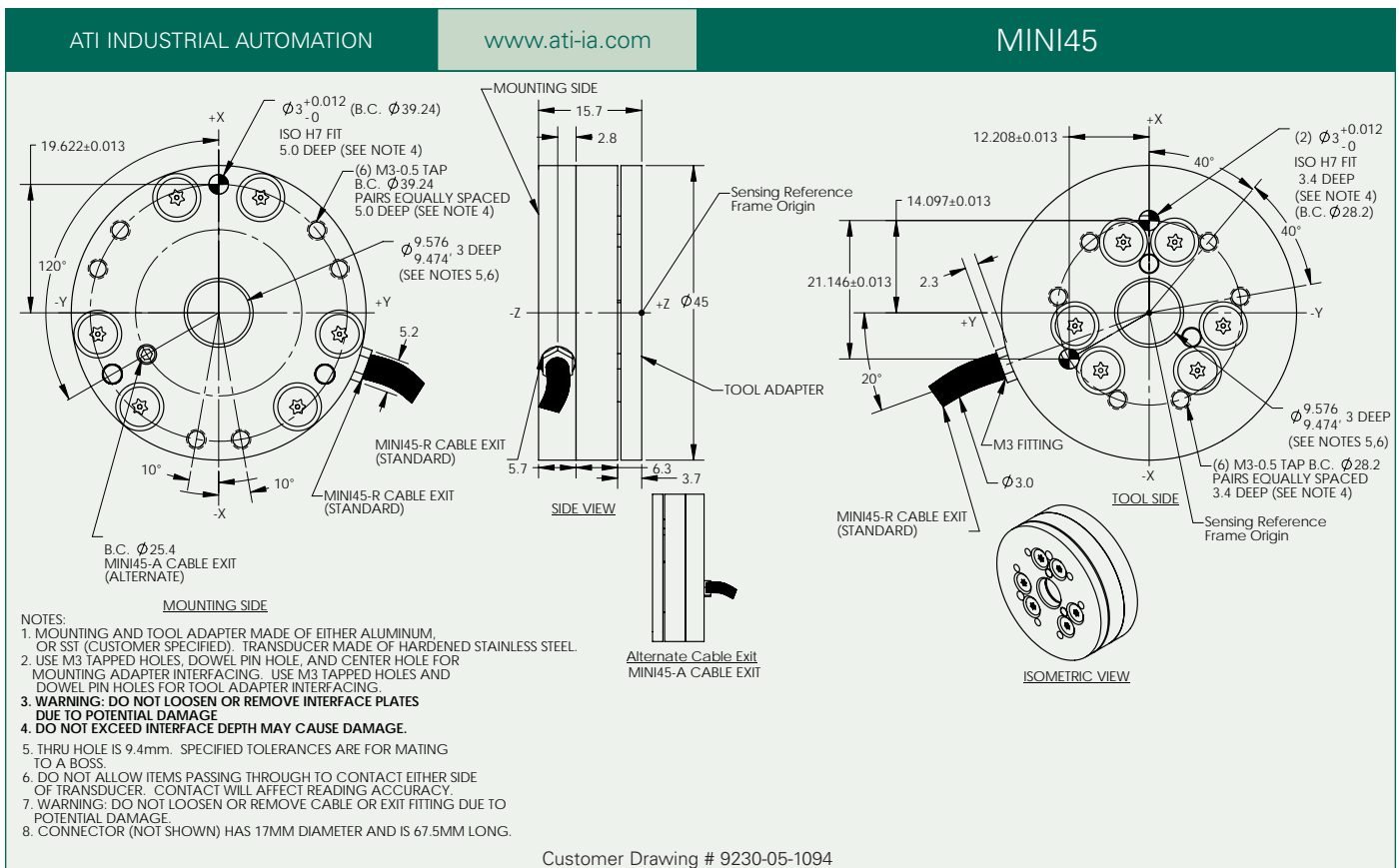
Contact ATI for complex loading information. Resolutions are typical. All Sensors calibrated by ATI. *CON: Controller F/T System, DAQ: 16-bit DAQ F/T System

Single-Axis Overload	English	Metric
Fxy	±1147 lbf	±5100 N
Fz	±2312 lbf	±10000 N
Txy	±1014 lbf-in	±110 Nm
Tz	±1227 lbf-in	±140 Nm
Stiffness (Calculated)	English	Metric
X-axis & Y-axis force (Kx, Ky)	420x10 ³ lb/in	74x10 ⁶ N/m
Z-axis force (Kz)	560x10 ³ lb/in	98x10 ⁶ N/m
X-axis & Y-axis torque (Ktx, Kty)	150x10 ³ lbf-in/rad	17x10 ³ Nm/rad
Z-axis torque (Ktz)	310x10 ³ lbf-in/rad	35x10 ³ Nm/rad
Physical Specifications	English	Metric
Weight*	0.20 lb	92 g
Diameter (OD/ID)*	1.77 in/0.373 in	45 mm/9.5 mm
Height*	0.62 in	15.7 mm

*Specifications include standard interface plates.

“ATI’s sales support has been invaluable in helping us select the appropriate sensor and explaining detailed technical issues. I am extremely pleased with the ATI sensor we have chosen. It has enabled us to measure forces exerted by a physician, during a medical procedure, which have never been measured before.”

Nathan Delson, PhD
 Director, Mechanical Engineering
 Design Center
 University of California, San Diego
 Department of Mechanical
 and Aerospace Engineering



Product Advantages

Extremely High Strength:

- Precision machined from high-strength aircraft aluminum.
- Maximum allowable single-axis overload values are 6.1 to 27.9 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

- Real-time force control
- Haptics feedback
- Prosthetic device testing
- Robotic assembly
- Automotive part testing



The Gamma F/T Mux transducer

The transducer and the standard mounting adapter are made of high-strength aircraft aluminum.

	SENSING RANGES		Calibrations					
	Axes		US-7.5-25		US-15-50		US-30-100	
ENGLISH CALIBRATIONS	Fx, Fy (\pm lbf)		75		15		30	
	Fz (\pm lbf)		25		50		100	
	Tx, Ty (\pm lbf-in)		25		50		100	
	Tz (\pm lbf-in)		25		50		100	
	RESOLUTION		System Type*					
	Axes		CON	DAQ	CON	DAQ	CON	DAQ
	Fx, Fy (lbf)		1/320	1/2560	1/160	1/1280	1/80	1/640
	Fz (lbf)		1/160	1/1280	1/80	1/640	1/40	1/320
	Tx, Ty (lbf-in)		1/160	1/1280	1/80	1/640	1/40	1/320
	Tz (lbf-in)		1/160	1/1280	1/80	1/640	1/40	1/320

	SENSING RANGES		Calibrations					
	Axes		SI-32-2.5		SI-65-5		SI-130-10	
METRIC CALIBRATIONS	Fx, Fy (\pm N)		32		65		130	
	Fz (\pm N)		100		200		400	
	Tx, Ty (\pm Nm)		2.5		5		10	
	Tz (\pm Nm)		2.5		5		10	
	RESOLUTION		System Type*					
	Axes		CON	DAQ	CON	DAQ	CON	DAQ
	Fx, Fy (N)		1/80	1/640	1/40	1/320	1/20	1/160
	Fz (N)		1/40	1/320	1/20	1/160	1/10	1/80
	Tx, Ty (Nm)		1/1000	1/8000	1/667	3/16000	1/400	1/3200
	Tz (Nm)		1/1000	1/8000	1/667	3/16000	1/400	1/3200

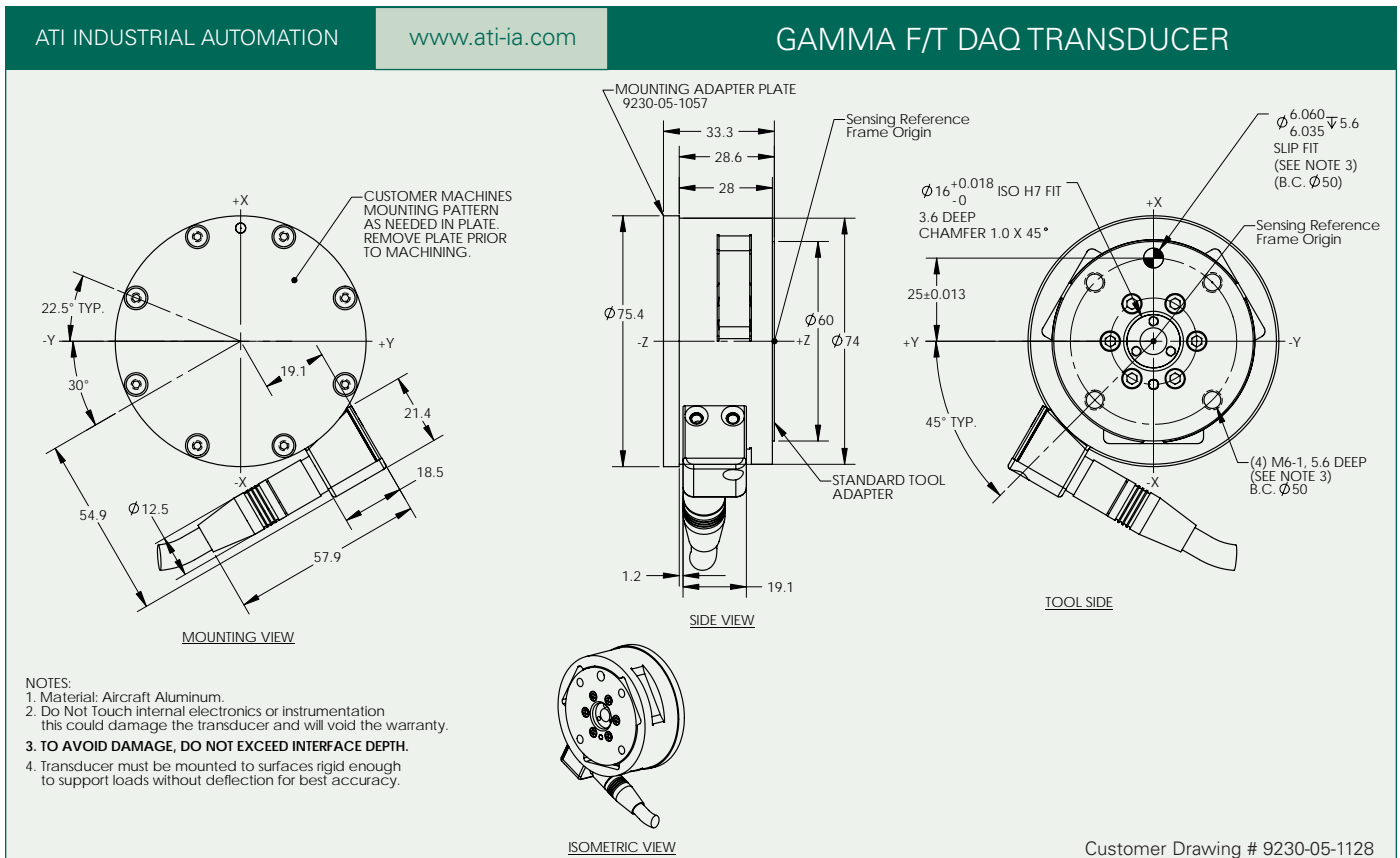
Contact ATI for complex loading information. Resolutions are typical. All Sensors calibrated by ATI. *CON: Controller F/T System, DAQ: 16-bit DAQ F/T System

Single-Axis Overload	English	Metric
F _{xy}	±235 lbf	±1000 N
F _z	±736 lbf	±3300 N
T _{xy}	±618 lbf-in	±70 Nm
T _z	±727 lbf-in	±82 Nm
Stiffness (Calculated)	English	Metric
X-axis & Y-axis force (K _x , K _y)	51x10 ³ lb/in	8.9x10 ⁶ N/m
Z-axis force (K _z)	92x10 ³ lb/in	16x10 ⁶ N/m
X-axis & Y-axis torque (K _{tx} , K _{ty})	86x10 ³ lbf-in/rad	9.7x10 ³ Nm/rad
Z-axis torque (K _{tz})	140x10 ³ lbf-in/rad	16x10 ³ Nm/rad
Resonant Frequency (Measured)		
F _x , F _y , T _z	1400 Hz	
F _z , T _x , T _y	2000 Hz	
Physical Specifications	English	Metric
Weight*	0.56 lb	250 g
Diameter*	2.97 in	75.4 mm
Height*	1.31 in	33.3 mm

*Specifications include standard interface plates. Diameter excludes any connector block.

"I highly recommend ATI's force/torque transducers to anyone who needs a reliable, pre-calibrated, easily programmable transducer. It is a truly versatile plug-and-play system."

Prof. Francisco Valera-Cuevas
Neuromuscular Biomechanics Laboratory
Cornell University



Product Advantages

Extremely High Strength:

- Precision machined from high-strength aircraft aluminum.
- Overload pin stops make this an especially rugged transducer.
- Maximum allowable single-axis overload values are 1.6 to 7.1 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.

IP60, IP65 and IP68 (10m) Versions Available: An IP60 version is for use in dusty environments. The IP65 version of the transducer provides protection against water spray. The IP68 version is for underwater environments to a maximum depth of 10 meters in fresh water. Contact ATI Industrial Automation for drawings and more information.



The Delta F/T transducer

The transducer is made of hardened stainless steel, and the standard mounting adapter is made of high-strength aircraft aluminum.

Typical Applications

- Real-time force control
- Robotic assembly
- Haptics feedback
- Rehabilitation research

SENSING RANGES		Calibrations								
Axes		US-50-150		US-75-300		US-150-600				
ENGLISH CALIBRATIONS	Fx, Fy (\pm lbf)	50		75		150				
	Fz (\pm lbf)	150		225		450				
	Tx, Ty (\pm lbf-in)	150		300		600				
	Tz (\pm lbf-in)	150		300		600				
	RESOLUTION		System Type*							
	Axes		CON		DAQ		CON		DAQ	
	Fx, Fy (lbf)	1/64	1/512	1/32	1/256	1/16	1/128			
	Fz (lbf)	1/32	1/256	1/16	1/128	1/8	1/64			
	Tx, Ty (lbf-in)	3/64	3/512	3/32	3/256	3/16	3/128			
	Tz (lbf-in)	1/32	1/256	1/16	1/128	1/8	1/64			

SENSING RANGES		Calibrations								
Axes		SI-165-15		SI-330-30		SI-660-60				
METRIC CALIBRATIONS	Fx, Fy (\pm N)	165		330		660				
	Fz (\pm N)	495		990		1980				
	Tx, Ty (\pm Nm)	15		30		60				
	Tz (\pm Nm)	15		30		60				
	RESOLUTION		System Type*							
	Axes		CON		DAQ		CON		DAQ	
	Fx, Fy (N)	1/16	1/128	1/8	1/64	1/4	1/32			
	Fz (N)	1/8	1/64	1/4	1/32	1/2	1/16			
	Tx, Ty (Nm)	1/264	1/2112	3/400	3/3200	3/200	3/1600			
	Tz (Nm)	1/264	1/2112	3/400	3/3200	3/200	3/1600			

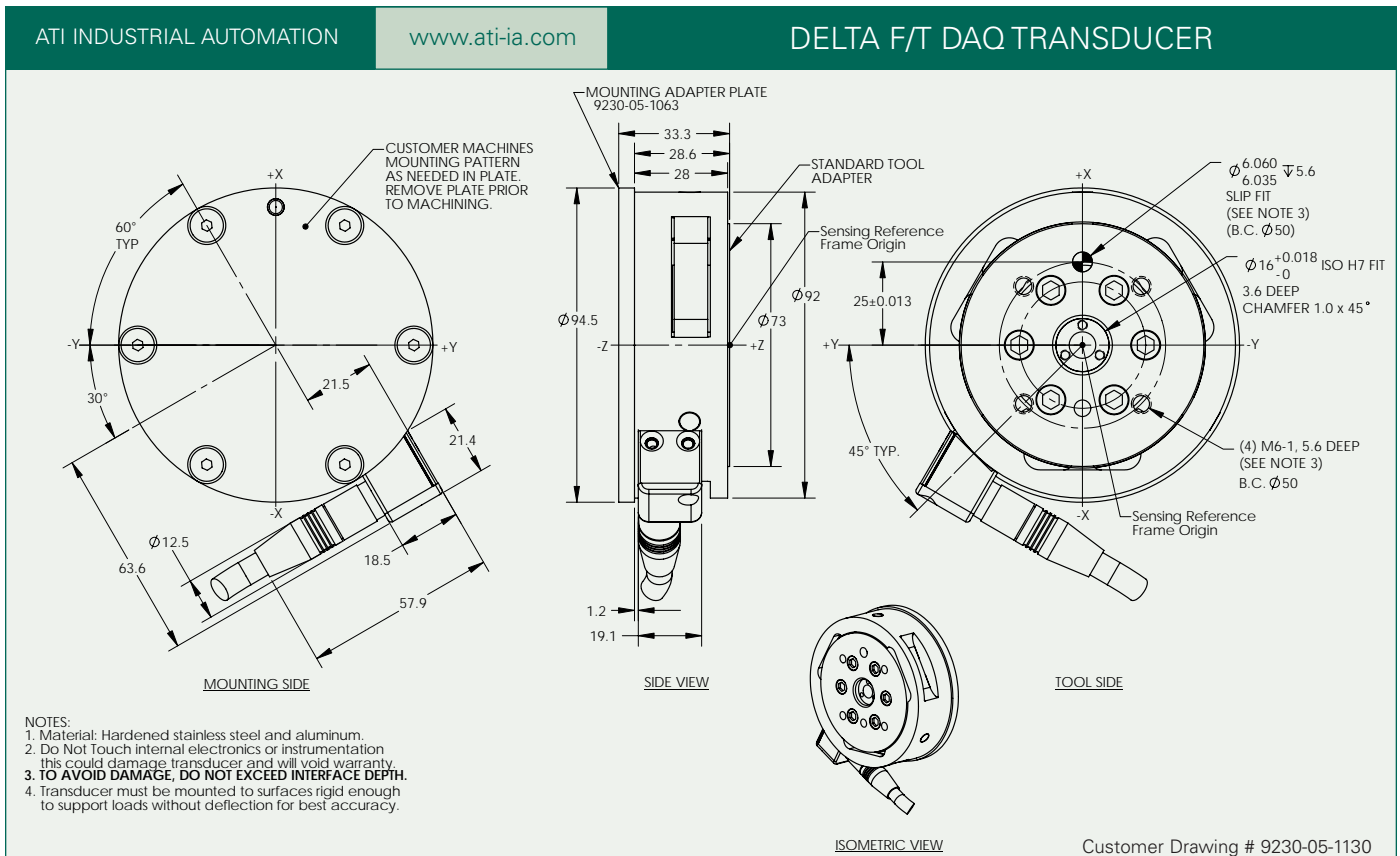
Contact ATI for complex loading information. Resolutions are typical. All Sensors calibrated by ATI. *CON: Controller F/T System, DAQ: 16-bit DAQ F/T System

Single-Axis Overload	English	Metric
Fxy	±299 lbf	±1300 N
Fz	±1410 lbf	±6300 N
Txy	±956 lbf-in	±110 Nm
Tz	±3934 lbf-in	±440 Nm
Stiffness (Calculated)	English	Metric
X-axis & Y-axis force (Kx, Ky)	180x10 ³ lb/in	32x10 ⁶ N/m
Z-axis force (Kz)	220x10 ³ lb/in	39x10 ⁶ N/m
X-axis & Y-axis torque (Ktx, Kty)	330x10 ³ lbf-in/rad	38x10 ³ Nm/rad
Z-axis torque (Ktz)	760x10 ³ lbf-in/rad	86x10 ³ Nm/rad
Resonant Frequency (Non-IP rated, Measured)		
Fx, Fy, Tz	1500 Hz	
Fz, Tx, Ty	1700 Hz	
Physical Specifications	English	Metric
Weight*	2.0 lb	910 g
Diameter*	3.72 in	94.5 mm
Height*	1.31 in	33.3 mm

“I use the ATI Delta force transducers to measure multi-axial forces and moments applied by the foot during pedaling of an experimental bicycle ergometer. These transducers are a simple, accurate, and cost-effective measurement tool and they enable me to collect data on movement behavior in healthy individuals and persons with post-stroke hemiparesis.”

David A. Brown, PT, PhD
Physical Therapist Scientist

*Specifications include standard interface plates and are for non-IP rated models.
Diameter excludes any connector block.



Product Advantages

Extremely High Strength:

- Precision machined from high-strength stainless steel.
- Overload pin stops make this an especially rugged transducer.
- Maximum allowable single-axis overload values are 5.1 to 18.7 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.

IP60, IP65 and IP68 (10m) Versions Available: An IP60 version is for use in dusty environments. The IP65 version of the transducer provides protection against water spray. The IP68 version is for underwater environments to a maximum depth of 10 meters in fresh water. Contact ATI Industrial Automation for drawings and more information.



The Theta F/T transducer

The transducer is made of hardened stainless steel, and the standard mounting adapter is made of high-strength stainless steel.

Typical Applications

- Rehabilitation research
- Product testing
- Orthopedic research
- Robotic assembly
- Telerobotics
- Part placement and removal in precision fixtures

ENGLISH CALIBRATIONS	SENSING RANGES		Calibrations					
	Axes		US-200-1000		US-300-1800		US-600-3600	
	Fx, Fy (\pm lbf)		200		300		600	
	Fz (\pm lbf)		500		875		1500	
	Tx, Ty (\pm lbf-in)		1000		1800		3600	
	Tz (\pm lbf-in)		1000		1800		3600	
	RESOLUTION		System Type*					
	Axes		CON	DAQ	CON	DAQ	CON	DAQ
	Fx, Fy (lbf)		1/16	1/128	5/34	5/272	1/4	1/32
	Fz (lbf)		1/8	1/64	5/17	5/136	1/2	1/16
Tx, Ty (lbf-in)		1/4	1/32	5/8	5/64	1	1/8	
Tz (lbf-in)		1/4	1/32	5/8	5/64	1	1/8	

METRIC CALIBRATIONS	SENSING RANGES		Calibrations					
	Axes		SI-1000-120		SI-1500-240		SI-2500-400	
	Fx, Fy (\pm N)		1000		1500		2500	
	Fz (\pm N)		2500		3750		6250	
	Tx, Ty (\pm Nm)		120		240		400	
	Tz (\pm Nm)		120		240		400	
	RESOLUTION		System Type*					
	Axes		CON	DAQ	CON	DAQ	CON	DAQ
	Fx, Fy (N)		1/2	1/16	1/2	1/16	1	1/8
	Fz (N)		1/2	1/16	1	1/8	1 1/2	3/16
Tx, Ty (Nm)		1/40	1/320	1/20	1/160	1/10	1/80	
Tz (Nm)		1/40	1/320	1/20	1/160	1/10	1/80	

Contact ATI for complex loading information. Resolutions are typical. All Sensors calibrated by ATI. *CON: Controller F/T System, DAQ: 16-bit DAQ F/T System

Single-Axis Overload	English	Metric
Fxy	±5915 lbf	±26000 N
Fz	±12268 lbf	±55000 N
Txy	±19900 lbf-in	±2200 Nm
Tz	±26250 lbf-in	±3000 Nm
Stiffness (Calculated)	English	Metric
X-axis & Y-axis force (Kx, Ky)	390x10 ³ lb/in	68x10 ⁶ N/m
Z-axis force (Kz)	640x10 ³ lb/in	110x10 ⁶ N/m
X-axis & Y-axis torque (Ktx, Kty)	2.8x10 ⁶ lbf-in/rad	320x10 ³ Nm/rad
Z-axis torque (Ktz)	4.6x10 ⁶ lbf-in/rad	520x10 ³ Nm/rad
Resonant Frequency (Non-IP rated, Measured)		
Fx, Fy, Tz	680 Hz	
Fz, Tx, Ty	820 Hz	
Physical Specifications	English	Metric
Weight*	11.0 lb	5.0 kg
Diameter*	6.10 in	155 mm
Height*	2.41 in	61.1 mm

“We have been using the ATI F/T for automotive seat testing since 1998. We are impressed with its ruggedness and reliability.”

Kevin Moore
Automotive Testing Technologies

*Specifications include standard interface plates and are for non-IP rated models.
Diameter excludes any connector block.

ATI INDUSTRIAL AUTOMATION
www.ati-ia.com
THETA F/T DAO TRANSDUCER

NOTES:

1. Material: Hardened stainless steel and aluminum.
2. Do Not Touch internal electronics or instrumentation this could damage transducer and will void warranty.
3. **TO AVOID DAMAGE, DO NOT EXCEED INTERFACE DEPTH.**
4. Transducer must be mounted to surfaces rigid enough to support loads without deflection for best accuracy.

Customer Drawing # 9230-05-1129

Product Advantages

Industrial:

- Mounting plate may be bored for a 40mm through-hole in some cases.

Extremely High Strength:

- EDM wire-cut from high yield-strength stainless steel.
- Maximum allowable single-axis overload values are 4.2 to 15.2 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.

IP60, IP65 and IP68 (10m) Versions Available: An IP60 version is for use in dusty environments. The IP65 version of the transducer provides protection against water spray. The IP68 version is for underwater environments to a maximum depth of 10 meters in fresh water. Contact ATI Industrial Automation for drawings and more information.

Typical Applications

- Rehabilitation research
- Product testing
- Orthopedic research
- Robotic assembly
- Telerobotics
- Part placement and removal in precision fixtures



The Omega160 F/T transducer

The transducer is made of hardened stainless steel, and the tool and mounting adapters are made of high-strength aircraft aluminum.

ENGLISH CALIBRATIONS	SENSING RANGES		Calibrations											
	Axes		US-200-1000		US-300-1800		US-600-3600							
	Fx, Fy (\pm lbf)		200		300		600							
	Fz (\pm lbf)		500		875		1500							
	Tx, Ty (\pm lbf-in)		1000		1800		3600							
	Tz (\pm lbf-in)		1000		1800		3600							
ENGLISH CALIBRATIONS	RESOLUTION		System Type*											
	Axes		CON		DAQ		CON		DAQ					
	Fx, Fy (lbf)		1/16		1/128		5/34		5/272		1/4		1/32	
	Fz (lbf)		1/8		1/64		5/17		5/136		1/2		1/16	
	Tx, Ty (lbf-in)		1/4		1/32		5/8		5/64		1		1/8	
	Tz (lbf-in)		1/4		1/32		5/8		5/64		1		1/8	

METRIC CALIBRATIONS	SENSING RANGES		Calibrations											
	Axes		SI-1000-120		SI-1500-240		SI-2500-400							
	Fx, Fy (\pm N)		1000		1500		2500							
	Fz (\pm N)		2500		3750		6250							
	Tx, Ty (\pm Nm)		120		240		400							
	Tz (\pm Nm)		120		240		400							
METRIC CALIBRATIONS	RESOLUTION		System Type*											
	Axes		CON		DAQ		CON		DAQ					
	Fx, Fy (N)		1/4		1/32		1/2		1/16		1		1/8	
	Fz (N)		1/2		1/16		1		1/8		1 1/2		3/16	
	Tx, Ty (Nm)		1/40		1/320		1/20		1/160		1/10		1/80	
	Tz (Nm)		1/40		1/320		1/20		1/160		1/10		1/80	

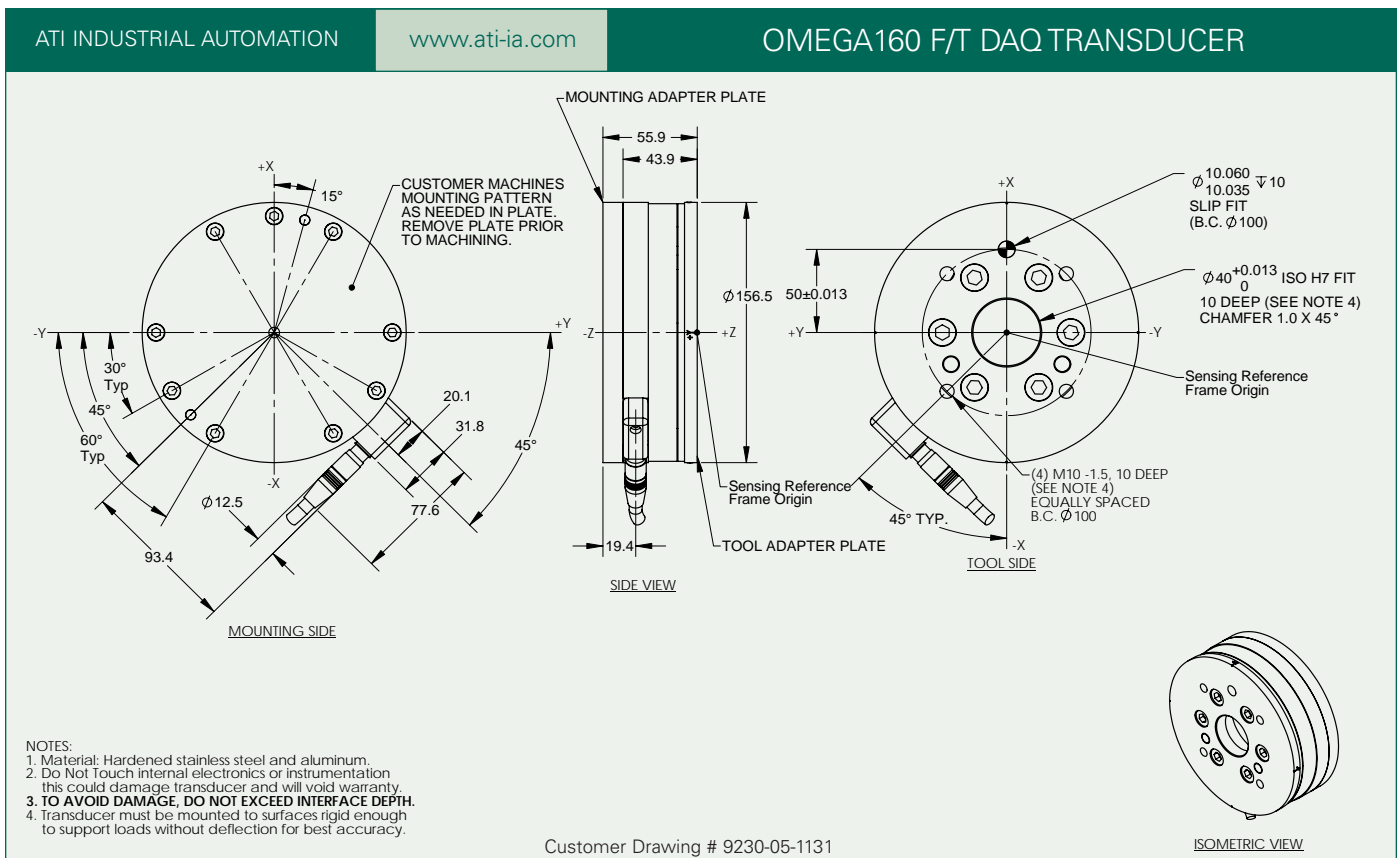
Contact ATI for complex loading information. Resolutions are typical. All Sensors calibrated by ATI. *CON: Controller F/T System, DAQ: 16-bit DAQ F/T System

Single-Axis Overload	English	Metric
Fxy	±3938 lbf	±18000 N
Fz	±10751 lbf	±48000 N
Txy	±15217 lbf-in	±1700 Nm
Tz	±16667 lbf-in	±1900 Nm
Stiffness (Calculated)	English	Metric
X-axis & Y-axis force (Kx, Ky)	400x10 ³ lb/in	70x10 ⁶ N/m
Z-axis force (Kz)	680x10 ³ lb/in	120x10 ⁶ N/m
X-axis & Y-axis torque (Ktx, Kty)	2.9x10 ⁶ lbf-in/rad	330x10 ³ Nm/rad
Z-axis torque (Ktz)	4.6x10 ⁶ lbf-in/rad	520x10 ³ Nm/rad
Resonant Frequency (Non-IP rated, Measured)		
Fx, Fy, Tz	1300 Hz	
Fz, Tx, Ty	1000 Hz	
Physical Specifications	English	Metric
Weight*	6.0 lb	2.7 kg
Diameter*	6.14 in	156 mm
Height*	2.20 in	55.9 mm

“ATI force/torque sensors use simple ActiveX controls that make it compatible with Open Robot Control Architecture. Ease of integration, rugged design and excellent performance are reasons that many customers use these force sensors with our robots, and it is now even easier with our PC-based SeikoRCS robot controller.”

Everette Phillips
General Manager
Seiko Robotics

*Specifications include standard interface plates and are for non-IP rated models.
Diameter excludes any connector block.



Product Advantages

Extremely High Strength:

- EDM wire-cut from high yield-strength stainless steel.
- Maximum allowable single-axis overload values are 4.8 to 19.9 times rated capacities.
- Through-hole available in some cases.

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.

IP60, IP65 and IP68 (10m) Versions Available: An IP60 version is for use in dusty environments. The IP65 version of the transducer provides protection against water spray. The IP68 version is for underwater environments to a maximum depth of 10 meters in fresh water. Contact ATI Industrial Automation for drawings and more information.



The Omega190 F/T transducer

The transducer is made of hardened stainless steel, and the tool and mounting adapters are made of high-strength aircraft aluminum.

Typical Applications

- Product testing
- Force feedback
- Telerobotics
- Part placement and removal in precision fixtures

ENGLISH CALIBRATIONS	SENSING RANGES		Calibrations											
	Axes		US-400-3000		US-800-6000		US-1600-12000							
	Fx, Fy (\pm lbf)		400		800		1600							
	Fz (\pm lbf)		1000		2000		4000							
	Tx, Ty (\pm lbf-in)		250		500		1000							
	Tz (\pm lbf-in)		250		500		1000							
	RESOLUTION		System Type*											
	Axes		CON		DAQ		CON		DAQ					
	Fx, Fy (lbf)		5/32		5/256		5/16		5/128		5/8		5/64	
	Fz (lbf)		5/16		5/128		5/8		5/64		1 1/4		5/32	
Tx, Ty (lbf-in)		5/64		5/512		5/32		5/256		5/16		5/128		
Tz (lbf-in)		5/96		5/768		5/48		5/384		5/24		5/192		

METRIC CALIBRATIONS	SENSING RANGES		Calibrations											
	Axes		SI-1800-350		SI-3600-700		SI-7200-1400							
	Fx, Fy (\pm N)		1800		3600		7200							
	Fz (\pm N)		4500		9000		18000							
	Tx, Ty (\pm Nm)		350		700		1400							
	Tz (\pm Nm)		350		700		1400							
	RESOLUTION		System Type*											
	Axes		CON		DAQ		CON		DAQ					
	Fx, Fy (N)		3/4		3/32		1 1/2		3/16		3		3/8	
	Fz (N)		1 1/2		3/16		3		3/8		6		3/4	
Tx, Ty (Nm)		5/48		5/384		5/24		5/192		5/12		5/96		
Tz (Nm)		5/72		5/576		5/36		5/288		5/18		5/144		

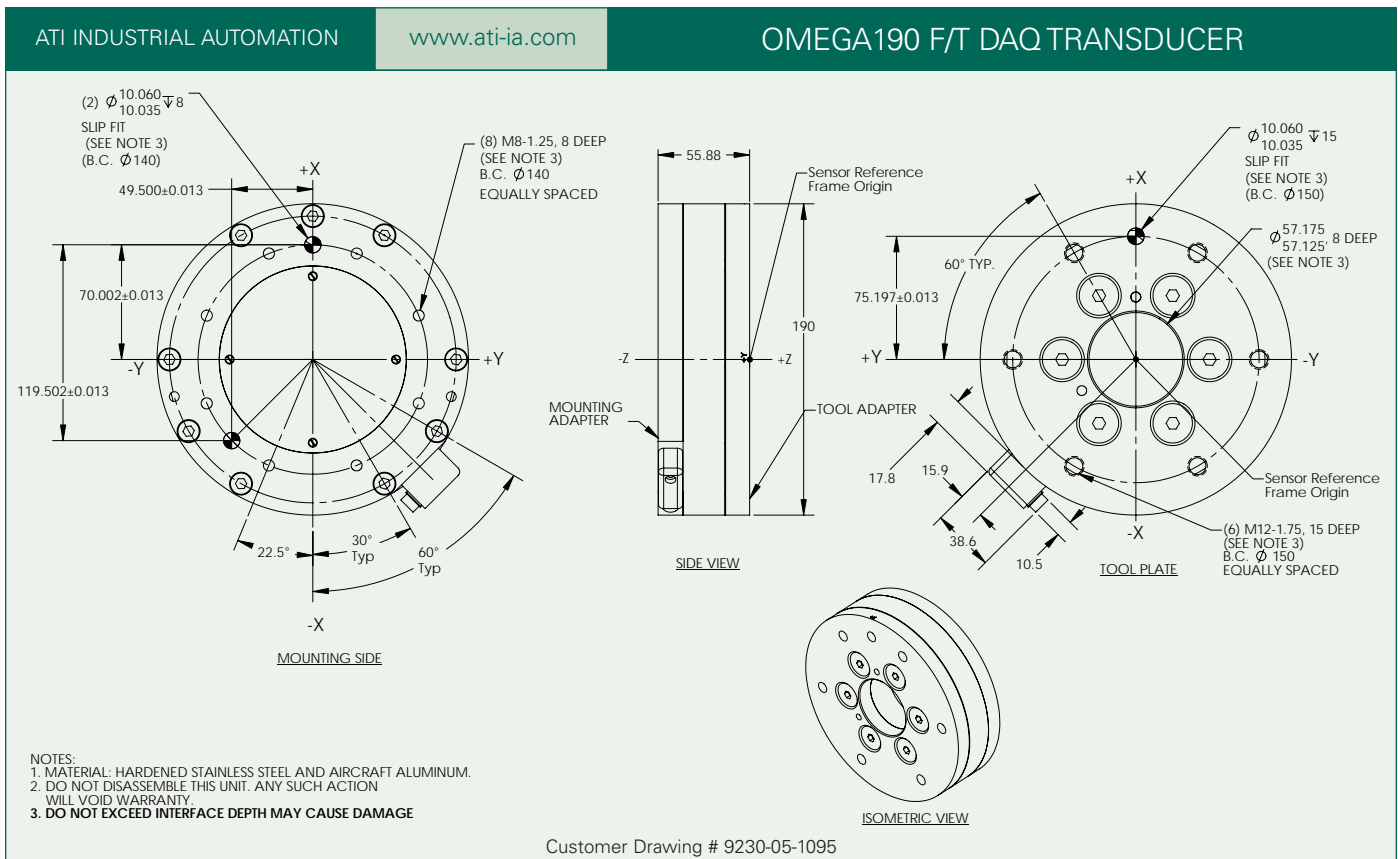
Contact ATI for complex loading information. Resolutions are typical. All Sensors calibrated by ATI. *CON: Controller F/T System, DAQ: 16-bit DAQ F/T System

Single-Axis Overload	English	Metric
Fxy	±7982 lbf	±36000 N
Fz	±24700 lbf	±110000 N
Txy	±59950 lbf-in	±6800 Nm
Tz	±69120 lbf-in	±7800 Nm
Stiffness (Calculated)	English	Metric
X-axis & Y-axis force (Kx, Ky)	1.4x10 ⁶ lb/in	240x10 ⁶ N/m
Z-axis force (Kz)	2.1x10 ⁶ lb/in	360x10 ⁶ N/m
X-axis & Y-axis torque (Ktx, Kty)	14x10 ⁶ lbf-in/rad	1.5x10 ⁶ Nm/rad
Z-axis torque (Ktz)	28x10 ⁶ lbf-in/rad	3.2x10 ⁶ Nm/rad
Physical Specifications	English	Metric
Weight*	14 lb	6.4 kg
Diameter (OD/ID)*	7.48 in/2.25 in	190 mm/57 mm
Height*	2.20 in	55.9 mm

*Specifications include standard interface plates and are for non-IP rated models.
Diameter excludes any connector block.

“ATI force sensors have become our choice sensors for force measurement in surface finishing processes. With this in mind, we are about to place our 6th order for ATI sensors in the past two years.”

Dr. Vikram Cariapa
Dr. Robert Stango
Associate Professors of Mechanical
and Industrial Engineering
Marquette University



Product Advantages

Extremely High Strength:

- EDM wire-cut from high yield-strength stainless steel.
- Maximum allowable single-axis overload values are 10.1 to 40.8 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.

IP65 and IP68 (10m) Versions Available: An IP65 version of the transducer provides protection against water spray. The IP68 version is for underwater environments to a maximum depth of 10 meters in fresh water. Contact ATI Industrial Automation for drawings and more information.

Typical Applications

- Product testing
- Force feedback
- Telerobotics
- Part placement and removal in precision fixtures



The Omega250 F/T transducer

The transducer is made of hardened stainless steel, and the tool and mounting adapters are made of high-strength stainless steel.

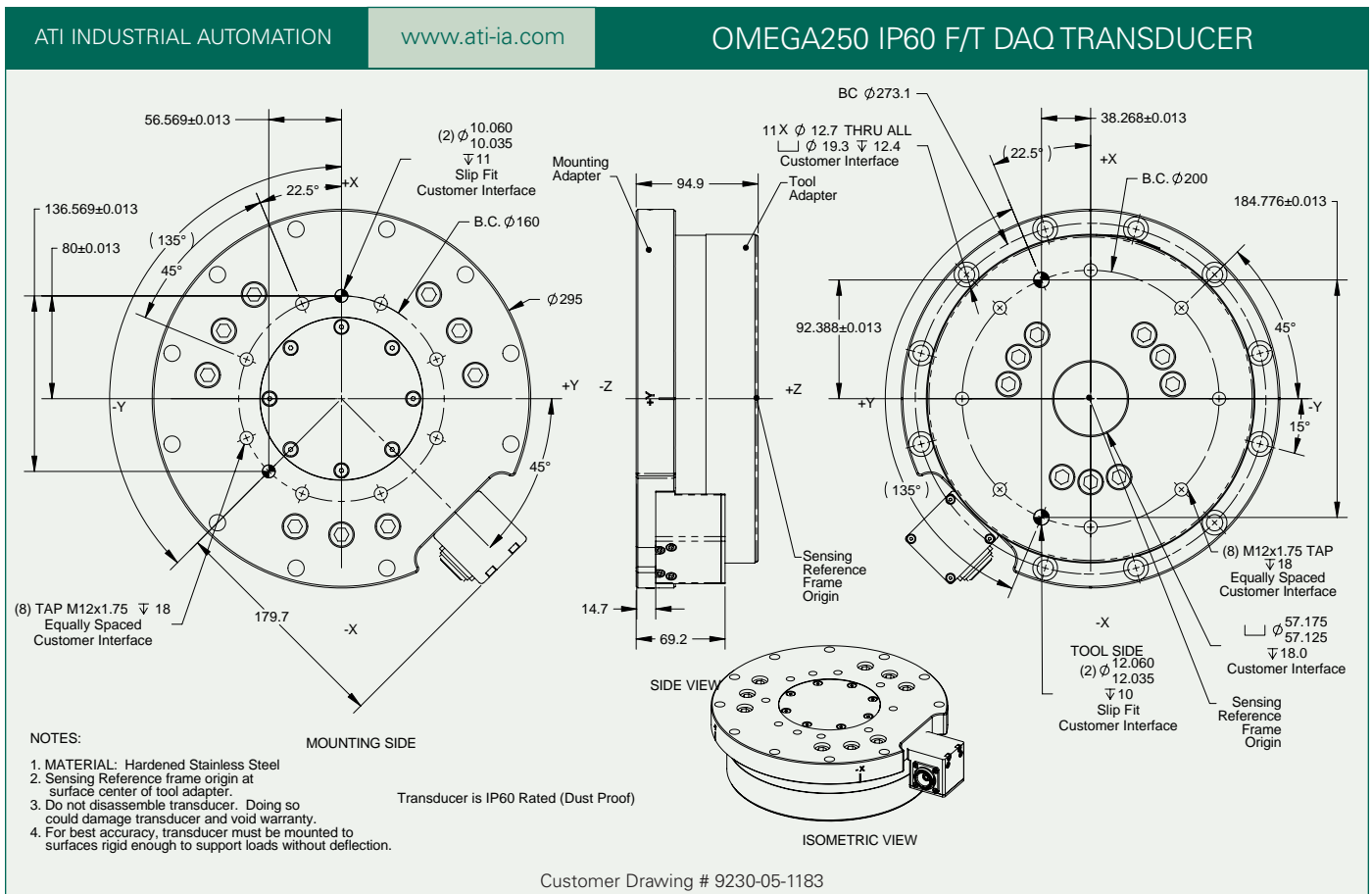
ENGLISH CALIBRATIONS	SENSING RANGES		Calibrations											
	Axes		US-900-4500		US-1800-9000		US-3600-18000							
	Fx, Fy (\pm lbf)		900		1800		3600							
	Fz (\pm lbf)		1800		3600		7200							
	Tx, Ty (\pm lbf-in)		4500		9000		18000							
	Tz (\pm lbf-in)		4500		9000		18000							
	RESOLUTION		System Type*											
	Axes		CON		DAQ		CON		DAQ					
	Fx, Fy (lbf)		3/8		3/64		3/4		3/32		1 1/2		3/16	
	Fz (lbf)		5/8		5/64		1 1/4		5/32		2 1/2		5/16	
Tx, Ty (lbf-in)		1 7/8		15/64		3 3/4		15/32		7 1/2		15/16		
Tz (lbf-in)		1 1/2		3/16		3		3/8		6		3/4		

METRIC CALIBRATIONS	SENSING RANGES		Calibrations											
	Axes		SI-4000-500		SI-8000-1000		SI-16000-2000							
	Fx, Fy (\pm N)		4000		8000		16000							
	Fz (\pm N)		8000		16000		32000							
	Tx, Ty (\pm Nm)		500		1000		2000							
	Tz (\pm Nm)		500		1000		2000							
	RESOLUTION		System Type*											
	Axes		CON		DAQ		CON		DAQ					
	Fx, Fy (N)		1 3/4		7/32		3 1/2		7/16		7		7/8	
	Fz (N)		2 3/4		11/32		5 1/2		11/16		11		1 3/8	
Tx, Ty (Nm)		7/32		7/256		7/16		7/28		7/8		7/64		
Tz (Nm)		3/16		3/128		3/8		3/64		3/4		3/32		

Contact ATI for complex loading information. Resolutions are typical. All Sensors calibrated by ATI. *CON: Controller F/T System, DAQ: 16-bit DAQ F/T System

Single-Axis Overload	English	Metric
F _{xy}	±36690 lbf	±160000 N
F _z	±74002 lbf	±330000 N
T _{xy}	±183007 lbf-in	±21000 Nm
T _z	±221782 lbf-in	±25000 Nm
Stiffness (Calculated)	English	Metric
X-axis & Y-axis force (K _x , K _y)	2.4x10 ⁶ lb/in	420x10 ⁶ N/m
Z-axis force (K _z)	3.2x10 ⁶ lb/in	560x10 ⁶ N/m
X-axis & Y-axis torque (K _{tx} , K _{ty})	27x10 ⁶ lbf-in/rad	3.0x10 ⁶ Nm/rad
Z-axis torque (K _{tz})	55x10 ⁶ lbf-in/rad	6.2x10 ⁶ Nm/rad
Physical Specifications	English	Metric
Weight*	66 lb	30 kg
Diameter (OD/ID)*	10.01 in/2.12 in	254 mm/54 mm
Height*	3.74 in	95 mm

*Specifications include standard interface plates. Diameter excludes any connector block.



Product Advantages

Extremely High Strength:

- EDM wire-cut from high yield-strength stainless steel.
- Maximum allowable single-axis overload values are 5.3 to 21.8 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

- Product testing
- Force feedback
- Telerobotics



The Omega331 F/T transducer

The transducer is made of hardened stainless steel, and the tool and mounting adapters are made of high-strength stainless steel.

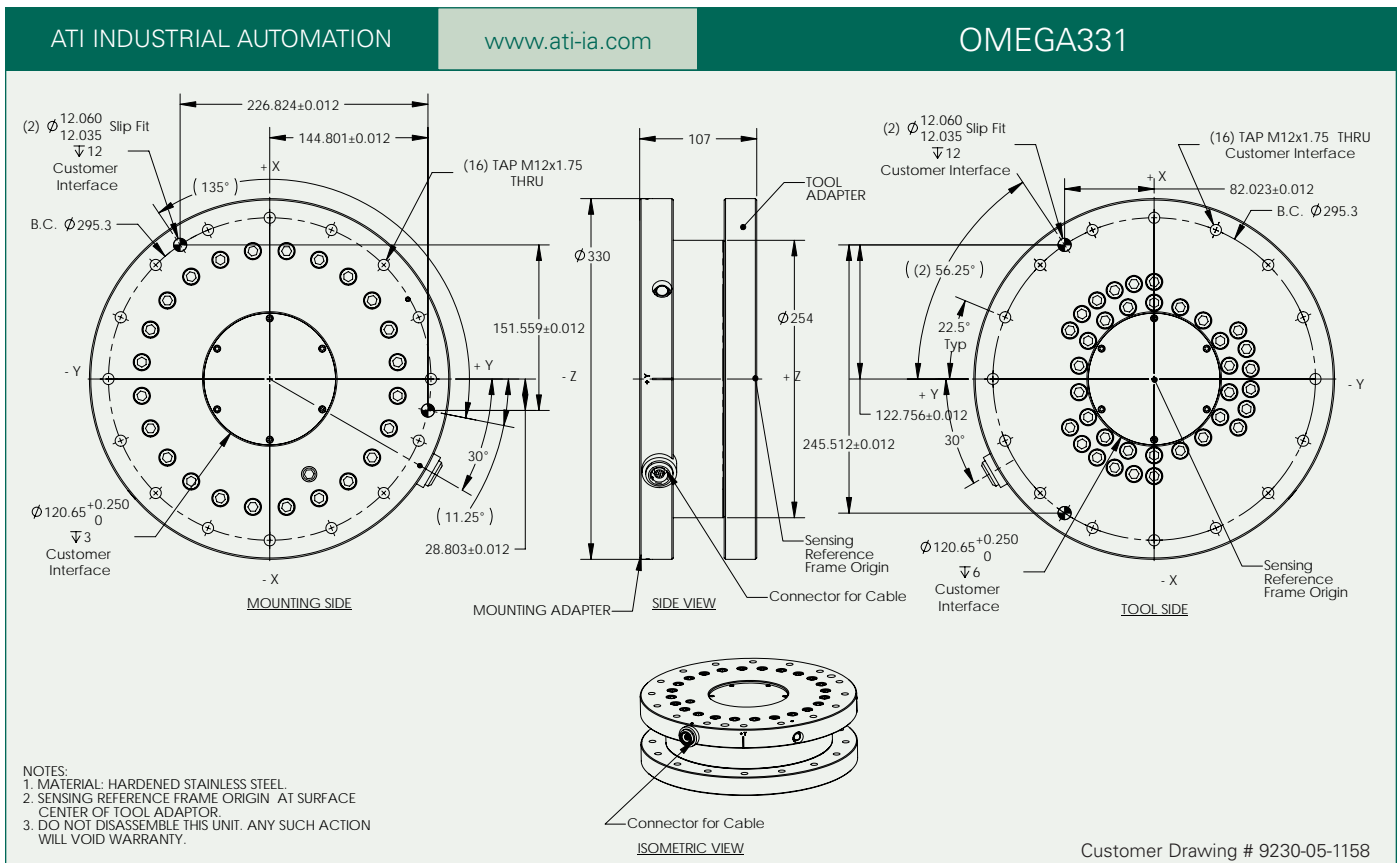
ENGLISH CALIBRATIONS	SENSING RANGES		Calibrations											
	Axes		US-2250-13000		US-4500-26000		US-9000-52000							
	Fx, Fy (\pm lbf)		2250		4500		9000							
	Fz (\pm lbf)		5250		10500		21000							
	Tx, Ty (\pm lbf-in)		13000		26000		52000							
	Tz (\pm lbf-in)		13000		26000		52000							
	RESOLUTION		System Type*											
	Axes		CON		DAQ		CON		DAQ					
	Fx, Fy (lbf)		1		1/8		2		1/4		4		1/2	
	Fz (lbf)		2		1/4		4		1/2		8		1	
Tx, Ty (lbf-in)		7 1/2		15/16		15		1 7/8		30		3 3/4		
Tz (lbf-in)		3 3/4		15/32		7 1/2		15/16		15		1 7/8		

METRIC CALIBRATIONS	SENSING RANGES		Calibrations											
	Axes		SI-10000-1500		SI-20000-3000		SI-40000-6000							
	Fx, Fy (\pm N)		10000		20000		40000							
	Fz (\pm N)		22000		44000		88000							
	Tx, Ty (\pm Nm)		1500		3000		6000							
	Tz (\pm Nm)		1500		3000		6000							
	RESOLUTION		System Type*											
	Axes		CON		DAQ		CON		DAQ					
	Fx, Fy (N)		1/240		1/1920		1/120		1/960		1/60		1/480	
	Fz (N)		1/120		1/960		1/60		1/480		1/30		1/240	
Tx, Ty (Nm)		3/4000		3/32000		3/2000		3/16000		3/1000		3/8000		
Tz (Nm)		1/2000		1/16000		1/1000		1/8000		1/500		1/4000		

Contact ATI for complex loading information. Resolutions are typical. All Sensors calibrated by ATI. *CON: Controller F/T System, DAQ: 16-bit DAQ F/T System

Single-Axis Overload	English	Metric
F _{xy}	±57888 lbf	±260000 N
F _z	±115830 lbf	±520000 N
T _{xy}	±284400 lbf-in	±32000 Nm
T _z	±406452 lbf-in	±46000 Nm
Stiffness (Calculated)	English	Metric
X-axis & Y-axis force (K _x , K _y)	6.9x10 ⁶ lb/in	1.2x10 ⁹ N/m
Z-axis force (K _z)	7.3x10 ⁶ lb/in	1.3x10 ⁹ N/m
X-axis & Y-axis torque (K _{tx} , K _{ty})	81x10 ⁶ lbf-in/rad	9.2x10 ⁶ Nm/rad
Z-axis torque (K _{tz})	210x10 ⁶ lbf-in/rad	24x10 ⁶ Nm/rad
Physical Specifications	English	Metric
Weight*	104 lb	47 kg
Diameter (OD/ID)*	13 in/4 in	330 mm/102mm
Height*	4.29 in	110 mm

*Specifications include standard interface plates. Diameter excludes any connector block.



Other ATI Products

Robotic/Automatic Tool Changer

A high-precision rugged device that automatically changes tooling. Patented fail-safe locking mechanism uses No-Touch Locking™ technology, allowing plate separation when locking.

Robotic/Automatic Tool Changers for Heavy Automation

This series of modular tool changers are designed specifically for high-payload and high-moment applications. **Utility Modules** to pass air, fluid, and electrical signals are also available for use in non-tool changer applications. Useful for processes requiring repeated connection/disconnection of utilities.

Robotic Collision Sensor

Designed to prevent damage to robotic end-effectors resulting from robot crashes. Features include: Automatic reset, high-repeatability, and large moment rotation.

Robotic and CNC Deburring Tools

These air-driven robotic tools cover a wide variety of automated deburring applications with fast cycle times and clean, accurate cuts. The Radially-Compliant Deburring Tool is designed for removal of parting lines and flash, while the Axially-Compliant Deburring Tool is specially designed for edge deburring and chamfering.

Robotic Rotary Joint

A device that allows unlimited rotation of end-of-arm tooling without tangling or twisting robot lines. Utilizes advanced slip-ring technology to pass electrical and pneumatic signals from robot to tooling.

Automated Assembly Alignment Device

An insertion device using Remote Center Compliance technology that helps assembly machines automatically align close-fitting parts, preventing jamming and galling.

Company Profile

ATI Industrial Automation is a world-leading developer of Automatic Tool Changers, Multi-Axis Force/Torque Sensing Systems, Compliance Devices, Robotic Crash Protection Devices, Robotic Deburring Tools, and Robotic Rotary Joints. Our products are found in thousands of successful applications around the world.

Since 1982, our engineers have been developing cost-effective, state-of-the-art products and solutions to improve manufacturing productivity.

Our Mission is to provide customers around the world with high-quality robotic peripheral devices, tooling and sensors that enhance customer profitability by increasing the effectiveness, flexibility, safety and productivity of their automation applications. We accomplish this through continuous improvement of existing products, product customization and new product innovation.

Our engineering-centric staff focuses on providing customer solutions to robotic, automation and sensing applications.

Our Quality Policy

ATI Industrial Automation strives to provide customer satisfaction through continual improvement of on-time delivery, quality and reliability, and a constant focus on innovation and profitability.



Engineered Products for Robotic Productivity

Pinnacle Park
1031 Goodworth Drive
Apex, NC 27539 USA

+1 919.772.0115
+1 919.772.8259 fax
E-mail: info@ati-ia.com
www.ati-ia.com