Detailed Certificate of Calibration

Equipment Calibrated		Customer Information
Description:	Six-Axis Force/Torque Sensor	Dr Jennifer Rieser
Manufacturer:	ATI Industrial Automation	Georgia Institute of Technology
Serial Number:	FT21164	School of Physics
Model:	Nano43	837 State Street NW
Calibration:	SI-9-0.125	Atlanta , GA 30332-0430
Electronics:	DAQ	USA
Output Range:	±10V	jennifer.rieser@physics.gatech.edu
Gain Multiplier:	100%	

Equipment Condition and Notes: Factory new.

Calibration Results: Passed
  Offset: Normal
  Gain: Normal

Calibrated Ranges (±):

Fx	Fy	Fz	Tx	Ty	Tz
9 N	9 N	9 N	125 N-mm	125 N-mm	125 N-mm

Measurement Uncertainty (95% confidence level, percent of full-scale load):

Fx	Fy	Fz	Tx	Ty	Tz
1.25%	1.25%	1.25%	1.25%	1.25%	1.25%

The above Measurement Uncertainty values are the maximum amount of error for each axis expressed as a percentage of its full-scale load.

Calibration Temperature:	22.2°±1.1° C (72°±2° F)
Temperature Compensation:	hardware
Calibration Method:	WI-FTP-026, DAQ Calibration Instructions

Date of Calibration: 24 Jul 2017

Certificate Date: 24 Jul 2017
Calibrated by: Shane Bruce, Calibration Technician

This calibration is traceable to the National Institute of Standards and Technology (NIST).

ATI Industrial Automation (ATI) certifies that the above product was calibrated in accordance with applicable ATI procedures. These procedures are compliant with the ISO 9001 standard to ensure that the above product is within ATI specifications. To meet this level of accuracy any loads must be correctly aligned to the transducer origin and the transducer must be mounted to a sufficiently strong surface.

To ensure the transducer measurement uncertainties listed on page 1 are met, more-conservative limits are used as calibration targets during the calibration process. If any of the calibration targets are exceeded the calibration will not pass. It is possible for a transducer to exceed these calibration targets while meeting the page 1 measurement uncertainties. The following calibration targets were used for this transducer: F_x=1.00%, F_y=1.00%, F_z=1.00%, T_x=1.00%, T_y=1.00%, and T_z=1.00%.

Note: If this is a recalibration of a legacy transducer that does not have precision locating features (such as dowel holes), there could be additional error in T_x and T_y due to inexact mounting location. Precision locating features are highly recommended for best accuracy and can be added by ATI.

This certificate shall not be reproduced except in full without written approval from ATI. This certificate only applies to the items listed and does not include unlisted ancillary items such as data acquisition equipment.

For questions or comments, please contact your ATI representative.

Calibration Accuracy Section
Sensor System FT21164, Nano43/SI-9-0.125
Force units: N; Torque units: N-mm

Calibrated Ranges (±)					
Fx	**Fy**	**Fz**	**Tx**	**Ty**	**Tz**
9	9	9	125	125	125

Applied Loads						
	Fx	**Fy**	**Fz**	**Tx**	**Ty**	**Tz**
1	0.000	1.668	0.000	-97.305	0.000	0.000
2	-1.668	0.000	0.000	0.000	-97.305	0.000
3	0.000	-1.668	0.000	97.305	0.000	0.000
4	1.668	0.000	0.000	0.000	97.305	0.000
5	0.000	7.784	0.000	-68.412	0.000	0.000
6	-7.784	0.000	0.000	0.000	-68.412	0.000
7	0.000	-7.784	0.000	68.412	0.000	0.000
8	7.784	0.000	0.000	0.000	68.412	0.000
9	0.000	1.390	0.000	6.002	0.000	-105.764
10	0.000	1.390	0.000	6.002	0.000	105.807
11	-1.390	0.000	0.000	0.000	6.002	-105.789
12	-1.390	0.000	0.000	0.000	6.002	105.824
13	0.000	-1.390	0.000	-6.002	0.000	-105.807
14	0.000	-1.390	0.000	-6.002	0.000	105.764
15	1.390	0.000	0.000	0.000	-6.002	-105.824
16	1.390	0.000	0.000	0.000	-6.002	105.789
17	0.000	0.000	1.946	-108.521	0.000	0.000
18	0.000	0.000	1.946	0.000	-108.570	0.000
19	0.000	0.000	1.946	108.555	0.000	0.000
20	0.000	0.000	1.946	0.000	108.535	0.000
21	0.000	0.000	7.784	0.000	0.000	0.000
22	0.000	0.000	-7.784	0.000	0.000	0.000
23	0.000	0.000	-1.946	108.521	0.000	0.000
24	0.000	0.000	-1.946	0.000	108.570	0.000
25	0.000	0.000	-1.946	-108.555	0.000	0.000
26	0.000	0.000	-1.946	0.000	-108.535	0.000

Refer to page 6 for important information on regarding this report.

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	Full-Scale Error					
	Fx	Fy	Fz	Tx	Ty	Tz
1	0.06%	0.16%	0.06%	0.07%	-0.25%	-0.09%
2	-0.09%	0.04%	0.02%	-0.02%	0.11%	-0.10%
3	0.04%	-0.14%	0.00%	0.05%	0.41%	0.15%
4	0.07%	-0.02%	0.02%	-0.25%	0.06%	0.03%
5	0.01%	-0.04%	0.17%	0.00%	-0.06%	0.12%
6	-0.07%	-0.09%	0.17%	0.04%	0.22%	0.14%
7	0.03%	0.01%	0.16%	-0.10%	-0.16%	0.08%
8	-0.09%	-0.08%	0.16%	0.00%	0.15%	0.09%
9	0.08%	-0.01%	0.01%	-0.26%	0.08%	-0.01%
10	-0.01%	-0.10%	0.00%	-0.13%	0.15%	0.02%
11	0.02%	-0.07%	0.07%	-0.40%	-0.07%	0.04%
12	0.03%	0.00%	0.02%	-0.03%	-0.62%	-0.11%
13	-0.04%	0.03%	0.05%	-0.08%	-0.45%	-0.08%
14	0.01%	-0.02%	0.08%	0.27%	0.42%	0.01%
15	-0.04%	-0.07%	0.06%	0.46%	0.10%	0.01%
16	0.00%	0.01%	0.08%	-0.39%	-0.29%	0.03%
17	0.02%	-0.05%	-0.05%	0.02%	-0.40%	-0.02%
18	-0.17%	-0.04%	-0.06%	-0.13%	0.08%	0.01%
19	0.04%	0.07%	-0.01%	0.03%	-0.53%	-0.02%
20	-0.23%	0.00%	-0.04%	-0.03%	0.13%	0.06%
21	0.09%	0.09%	-0.03%	0.15%	0.55%	0.15%
22	-0.07%	0.10%	-0.05%	0.10%	0.19%	0.20%
23	-0.05%	0.07%	0.00%	0.05%	0.19%	-0.14%
24	0.13%	-0.04%	-0.02%	0.12%	-0.02%	-0.11%
25	-0.02%	-0.04%	-0.03%	-0.05%	0.61%	0.05%
26	0.20%	-0.05%	-0.02%	-0.03%	-0.06%	0.02%

Refer to page 6 for important information on regarding this report.

	Offset Report					
	Fx	Fy	Fz	Tx	Ty	Tz
F/T Offset	0.0582	-0.0153	-0.0466	-0.2605	-0.3268	-0.0094
	SG0	SG1	SG2	SG3	SG4	SG5
SG Offset	0.0173	0.0085	0.0305	0.0228	0.0136	0.0300
±SG Limit	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000

Offsets are measured in a unique configuration not available to the user.
Refer to page 6 for important information on regarding this report.

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Gain-Check Report					
SG0	**SG1**	**SG2**	**SG3**	**SG4**	**SG5**
0.6000	*0.6000*	*0.6000*	*0.6000*	*0.6000*	*0.6000*
0.8141	0.7740	0.7710	0.7994	0.7904	0.7980
0.8194	0.7932	0.7726	0.8136	0.7956	0.8051
1.0000	*1.0000*	*1.0000*	*1.0000*	*1.0000*	*1.0000*

Gain readings are measured in a unique loading configuration.

Certificate Number: FT21164-20170724

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As part of our commitment to quality, each ATI force/torque transducer undergoes rigorous accuracy testing. This process, which involves applying and verifying a rich set of loading cases designed to cover the transducer's entire six-axis calibrated range, is designed to ensure that your transducer meets the measurement uncertainties listed in this Certificate of Calibration.

Our transducers often exceed our quality standards for accuracy. Often, transducers perform exceptionally well in certain loading situations. This report summarizes the performance of your ATI F/T transducer in our factory tests. It can be thought of as a 'best-case scenario' snapshot of your transducer's performance under laboratory conditions, in a variety of loading situations. You can expect the accuracy of your transducer measurements to fall somewhere between its performance during testing and the measurement uncertainties listed on its calibration certificate.

The *Calibration Accuracy Section* contains several tables of data. The *Calibrated Ranges (±)* table lists the transducer's rated range for each axis. The *Applied Loads* table lists the loads applied during calibration and testing. The *Full-Scale Error* table shows the sensor system's measurement error as a percentage of full scale for each axis in each loading case. The *Offset Report* table, if included, shows transducer readings during offset adjustment and associated control limits. And the *Gain-Check Report* table , if included, shows verification of the transducer's sensitivity and associated control limits. If included, the *Before and After Report* table shows a loading case relating the transducer's performance as received to its performance after recalibration.

For best accuracy, be sure to use your transducer's precision location features, and mount your transducer to a stiff surface. If an ongoing guarantee of sensor accuracy is important to you, we recommend that your sensor be tested annually. Contact your ATI Industrial Automation distributor to schedule recalibrations.

Certificate Number: FT21164-20170724

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