

CERTIFICATE OF CALIBRATION

This document certifies that the equipment referenced below meets published specifications.

Model Number: FAS-G

Serial Number: 0001050

Calibration Date: 2/14/2003

Description: Gyro-Enhanced Inclinometer

Calibration Technician: DLC

MicroStrain, Inc.

310 Hurricane Lane, Suite 4
Williston, VT 05495-3211

USA

Ph (802) 862-6629, Fax (802) 863-4093

1 - 800-449-DVRT (3878)

www.microstrain.com

info@microstrain.com

For any questions concerning this certificate, please call MicroStrain, Inc. for an application engineer.

MicroStrain, Inc
FAS-G Calibration Report

Calibration Parameter Summary

Serial Number: 1050
Firmware Version Number: 2.0.00
Calibration Date: 2/14/2003

Sensor Calibration Parameters

These values constitute the sensor calibrations, and should not be changed by the user

EEPROM Location	Description	Value
2	X Accelerometer Offset	32772
6	Z Accelerometer Offset	32767
8	Y Gyroscope Offset	32758
14	X Accelerometer Gain	33929
18	Z Accelerometer Gain	33900
20	Y Gyroscope Gain	56137
48	X Accelerometer DAC Offset	462
50	Z Accelerometer DAC Offset	501
52	Y Gyroscope DAC Offset	233
74	1/Cos(Orthogonality Error)	32768
76	Sin(Orthogonality Error)	32878

Filter Parameters

These parameters govern the performance of the on-board filtering algorithms.
The user may alter these values to suit the application.

EEPROM Location	Description	Value
40	Integral Gain	66
46	Proportional Gain	655
36	Vector Magnitude Factor	5

Analog Output Slopes

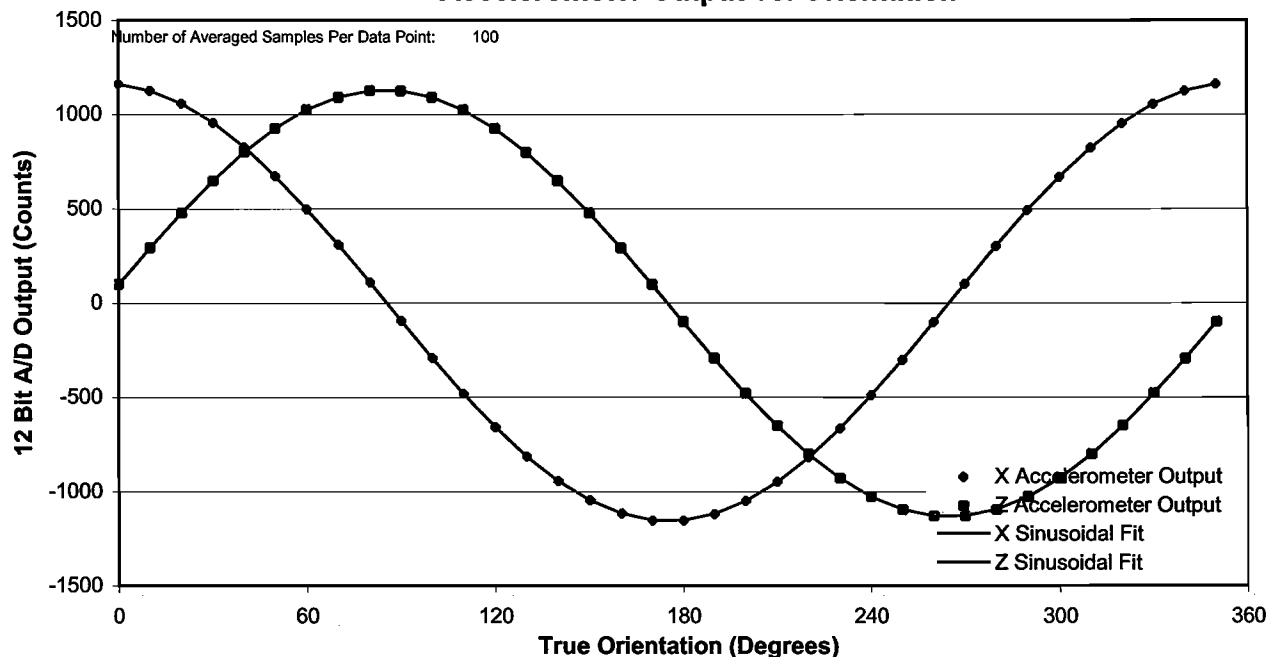
These values report the best-fit linear slope of the analog outputs.
The units are (microvolts/degree)

EEPROM Location	Description	Value
70	UnCompensated Analog Output Slope	11406
72	Gyro-Compensated Analog Output Slope	11413

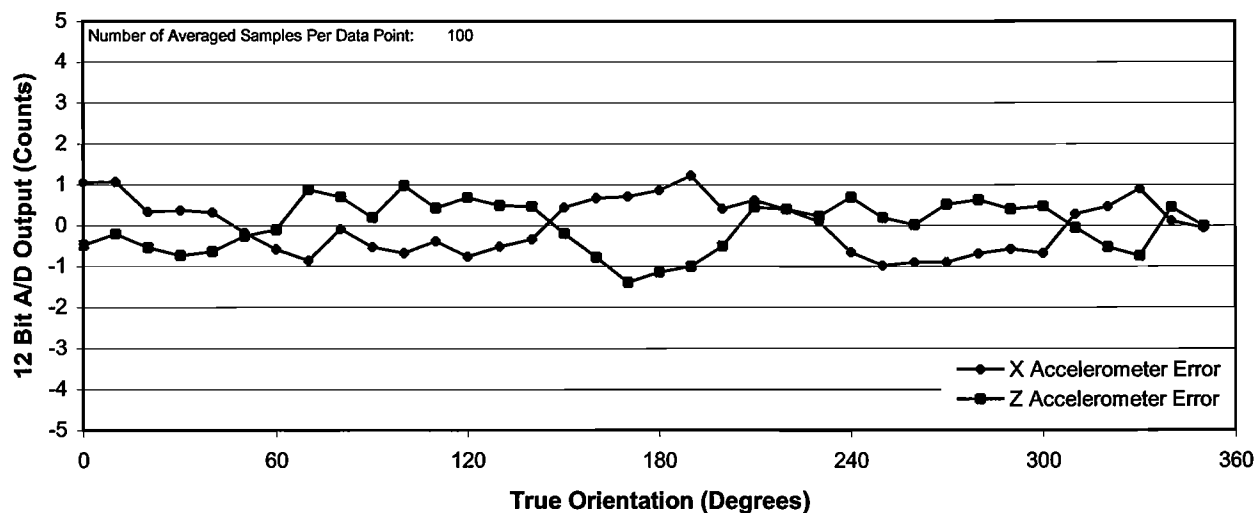
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Accelerometer Output vs. Orientation



Accelerometer Error vs. Orientation

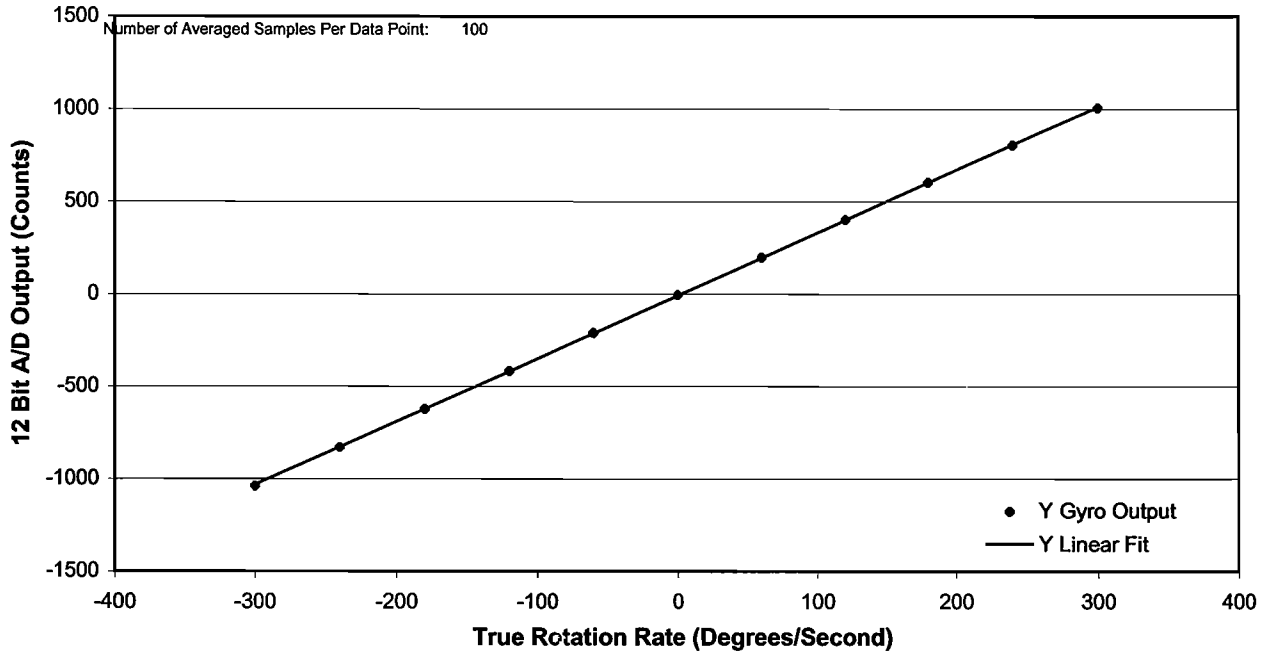


Accelerometer Calibration was performed by mounting the FAS-G to a precision rotary stage. The stage's rotation axis was horizontal. The FAS-G's sensitive axis was aligned parallel to the stage's rotatory axis. The stage was indexed through a number of known orientations in both the positive and negative directions, and the FAS-G accelerometer outputs recorded. Least-squared sinusoids were fit to each accelerometer's dataset. "Accelerometer Error" represents the deviation between the measured accelerometer output and the sinusoidal fit.

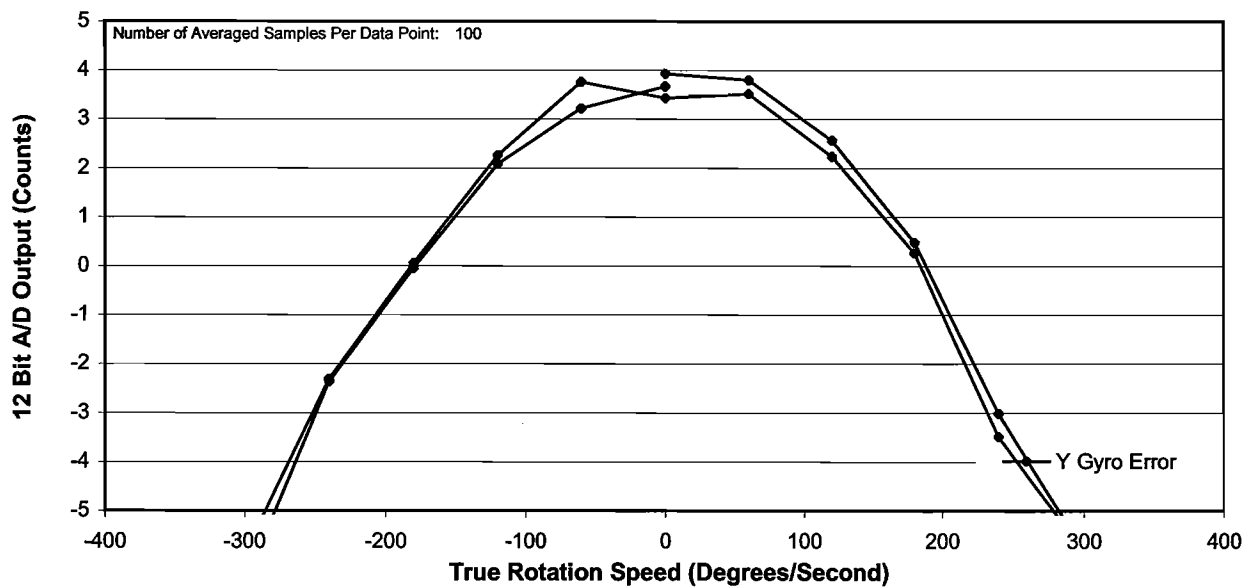
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Gyroscope Output vs. Rotation Rate



Gyroscope Error vs. Rotation Rate

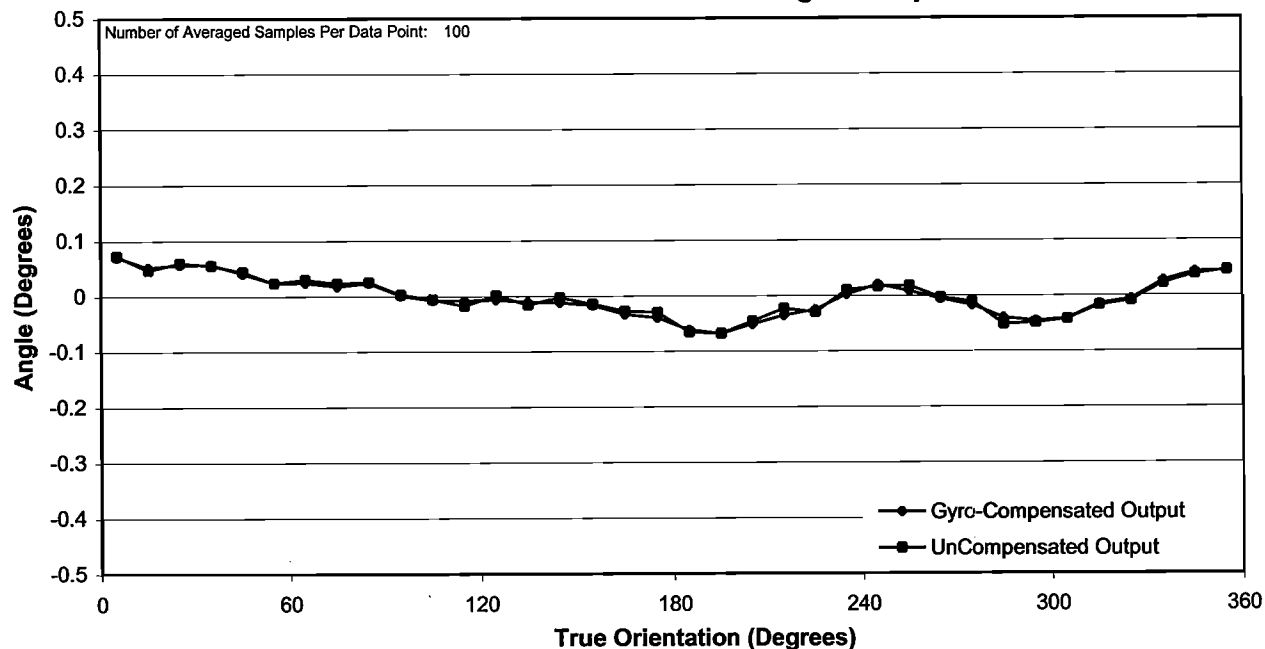


Gyroscope Calibration was performed by mounting the FAS-G to a precision rotary stage. The stage's rotation axis was horizontal. The FAS-G's sensitive axis was aligned parallel to the stage's rotatory axis. The stage was rotated at a number of known constant rates in both the positive and negative directions, and the FAS-G gyroscope output recorded. A least-squared line was fit to the dataset. "Gyroscope Error" represents the deviation between the measured gyroscope output and the linear fit.

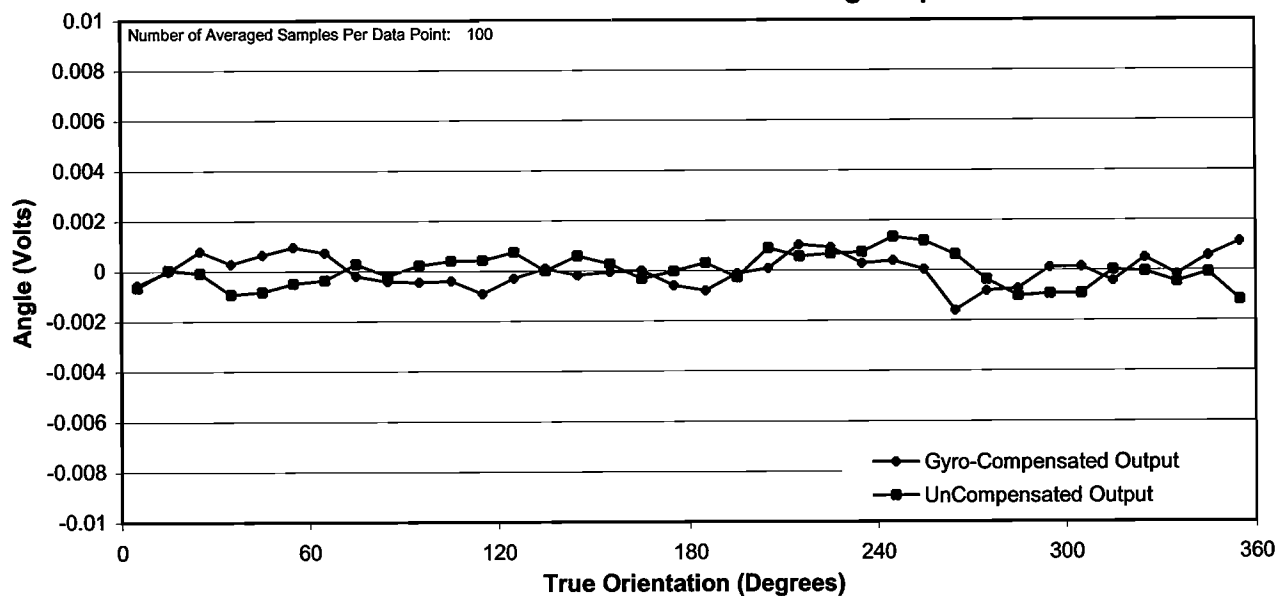
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Static Reference Error: Digital Output



Static Reference Error: Analog Outputs

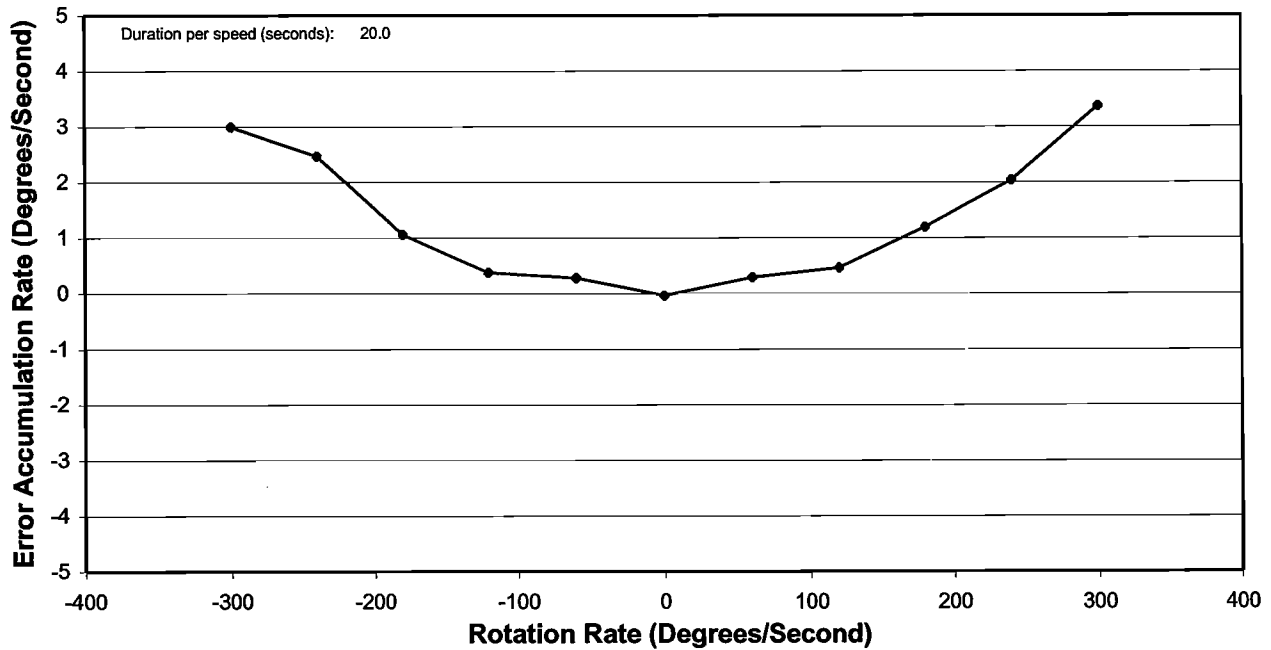


The static reference accuracy quantifies the ability of the FAS-G to correctly report its orientation under static conditions. The FAS-G was mounted to a precision rotary stage. The stage's rotation axis was horizontal. The FAS-G's sensitive axis was aligned parallel to the stage's rotatory axis. The stage was indexed to a number of known orientations, and the FAS-G's digital and analog outputs recorded. "Static Reference Error" is the difference between the reported orientation and the true orientation.

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Gyroscope Error Accumulation Rate vs. Rotation Rate



The "Error Accumulation Rate" quantifies the ability of the time integral of the gyroscope to correctly measure orientation. To evaluate the error accumulation rate, the FAS-G was fixed to a precision rotary stage. The stage was rotated at a constant speed for a fixed time interval and then stopped. The reported orientation as determined by the time integral of the gyroscope output was then calculated and compared to the actual orientation. This error divided by the duration of rotation is the error accumulation rate.