# CERTIFICATE OF CALIBRATION

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

Model Number: FAS-G

Serial Number: 0001407

Calibration Date: 6/27/2003

Description: Gyro-Enhanced Inclinometer

Calibration Technician: RB

## MicroStrain, Inc.

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

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# MicroStrain, Inc
# FAS-G Calibration Report

## Calibration Parameter Summary

Serial Number: 1407
Firmware Version Number: 2.0.00
Calibration Date: 6/27/2003

### Senor 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 | 32766 |
| 8 | Y Gyroscope Offset | 32757 |
| 14 | X Accelermeter Gain | 33965 |
| 18 | Z Accelerometer Gain | 33882 |
| 20 | Y Gyroscope Gain | 56498 |
| 48 | X Accelerometer DAC Offset | 495 |
| 50 | Z Accelerometer DAC Offset | 491 |
| 52 | Y Gyroscope DAC Offset | 234 |
| 74 | 1/Cos(Orthogonality Error) | 32768 |
| 76 | Sin(Orthogonality Error) | 32887 |

### 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 ouputs.
The units are (microvolts/degree)

| EEPROM Location | Description | Value |
|---|---|---|
| 70 | UnCompensated Analog Output Slope | 11424 |
| 72 | Gyro-Compensated Analog Output Slope | 11409 |

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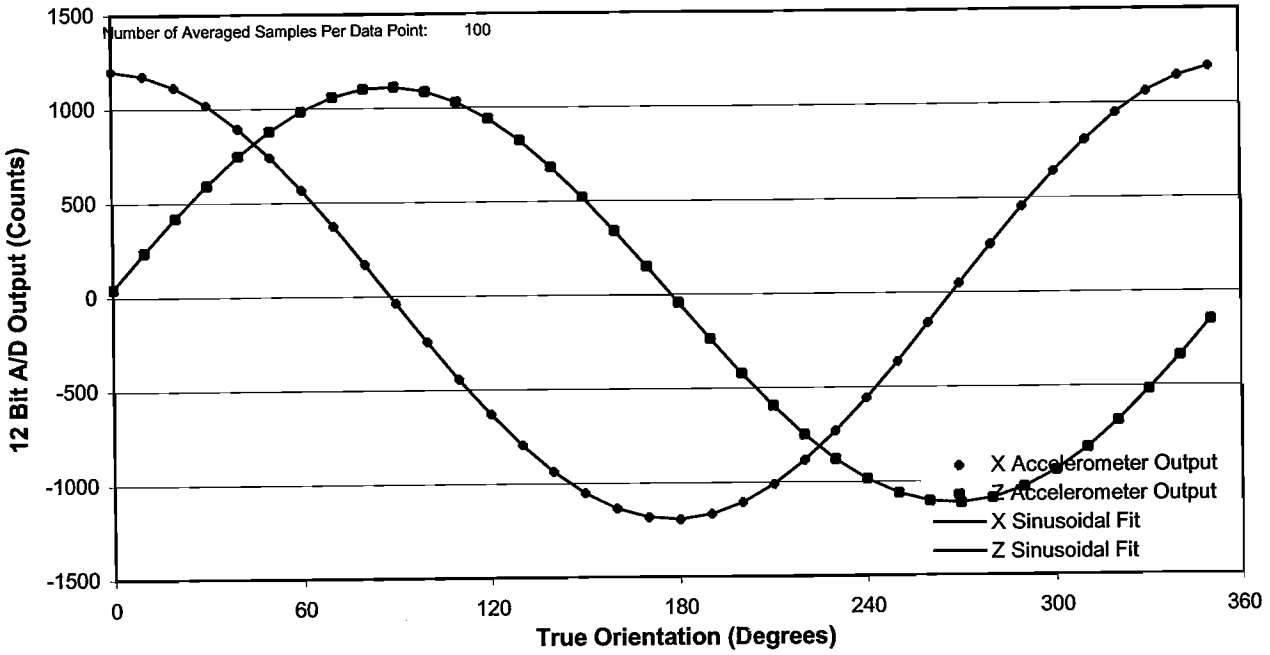
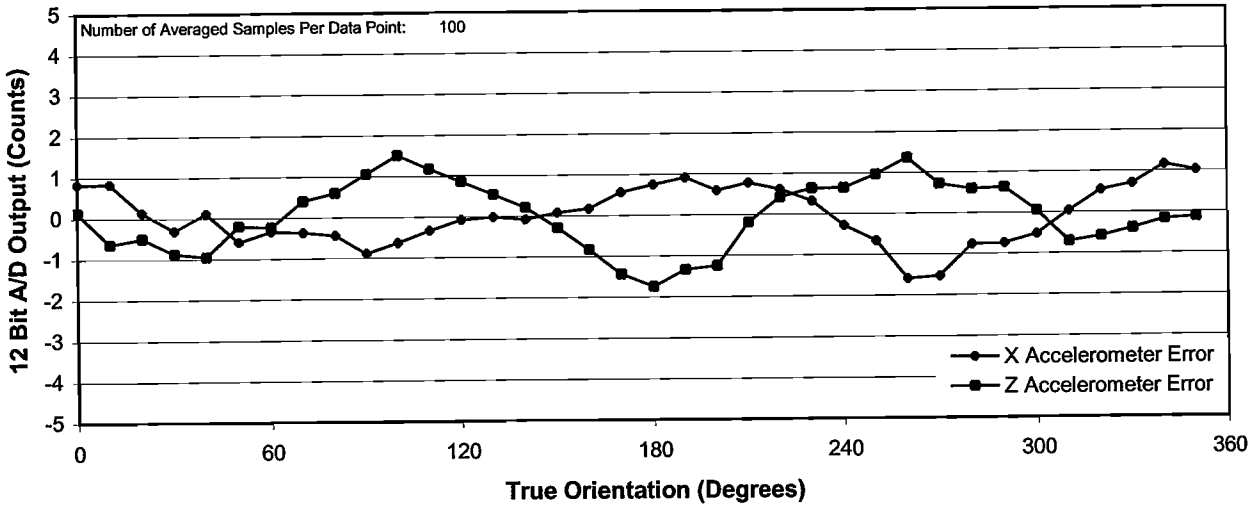
## Accelerometer Output vs. Orientation




## 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 rotatary 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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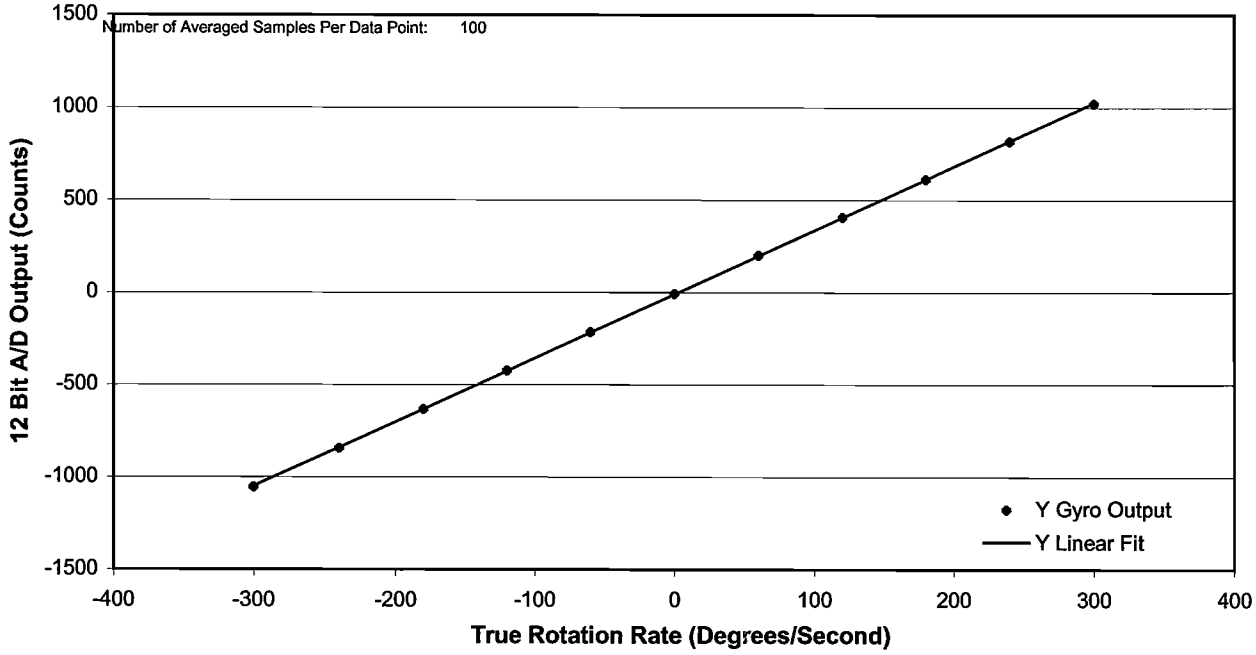
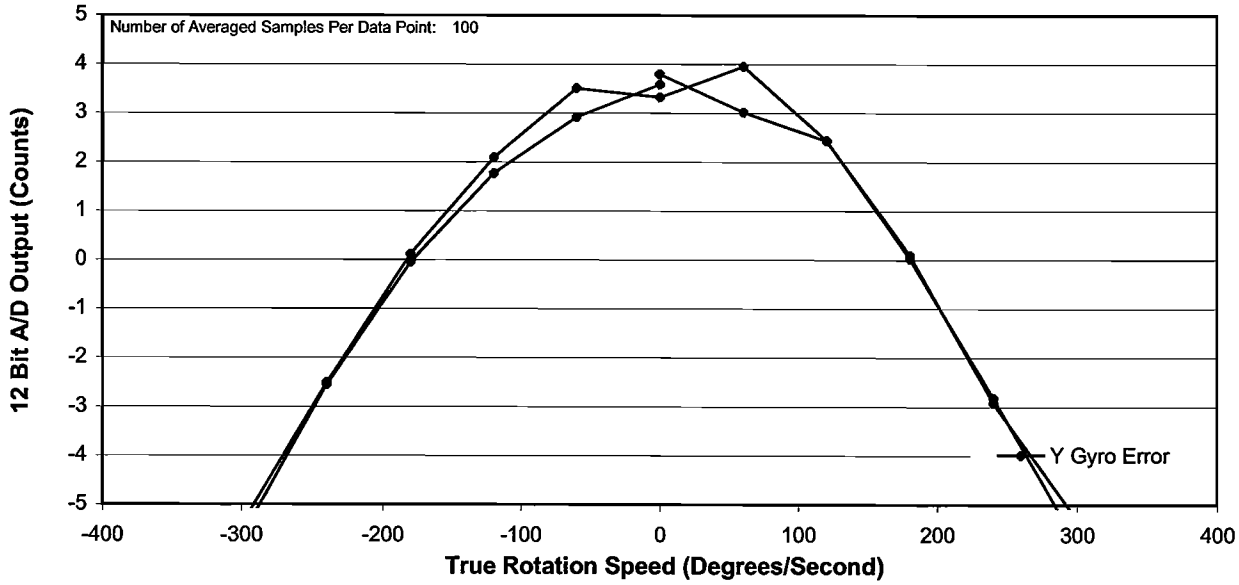
## Gyroscope Output vs. Rotation Rate




## 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 rotatary axis. The stage was rotated at a number of known constant rated 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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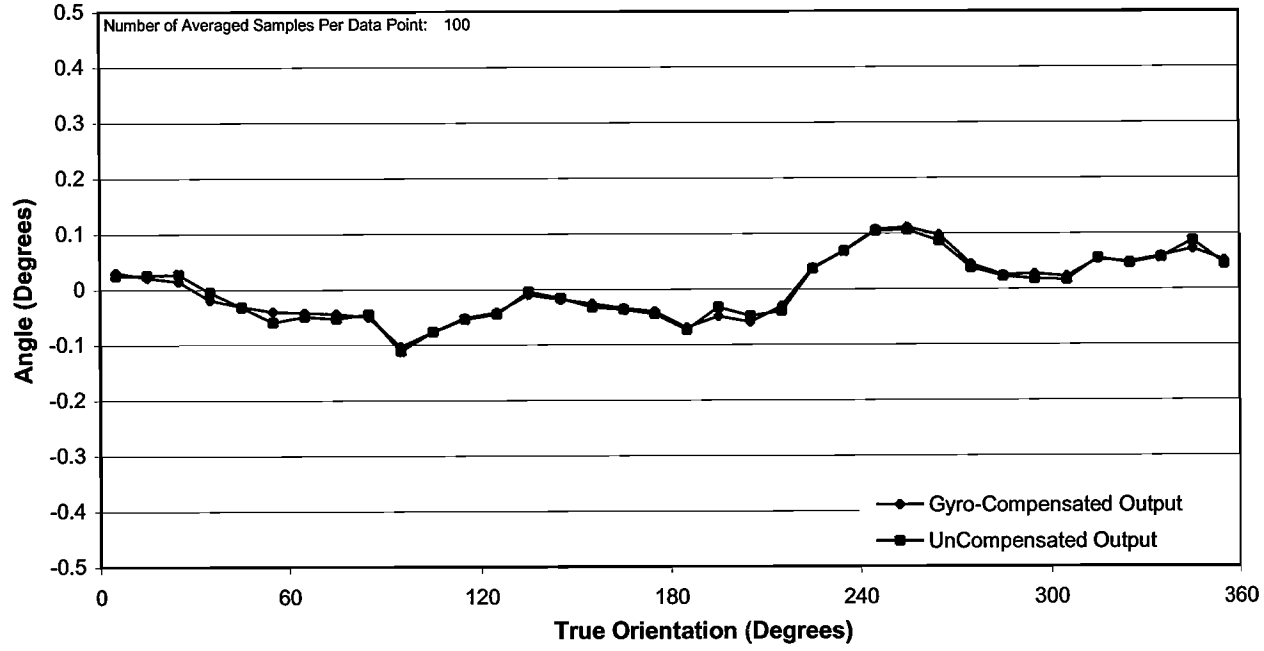
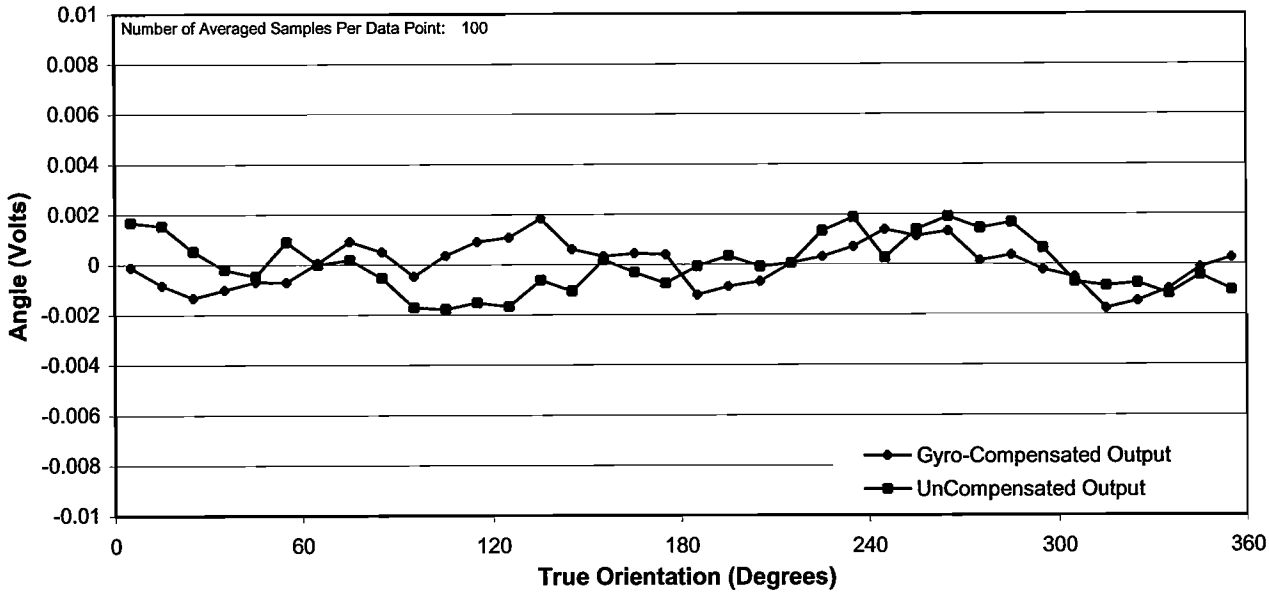
## Static Reference Error: Digital Output




## 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 rotatary 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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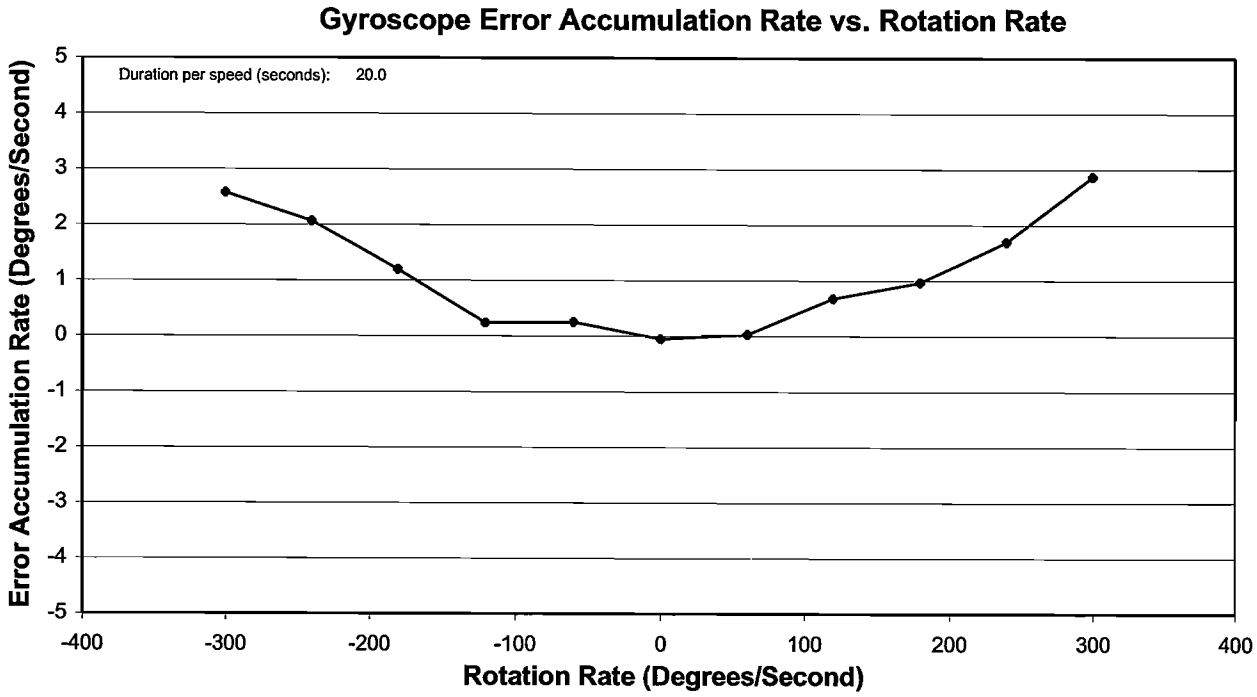


The "Error Accumulation Rate" quantifies the ability of the time integral of the gyroscope to correctly measure orientation. To evaluate the error accumulation rate, the FAS-G was fixed to a precision rotary stage. The stage was rotated at a constant speed for a fixed time interval and then stopped. 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.