



Ten Degrees of Freedom MEMS Inertial Sensor with Dynamic Orientation Outputs

Silicon Anomaly

ADIS16480

This anomaly list describes the known bugs, anomalies, and workarounds for the [ADIS16480](#).

Analog Devices, Inc., is committed, through future silicon revisions, to continuously improve silicon functionality. Analog Devices tries to ensure that these future silicon revisions remain compatible with your present software/systems by implementing the recommended workarounds outlined here.

FUNCTIONALITY ISSUES

Table 1. Incorrect Scale Factors for the x_DELTANG_OUT Registers and the x_DELTANG_LOW Registers [er001]

Background	The ADIS16480 provides delta angle registers, which contain sample-to-sample angle displacement estimates for all three axes. The x_DELTANG_OUT registers provide the upper 16 bits, and the x_DELTANG_LOW registers provide the lower 16 bits. The x_DELTANG_OUT registers typically provide a scale factor of $720 \div 2^{15}$ degrees per LSB, and the x_DELTANG_LOW registers provide additional resolution ($720 \div 2^{31}$ degrees per LSB).
Issue	On units that have Firmware Revision 2.01 (or earlier), the delta angle registers do not have the same scale factors as those listed in the ADIS16480 data sheet. For these units, the scale factors are $274 \div 2^{15}$ degrees per LSB for x_DELTANG_OUT and $274 \div 2^{31}$ degrees per LSB for x_DELTANG_LOW.
Workaround	Use $274 \div 2^{15}$ degrees per LSB for the x_DELTANG_OUT scale factor and $274 \div 2^{31}$ degrees per LSB for the x_DELTANG_LOW scale factor. Use the FIRM_REV register to determine the firmware revision of a unit. For example, FIRM_REV = 0x0201 equates to a Firmware Revision 2.01.
Related Issues	None.

Table 2. Incorrect Scale Factors for the x_DELTVEL_OUT Registers and the x_DELTVEL_LOW Registers [er002]

Background	The ADIS16480 provides delta velocity registers, which contain sample-to-sample velocity estimates for all three axes. The x_DELTVEL_OUT registers provide the upper 16 bits, and the x_DELTVEL_LOW registers provide the lower 16 bits. The x_DELTVEL_OUT registers typically provide a scale factor of $200 \div 2^{15}$ m/sec per LSB, and the x_DELTVEL_LOW registers provide additional resolution ($200 \div 2^{31}$ m/sec per LSB). The ADIS16480 (Rev. A) data sheet incorrectly documents these scale factors as $160 \div 2^{15}$ and $160 \div 2^{31}$, respectively; these errors are being addressed in Rev. B of the data sheet.
Issue	On units that have Firmware Revision 2.01 (or earlier), the delta velocity registers do not have the same scale factors as those listed in the ADIS16480 data sheet. For these units, the scale factors are $97.65 \div 2^{15}$ m/sec per LSB for x_DELTVEL_OUT and $97.65 \div 2^{31}$ m/sec per LSB for x_DELTVEL_LOW.
Workaround	Use $97.65 \div 2^{15}$ m/sec per LSB for the x_DELTVEL_OUT scale factor and $97.65 \div 2^{31}$ m/sec per LSB for the x_DELTVEL_LOW scale factor. Use the FIRM_REV register to determine the firmware revision of a unit. For example, FIRM_REV = 0x0201 equates to a Firmware Revision 2.01.
Related Issues	None.

Table 3. Inaccurate TEMP_OUT Readings [er003]

Background	The TEMP_OUT register provides the internal temperature measurement, which serves as an input to the inertial calibration outputs and also provides a variable that enables users to monitor relative temperature changes inside the unit.
Issue	On units that have Firmware Revision 2.01 (or earlier), the TEMP_OUT bias error is -10°C , and the scale factor is approximately 5% lower than the scale factor reflected in the ADIS16480 data sheet.
Workaround	Use devices that have Firmware Revision 2.02 or later to benefit from the improvement in the TEMP_OUT accuracy. For specific, in-application accuracy, users may want to consider their own calibration process because attachment, airflow, and other mechanical variables can affect the TEMP_OUT relationship with ambient temperature conditions. Use the FIRM_REV register to determine the firmware revision of a unit. For example, FIRM_REV = 0x0201 equates to a FirmwareRevision 2.01.
Related Issues	None.

Rev. 0

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Table 4. Incorrect Output Data String After Writing to the FNCTIO_CTRL Register [er004]

Background	The FNCTIO_CTRL register provides user configuration control for the digital I/O pins, and the TEMP_OUT register provides the internal temperature measurement, which serves as an input to the inertial calibration outputs.
Issue	On units that have Firmware Revision 2.01 (or earlier), a write to the FNCTIO_CTRL register causes the TEMP_OUT variable to contain an incorrect value for 120 samples. Because this is an input to the calibration function for the gyroscopes and accelerometers, this issue causes the appearance of a discrete bias change between Sample 120 and Sample 121.
Workaround	When using units that have Firmware Revision 2.01 (or earlier), ignore the first 120 samples of the output registers after writing to the FNCTIO_CTRL register. Use the FIRM_REV register to determine the firmware revision of a unit. For example, FIRM_REV = 0x0201 equates to a firmware revision of 2.01.
Related Issues	None.

Table 5. Incorrect Offset and Scale Correction Order [er005]

Background	Each accelerometer and gyroscope has unique user configurable offset and scale correction registers. For instance, on the x-axis gyroscope, the XG_BIAS_HIGH and XG_BIAS_LOW registers combine to provide the 32-bit, twos complement bias (offset) correction factor, and the X_GYRO_SCALE register provides the scale correction function. The proper order of applying these correction factors is bias correction first and scale correction second.
Issue	On units that have Firmware Revision 2.01 (or earlier), the order of application is reversed, and the ADIS16480 applies the scale correction value first, followed by the offset value.
Workaround	When using units that have firmware Revision 2.01 or earlier, if this function is part of the system-level calibration processes, note this difference. Use the FIRM_REV register to determine the firmware revision of a unit. For example, FIRM_REV = 0x0201 equates to a Firmware Revision 2.01.
Related Issues	None.

Table 6. Factory Restore Command in GLOB_CMD Not Working Properly [er006]

Background	GLOB_CMD[6] provides a factory restore function that enables users to reset all user configurable calibration registers to 0x0000 (factory default). To activate this function, turn to Page 3 by setting DIN = 0x8003, and then set GLOB_CMD[6] = 1 by writing the following two 16-bit commands to the DIN line: 0x8240 and 0x8300.
Issue	On units that have Firmware Revision 2.03 (or earlier), setting GLOB_CMD[6] = 1 does not reset all calibration registers.
Workaround	When using units that have Firmware Revision 2.03 (or earlier), write 0x0000 to each individual calibration register. Use the FIRM_REV register to determine the firmware revision of a unit. For example, FIRM_REV = 0x0203 equates to a Firmware Revision 2.03.
Related Issues	None.

Table 7. EKF Setting Time and Accuracy Affected by Accidental Writes to Hidden Register [er007]

Background	In the ADIS16480 data sheet, Address 0x0E on Page 3 is a reserved location. Although this location contains a valid user register for other products in this same family, it is not accessible through the serial peripheral interface (SPI) for users.
Issue	On units that have Firmware Revision 2.04 and earlier, this location is not write protected and can influence the extended Kalman filter (EKF) operation.
Workaround	On Page 3, write 0x04 to Address 0x0E and write 0x07 to Address 0x0F to restore proper EKF settling and operation. Note that the factory default is 0x070A for all devices that have Firmware Revision 2.04 and earlier. If this setting is providing proper service for a particular application, there is no need to change it. Ensure that this location does not experience any other write commands. The impact of moving from 0x070A to 0x0704 is that the EKF settling time is reduced from ~26 sec to ~416 ms.
Related Issues	None.

Table 8. Magnetometer Calibration Equation Updates [er008]

Background	The ADIS16480 offers a 3×3 soft iron correction matrix and a 3×1 hard iron correction array for users who implement these types of correction processes into their systems and processes. Each of these correction factors has a user programmable register location that contains their specific values.
Issue	<p>The manner in which these factors apply to the magnetometer data has changed. On units that have Firmware Revision 2.02 and earlier, these correction factors apply to the magnetometer data using the following formula:</p> $\begin{bmatrix} M_{XC} \\ M_{YC} \\ M_{ZC} \end{bmatrix} = \begin{bmatrix} 1 + S_{11} & S_{12} & S_{13} \\ S_{21} & 1 + S_{22} & S_{23} \\ S_{31} & S_{32} & 1 + S_{33} \end{bmatrix} \times \begin{bmatrix} M_X \\ M_Y \\ M_Z \end{bmatrix} + \begin{bmatrix} H_X \\ H_Y \\ H_Z \end{bmatrix}$ <p>On units that have Firmware Revision 2.03 and later, these correction factors apply to the magnetometer data using the following formula:</p> $\begin{bmatrix} M_{XC} \\ M_{YC} \\ M_{ZC} \end{bmatrix} = \begin{bmatrix} 1 + S_{11} & S_{12} & S_{13} \\ S_{21} & 1 + S_{22} & S_{23} \\ S_{31} & S_{32} & 1 + S_{33} \end{bmatrix} \times \left[\begin{bmatrix} M_X \\ M_Y \\ M_Z \end{bmatrix} + \begin{bmatrix} H_X \\ H_Y \\ H_Z \end{bmatrix} \right]$
Workaround	This difference is associated with Revision B of the ADIS16480 data sheet. For those who use this function and want to maintain long term consistency, use external processing to apply these correction factors to the magnetometer data produced by ADIS16480 units that have Firmware Revision 2.02 or earlier.
Related Issues	None.

ANOMALY STATUS

Table 9. [ADIS16480](#) Functionality Issues Status

Reference Number	Description	Status	Date Code
er001	Incorrect scale factors for the x_DELTANG_OUT registers and the x_DELTANG_LOW registers	Fixed	1226
er002	Incorrect scale factors for the x_DELTVEL_OUT registers and the x_DELTVEL_LOW registers	Fixed	1226
er003	Inaccurate TEMP_OUT readings	Fixed	1226
er004	Incorrect output data string after writing to the FNCTIO_CTRL register	Fixed	1226
er005	Incorrect offset and scale correction order	Fixed	1226
er006	Factory restore command in GLOB_CMD not working properly	Fixed	1314
er007	EKF setting time and accuracy affected by accidental writes to hidden register	Open	
er008	Magnetometer calibration equation updates	Open	

NOTES