±300°/sec Yaw Rate Gyro

ADXRS620

FEATURES

Complete rate gyroscope on a single chip
Z-axis (yaw rate) response
High vibration rejection over wide frequency
2000 *g* powered shock survivability
Ratiometric to referenced supply
5 V single-supply operation
105°C operation
Self-test on digital command
Ultrasmall and light (<0.15 cc, <0.5 gram)
Temperature sensor output
RoHS compliant

APPLICATIONS

Vehicle chassis rollover sensing
Inertial measurement units
Platform stabilization

GENERAL DESCRIPTION

The ADXRS620 is a complete angular rate sensor (gyroscope) that uses the Analog Devices, Inc., surface-micromachining process to create a functionally complete and low cost angular rate sensor integrated with all required electronics on one chip. The manufacturing technique for this device is the same high volume BiMOS process that is used for high reliability automotive airbag accelerometers.

The output signal, RATEOUT (1B, 2A), is a voltage that is proportional to angular rate about the axis normal to the top surface of the package. The output is ratiometric with respect to a provided reference supply. An external capacitor sets the bandwidth. Other external capacitors are required for operation.

A temperature output is provided for compensation techniques. Two digital self-test inputs electromechanically excite the sensor to test proper operation of both the sensor and the signal conditioning circuits. The ADXRS620 is available in a 7 mm × 7 mm × 3 mm BGA ceramic package.

FUNCTIONAL BLOCK DIAGRAM

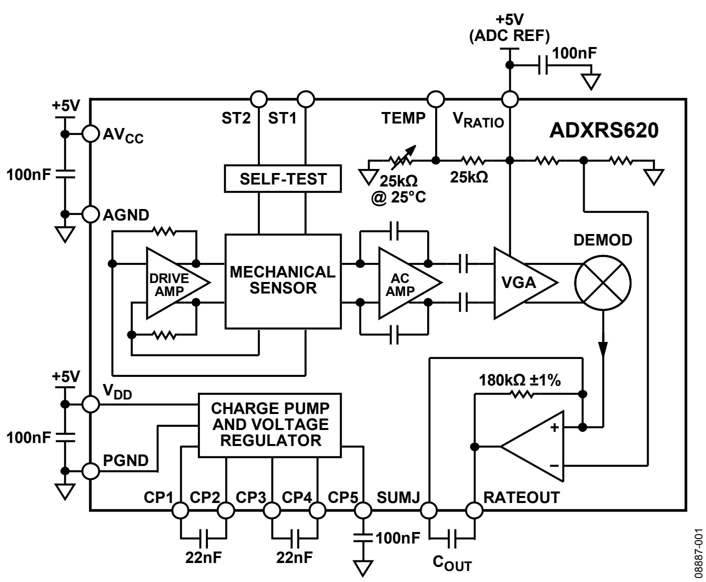

Figure 1.

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REVISION HISTORY

3/10—Revision 0: Initial Version

SPECIFICATIONS

All minimum and maximum specifications are guaranteed. Typical specifications are not guaranteed. T_A = −40°C to +105°C, V_S = AV_{CC} = V_{DD} = 5 V, V_{RATIO} = AV_{CC}, angular rate = 0°/sec, bandwidth = 80 Hz (C_{OUT} = 0.01 μF), I_{OUT} = 100 μA, ±1 *g*, unless otherwise noted.

Table 1.

Parameter	Conditions	Min	Typ	Max	Unit
SENSITIVITY[1]	Clockwise rotation is positive output				
Measurement Range[2]	Full-scale range over specifications range	±300			°/sec
Initial and Over Temperature	−40°C to +105°C	5.52	6	6.48	mV/°/sec
Temperature Drift[3]			±2		%
Nonlinearity	Best fit straight line		0.1		% of FS
NULL[1]					
Null	−40°C to +105°C	2.2	2.5	2.8	V
Linear Acceleration Effect	Any axis		0.1		°/sec/*g*
NOISE PERFORMANCE					
Rate Noise Density	T_A ≤ 25°C		0.05		°/sec/√Hz
FREQUENCY RESPONSE					
Bandwidth[4]		0.01		2500	Hz
Sensor Resonant Frequency		12	14.5	17	kHz
SELF-TEST[1]					
ST1 RATEOUT Response	ST1 pin from Logic 0 to Logic 1	−650	−450	−250	mV
ST2 RATEOUT Response	ST2 pin from Logic 0 to Logic 1	250	450	650	mV
ST1 to ST2 Mismatch[5]		−5		+5	%
Logic 1 Input Voltage		3.3			V
Logic 0 Input Voltage				1.7	V
Input Impedance	To common	40	50	100	kΩ
TEMPERATURE SENSOR[1]					
V_{OUT} at 25°C	Load = 10 MΩ	2.35	2.5	2.65	V
Scale Factor[6]	@ 25°C, V_{RATIO} = 5 V		9		mV/°C
Load to V_S			25		kΩ
Load to Common			25		kΩ
TURN-ON TIME	Power on to ±½°/sec of final			50	ms
OUTPUT DRIVE CAPABILITY					
Current Drive	For rated specifications			200	μA
Capacitive Load Drive				1000	pF
POWER SUPPLY					
Operating Voltage (V_S)		4.75	5.00	5.25	V
Quiescent Supply Current			3.5	4.5	mA
TEMPERATURE RANGE					
Specified Performance		−40		+105	°C

[1] Parameter is linearly ratiometric with V_{RATIO}.
[2] The maximum range possible, including output swing range, initial offset, sensitivity, offset drift, and sensitivity drift at 5 V supplies.
[3] From +25°C to −40°C or from +25°C to 105°C.
[4] Adjusted by external capacitor, C_{OUT}. Reducing bandwidth below 0.01 Hz does not reduce noise further.
[5] Self-test mismatch is described as (ST2 + ST1)/((ST2 − ST1)/2).
[6] For a change in temperature from 25°C to 26°C. V_{TEMP} is ratiometric to V_{RATIO}. See the Temperature Output and Calibration section for more details.

ABSOLUTE MAXIMUM RATINGS

Table 2.

Parameter	Rating
Acceleration (Any Axis, 0.5 ms)	
Unpowered	2000 *g*
Powered	2000 *g*
V_{DD}, AV_{CC}	−0.3 V to +6.0 V
V_{RATIO}	AV_{CC}
ST1, ST2	AV_{CC}
Output Short-Circuit Duration (Any Pin to Common)	Indefinite
Operating Temperature Range	−55°C to +125°C
Storage Temperature Range	−65°C to +150°C

Stresses above those listed under the Absolute Maximum Ratings may cause permanent damage to the device. This is a stress rating only; functional operation of the device at these or any other conditions above those indicated in the operational section of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Drops onto hard surfaces can cause shocks of greater than 2000 *g* and can exceed the absolute maximum rating of the device. Exercise care during handling to avoid damage.

RATE SENSITIVE AXIS

The ADXRS620 is a Z-axis rate-sensing device (also called a yaw rate sensing device). It produces a positive going output voltage for clockwise rotation about the axis normal to the package top, that is, clockwise when looking down at the package lid.

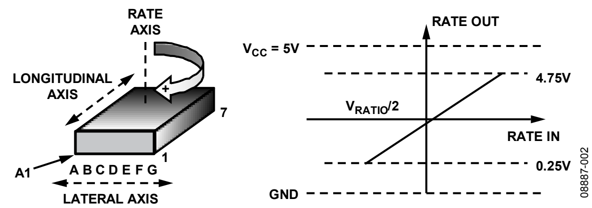
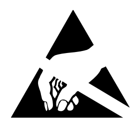


Figure 2. RATEOUT Signal Increases with Clockwise Rotation

ESD CAUTION



ESD (electrostatic discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

PIN CONFIGURATION AND FUNCTION DESCRIPTIONS

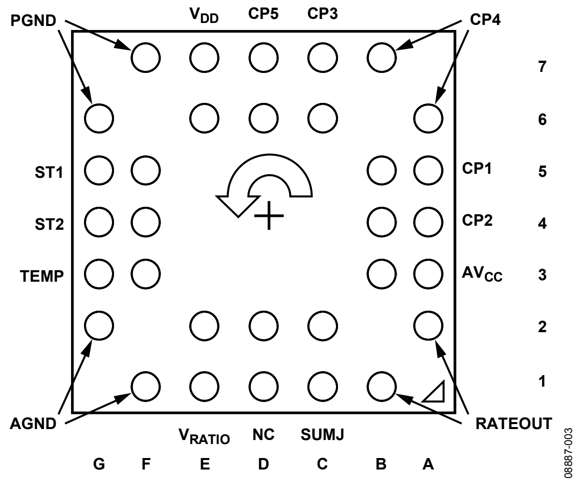


Figure 3. Pin Configuration

Table 3. Pin Function Descriptions

Pin No.	Mnemonic	Description
6D, 7D	CP5	HV Filter Capacitor (0.1 µF).
6A, 7B	CP4	Charge Pump Capacitor (22 nF).
6C, 7C	CP3	Charge Pump Capacitor (22 nF).
5A, 5B	CP1	Charge Pump Capacitor (22 nF).
4A, 4B	CP2	Charge Pump Capacitor (22 nF).
3A, 3B	AV_{CC}	Positive Analog Supply.
1B, 2A	RATEOUT	Rate Signal Output.
1C, 2C	SUMJ	Output Amp Summing Junction.
1D, 2D	NC	No Connect.
1E, 2E	V_{RATIO}	Reference Supply for Ratiometric Output.
1F, 2G	AGND	Analog Supply Return.
3F, 3G	TEMP	Temperature Voltage Output.
4F, 4G	ST2	Self-Test for Sensor 2.
5F, 5G	ST1	Self-Test for Sensor 1.
6G, 7F	PGND	Charge Pump Supply Return.
6E, 7E	V_{DD}	Positive Charge Pump Supply.

TYPICAL PERFORMANCE CHARACTERISTICS

N > 1000 for all typical performance plots, unless otherwise noted.

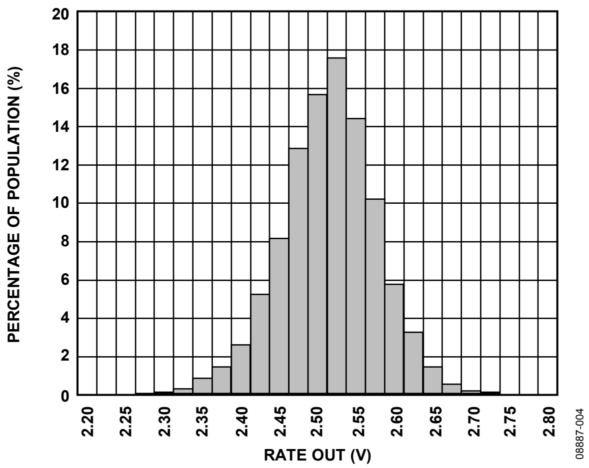


Figure 4. Null Output at 25°C (V_{RATIO} = 5 V)

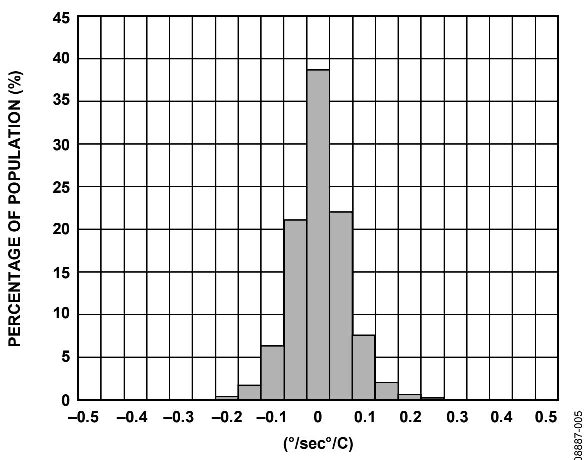


Figure 5. Null Drift over Temperature (V_{RATIO} = 5 V)

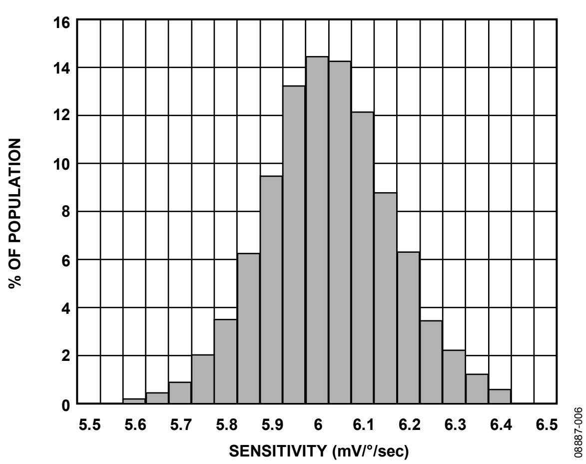


Figure 6. Sensitivity at 25°C (V_{RATIO} = 5 V)

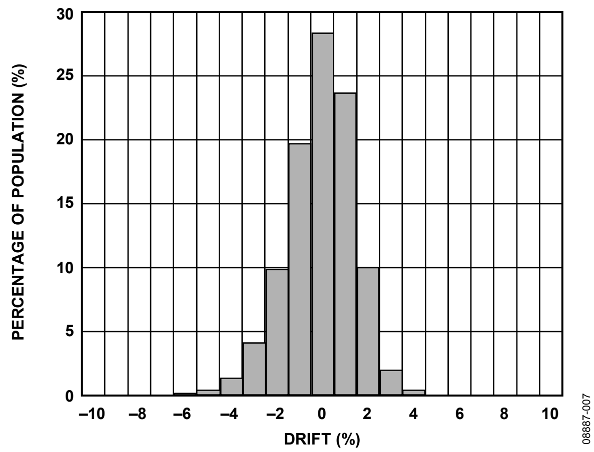


Figure 7. Sensitivity Drift over Temperature

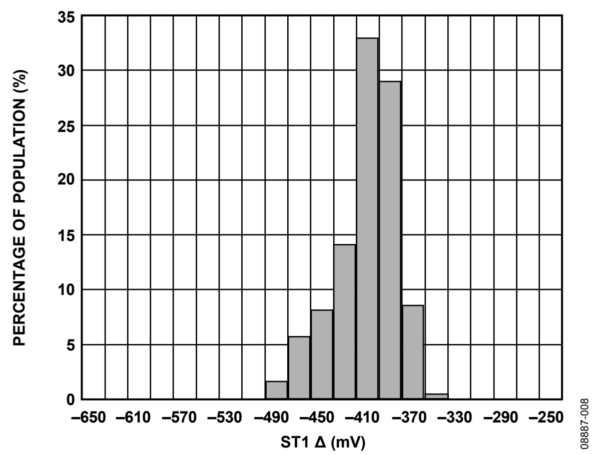


Figure 8. ST1 Output Change at 25°C (V_{RATIO} = 5 V)

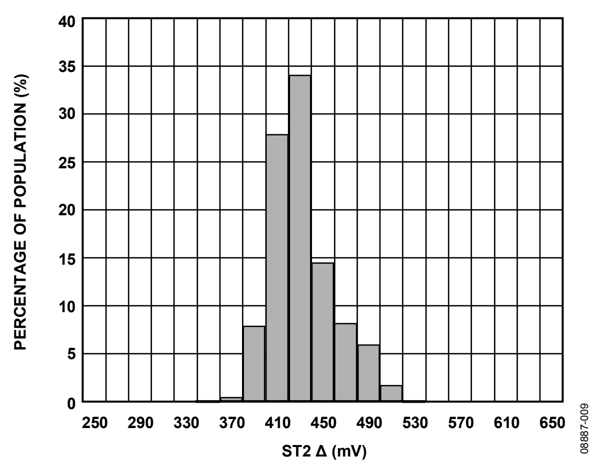


Figure 9. ST2 Output Change at 25°C (V_{RATIO} = 5 V)

Figure 10. Self-Test Mismatch at 25°C (V_{RATIO} = 5 V)

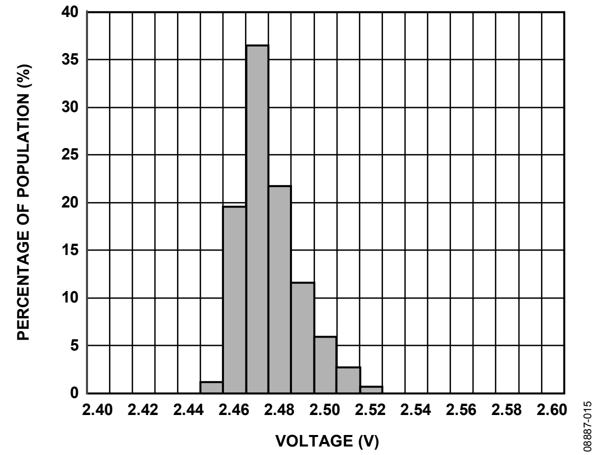


Figure 13. V_{TEMP} Output at 25°C (V_{RATIO} = 5 V)

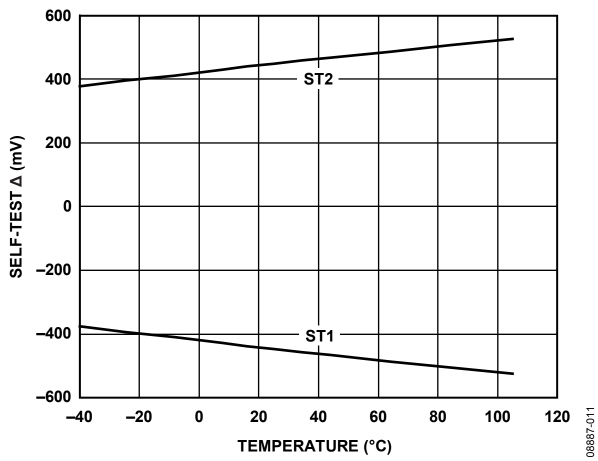


Figure 11. Typical Self-Test Change over Temperature

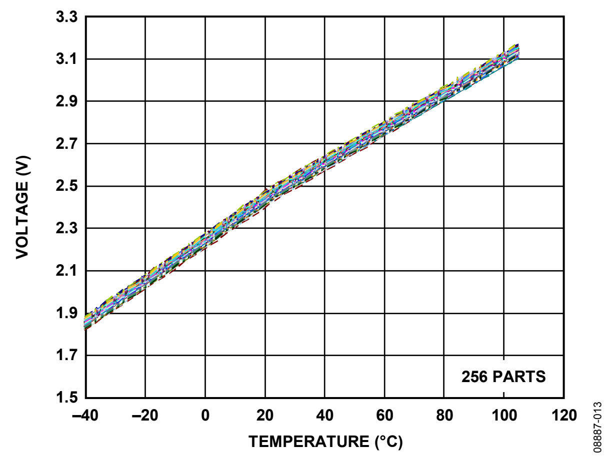


Figure 14. V_{TEMP} Output over Temperature (V_{RATIO} = 5 V)

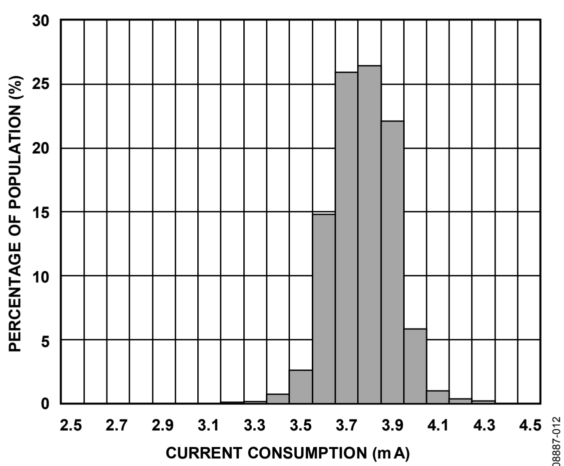


Figure 12. Current Consumption at 25°C (V_{RATIO} = 5 V)

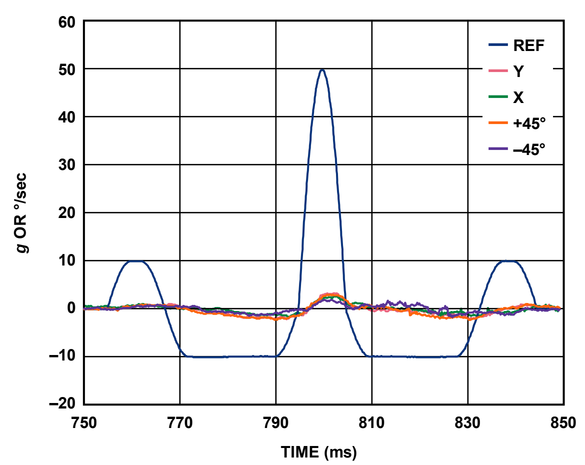


Figure 15. g *and* g × g *Sensitivity for a 50* g*, 10 ms Pulse*

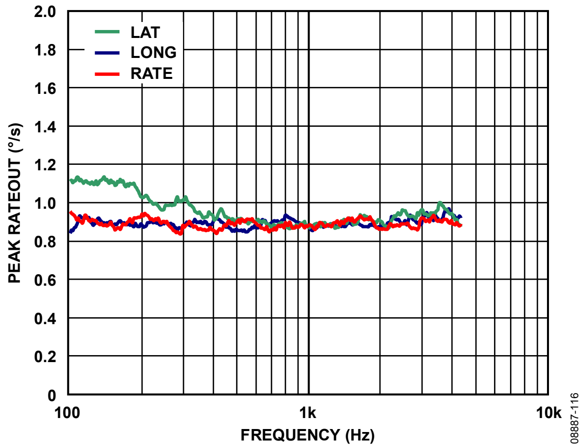


Figure 16. Typical Response to 10 g Sinusoidal Vibration (Sensor Bandwidth = 2 kHz)

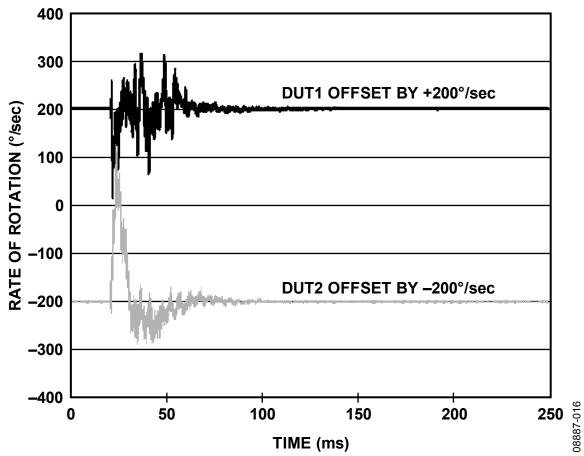


Figure 17. Typical High g (2500 g) Shock Response (Sensor Bandwidth = 40 Hz)

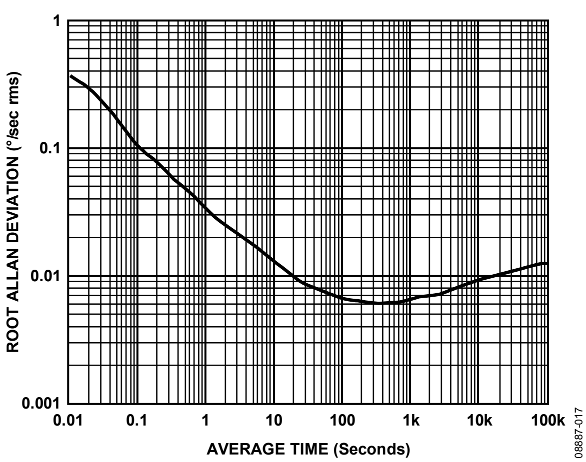


Figure 18. Typical Root Allan Deviation at 25°C vs. Averaging Time

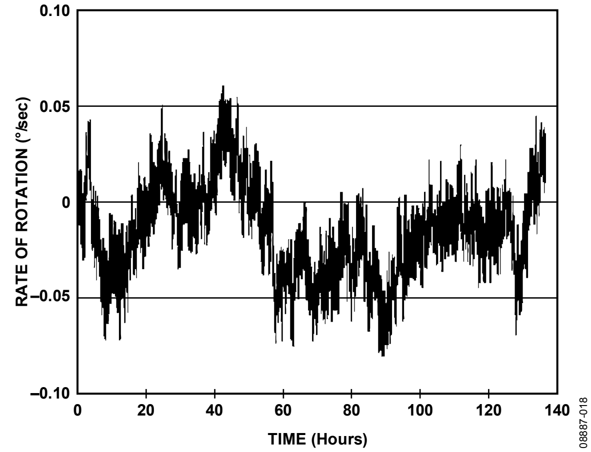


Figure 19. Typical Shift in 90 sec Null Averages Accumulated over 140 Hours

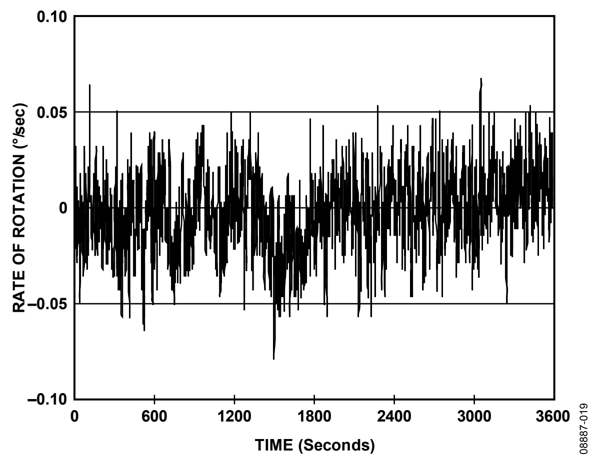


Figure 20. Typical Shift in Short-Term Null (Bandwidth = 1 Hz)

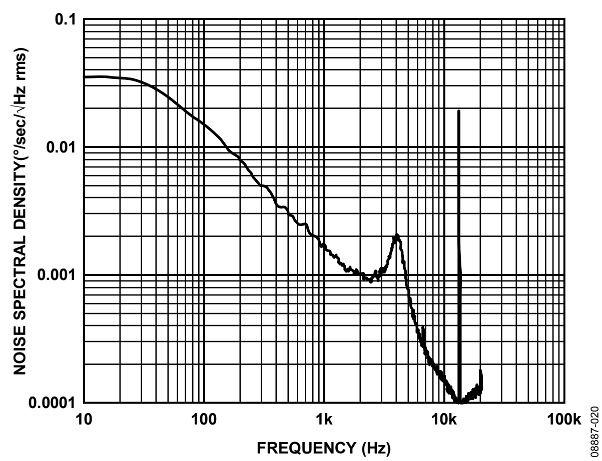


Figure 21. Typical Noise Spectral Density (Bandwidth = 40 Hz)