



±5 g Out-of-balance Detection Module with Ratiometric Analog Outputs

MXR7202GMW

FEATURES

- Dual axis out-of-balance detection module
- Small waterproof package: 15mm X 27mm X 9mm
- RoHS Compliant
- Ultra low initial Zero-g Offset
- No adjustment needed outside
- Easily mounted
- 2.7V to 5.25V single supply continuous operation
- >50,000 g shock survival rating
- Resolution better than 1 milli-g
- Complete with 4-wire harness



MXR7202GMW PICTURE

APPLICATIONS

Whitegoods – Washing machine out-of-balance detection

GENERAL DESCRIPTION

The MXR7202GMW is a low cost, watertight out-of-balance detection module capable of detecting both low and high RPM out-of-balance conditions in today's front and top loading washing machines. The trend of washing machines using higher spin speed to meet the energy efficiency goals set forth by the EU and other nations requires closer monitoring of out-of-balance conditions than available with legacy solutions. The MXR7202GMW provides precise information on the magnitude of the out-of-balance condition, enabling corrective action to be taken at lower RPM. The out-of-balance condition can be monitored at each RPM setting to determine when it is safe to move to the next higher speed. The MXR7202GMW measures acceleration with a full-scale range of ±5g with a sensitivity of 312mV/g @5V at 25°C.

The MXR7202GMW design is based on heat convection and has no moving parts or resonant frequencies, providing accurate acceleration data in all operating environments. The no-moving-part design eliminates stiction and particle problems associated with competitive devices and provides shock survival greater than 50,000 g, leading to significantly lower field failure rates and associated warranty repair costs. The MXR7202GMW provides two ratiometric analog outputs that are proportional to supply voltage. Zero acceleration is centered at 50% of the supply voltage.

The typical noise floor is $0.3 \text{ mg}/\sqrt{\text{Hz}}$ allowing signals below 1 milli-g to be resolved at 1 Hz bandwidth. The MXR7202GMW is packaged in a waterproof package (15 mm x 27 mm x 9 mm height) and is operational from 0C to 70C.

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MXR7202GMW SPECIFICATIONS (Measurements @ 25°C, Acceleration = 0 g unless otherwise noted; V_{DD} = 5.0V unless otherwise specified)

Parameter	Conditions	MXR7202GMW			Units
		Min	Typ.	Max	
SENSOR INPUT					
Measurement Range ¹	Each Axis	±5.0			g
Nonlinearity	Best fit straight line		0.5	1.0	% of FS
Alignment Error ²			±1.0		degrees
Alignment Error	X Sensor to Y Sensor		0.01		degrees
Cross Axis Sensitivity ³			±0.5		%
SENSITIVITY					
Sensitivity Xout, Yout	Each Axis V _{DD} =5.0V	287	312	337	mV/g
Sensitivity Xout, Yout	V _{DD} =3.0V	168	187	206	mV/g
Sensitivity Change over Temperature ⁴	Delta from 25°C			10	%
ZERO g BIAS LEVEL					
0 g Voltage Xout, Yout	V _{DD} =5.0V	2.42	2.50	2.58	V
0 g Voltage Xout, Yout	V _{DD} =5.0V	-0.26	0.00	0.26	g
0 g Voltage Xout, Yout	V _{DD} =3.0V	1.44	1.50	1.56	V
0 g Voltage Xout, Yout	V _{DD} =3.0V	-0.32	0.00	0.32	g
0 g Offset vs. Temperature ⁴	Delta from 25°C		1.5		mg/°C
NOISE PERFORMANCE					
Noise Density, rms	@25°C		0.3	0.8	mg/√Hz
FREQUENCY RESPONSE					
3dB Bandwidth		17	19	21	Hz
POWER SUPPLY					
Operating Voltage Range		2.70		5.25	V
Quiescent Supply Current	@5.0V		4.0	4.9	mA
Quiescent Supply Current	@3.0V		4.3	5.3	mA
AoutX and AoutY OUTPUTS					
Output High Voltage	@5.0V Supply	4.6			V
Output Low Voltage				0.4	V
Current	Source or sink @3.0V-5.0V Supply			100	uA
Turn-On Time ⁵			160		mS
TEMPERATURE RANGE					
Operating Range		0		+70	°C

NOTES

- ¹ Guaranteed by measurement of initial offset and sensitivity.
- ² Alignment error is specified as the angle between the true and indicated axis of sensitivity.
- ³ Cross axis sensitivity is the algebraic sum of the alignment and the inherent sensitivity errors.
- ⁴ Defined as the output change from ambient to maximum temperature or ambient to minimum temperature.
- ⁵ Output settled to within ±17mg.

ABSOLUTE MAXIMUM RATINGS*

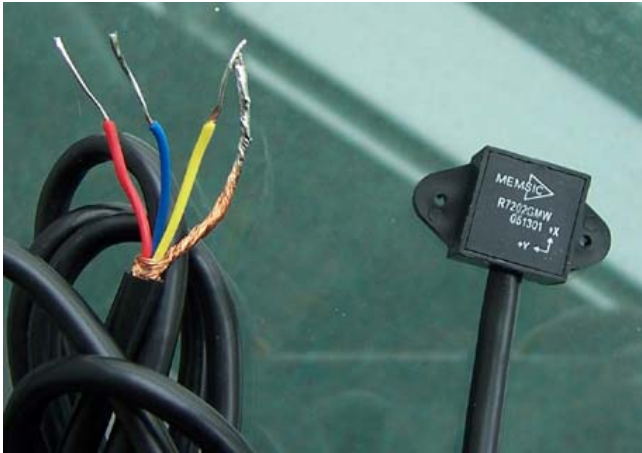
Supply Voltage (V_{DD})-0.5 to +7.0V
 Storage Temperature-65°C to +150°C
 Acceleration50,000 g

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

Pin Description:

Pin	Name	Description
1	GND	Ground
2	Vcc (Red)	Power supply
3	AoutX (Yellow)	X-axis output
4	AoutY (Blue)	Y-axis output

Caution: ESD (electrostatic discharge) sensitive device.



MXR7202GMW PIN DESCRIPTIONS

V_{cc} – This is the supply input for the accelerometer module. The DC voltage should be between 2.7 and 5.25 volts.

GND– This is the ground pin for the accelerometer module.

Aoutx – This pin is the output of the x-axis acceleration sensor. The user should ensure the load impedance is sufficiently high as to not source/sink >100µA typical.

Aouty – This pin is the output of the y-axis acceleration sensor. The user should ensure the load impedance is sufficiently high as to not source/sink >100µA typical.

Resolution: The accelerometer resolution is limited by noise. The output noise will vary with the measurement bandwidth. With the reduction of the bandwidth, by applying an external low pass filter, the output noise drops. Reduction of bandwidth will improve the signal to noise

ratio and the resolution. The output noise scales directly with the square root of the measurement bandwidth. The maximum amplitude of the noise, its peak- to- peak value, approximately defines the worst case resolution of the measurement. With a simple RC low pass filter, the rms noise is calculated as follows:

$$\text{Noise (mg rms)} = \text{Noise(mg/}\sqrt{\text{Hz)}} * \sqrt{(\text{Bandwidth(Hz)}*1.6)}$$

The peak-to-peak noise is approximately equal to 6.6 times the rms value (for an average uncertainty of 0.1%).

USING THE MXR7202GMW WITH OPERATING VOLTAGES OTHER THAN 5V

The MXR7202GMW is tested and specified at V_{DD}=5V; however, it can be powered with V_{DD} as low as 2.7V or as high as 5.25V. Some performance parameters will change as the supply voltage is varied. The MXR7202GMW output sensitivity will be linearly proportional to supply voltage. At 3V the output sensitivity is 3.0/5.0* 312mV/g = 187.2 mV/g. The zero g bias output is also ratiometric, so the zero g is normally equal to V_{cc}/2 at all supply voltages.

EXTERNAL FILTERS

AC Coupling: For applications where only dynamic accelerations (vibration) are to be measured, it is recommended to AC couple the accelerometer output as shown in Figure 2. The advantage of ac coupling is that zero g offset variations from part to part and zero g offset change over temperature can be eliminated. Figure 3 is a HFP (high pass filter) with a –3dB breakpoint given by the equation: $f = \frac{1}{2\pi RC}$. In many applications it may be desirable to have the HFP –3dB point at a very low frequency in order to detect very low frequency accelerations. Sometimes the implementation of this HFP may result in unreasonably large capacitors, and the designer may turn to digital implementations of HFPs where very low frequency –3dB breakpoints can be achieved.

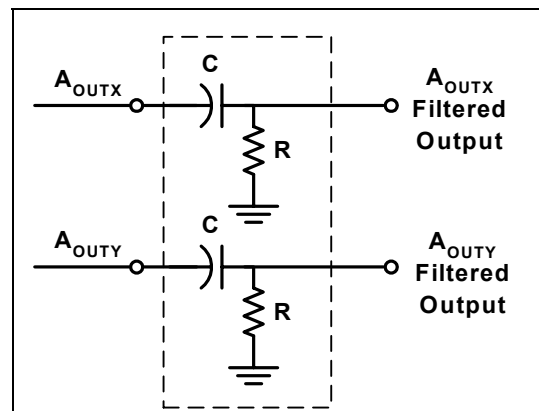


Figure 2: High Pass Filter

Low Pass Filter: An external low pass filter is useful in low frequency applications such as tilt or inclination. The low pass filter limits the noise floor and improves the resolution of the accelerometer. The low pass filter shown in Figure 4 has a -3dB breakpoint given by the equation: $f = 1/2\pi RC$. For the 200 Hz ratiometric output device filter, $C=0.1\mu\text{F}$ and $R=8\text{k}\Omega, \pm 5\%, 1/8\text{W}$.

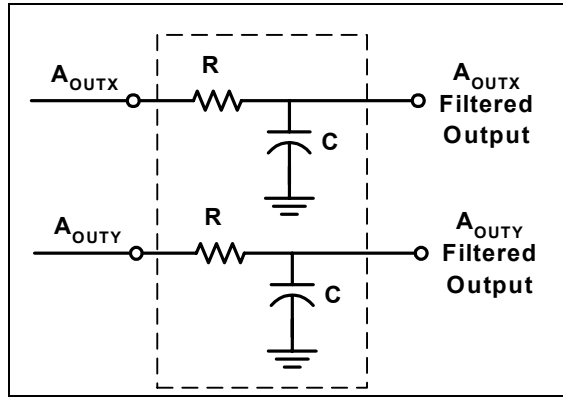


Figure 3: Low Pass Filter

Wiring Harness specification

Type: RVVP 3 X 0.12mm, stranded copper

Length: User definable between 0.5m – 1.5m

Wiring Harness Termination

Standard: 4 stripped and tinned copper stranded wire.

Optional: OEM defined connector

Housing Material

Halogen-contained Epoxy resins with acid anhydride as curing agent. Type: 9001(5203 2)A/-2B.

Related Products

MXD7205HMMW – Digital PWM output Out-of-balance detection module

MXC6205GMW – Digital I2C output Out-of-balance detection module

Other full scale g-ranges and sensitivities available upon request.

Package Drawing

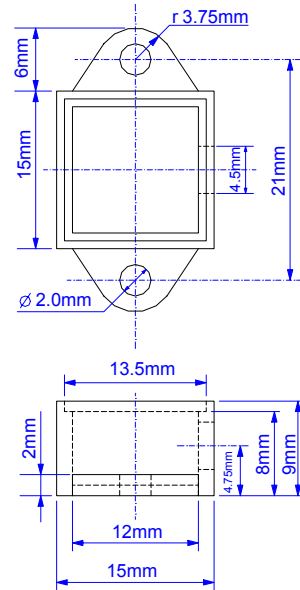


Fig 5: Sealed Package Outline