AccelRate-MAG3
Accelerometer Drive Capability
Revision 1

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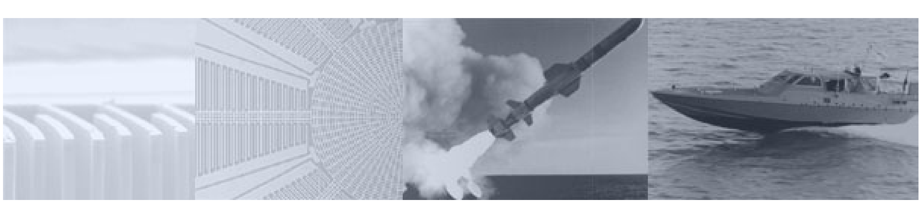
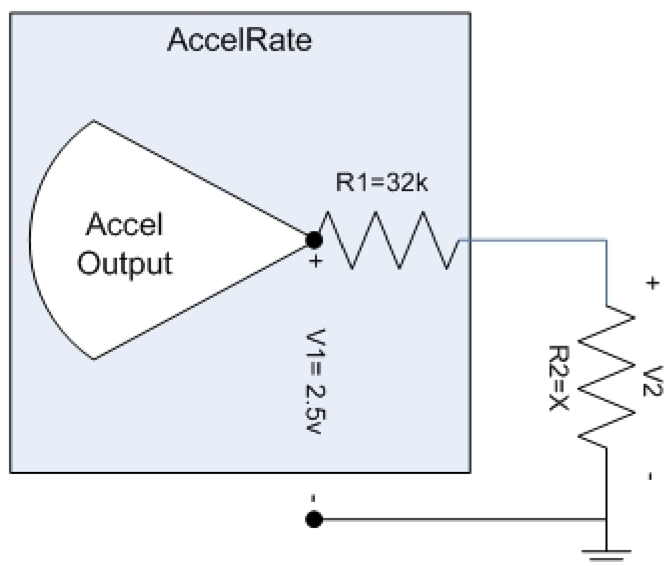


Accelerometer Drive Capability

Initial Considerations
The AccelRate and MAG3 products incorporate MEMS accelerometers that utilize a first order passive filter to limit the accelerometers' bandwidth. The inclusion of the resistive element in this filter can affect the output accuracy of the accelerometer if interfaced to a low impedance circuit.

Accelerometer Output Circuit Model
Approaching the output circuit as a resistive divider allows one to determine the amount of voltage error induced by the load on the circuit.

AccelRate Output Model



The resistive divider formula is:

Equation 1: $\frac{V2}{V1} = \frac{R2}{R1 + R2}$

Where V1 is the voltage output from the accelerometer; V2 is the voltage at the load; R1 is the output filter resistance; and R2 is the load resistance.

Equation 1 can be solved for V2 and compared to V1 to determine the error induced by the load resistance.

Equation 2: $V2 = \frac{R2}{(R1 + R2)} V1$

Next we want to see a range of typical operational amplifier input resistance values applied to Equation 2 along with the output resistor used on the accelerometers bandwidth filter. So fixing V1 at 2.5V (0 g) and R1 at 32K, R2 can then be swept to determine the percentage of error induced by the voltage divider between R1 and R2. The table below shows this result.

V1	R1	R2	V2	Percent Error
2.500	32.0E+3	4.0E+6	2.480	0.794%
2.500	32.0E+3	3.9E+6	2.480	0.814%
2.500	32.0E+3	3.8E+6	2.479	0.835%
2.500	32.0E+3	3.7E+6	2.479	0.857%
2.500	32.0E+3	3.6E+6	2.478	0.881%
2.500	32.0E+3	3.5E+6	2.477	0.906%
2.500	32.0E+3	3.4E+6	2.477	0.932%
2.500	32.0E+3	3.3E+6	2.476	0.960%
2.500	32.0E+3	3.2E+6	2.475	0.990%
2.500	32.0E+3	3.1E+6	2.474	1.022%
2.500	32.0E+3	3.0E+6	2.474	1.055%
2.500	32.0E+3	2.9E+6	2.473	1.091%
2.500	32.0E+3	2.8E+6	2.472	1.130%
2.500	32.0E+3	2.7E+6	2.471	1.171%
2.500	32.0E+3	2.6E+6	2.470	1.216%
2.500	32.0E+3	2.5E+6	2.468	1.264%
2.500	32.0E+3	2.4E+6	2.467	1.316%
2.500	32.0E+3	2.3E+6	2.466	1.372%
2.500	32.0E+3	2.2E+6	2.464	1.434%
2.500	32.0E+3	2.1E+6	2.462	1.501%
2.500	32.0E+3	2.0E+6	2.461	1.575%
2.500	32.0E+3	1.9E+6	2.459	1.656%
2.500	32.0E+3	1.8E+6	2.456	1.747%
2.500	32.0E+3	1.7E+6	2.454	1.848%
2.500	32.0E+3	1.6E+6	2.451	1.961%
2.500	32.0E+3	1.5E+6	2.448	2.089%
2.500	32.0E+3	1.4E+6	2.444	2.235%
2.500	32.0E+3	1.3E+6	2.440	2.402%
2.500	32.0E+3	1.2E+6	2.435	2.597%
2.500	32.0E+3	1.1E+6	2.429	2.827%
2.500	32.0E+3	1.0E+6	2.422	3.101%

Summary

Clearly operational amplifiers and analog buffers with high impedance inputs provide the least error in the accelerometer output. It must also be considered that the error caused by this voltage divider will be linear with the exception of nonlinear effects caused by resistor temperature coefficients.

The effects caused by the resistive divider and many more errors are corrected in MEMSense inertial measurement units through extensive test and embedded compensation algorithms. For more information on this topic or any of the MEMSense inertial products contact MEMSense at 888-668-8743 or email at info@memsense.com.