



### General Description

The DE-ACCM2G is an off the shelf 2 axis 2g accelerometer solution with analog outputs. It features integrated op amp buffers for direct connection to a microcontroller's analog inputs, or for driving heavier loads.

Additional circuitry ensures that the product won't be damaged by reversed power connections, or voltages above the recommended ratings.

The DE-ACCM2G is designed to fit the DIP-14 form factor, making it suitable for breadboarding, perfboarding, and insertion into standard chip sockets.

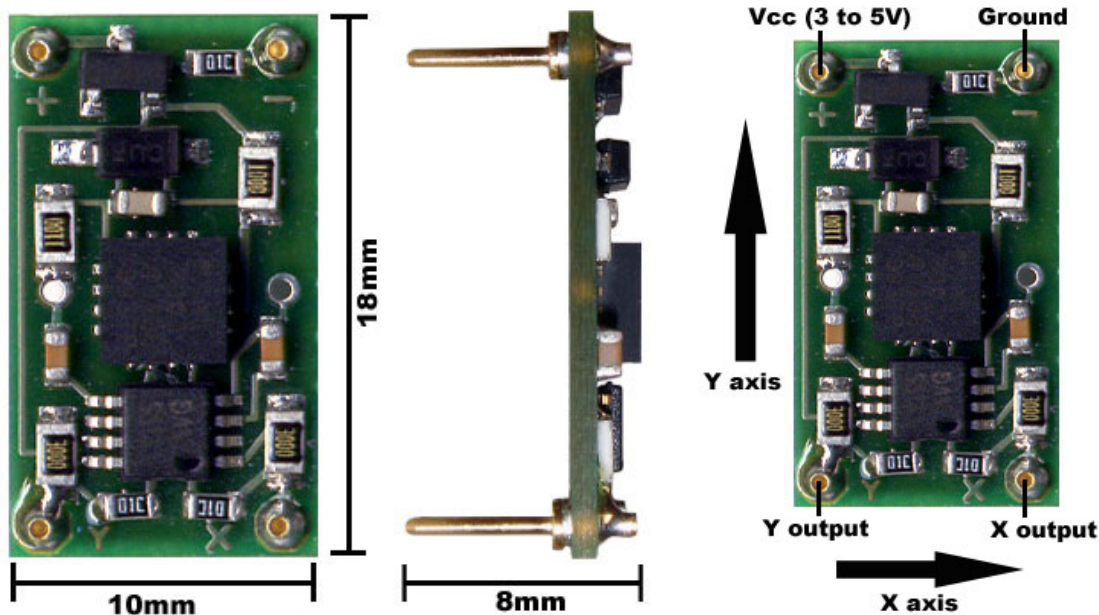
It is based on the Analog Devices ADXL322 for superior sensitivity and lower cost.

### Features

- Dual axis  $\pm 2g$  sense range
- Up to 750mV/g sensitivity
- 500Hz bandwidth
- Operating voltage 3 to 5V
- Reverse voltage protection
- Overvoltage protected up to 14V
- Output short protection
- Standard DIP-14 form factor
- Integrated power supply decoupling
- Draws under 2mA
- <4% typical 0g bias deviation from  $V_{cc}/2$
- Shiny gold pins to distract the enemy!

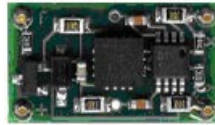
### Applications

- Motion, tilt and slope measurement
- Shock sensing
- Vehicle acceleration logging



## Measuring acceleration and tilt

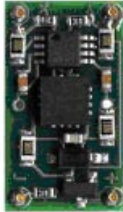
$V_{cc} = 3V$



Xout = 1.08V  
Yout = 1.50V



Xout = 1.500V  
Yout = 1.500V



Xout = 1.50V  
Yout = 1.92V



Xout = 1.50V  
Yout = 1.08V

Gravity's  
accelerative  
force of 1g



Xout = 1.92V  
Yout = 1.50V



Earth's surface

The voltage outputs on the DE-ACCM2G correspond to acceleration being experienced in the X and Y directions. The output is ratiometric, so the output sensitivity (in mV/g) will depend on the supply voltage. When supplied with 5V, sensitivity is typically 750mV/g. At 3V, sensitivity drops to 420mV/g. Zero acceleration (0g) will result in an output of  $V_{cc}/2$  regardless of the voltage supplied to the unit. Due to manufacturing variances when Analog Devices makes their accelerometer chips, these values aren't always set in stone. They can vary by up to 5% in extreme cases, including the 0g bias point. For projects that require a very high degree of accuracy, we recommend that you incorporate measured calibrations into your hardware/software.

**Voltage to acceleration example:**

"With a 5V supply, the X output reads 3.06V. What acceleration does this correspond to?"

At 5V, the 0g point is approximately  $V_{cc} / 2 = 5.00 / 2 = 2.50V$

$3.06V - 2.50V = +0.56V$  with respect to the 0g point

At 5V, if sensitivity is 750mV/g,  $0.56 / 0.750 = 0.747g$

Therefore the acceleration in the X direction is +0.747g

**Acceleration to voltage example:**

"I am powering the DE-ACCM2G with 3V. What voltage will correspond to an acceleration of -0.5g?"

At 3V, the 0g point is approximately 1.50V

If sensitivity at 3V is 420mV/g,  $-0.5 * 0.420 = -0.21V$  with respect to the 0g point.

$1.50V - 0.21V = 1.29V$

Therefore you can expect a voltage of approximately 1.29V when experiencing an acceleration of -0.5g.

**Voltage to tilt example:**

"With a  $V_{cc}$  of 3V, and the accelerometer oriented flat and parallel to ground in my robot,  $Y_{out}$  is 1.500V.

When my robot goes uphill,  $Y_{out}$  increases to 1.582V. What is the slope of the hill?"

$1.582V - 1.500 = +0.082V$  with respect to the 0g point.

With a sensitivity of 420mV/g,  $0.082 / 0.420 = 0.195g$

$\sin^{-1}(0.195) = 11.2^\circ$

The slope of the hill is  $11.2^\circ$  in the Y axis

**Tilt to voltage example:**

"I am making an antitheft device that will sound an alarm if it is tilted more than  $30^\circ$  with respect to ground in any direction. I have measured the 0g bias point to be 2.521V, and I want to know what voltage to trigger the alarm at. I am using a 5V source."

$\sin(30^\circ) = 0.5$  so acceleration with a tilt of  $30^\circ$  will be 0.5g

$0.5g * 0.750V/g = 0.375V$  with respect to the 0g point

$2.521 + 0.375 = 2.896V$

$2.521 - 0.375 = 2.146V$

Sound the alarm when the voltage reaches more than 2.896V or less than 2.146V.

# Performance features

## Output buffers

A bare accelerometer chip has an output impedance of  $32\text{k}\Omega$ , which is unsuitable for obtaining reliable measurements when connected to an analog to digital converter. On the DE-ACCM2G, a dual rail to rail operational amplifier buffers the outputs from the ADXL322, greatly reducing output impedance.

### → Buffer loading characteristics

For the purposes of this section, “max load” is defined as the resistive load that will cause a 2mV drop in the output voltage at 0g. If your application does not require this level of accuracy, the DE-ACCM2G can supply even more current at the cost of a larger drop in output voltage.

Max load at Vcc of 5v is 0.83mA, or a resistance of  $3\text{k}\Omega$

Max load at Vcc of 3v is 0.50mA, or a resistance of  $3\text{k}\Omega$

## Supply filtering

A pair of resistors and a 0.1uF ceramic bypass capacitor on the DE-ACCM2G provide excellent power supply decoupling. No external capacitors are necessary between Vcc and GND.

## Output filtering and noise

A pair of 10nF capacitors limit the noise figure of the DE-ACCM2G, without overly sacrificing bandwidth. RMS noise is typically 6.2mg, and output bandwidth is 500Hz - making it suitable for high frequency sampling of acceleration.

# Protection features

## Overvoltage up to 14V

During prototyping, a common mistake is to power a device without checking the voltage output of one's bench supply first. To ensure the ADXL322 chip on a DE-ACCM2G won't get damaged by this, a zener diode in parallel with the ADXL322's power pins clamps the voltage supplied to a maximum of 5.6V. This is not intended to be a long-term voltage regulation solution. Do not run the DE-ACCM2G at more than its recommended input voltage of 3-5V for more than 5 minutes at a time!

It is important to note that the X and Y outputs remain unclamped, i.e. 0g still corresponds to  $V_{cc}/2$ . So if one accidentally powers a DE-ACCM2G with 14V, the outputs would read 7v or more, which might be enough to damage an external device connected at the time.

## Reverse voltage

Even the best engineers sometimes get their wires crossed. In the event that you mix up VCC and GND, a P channel MOSFET will prevent current from flowing – protecting the DE-ACCM2G from damage. This protection is only designed to work with DC voltages. Do not apply AC voltages to the power pins.

## Improper insertion

A resistor network ensures that the DE-ACCM2G will not be permanently damaged if you insert it backwards (i.e. apply power to the output pins). The product will not function properly while it is used backwards. Do not leave the DE-ACCM2G inserted backwards for more than 5 minutes at a time.

## Output shorting

The operational amplifier driving the DE-ACCM2G's outputs is capable of handling a direct short from the X and Y outputs to ground for as long as you want.