Acceleration Measurement

Rick Sellens

Seismic Transducer

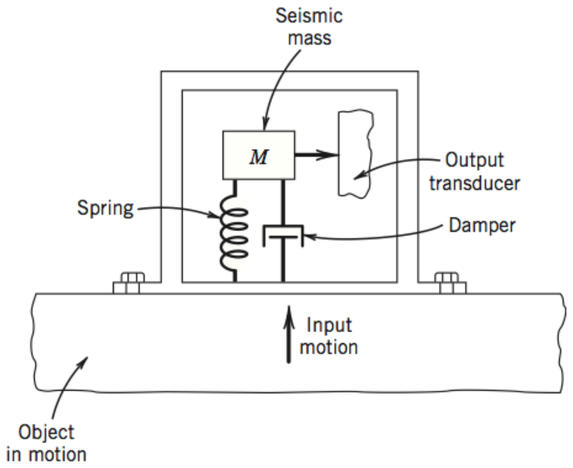
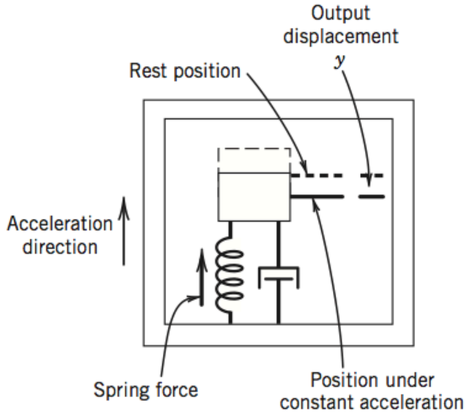


Figure 12.7 Seismic transducer.

- Big, old school system will have a low natural frequency
- Smaller, lighter, stiffer, faster possible in silicon



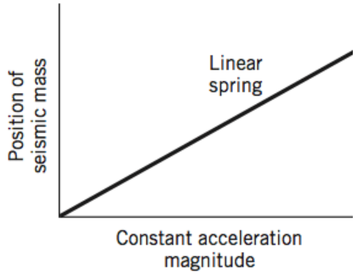


Figure 12.8 Response of a seismic transducer to a constant acceleration.

Senses Acceleration and Gravity

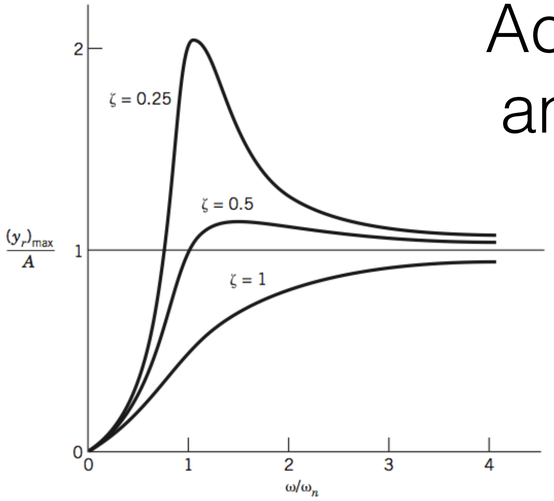
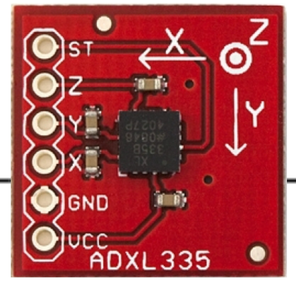


Figure 12.9 Displacement amplitude at steady state as a function of input frequency for a seismic transducer.

MEMS Accelerometers

ANALOG DEVICES



Small, Low Power, 3-Axis ±3 *g* Accelerometer

ADXL335

FEATURES

3-axis sensing
Small, low profile package
4 mm × 4 mm × 1.45 mm LFCSP
Low power : 350 µA (typical)
Single-supply operation: 1.8 V to 3.6 V
10,000 *g* shock survival
Excellent temperature stability
BW adjustment with a single capacitor per axis
RoHS/WEEE lead-free compliant

APPLICATIONS

Cost sensitive, low power, motion- and tilt-sensing applications
Mobile devices
Gaming systems
Disk drive protection
Image stabilization
Sports and health devices

- From the same people who brought us the TMP36
- Analog voltage outputs
- 5.5 kHz natural frequency

FUNCTIONAL BLOCK DIAGRAM

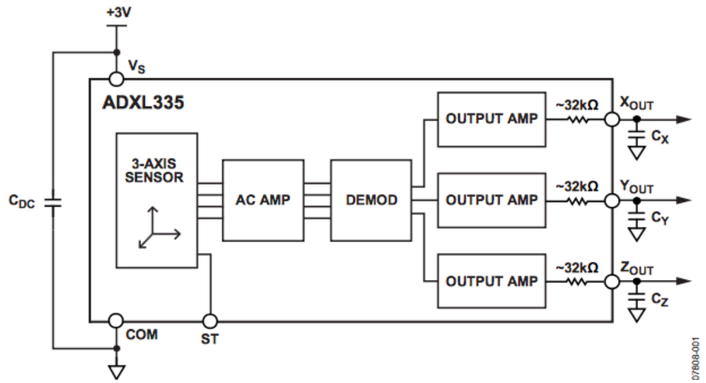


Figure 1.

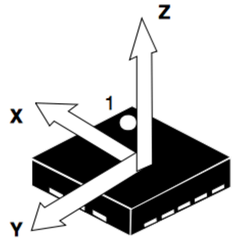
FREQUENCY RESPONSE[4]			
Bandwidth X_{OUT}, Y_{OUT}[5]	No external filter	1600	Hz
Bandwidth Z_{OUT}[5]	No external filter	550	Hz
R_{FILT} Tolerance		32 ± 15%	kΩ
Sensor Resonant Frequency		5.5	kHz

LIS3DH

MEMS digital output motion sensor
ultra low-power high performance 3-axes “nano” accelerometer

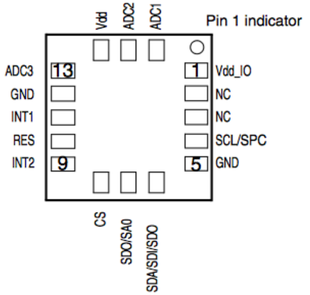
- Ultra low-power mode consumption down to 2 µA
- ±2*g*/±4*g*/±8*g*/±16*g* dynamically selectable full-scale
- I²C/SPI digital output interface
- 16 bit data output
- 2 independent programmable interrupt generators for free-fall and motion detection

Up to 5 kHz digital output data rate resolves frequencies up to 2.5 kHz or 150000 RPM



(TOP VIEW)

DIRECTION OF THE DETECTABLE ACCELERATIONS



(BOTTOM VIEW)

Applications

- Motion activated functions
- Free-fall detection
- Click/double click recognition
- Intelligent power saving for handheld devices
- Pedometer
- Display orientation
- Gaming and virtual reality input devices
- Impact recognition and logging
- Vibration monitoring and compensation

MEMS Rate Gyros

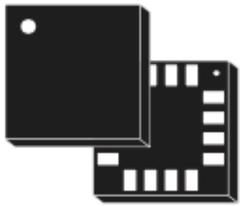
- Same approach as linear accelerometers, except configured to be sensitive to rotational acceleration
- Not really gyroscopes, as there are no spinning elements
- http://www.analog.com/en/analog-dialogue/articles/imems-angular-rate-sensing-gyroscope.html

life.augmented

L3GD20

MEMS motion sensor: three-axis digital output gyroscope

Datasheet - production data



LGA-16 (4x4x1 mm)

Features

- Three selectable full scales (250/500/2000 dps)
- I^2C/SPI digital output interface
- 16 bit-rate value data output

Applications

- Gaming and virtual reality input devices
- Motion control with MMI (man-machine interface)
- GPS navigation systems
- Appliances and robotics

Description

The L3GD20 is a low-power three-axis angular rate sensor.

It includes a sensing element and an IC interface capable of providing the measured angular rate to the external world through a digital interface (I^2C/SPI).

Magnetometer & Accelerometer

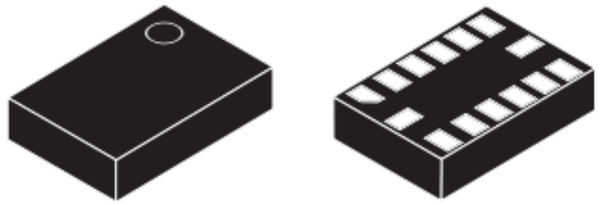
LSM303DLHC

Ultra compact high performance e-compass
3D accelerometer and 3D magnetometer module

Preliminary data

Features

- 3 magnetic field channels and 3 acceleration channels
- From ±1.3 to ±8.1 gauss magnetic field full-scale
- ±2g/±4g/±8g/±16g selectable full-scale
- 16 bit data output
- I^2C serial interface
- Analog supply voltage 2.16 V to 3.6 V
- Power-down mode/ low-power mode
- 2 independent programmable interrupt generators for free-fall and motion detection

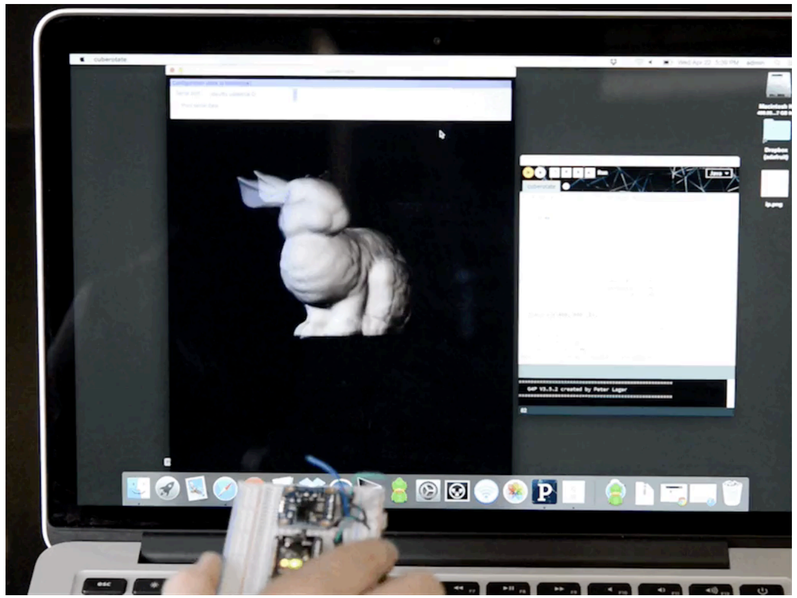


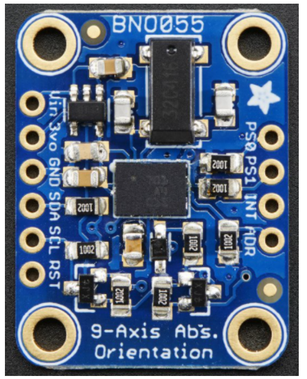
LGA-14 (3x5x1mm)

Description

The LSM303DLHC is a system-in-package featuring a 3D digital linear acceleration sensor and a 3D digital magnetic sensor.

IMUs (Inertial Measurement Units)





Adafruit 9-DOF Absolute Orientation IMU Fusion Breakout - BNO055

PRODUCT ID: 2472

$34.95

IN STOCK

- Accelerometer XYZ
- Rate Gyro XYZ Rotation
- Magnetometer XYZ Compass
- 32 bit microcontroller to do the sensor fusion math (hard stuff!)
- 100 Hz Absolute Orientation Output
- Good enough for controlling drones, fighter jets, space launches