

GENERAL DESCRIPTION

The MC3672 is an ultra-low power, low noise, integrated digital output 3-axis accelerometer with a feature set optimized for wearables and consumer product motion sensing. Applications include wearable consumer products, IoT devices, user interface control, gaming motion input, electronic compass tilt compensation for cell phones, game controllers, remote controls and portable media products.

The EVA3672A is a prebuilt circuit board with MC3672 WLCSP 3-axes sensor. The MC3672 has internal sample rate from 14 to 1300 samples / second and measures acceleration with a wide usage range, from +/-2g up to +/-16g, and 6-bit to 14-bit high precision ADC output, which is easy to fit on top of the microcontroller, such as an Arduino. The accelerometer communicates via I2C and gives out motion detection or sample acquisition conditions to trigger an interrupt toward a MCU.

The sensor data is easily readable by connecting DVDD to 3.3V, GND to ground, and SCL/SDA pins to your Arduino I2C clock and data pin respectively. Download the MC3672 library from GitHub onto the board, run the example sketch, and then sensor data shortly comes out in raw data count and SI unit accelerometer measurements. An easy-to-use demonstration on EVA3672A using the Arduino platform is included in this document.

MC3672 FEATURES

Range, Sampling & Power

- $\pm 2, 4, 8, 12$ or 16g ranges
- 8, 10 or 12-bit resolution with FIFO
 - 14-bit single samples
- Sample rate 14 - 1300 samples/sec
- Sample trigger via internal oscillator, clock pin or software command
- Sniff and Wake modes
- 0.4 μA Sniff current @ 6Hz
- Separate or combined sniff/wake
- Ultra-Low Power with 32 sample FIFO
 - 0.9 μA typical current @ 25Hz
 - 1.6 μA typical current @ 50Hz
 - 2.8 μA typical current @ 100Hz
 - 36 μA typical current @ 1300Hz

Simple System Integration

- I2C interface, up to 1 MHz
- SPI Interface, up to 8 MHz
- 1.29 x 1.09 x 0.742 mm 8-pin WLCSP package
- Single-chip 3D silicon MEMS
- Low noise to 2.3mg RMS

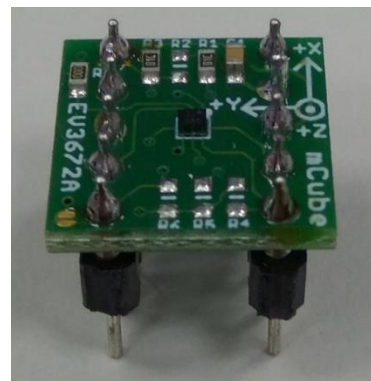


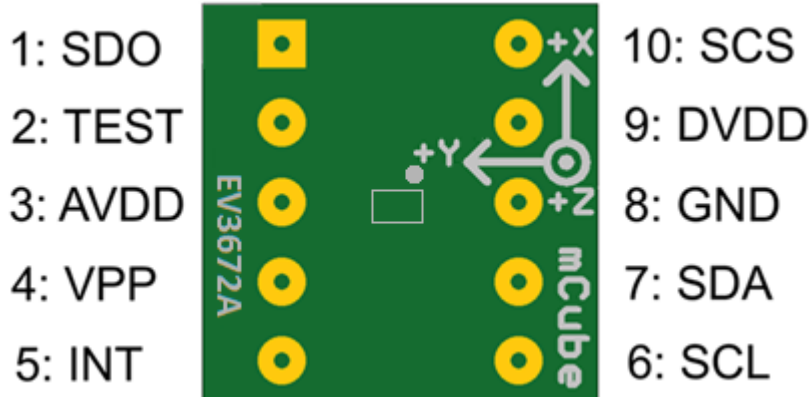
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1 GENERAL OPERATION

1.1 PINOUTS



1.2 POWER PINS

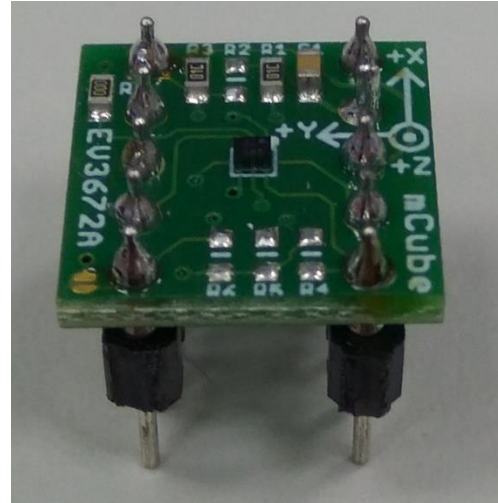
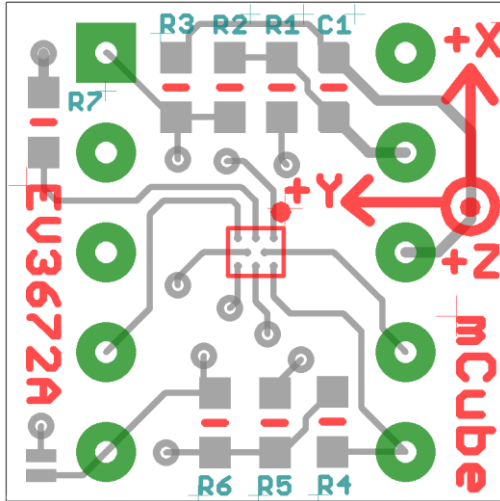
- DVDD** – 3.3V Power Supply Input
- GND** – Ground Pin for Power and Logic

1.3 I2C PINS

Connect the **SCL** (I2C clock pin) to your microcontroller’s I2C clock line. This pin can be used with **3V** logic. A **4.7K** pull-up resistor is required for this pin. Simply, add a **4.7K** pull-up resistor on **R4** to make the I2C clock signal works normally.

Connect the **SDA** (I2C data pin) to your microcontroller’s I2C data line. This pin can be used with **3V** logic. A **4.7K** pull-up resistor is required for this pin. Simply, add a **4.7K** pull-up resistor on **R5** to ensure functionality of the I2C data signal.





R4, R5: If using I2C and I2C pull-up resistors are needed for your application then install ~4.7K Ω resistors into R4 (SCL clock pin) and R5 (SDA data pin) which are not installed by factory default. In addition, besides soldering resistors on R4/R5, you can add axial lead 4.7K ohm resistors to the SDA and SCL pin respectively. It will work the same either way.

NOTE: DO NOT install more than one setup pull-up resistors per I2C bus.

1.4 SPI PINS

With an SPI connection, there is always one master device (usually a microcontroller) which controls the peripheral devices. Typically, there are three wires commonly connected to all the devices:

Connect the **SCS** (Slave Select) to the pin on the device that the master can use to enable and disable SPI cycles.

Connect the **SCL** (Serial clock) to the pin where the clock pulses synchronize data transmission generated by the master

Connect **SDO** to the pin where the Slave sends data to the master (Master Input, Slave Output).

Connect **SDA** to the pin where the Master sends data to the peripherals (Master Output, Slave Input).



1.5 INTERRUPT PINS

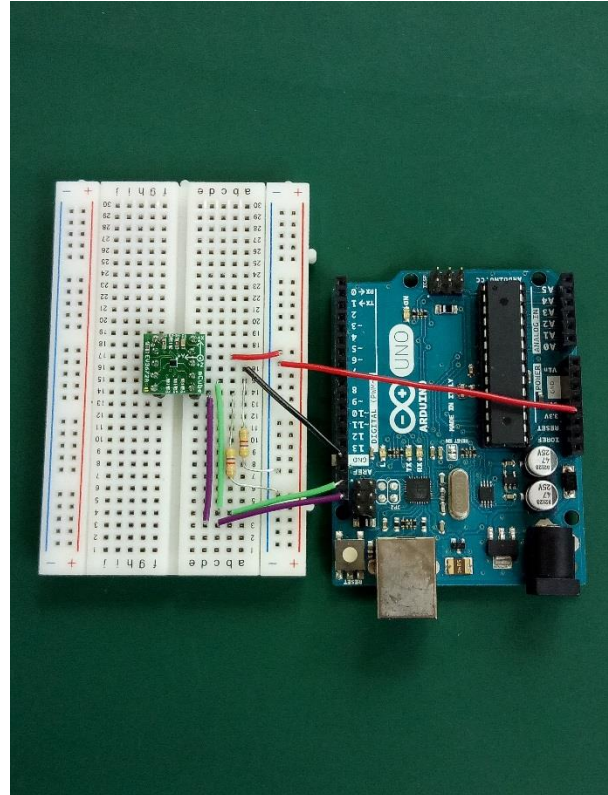
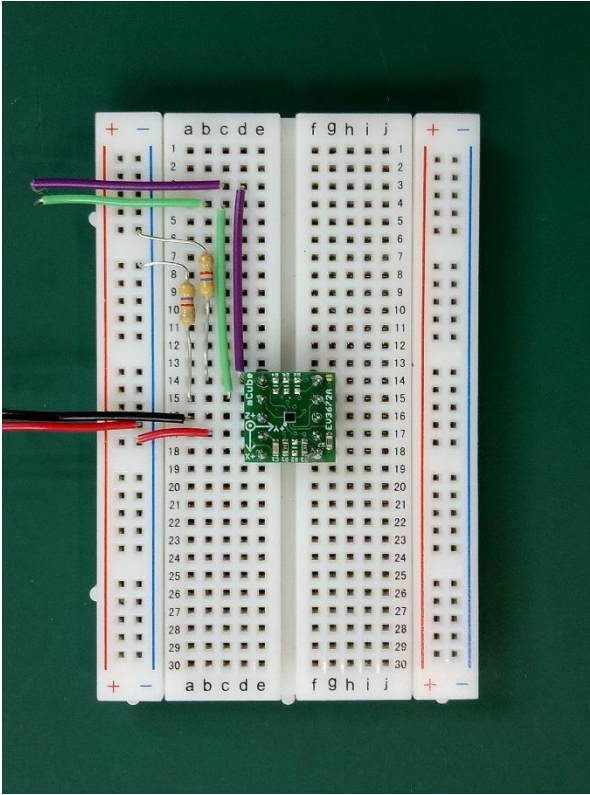
INT - HW interrupt signal pin. This pin will be triggered by the device when data is ready to read, or a motion event is detected by the accelerometer. (Not currently supported in the library for the interrupt pin, so please check the datasheet for the I2C commands and related registers).



2 ASSEMBLY AND TEST

Please note that the SPI and I2C interfaces cannot both be active at the same time as the clock (SCK) and data (SDA) are shared between the two protocols.

2.1 I2C INTERFACE



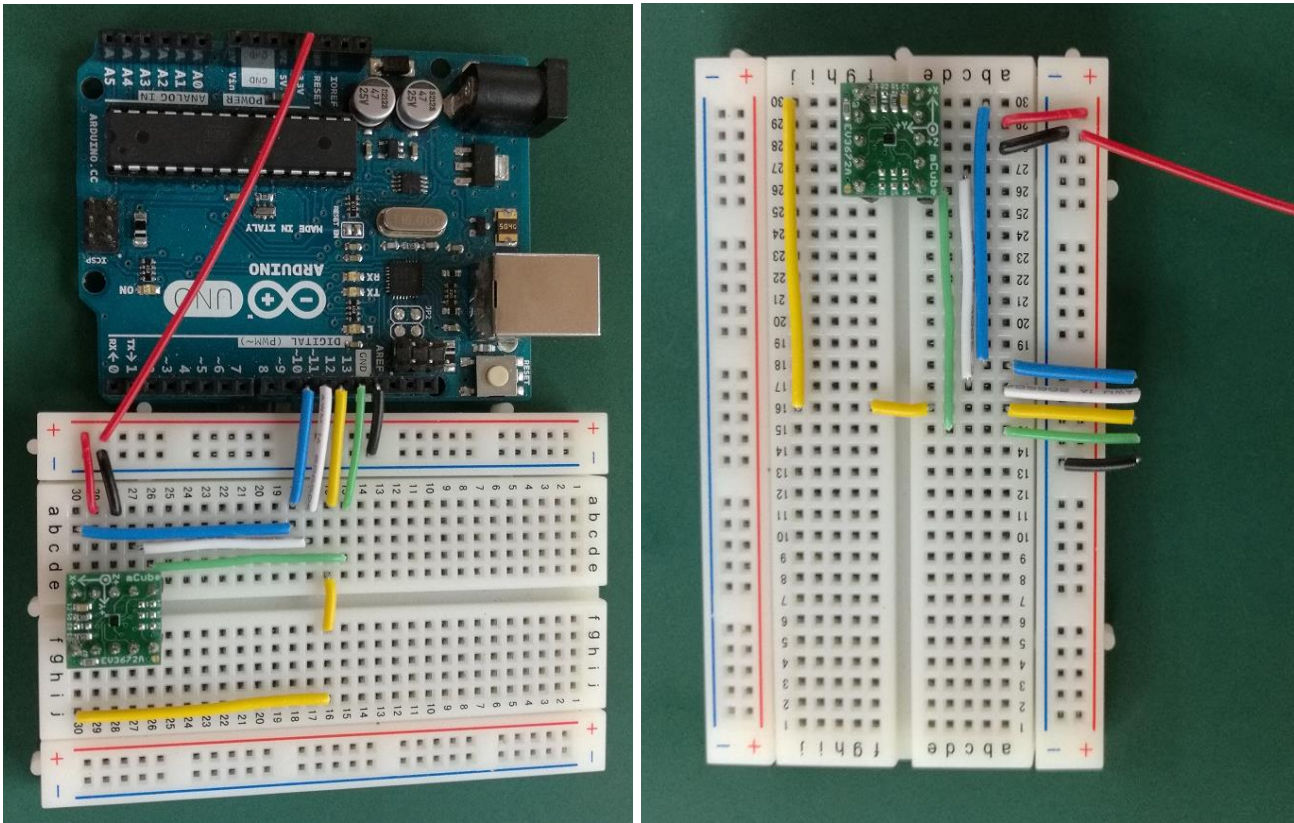
The EV3672A evaluation board can be easily wired to any microcontroller. This example shows a typical Arduino UNO platform. For other microcontrollers, be sure it has I2C with repeated-start support, then port the code. Please refer to the illustration below to connect the related pins.

- Connect **DVDD** to the power supply, **3.3V**. (Providing higher voltage, like 5V may damage the sensor).
- Connect **GND** to common power/data ground.
- Connect the **SCL** pin to the I2C clock **SCL** pin on your Arduino.
- Connect the **SDA** pin to the I2C data **SDA** pin on your Arduino.

The MC3672 has a default I2C address of 0x4C and it can be changed to 0x6C by tying the DOUT pin to VDD.



2.2 SPI INTERFACE



The EV3672A evaluation board can be easily wired to any microcontroller. This example shows a typical Arduino UNO platform. Please refer to the illustration below for connecting the related pins and then port the code to get the raw X, Y, Z sensor data.

- Connect **DVDD** to the power supply, **3.3V**. (Providing higher voltage, like 5V may damage the sensor.)
- Connect **GND** to common power/data ground.
- Connect **SCL** to digital I/O pin **13** as Serial Clock.
- Connect **SDO** to digital I/O pin **12** as Master Input, Slave Output.
- Connect **SDA** to digital I/O pin **11** as Master Output, Slave Input.
- Connect **SCS** to digital I/O pin **10** as Slave Select.

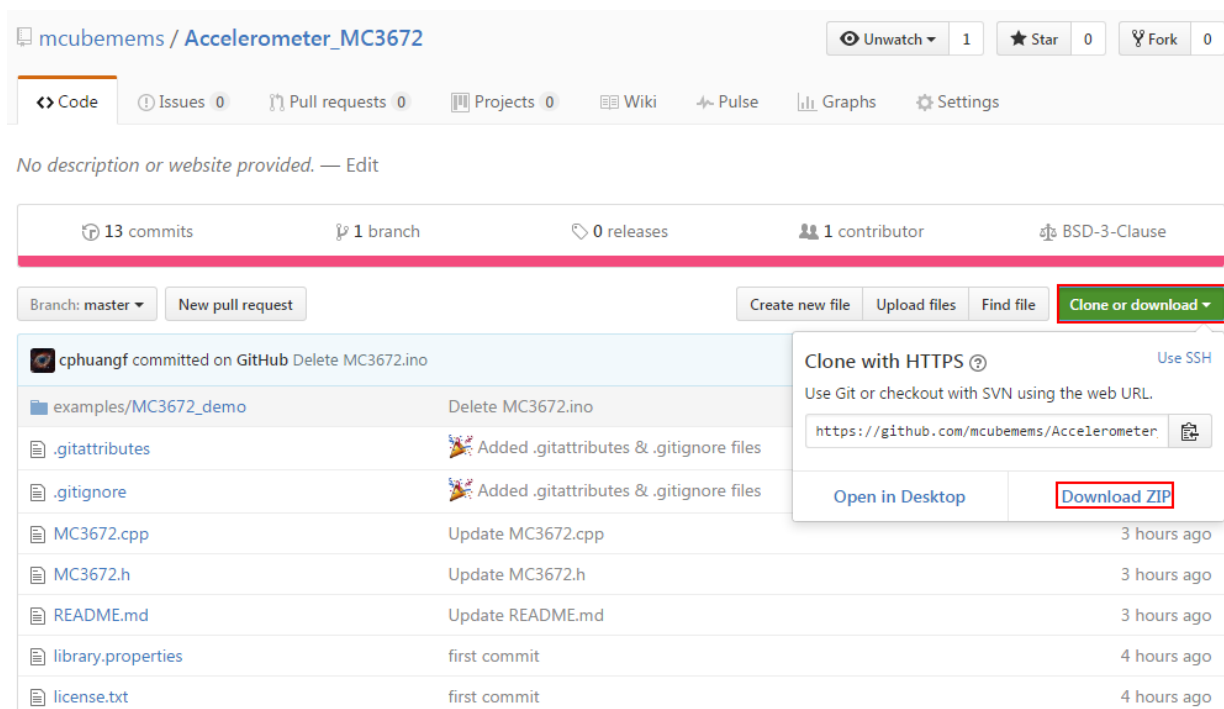


3 DEMO

3.1 DOWNLOAD THE DRIVER FROM GITHUB

To begin reading sensor data, you will need to download the MC3672 Library from the GitHub repository. Do this by visiting the GitHub repository and manually downloading or simply click this button the attached URL to download the zip file.

https://github.com/mcubemems/Accelerometer_MC36XX



Rename the uncompressed folder **Accelerometer_MC36XX** and check that the Accelerometer_MC36XX folder consisting of **MC36XX.cpp** and **MC36XX.h**

If you need the sensor running on SPI, please configure the bus as SPI in the MC36XX.h shown as below. Otherwise, the default is I2C bus.

```
///define MC36XX_CFG_BUS_I2C  
#define MC36XX_CFG_BUS_SPI
```

SPI could support 8MHz speed if high speed mode is enabled as below.

```
#define SPI_HS
```



Place the Accelerometer_MC3672 library folder to your **Arduino_sketch_folder/libraries/** folder.

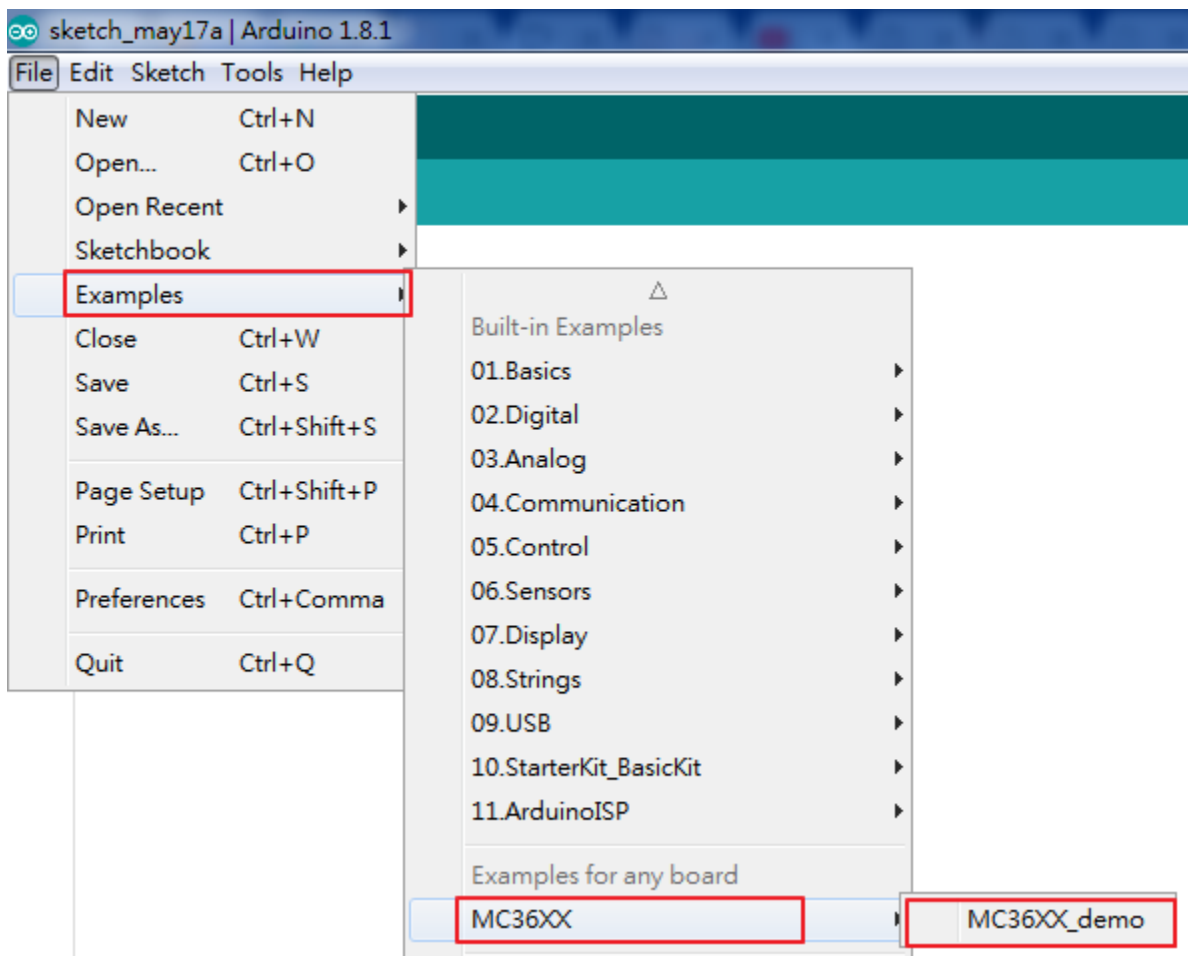
You may need to create the library subfolder if it is your first library files. Then just restart the IDE.

An excellent tutorial on Arduino library installation is located at:

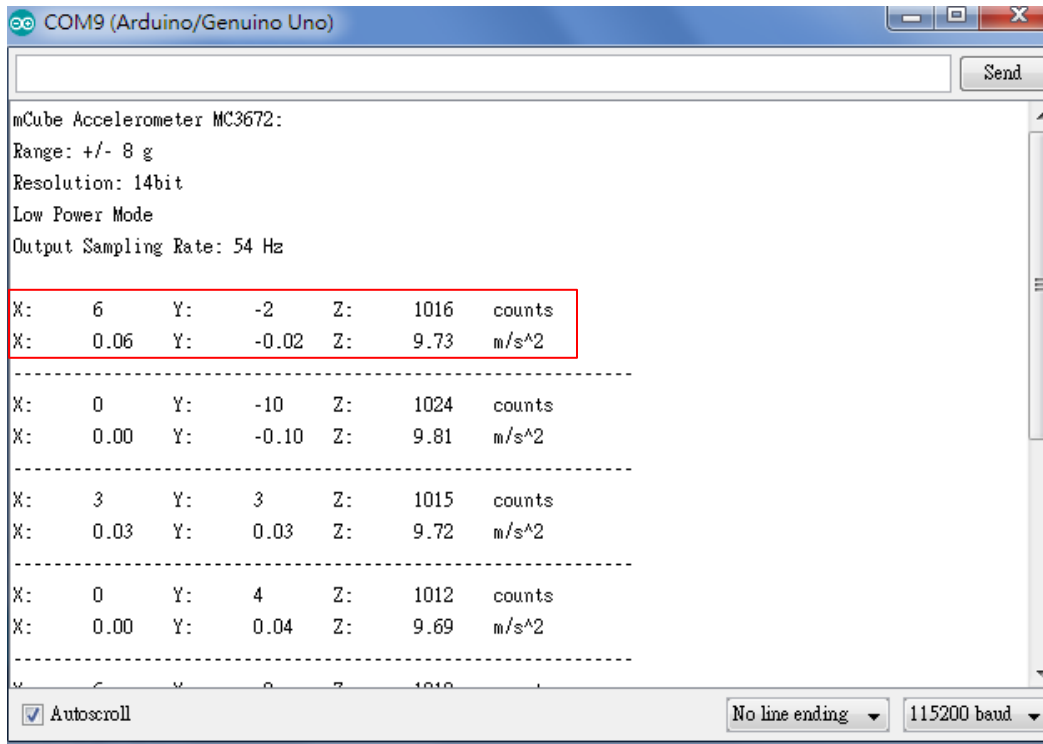
<http://learn.adafruit.com/adafruit-all-about-arduino-libraries-install-use>

3.2 LOAD THE DEMO

Open File->Examples->MC3672-> MC3672demo and upload to your Arduino while it is wired to the sensor.



Now open the serial terminal window at 115,200 baud rate speed to begin the test.



You will see the output from the serial terminal showing the current range scale and resolution of the sensor in the first three lines followed by two lines of output sensor data at some output data rate which depict “raw count” data for line 1: X: 6 Y: -2 Z: 1016 with 8G range, 14bit ADC resolution. Line 2 indicates the SI units for measuring acceleration as X: 0.06 m/s^2 Y: -0.02 m/s^2 Z: 9.73 m/s^2.

This demo also includes the example for FIFO and Sniff interrupt mode. Those could be enable by modify the definition below. **These two examples must be run separately.**

```
#define ENABLE_FIFO_WAKEUP 1
#define ENABLE_SNIFF_SHAKE_WAKEUP 0
```

Default input pin for interrupt is pin 8 and default FIFO threshold is 3 samples. FIFO size could be set to maximum 32 samples or just enable FIFO to FIFO_FULL mode.

```
#define INTERRUPT_PIN 8
#define FIFO_SIZE 3
```



4 LIBRARY REFERENCE

4.1 CREATE MCUBE_MC36XX OBJECT

You can create the MCUBE_MC36XX object with:

```
MC36XX MC36XX_acc = MC36XX();
```

4.2 INITIALIZE AND CONFIGURE SENSOR

Initialize and configure the sensor with:

```
MC36XX_acc.start();
```

Wake up sensor with your own configuration, it will follow the factory default setting:

```
MC36XX_acc.wake();
```

Stop sensor to change setting:

```
MC36XX_acc.stop();
```

Set sensor as sniff mode:

```
MC36XX_acc.sniff ();
```

4.3 SET RANGE

Set the accelerometer max range to $\pm 2g$, $\pm 4g$, $\pm 8g$ or $\pm 16g$ with:

```
MC36XX_acc.SetRangeCtrl(MC36XX_RANGE_8G);
```

4.4 READ RANGE

Read the current range with:

```
MC36XX_acc.GetRangeCtrl();
```

It returns: 0 for $\pm 2g$, | 1 for $\pm 4g$, | 2 for $\pm 8g$ | 3 for $\pm 16g$.



4.5 SET RESOLUTION

Set the accelerometer resolution to 6, 7, 8, 10, 12 or 14 bit.

```
MC36XX_acc.SetResolutionCtrl(MC36XX_RESOLUTION_14BIT);
```

When the FIFO is enabled, the output of the FIFO is mapped to registers 0x02 to 0x07, and the data has a maximum resolution of 12-bits.

4.6 READ RESOLUTION

Read the current resolution with:

```
MC36XX_acc.GetResolutionCtrl();
```

It returns: 0 for 6-bit | 1 for 7-bit | 2 for 8-bit | 3 for 10-bit | 4 for 12-bit | 5 for 14-bit.

4.7 SET CWAKE SAMPLING RATE

Set the accelerometer cwake mode sampling rate with:

```
MC36XX_acc.SetCWakeSampleRate (MC36XX_CWAKE_SR_DEFAULT_54Hz);
```

4.8 READ CWAKE SAMPLING RATE

Read the current cwake sampling rate with:

```
MC36XX_acc.GetCWakeSampleRate ();
```

It returns sampling rate from 14 ~ 600 Hz.

4.9 SET SNIFF SAMPLING RATE

Set the accelerometer sniff mode sampling rate with:

```
MC36XX_acc.SetSniffSampleRate (MC36XX_SNIFF_SR_DEFAULT_7Hz);
```



4.10 READ SNIFF SAMPLING RATE

Read the current sniff sampling rate with:

```
MC36XX_acc.GetSniffSampleRate ();
```

This returns sampling rate from 7 ~ 600 Hz.

4.11 CONFIG SNIFF MODE

Set the threshold values used by the SNIFF logic for activity detection:

```
MC36XX_acc.SetSniffThreshold (MC36XX_AXIS_X,5);
```

All three axes could be configured separately with different threshold value.

Set the threshold values used by the SNIFF logic for activity detection:

```
MC36XX_acc.SetSniffDetectCount (MC36XX_AXIS_X,3);
```

For each axis, a delta count is generated and compared to the threshold. When the delta count is greater than the threshold, a SNIFF wakeup event occurs. There is a unique sniff threshold for each axis, and an optional “false detection count” which requires multiple sniff detection events to occur before a wakeup condition is declared.

Configure sniff and/or mode with:

```
MC36XX_acc.SetSniffAndOrN(MC36XX_ANDORN_OR);
```

The SNIFF block supports the logical AND or OR of the X/Y/Z SNIFF wakeup flags when generating a SNIFF wakeup interrupt.

Configure sniff delta mode with:

```
MC36XX_acc.SetSniffDeltaMode(MC36XX_DELTA_MODE_C2P);
```



C2P mode: The current sample and the immediate previous sample are subtracted generate a delta

C2B mode: The current sample and the first sample captured when entering SNIFF mode are subtracted to generate a delta.

4.12 CONFIG INTERRUPT MODE

Configure the interrupt mode with:

```
MC36XX_acc.SetINTCtrl(0,0,0,0,1);
```

MC36XX have 5 interrupt modes – FIFO_THR | FIFO FULL | FIFO EMPTY | ACQ | WAKE.

These modes can only be enabled separately.

4.13 READ RAW COUNT DATA

Read the raw count data and SI unit measurement with:

```
MC36XX_acc.readRawAccel();
```



5 DOWNLOADS

5.1 MC3630 ACCELEROMETER DATASHEET

<http://www.mcubemems.com/product/mc3630-3-axis-accelerometer/>

5.2 MC3635 ACCELEROMETER DATASHEET

<http://www.mcubemems.com/product/mc3635-3-axis-accelerometer/>

5.3 MC3672 ACCELEROMETER DATASHEET

<http://www.mcubemems.com/product/mc3672-3-axis-accelerometer/>

5.4 MC36XX DRIVER AT GITHUB

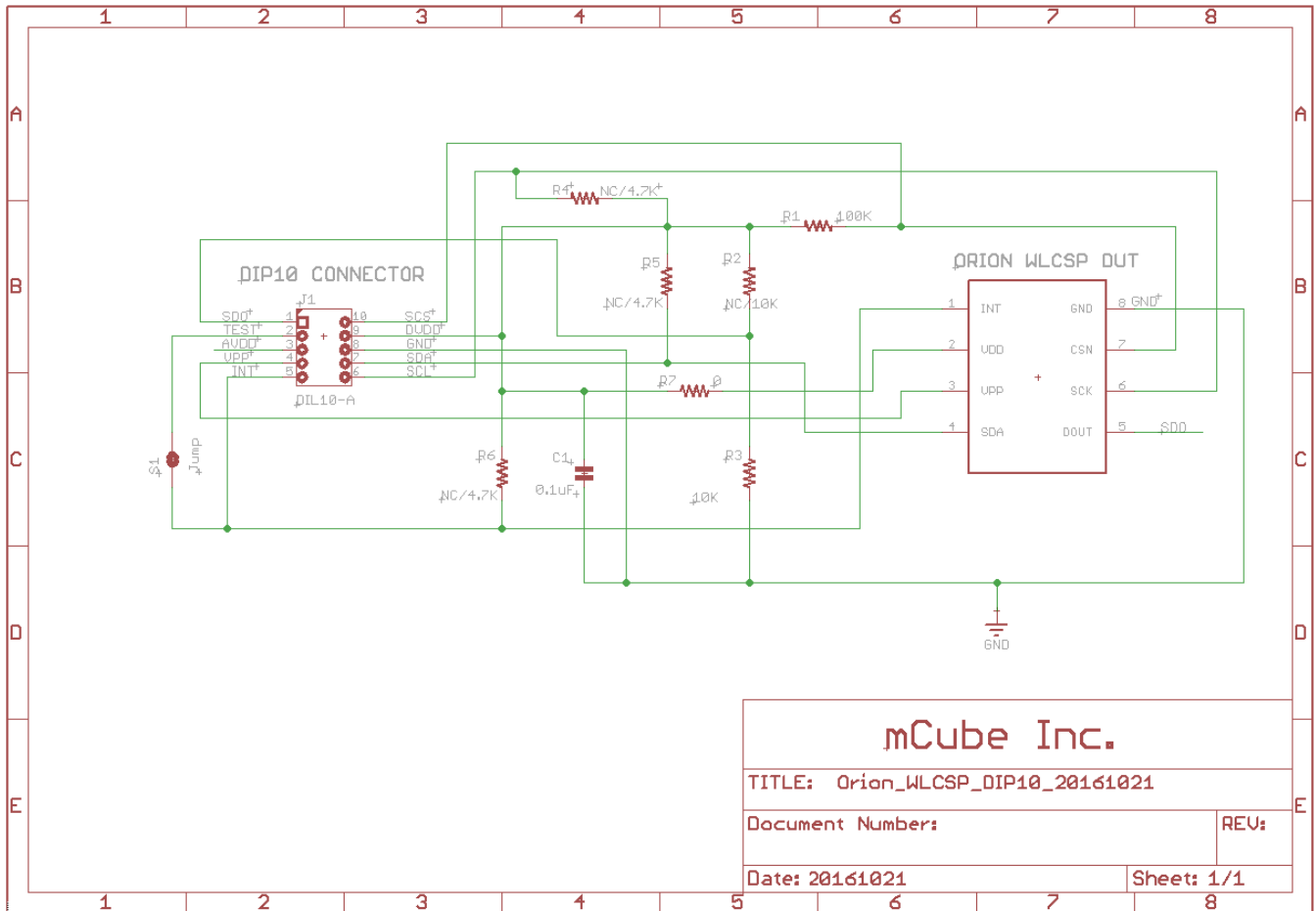
https://github.com/mcubemems/Accelerometer_MC36XX

5.5 ALL OTHER MCUBE DOCUMENTATION

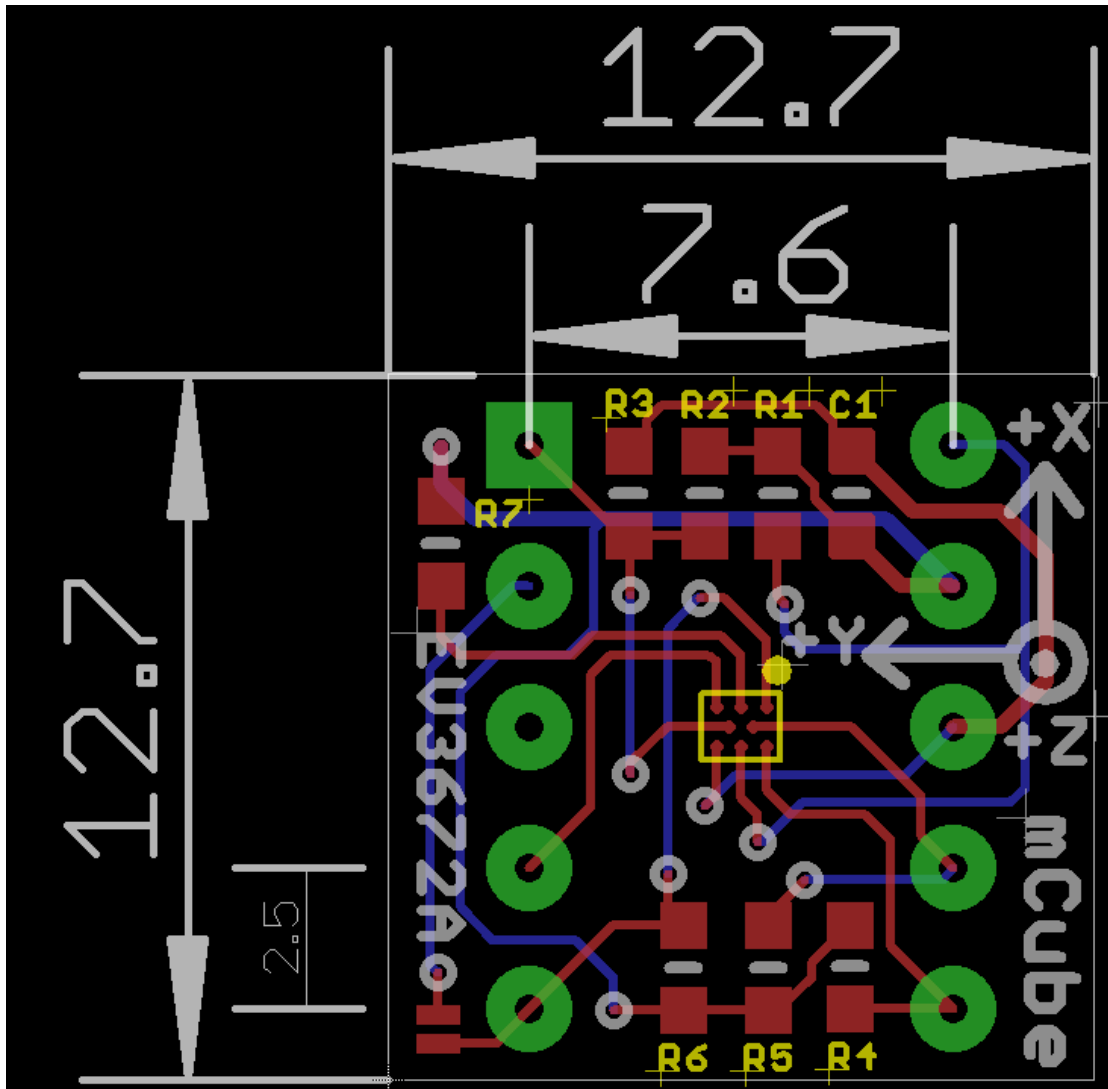
<http://www.mcubemems.com/resources-support/resources/>



6 SCHEMATICS



7 FABRICATION PRINT



8 REVISION HISTORY

Date	Revision	Description
2016-12-08	APS-045-0017v1.0	First release.
2017-02-06	APS-045-0017v1.1	Added SPI mode interface.
2018-05-10	APS-045-0017v1.2	Added example codes for high speed SPI mode, FIFO mode, and Sniff mode.



9 LEGAL

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