# DB3672B Demo Board User Guide

**MEMSIC Semiconductor (Tianjin) Co., Ltd.**

# INTRODUCTION

The DB3672B Demo Board is a standalone accelerometer demonstration platform that enables firsthand user experience of the IoMT (Internet of Moving Things) functionality for the latest MEMSIC motion sensors. It highlights either the MC3672 (1.1 x 1.3 mm CSP) and MC3635 (1.6 x 1.6 mm LGA) ultra-low power, 3-axis accelerometers by providing g-force data to 32-bit ARM Cortex-M4. Motion sensing algorithms are performed in firmware on the MCU to demonstrate popular accelerometer use cases. These include a variety activity tracking, user interface and power management functions. Results and status are displayed live on the on-board OLED display.  The board is also equipped with an USB/UART interface for easy firmware upgrades and external power.
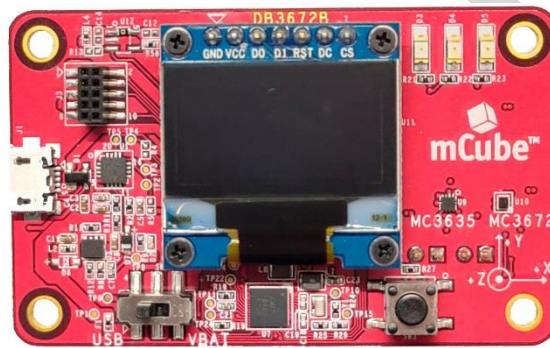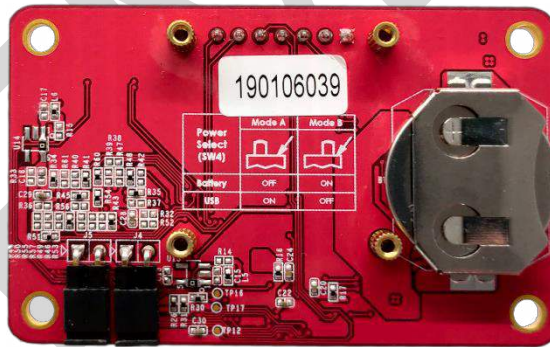


**Figure 1: Top View**



**Figure 2: Bottom View**

# TABLE OF CONTENTS

# FEATURES

The DB3672B (demo) board offers the following features:

1. MEMSIC 3-axis Accelerometer MC3635 (U9) in 1.6 x 1.6mm LGA package
2. MEMSIC 3-axis Accelerometer MC3672 (U10) in 1.3 x 1.1 mm WLCSP package
3. Ambiq 32-bit ARM Cortex-M4F Apollo2 MCU (U7) with 48 MHz clock frequency, 1 MB flash storage and 256 KB SRAM
4. 0.96" 128x64 monochrome OLED (U11) using ssd1306 controller
5. CP210x USB-to-UART interface(J1) chip for connection to PC
6. Four LEDs:
    1. Application controllable Red(D3), Green(D4), Yellow(D5)
    2. Power(D2)
7. Push-button (SW3)
8. Power-on slide switch (SW4)
9. Pre-programmed bootloader
10. Coin-cell battery CR2032 (BT1) powered for standalone use
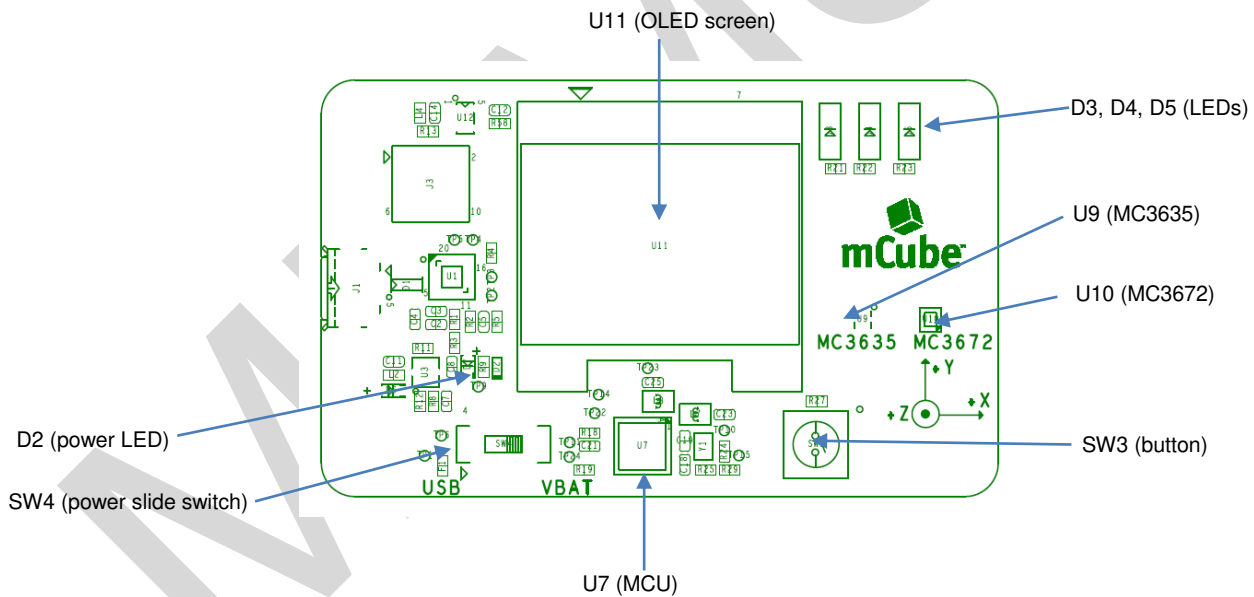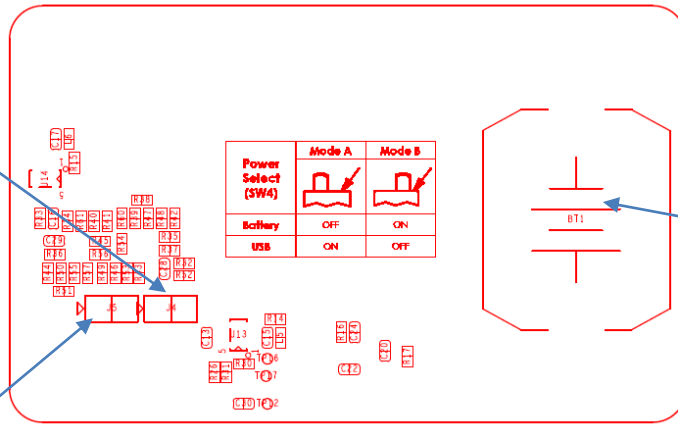11. Demo application with various motion algorithms

# COMPONENT LAYOUT



**Figure 3 Components (front view)**

**Figure 4 Components (bottom view)**

# DEMO APPLICATIONS

DB3672B illustrates with a few common IoT gestures of accelerometer. All results are shown on screen with LEDs to assist demonstration, which consists of following features:

| Feature | KPI | Memory (KB) | DMIPS | Version | Comments |
|---|---|---|---|---|---|
| Data Readout | N/A | N/A | N/A | v1.0.0 | Raw data |
| Tap | 90% | 2.7 | 0.32 | v1.0.0 | Single Tap |
| | 95% | | | | Double Tap |
| | 90% | | | | Triple Tap |
| Shake | 95% | 1.3 | 0.23 | v1.0.0 | 2 (or more) back-and-forth shakes |
| Freefall | 99% | 0.6 | 0.16 | v1.0.0 | > 2 cm drop |
| Tilt Angle | N/A | 3.6 | 6.73 | v1.0.0 | Pitch/Roll |
| Face Side | N/A | N/A | N/A | v1.0.0 | Dominant side |
| Jump Rope | 90% | 1.7 | 0.03 | v1.0.0 | Jump rope |
| Activity | 95% | 3.5 | 1.64 | v1.0.0 | Steps/State |
| Sniff | N/A | N/A | N/A | v1.0.0 | Power switch |

## APPLICATION FLOW

The board can be turned-on by sliding the power slide switch (SW4) to the right. When powered ON, it will show a splash screen containing logo with FW version.
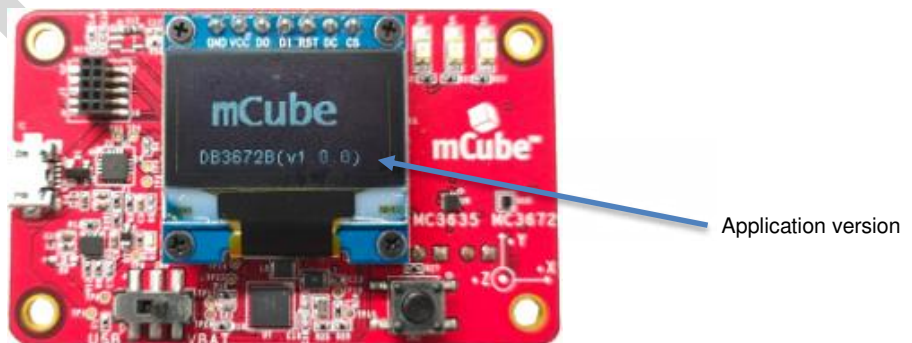


**Figure 5 splash screen**

Splash screen is followed by 1st feature on sensor data output. Long press (SW3) to toggle sensor MC3672 and MC3635. Default accelerometer is MC3672 (U10). See Image below for
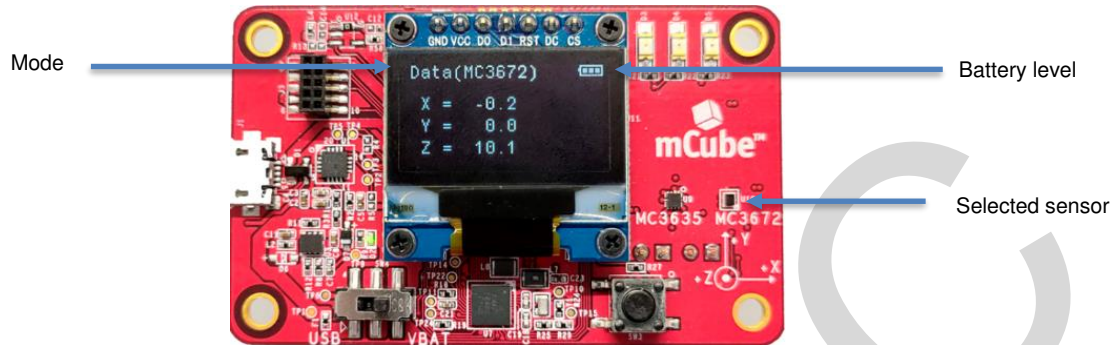


**Figure 6 Data mode**

**Tap Mode:** On pressing button (SW3), subsequent feature is shown. This button is used to toggle between different demo modes. First feature is Tap mode.
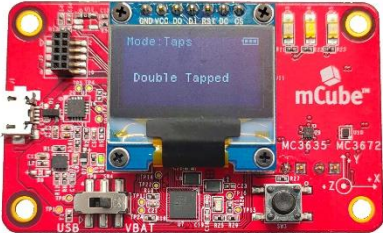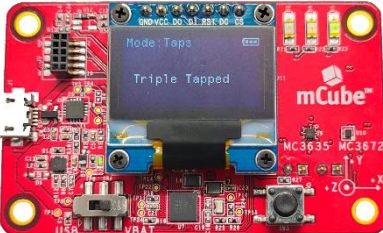
| | |
|---|---|
| Tap window: waiting for tapping on the screen | |
| When screen is tapped once, Single Tapped is shown and Red LED (D3) is ON for 2 seconds |  |
| When screen is tapped twice within 0.3 secs, Double Tapped is shown and Yellow LED (D4) is ON for 2 seconds. |  |
| When screen is tapped three times with 0.7secs, Triple Tapped is shown and Green LED (D5) is ON for 2 seconds. |  |

**Figure 7 Tap Mode**
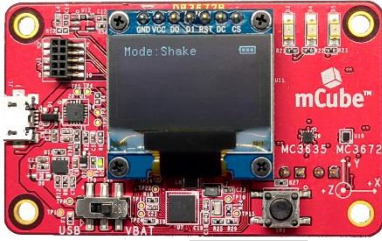
**Shake Mode:**

| | |
|---|---|
| Shake mode window: waiting for shake event |  |
| When device is shaken two to-and-fro movement, Shaken is shown and **Red** LED (D3) is ON for 2 seconds. |  |

**Figure 8 Shake Mode**

**Freefall Mode:**
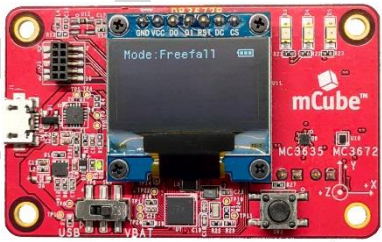
| | |
|---|---|
| Freefall mode window: waiting for freefall event |  |
| When device dropped over 10 cm height, freefall event is shown on screen and Green LED (D5) is ON for 2 seconds. |  |

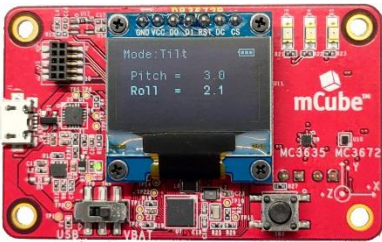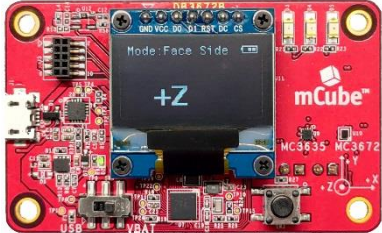**Figure 9 Freefall Mode**

**Tilt Mode:**

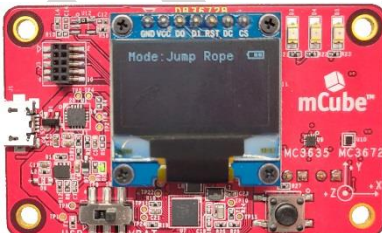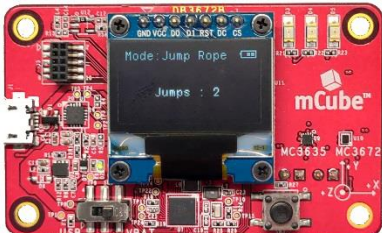| | |
|---|---|
| Tilt mode: Shows Roll and Pitch angle when board is rotated along X and Y axis.<br>Pitch > abs(30º), Green LED is ON<br>Roll > abs((30º), **Yellow** LED is ON<br>Both Green and **Yellow** are ON when Pitch and Roll > abs(30º). |  |

**Figure 10 Tilt Mode**

**Face Side Mode:**

| Dominant side displayed on screen, +Z when board is parallel to the plane of the horizon. |  |
| --- | --- |
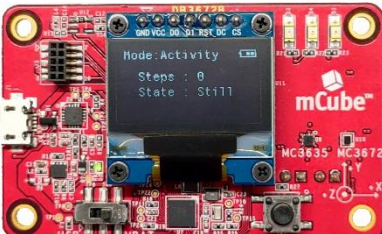
**Figure 11 Face Side Mode**
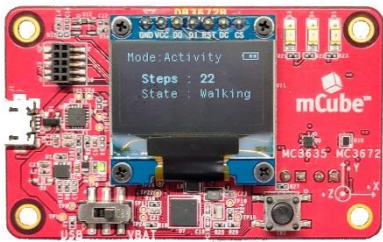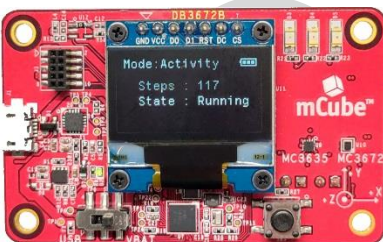
**Jump Rope Mode:**

| Jump mode: waiting for Jump |  |
| --- | --- |
| Jump Rope mode: track number of Jumps |  |

**Figure 12 Jump Rope Mode**
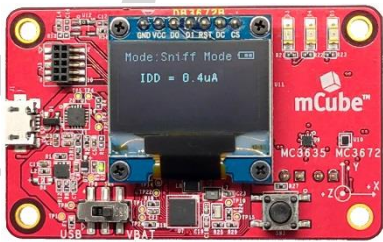
**Activity Mode:** In this mode DB3672B acts like a pedometer, which measures number of steps taken and current state: still, walking or running. At least 10 steps required to transit from Still to "Walking" or "Running" for every single trial.

| Activity mode: no activity |  |
| --- | --- |
| Steps: 0 | |
| State: Still | |

| | |
|---|---|
| Activity mode: Walking<br><br>Steps: number of step count<br><br>State: Walking |  |
| Activity mode: Running<br><br>Steps: number of step count<br><br>State: Running |  |

**Figure 13 Activity Mode**

**Sniff Mode:** Sniff mode is a unique feature in MC3672/MC3635 to have sensor enter an ultra-low power state (0.4uA) and can be activated when significant motion is detected.

| | |
|---|---|
| Sniff mode: waiting for motion detection |  |
| Sniff mode: motion detected event displayed on screen for 2 seconds |  |

**Figure 14 Activity Mode**

After Sniff page, subsequent screen shows QR code followed by Data page again in loop.

| | |
|---|---|
| QR Code |  |

**Figure 15 QR code Mode**
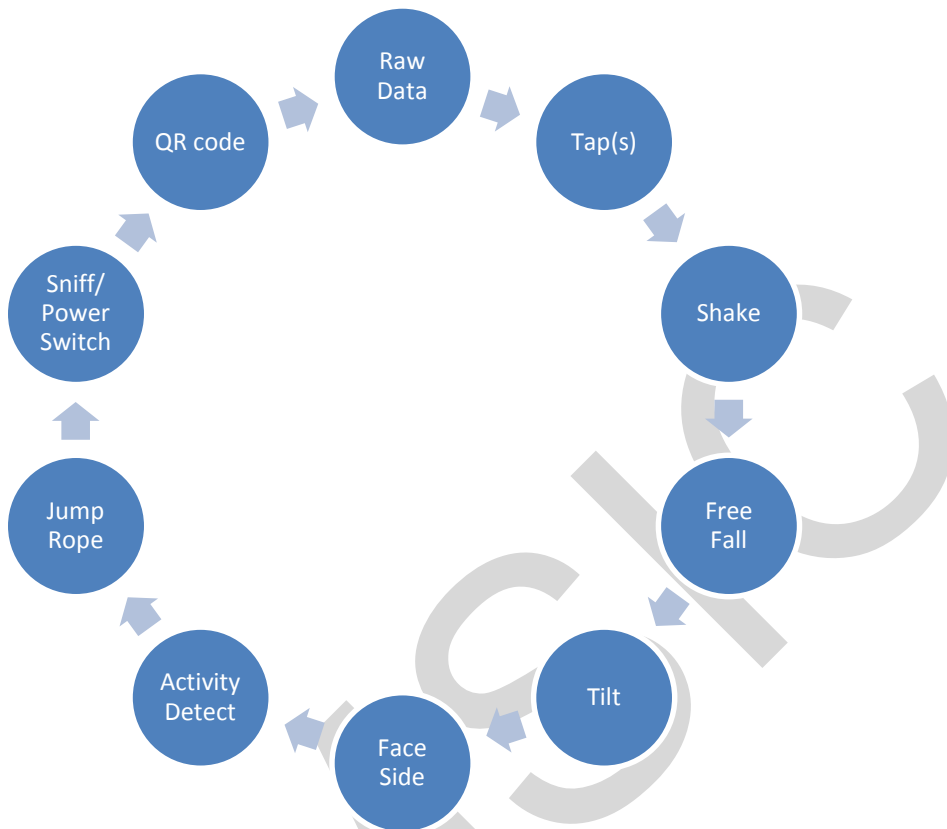
**Figure 16 Demo application flow**

# FIRMWARE UPDATE TOOL

Get the tools from MEMSIC

STEPS to update firmware:

1. Install CP2102 driver on your PC/laptop from link below:
   *https://www.silabs.com/products/development-tools/software/usb-to-uart-bridge-vcp-drivers*
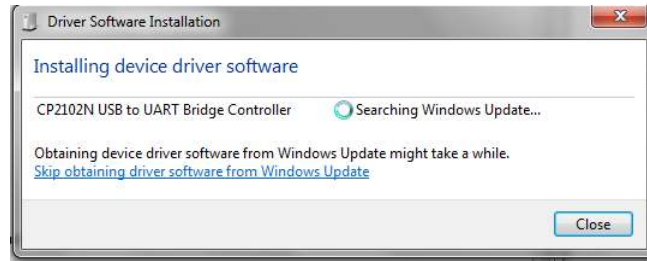


**Figure 17 Installing USB-to-UART Driver**

2. While pressing button (SW3) on sensor board, connect board to computer by micro USB cable
3. Now, on connecting sensor board to Windows PC will automatically install driver. Will show up in Device Manager as COM Port. See Image below.
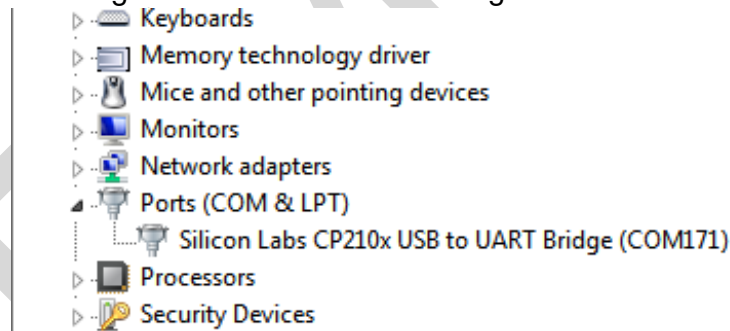


4. Unzip "MEMSIC_DB3672B_tools v1.0.0.zip file
5. Click to open "DB3672_flash_tool.exe" application from package. (Do NOT copy it outside of the folder).
6. Press "Load" button and choose firmware binary file "MEMSIC_DB3672B_v1.0.0.bin"
7. Select your COM port from "SerialPort" drop-down list menu. Should match to the one found in device manager. Press "Reload" button in case this does not work
8. Now press "Program" button to flash firmware.
9. If you don't see the Serial Port on the flash tool, which indicates that you may haven't installed the USB-to-UART device driver successfully. Try to reinstall it again, then you will see the com port on the flash tool when USB plug-in.
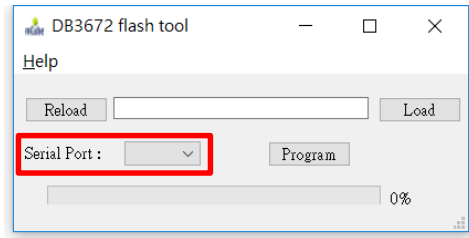
**Figure 18 Serial Port Not Detected**
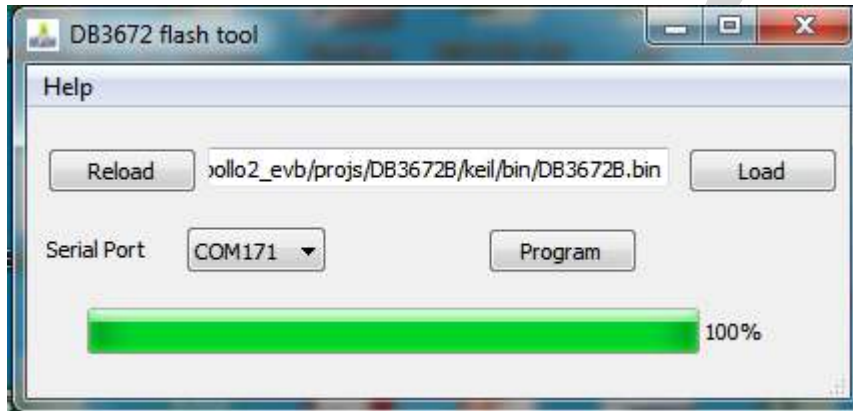


**Figure 19 DB3672 FW flash tool**

# CURRENT MEASUREMENT

DB3672B board has a pair of jumpers for measuring current consumption on MEMSIC accelerometers (U9 & U10).

J4 (MC3635) and J5(MC3672) jumper can be used to measure current on sensor, depicted ultra-low power at 0.4uA in Sniff mode.
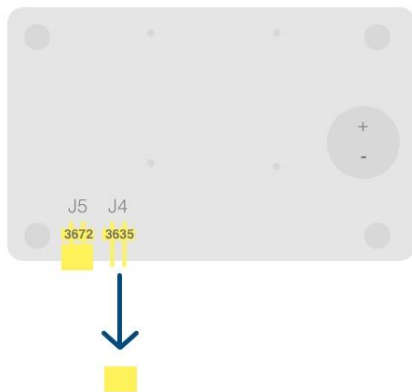
**Remove a jumper(J4 or J5) on the current measurement connector.**

**Note:**
1. Measure current of MC3635 from J4
2. Measure current of MC3672 from J5
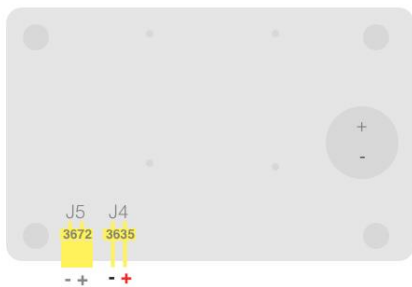
**Connect the Ammeter to the connector.**
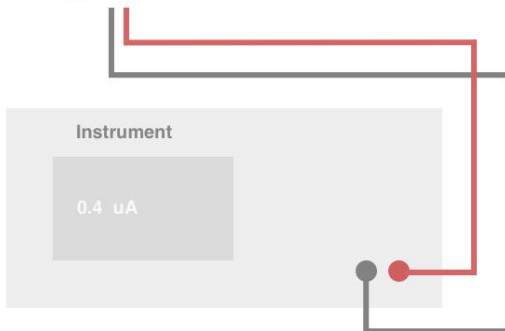
**Read the value from the instrument, current should be 0.4uA.**

**Figure 20 Current measurement by jumper J4, J5**

**Figure 21 Sniff current at 6Hz**



**Figure 22 Wake supply current @ ultra-low power, 25Hz**

| Sensor Category | Sniff Current @ 6Hz | Wake Current @ ULP, 25Hz |
|---|---|---|
| MC3672 | 0.4 uA | 0.9 uA |
| MC3635 | 0.4 uA | 0.9 uA |

# SCHEMATICS

# MCU

## SWD

vcc_mcu

J3
1 2 ambiq_swdio
3 4 ambiq_swclk
5 6 ambiq_swo
7 8
9 10 ambiq_nrst

2*5P, 1.27mm

## LED

led_red_ctrl
red_yellow_ctrl
led_green_ctrl

R21 220R, 1/16w
R22 220R, 1/16w
R23 220R, 1/16w

LTST-C150CKT D3
LTST-C150KSKT D4
LTST-C150KGKT D5

vcc_mcu    vcc_sys
R16    0R

### U7

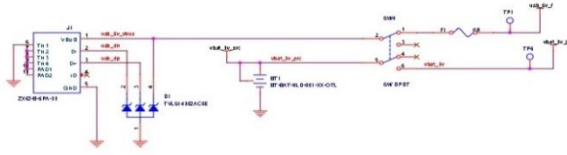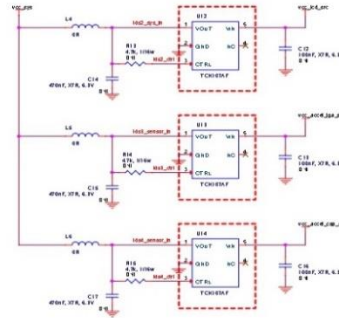| | | |
|---|---|---|
| G2 | GPIO0 | |
| F2 | GPIO1 | |
| E1 | GPIO2 | |
| F3 | GPIO3 | |
| H3 | GPIO4 | |
| E2 | GPIO5 | |
| D2 | GPIO6 | |
| D1 | GPIO7 | |
| F6 | GPIO8 | |
| G7 | GPIO9 | |
| D3 | GPIO10 | |
| A8 | GPIO11 | |
| B8 | GPIO12 | |
| D8 | GPIO13 | |
| C8 | GPIO14 | |
| A5 | GPIO15 | |
| D4 | GPIO16 | |
| C4 | GPIO17 | |
| C3 | GPIO18 | |
| H1 | GPIO19 | |
| G4 | GPIO20 | |
| E4 | GPIO21 | |
| E3 | GPIO22 | |
| F5 | GPIO23 | |
| D6 | GPIO24 | |
| F5 | GPIO25 | |
| D6 | GPIO26 | |
| E6 | GPIO27 | |
| B6 | GPIO28 | |
| C7 | GPIO29 | |
| A6 | GPIO30 | |
| B6 | GPIO31 | |
| B5 | GPIO32 | |
| A7 | GPIO33 | |
| A4 | GPIO34 | |
| A3 | GPIO35 | |
| H2 | GPIO36 | |
| H5 | GPIO37 | |
| H6 | GPIO38 | |

m2_i2c_ambiq_scl
m2_i2c_ambiq_sda
ambiq_lcd_dc
uart0_ambiq_ctb
m0_spi_ambiq_clock
m0_spi_ambiq_miso
m0_spi_ambiq_mosi
m0_spi_ambiq_clock
m1_spi_ambiq_miso
m1_spi_ambiq_mosi
ambiq_lcd_res
m1_spi_ambiq_lcd_nce0
ambiq_lds2_ctrl
ambiq_lds3_ctrl
ambiq_lds4_ctrl
vbat_sense
ambiq_accel_lga_int
ambiq_accel_csp_int
ambiq_button_sig
TP22
TP23
TP24
accel_lga_sense
accel_csp_sense

| | | |
|---|---|---|
| A3 | XI | |
| A4 | XO | |
| D3 | GPIO21/SWDIO | |
| G8 | GPIO20/SWDCK | |
| H8 | nRST | |
| C8 | ADC_VREF | |
| G4 | VDDH | |
| G5 | VSSL | |
| B4 | VDDA | |
| B3 | VSSA | |
| C2 | VDDP | |
| A1 | SW1 | |
| B1 | VOUT1 | |
| A2 | SW2 | |
| B2 | VOUT2 | |
| C1 | VSSP | |

GPIO49 G1
GPIO48 E3
GPIO47 F4
GPIO46 G3
GPIO45 F1
GPIO44 F8
GPIO43 H7
GPIO42 H4
GPIO41 D7
GPIO40 E7
GPIO39 E7

AMAPH1KK-KBR

ambiq_swdio
ambiq_swdck
ambiq_nrst
ambiq_adc_vref  TP12
vcc_mcu

m5_i2c_ambiq_sda
m5_i2c_ambiq_scl
m0_spi_ambiq_csp_nce1
m0_spi_ambiq_lga_nce0
ambiq_swo
uart0_ambiq_rx
uart0_ambiq_tx

TP10
ABS06-10T-32.768KHZ-T
Y1
32.768khz_xi
32.768khz_xo

C18 3pF, X7R, 6.3V
C19 3pF, X7R, 6.3V

R17 10k, 1/16w  vcc_mcu
R19 10k, 1/16w

R18  10k, 1/16w  vcc_mcu

C30  470nF, X7R, 6.3V
C20  100nF, X7R, 6.3V
C21  100nF, X7R, 6.3V
C22  100nF, X7R, 6.3V

L7  SRN2010TA-2R2MCT-ND
ambiq_swc  ambiq_vddc
ambiq_swm  ambiq_vddm
C24  10uF, X5R, 6.3V
vcc_mcu
C23  1uF, X7R, 6.3V
C25  1uF, X7R, 6.3V
L8  SRN2010TA-2R2MCT-ND

## ADC

vbat_3v_src
R24 4.7k, 1/16w
TP15
vbat_sense
R29 4.7k, 1/16w

vcc_accel_lga_src
R25 4.7k, 1/16w
TP16
accel_lga_sense
R30 4.7k, 1/16w

vcc_accel_csp_src
R26 4.7k, 1/16w
TP17
accel_csp_sense
R31 4.7k, 1/16w

## Push Button

vcc_mcu
R27 10k, 1/16w
TP14
ambiq_button_sig

SW3
SW_TC_SPST

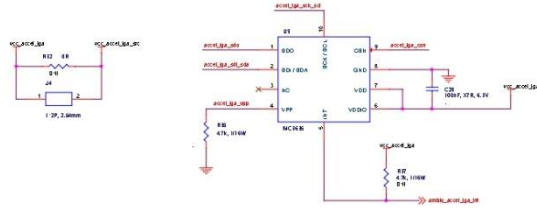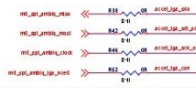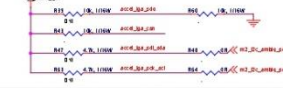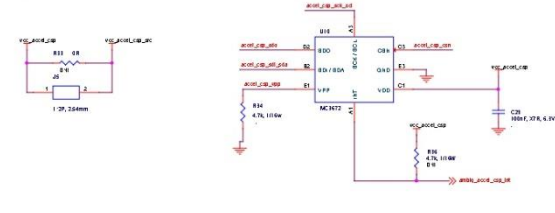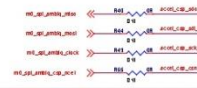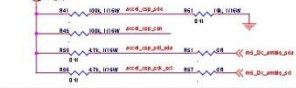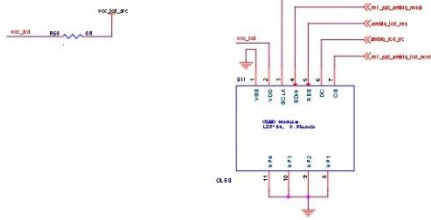| | | |
|---|---|---|
| Title | DB3672B | |
| Size | Document Number | Rev |
| B | DB3672B_HW_SCH_20190516 | 1.1 |
| Date: | Monday, June 24, 2019 | Sheet 5 of 7 |

# Accelerometer

## MC3635



### SPI

### I2C

## MC3672



### SPI

### I2C

## LCD

# EV3672/EV3635 EVAL BOARDS INSTALL

## ORDER A BOARD FROM WWW.MOUSER.COM

### EV3672A

| | | |
|---|---|---|
| **Mouser #:** | 498-EV3672A | |
| **Mfr. #:** | EV3672A | |
| **Mfr.:** | mCube | |
| **Customer #:** | Customer # | |
| **Description:** | Acceleration Sensor Development Tools DIP Evaluation Board For MC3672 | |
| **Datasheet:** | EV3672A Datasheet | |
| **More Information:** | Learn more about mCube EV3672A | |

Enlarge

Images are for reference only
See Product Specifications

Share

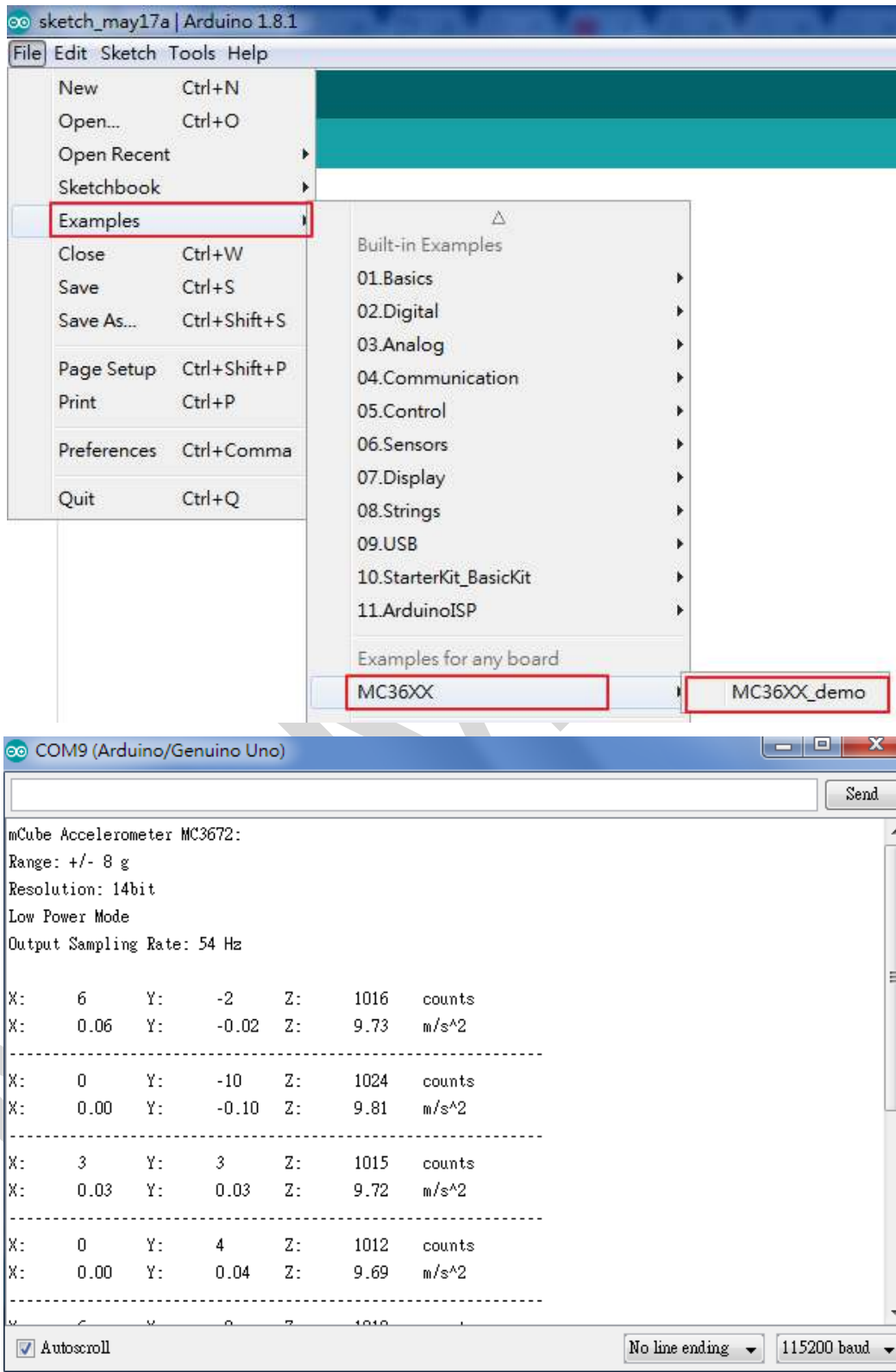## GET QUICK START GUIDE FROM MEMSIC

## PLUG EV36XXA INTO A BREADBOARD
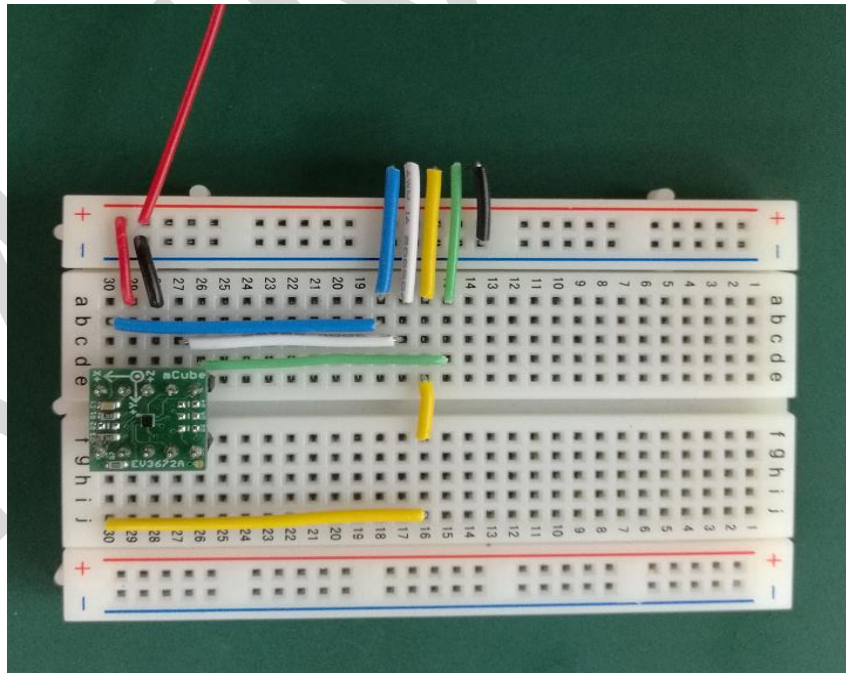
CONNECT TO PROCESSOR(ARDUINO) VIA SPI OR I2C
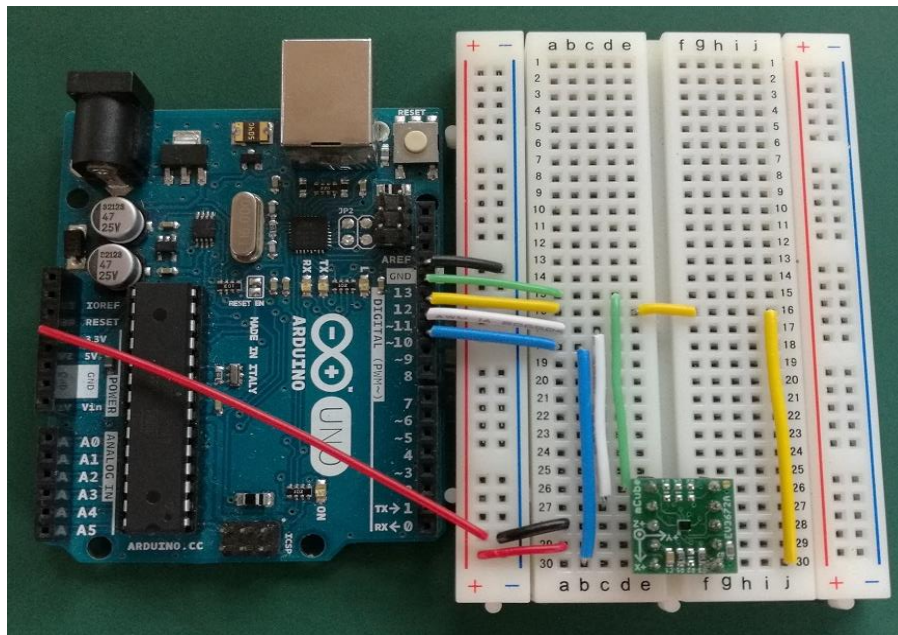


GET DRIVERS FROM MEMSIC

# LOAD AND RUN MC36XX DEMO

# REVISION HISTORY

| Date | Revision | Description |
|------|----------|-------------|
| 2019-06-18 | APS-045-0031v1.0 | First release. |
| 2020-08-17 | APS-045-0031v1.1 | Change to MEMSIC format based on the License Agreement with mCube. |
| | | |
| | | |