

# MPU6050 Raw Data Acquisition

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This tutorial demonstrates: how to obtain and print MPU6050 raw data through serial port.

## 1. Software and Hardware

- KEIL5
- MSPM0G3507 Development Board
- MPU6050 Module
- Type-C data cable or DAP-Link

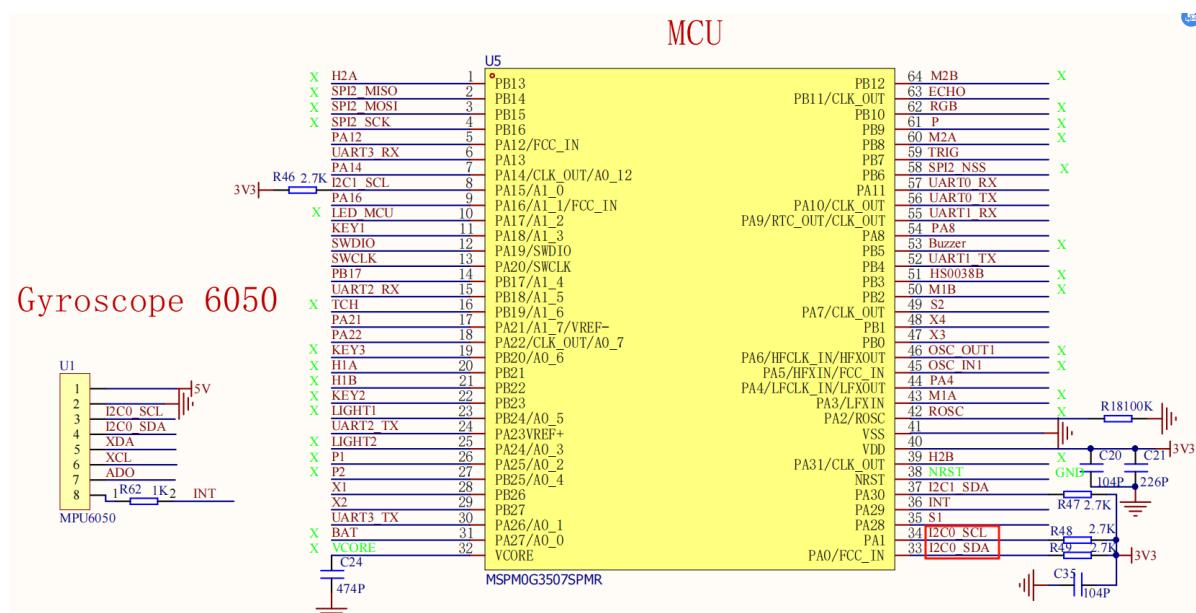
For programming download or simulation to the development board

- Serial Port Assistant

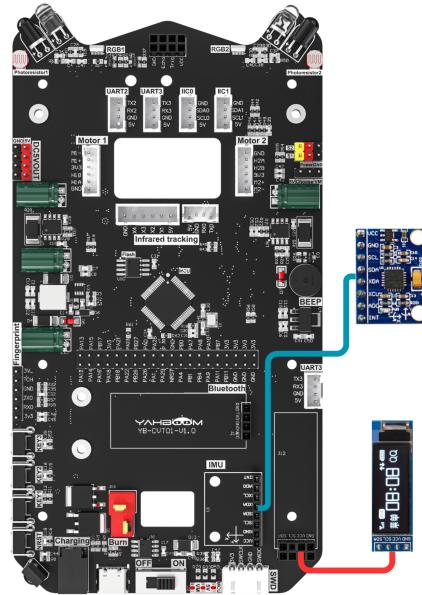
Receive and print serial port data

## 2. Basic Principles

### 2.1 Hardware Schematic



## 2.2 Physical Connection Diagram



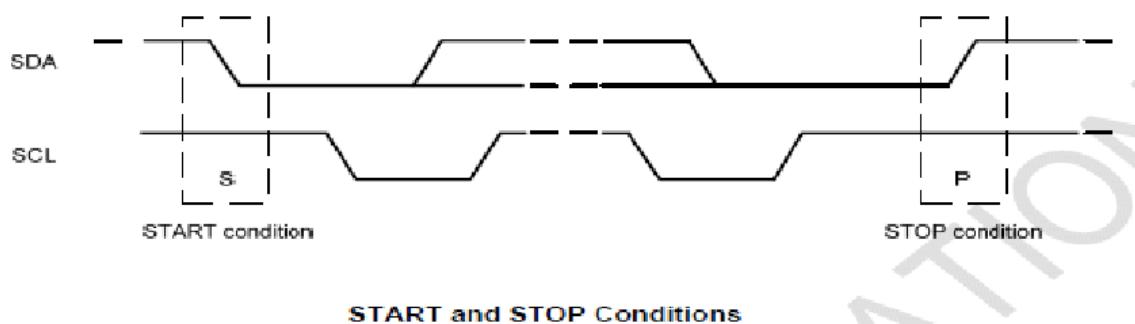
## 2.3 Control Principle

(Schematic Name)	Control Pin	Specific Meaning
I2C2_SCL	PA1	I2C Clock End
I2C2_SDA	PA0	I2C Data End

### I2C Communication:

Start Signal: The processor keeps the SCL clock high, then lets the SDA data signal go from high to low to indicate a start signal. At the same time, devices on the I2C bus detect this start signal and know that the processor is about to send data.

Stop Signal: The processor keeps the SCL clock high, then lets the SDA data signal go from low to high to indicate a stop signal. At the same time, devices on the I2C bus detect this stop signal and know that the processor has finished data transmission, and we can each go about our business, such as sleep, etc.



To read the value of MPU6050 registers, first the master device generates a start signal (S), then sends the slave device address bit and a write data bit, then sends the register address, before starting to read the register. Immediately after receiving the acknowledgment signal, the master device sends another start signal, then sends the slave device address bit and a read data bit. Then, the MPU6050 as the slave device generates an acknowledgment signal and starts sending

register data. Communication ends with a not-acknowledge signal (NACK) and end flag (P) generated by the master device. The not-acknowledge signal (NACK) is defined as SDA data remaining high during the 9th clock cycle.

### **MPU6050 Module:**

The MPU-6050 is an integrated 6-axis motion processing component. Compared to multi-component solutions, it eliminates the problem of axis differences when combining gyroscopes and accelerometers, reducing a large amount of packaging space. The MPU-6050 integrates a 3-axis gyroscope and 3-axis accelerometer, and includes a digital motion processing (DMP: Digital Motion Processor) hardware acceleration engine that can connect other brands of accelerometers, magnetic sensors, or other sensors through a second I2C port, outputting complete 9-axis fusion calculation technology to the application end in the form of a single data stream from the main I2C port.

### **MPU6050 Module Features:**

1. Digital output of 6-axis or 9-axis rotation matrix, quaternion, Euler angle format fusion calculation data.
2. 3-axis angular velocity sensor (gyroscope) with 131 LSBs/ $^{\circ}$ /sec sensitivity and full-scale sensing range of  $\pm 250$ ,  $\pm 500$ ,  $\pm 1000$  and  $\pm 2000$ / $^{\circ}$ /sec.
3. Programmable control 3-axis accelerometer with control range of  $\pm 2g$ ,  $\pm 4g$ ,  $\pm 8g$  and  $\pm 16g$ .
4. Removes sensitivity between accelerometer and gyroscope axes, reducing the impact of setup and sensor drift.
5. Digital Motion Processing (DMP) engine can reduce the load of complex fusion calculation data, sensor synchronization, posture sensing, etc.
6. Motion processing database supports Android, Linux and Windows
7. Digital output temperature sensor
8. Digital input synchronization pin (Sync pin) supports video electronic image stabilization technology and GPS
9. Programmable interrupts support posture recognition, panning, picture zoom in/out, scrolling, fast drop interrupt, high-G interrupt, zero motion sensing, tap sensing, shake sensing functions
10. VCC supply voltage is 3.3V or 5.0V
11. Gyroscope operating current: 5mA, gyroscope standby current: 5uA; accelerometer operating current: 350uA, accelerometer power-saving mode current: 20uA@10Hz
12. Up to 400kHz fast mode I2C, or up to 20MHz SPI serial host interface
13. Built-in frequency generator has only  $\pm 1\%$  frequency variation over full temperature range

### **Parameter information is as follows:**

## Basic parameters

Chip	MPU-6050
Output	Rotation matrix, Quaternion, Euler angle
ADC digits	16 bit data output
Input voltage	3-5 V voltage input (internal low dropout voltage stabilization)
Gyroscope operating current	5mA
Gyro standby current	5uA
Acceleration operating current	350uA
Accelerator power saving mode current	20uA@10Hz
Gyro range	±250°、±500°、±1000°、±2000° /S
Acceleration range	±2、±4、±8、±16 G
External interface	Externally connected magnetometer module
Interrupt	INT interrupt trigger pin
Communication mode	Standard IIC communication protocol
Transmission speed	400kHZ(IIC) (Max)
Compatible with multiple development platforms	STM32、C51、AR、MSPM0
Pin spacing	2.54mm
Product size	21mm*16mm*2mm

## 3. Project Configuration

### 3.1 Description

You can refer to the basic tutorial to complete the development environment setup.

### 3.2 Pin Configuration

**FILE ABOUT**

Type Filter Text... **RESTART**

**Software > GPIO**

**GPIO (4 Added)**

**+ ADD** **- REMOVE ALL**

**LED** **KEY** **OLED** **MPU6050**

Name: MPU6050  
Port: Any  
Port Segment: Any

**Group Pins**  
2 added

**+ ADD** **- REMOVE ALL**

**SDA** **SCL**

Name: SDA  
Direction: Output  
Initial Value: Set  
IO Structure: 5V Tolerant Open Drain

**Digital IOMUX Features**

Assigned Port: Any  
Assigned Port Segment: Any  
Assigned Pin: Any

**Interrupts/Events**

LaunchPad-Specific Pin: No Shortcut Used

**Problems**  
**ERRORS** **WARNINGS** **SUPPRESSED** **INFOS**

**Location** **Details**

**Generated Files**  
Filter: all

File name	Category	Include in build
<b>ti_msp_dl_config.c</b>	MSPM0 Driver Library	<input checked="" type="checkbox"/>
<b>ti_msp_dl_config.h</b>	MSPM0 Driver Library	<input checked="" type="checkbox"/>
<b>Event.dot</b>	MSPM0 Driver Library	<input checked="" type="checkbox"/>
<b>empty.syscfg</b>	Configuration Script	<input type="checkbox"/>

4 Total Files

**MSPM0G3507 (Device)**  
**LQFP-64(PM) (Package)**

**FILE ABOUT**

Type Filter Text... **RESTART**

**Software > GPIO**

**GPIO (4 Added)**

**+ ADD** **- REMOVE ALL**

**LED** **KEY** **OLED** **MPU6050**

Name: MPU6050  
Port: Any  
Port Segment: Any

**Group Pins**  
2 added

**+ ADD** **- REMOVE ALL**

**SDA** **SCL**

Name: SCL  
Direction: Output  
Initial Value: Set  
IO Structure: 5V Tolerant Open Drain

**Digital IOMUX Features**

Assigned Port: Any  
Assigned Port Segment: Any  
Assigned Pin: Any

**Interrupts/Events**

LaunchPad-Specific Pin: No Shortcut Used

**Problems**  
**ERRORS** **WARNINGS** **SUPPRESSED** **INFOS**

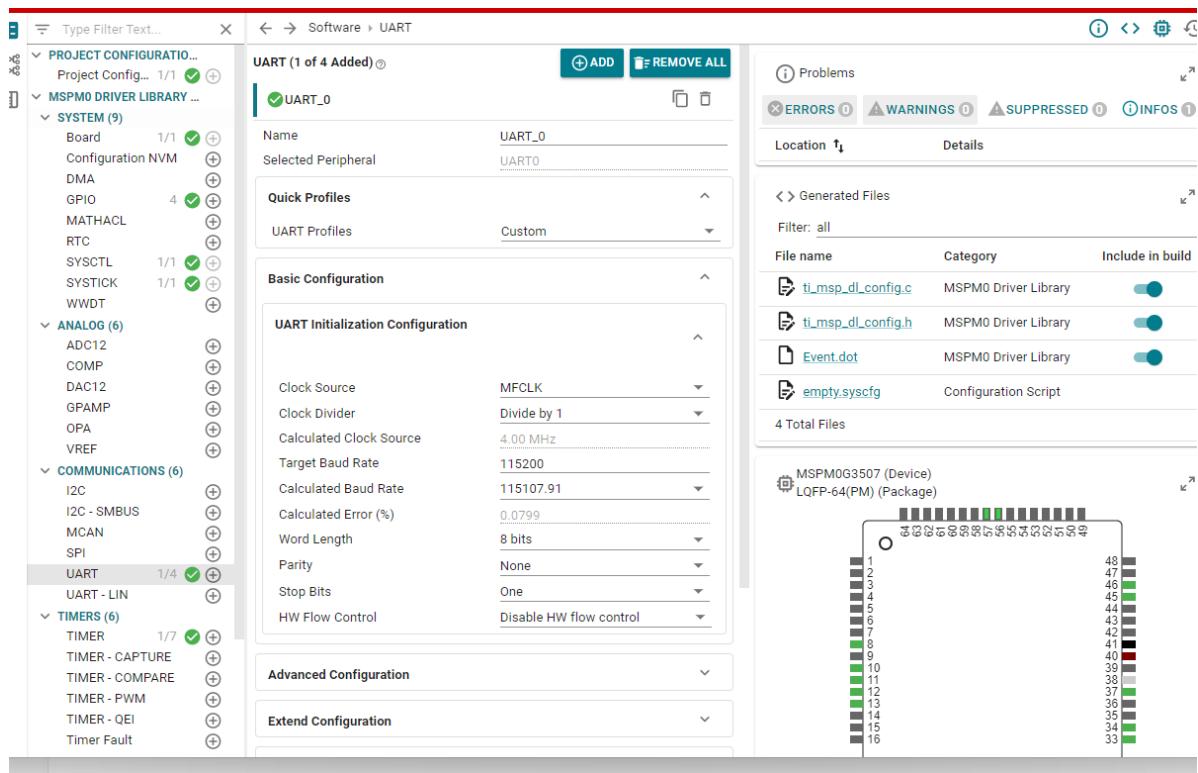
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<b>empty.syscfg</b>	Configuration Script	<input type="checkbox"/>

4 Total Files

**MSPM0G3507 (Device)**  
**LQFP-64(PM) (Package)**



## 4. Main Functions

### 4.1 User Functions

#### Function: Get\_EulerAngles()

<b>Function Prototype</b>	<b>void Get_EulerAngles(void)</b>
Function Description	<b>Get MPU6050 data and send through serial port</b>
Input Parameters	<b>None</b>
Return Value	<b>None</b>

#### Function: MPU6050\_Init

<b>Function Prototype</b>	<b>char MPU6050_Init(void)</b>
Function Description	<b>MPU6050 initialization</b>
Input Parameters	<b>None</b>
Return Value	<b>Judge whether MPU6050 is detected</b>

## 5. Experimental Phenomenon

After downloading the program, open the serial port assistant and set the parameters as shown in the figure below. Then open the serial port to receive the raw data of MPU6050.

For program download, refer to **【3. Development Environment Setup and Usage: 3. uniflash burning】**

The effect is as follows:

