**MPU6050N( 3 ACCEL + 3 GYROS)**

I2C ID: 0X68

**4.1 Registers 13 to 16 – Self Test Registers**

**SELF\_TEST\_X, SELF\_TEST\_Y, SELF\_TEST\_Z, and SELF\_TEST\_A**

**Type: Read/Write**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Register (hex)** | **Register**  **(decimal)** | **Bit7** | **Bit6** | **Bit5** | **Bit4** | | **Bit3** | **Bit2** | **Bit1** | **Bit0** |
| 0D | 13 | XA-TEST[4-2] | | | XG\_TEST[4-0] | | | | | |
| 0E | 14 | YA\_TEST[4-2] | | | YG\_TEST[4-0] | | | | | |
| 0F | 15 | ZA\_TEST[4-2] | | | ZG\_TEST[1-0] | | | | | |
| 10 | 16 | RESERVED | | XA\_TEST[1-0] | | YA\_TEST[1-0] | | | ZA\_TEST[1-0] | |

**Description:**

1. Gyroscope Hardware Self-Test: Relative Method

Gyroscope self-test permits users to test the mechanical and electrical portions of the gyroscope.

Code for operating self-test is included within the MotionApps™ software provided by InvenSense.

Please refer to the next section (Obtaining the Gyroscope Factory Trim (FT) Value) if not using

MotionApps software.

When self-test is activated, the on-board electronics will actuate the appropriate sensor. This

actuation will move the sensor’s proof masses over a distance equivalent to a pre-defined Coriolis

force. This proof mass displacement results in a change in the sensor output, which is reflected in

the output signal. The output signal is used to observe the self-test response.

**4.15 Register 55 – INT Pin / Bypass Enable Configuration**

**INT\_PIN\_CFG**

**Type: Read/Write**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Resgister  (hex) | Register  (decimal) | Bit7 | Bit6 | Bit5 | Bit4 | Bit3 | Bit2 | Bit1 | Bit0 |
| 37 | 55 | INT\_LEVEL | INT\_OPEN | LATCH\_INT\_EN | INT\_RD\_CLEAR | FSYNC\_INT\_LEVEL | FSYNC\_INT\_EN | I2C\_BYPASS\_EN | - |

**Description:**

This register configures the behavior of the interrupt signals at the INT pins. This register is also

used to enable the FSYNC Pin to be used as an interrupt to the host application processor, as well

as to enable Bypass Mode on the I

2

C Master. This bit also enables the clock output.

FSYNC\_INT\_EN enables the FSYNC pin to be used as an interrupt to the host application

processor. A transition to the active level specified in FSYNC\_INT\_LEVEL will trigger an interrupt.

The status of this interrupt is read from the PASS\_THROUGH bit in the I2

C Master Status Register

(Register 54).

When I2C\_BYPASS\_EN is equal to 1 and I2C\_MST\_EN (Register 106 bit[5]) is equal to 0, the host

application processor will be able to directly access the auxiliary I2

C bus of the MPU-60X0. When

this bit is equal to 0, the host application processor will not be able to directly access the auxiliary I2

C

bus of the MPU-60X0 regardless of the state of I2C\_MST\_EN

**4.18 Registers 59 to 64 – Accelerometer Measurements**

**ACCEL\_XOUT\_H, ACCEL\_XOUT\_L, ACCEL\_YOUT\_H, ACCEL\_YOUT\_L, ACCEL\_ZOUT\_H, and**

**ACCEL\_ZOUT\_L**

**Type: Read Only**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Register  (hex) | Register  (decimal) | Bit7 | Bit6 | Bit5 | Bit4 | Bit3 | Bit2 | Bit1 | Bit0 |
| 3B | 59 | ACCEL\_XOUT[15:8] | | | | | | | |
| 3C | 60 | ACCEL\_XOUT[7:0] | | | | | | | |
| 3D | 61 | ACCEL\_YOUT[15:8] | | | | | | | |
| 3E | 62 | ACCEL\_YOUT[7:0] | | | | | | | |
| 3F | 62 | ACCEL\_ZOUT[15:8] | | | | | | | |
| 40 | 64 | ACCEL\_ZOUT[7:0] | | | | | | | |

**Description:**

Accelerometer measurements are written to these registers at the Sample Rate as defined in

Register 25.

The accelerometer measurement registers, along with the temperature measurement registers,

gyroscope measurement registers, and external sensor data registers, are composed of two sets of

registers: an internal register set and a user-facing read register set.

The data within the accelerometer sensors’ internal register set is always updated at the Sample

Rate. Meanwhile, the user-facing read register set duplicates the internal register set’s data values

whenever the serial interface is idle. This guarantees that a burst read of sensor registers will read

measurements from the same sampling instant. Note that if burst reads are not used, the user is

responsible for ensuring a set of single byte reads correspond to a single sampling instant by

checking the Data Ready interrupt.

Each 16-bit accelerometer measurement has a full scale defined in ACCEL\_FS (Register 28). For

each full scale setting, the accelerometers’ sensitivity per LSB in ACCEL\_xOUT is shown in the table

below.

**4.20 Registers 67 to 72 – Gyroscope Measurements**

**GYRO\_XOUT\_H, GYRO\_XOUT\_L, GYRO\_YOUT\_H, GYRO\_YOUT\_L, GYRO\_ZOUT\_H, and**

**GYRO\_ZOUT\_L**

**Type: Read Only**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Register  (hex) | Register  (decimal) | Bit7 | Bit6 | Bit5 | Bit4 | Bit3 | Bit2 | Bit1 | Bit0 |
| 43 | 67 | GYRO\_XOUT[15:8] | | | | | | | |
| 44 | 68 | GYRO\_XOUT[7:0] | | | | | | | |
| 45 | 69 | GYRO\_YOUT[15:8] | | | | | | | |
| 46 | 70 | GYRO\_YOUT[7:0] | | | | | | | |
| 47 | 71 | GYRO\_ZOUT[15:8] | | | | | | | |
| 48 | 72 | GYRO\_ZOUT[7:0] | | | | | | | |

**Description:**

These registers store the most recent gyroscope measurements.

Gyroscope measurements are written to these registers at the Sample Rate as defined in Register

25.

These gyroscope measurement registers, along with the accelerometer measurement registers,

temperature measurement registers, and external sensor data registers, are composed of two sets of

registers: an internal register set and a user-facing read register set.

The data within the gyroscope sensors’ internal register set is always updated at the Sample Rate.

Meanwhile, the user-facing read register set duplicates the internal register set’s data values

whenever the serial interface is idle. This guarantees that a burst read of sensor registers will read

measurements from the same sampling instant. Note that if burst reads are not used, the user is

responsible for ensuring a set of single byte reads correspond to a single sampling instant by

checking the Data Ready interrupt.

**4.34 Register 117 – Who Am I**

**WHO\_AM\_I**

**Type: Read Only**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Register  (hex) | Register  (decimal) | Bit7 | Bit6 | Bit5 | Bit4 | Bit3 | Bit2 | Bit1 | Bit0 |
| 75 | 117 | - | WHO\_AM\_I[6:1]- | | | | | | - |

**Description:**

This register is used to verify the identity of the device. The contents of WHO\_AM\_I are the upper 6

bits of the MPU-60X0’s 7-bit I2

C address. The least significant bit of the MPU-60X0’s I

2

C address is

determined by the value of the AD0 pin. The value of the AD0 pin is not reflected in this register.

The default value of the register is 0x68.

Bits 0 and 7 are reserved. (Hard coded to 0)

**HMC5883L ( 3 AXIS MAGNETOMETER)**

I2C ID: 0X1E

|  |  |  |
| --- | --- | --- |
| Address Location | Name | Access |
| 00 | Configuration Register A | Read/Write |
| 01 | Configuration Register B | Read/Write |
| 02 | Mode Register | Read/Write |
| 03 | Data Output X MSB Register | Read |
| 04 | Data Output X LSB Register | Read |
| 05 | Data Output Z MSB Register | Read |
| 06 | Data Output Z LSB Register | Read |
| 07 | Data Output Y MSB Register | Read |
| 08 | Data Output Y LSB Register | Read |
| 09 | 09 Status Register | Read |
| 10 | Identification Register A | Read |
| 11 | Identification Register B | Read |
| 12 | Identification Register C | Read |

**BMP180 (BAROMETER)**

I2C ID: 0X77

**4. Global Memory Map**

The memory map below shows all externally accessible data registers which are needed to operate

BMP180. The left columns show the memory addresses. The columns in the middle depict the

content of each register bit. The colors of the bits indicate whether they are read-only, write-only or

read- and writable. The memory is volatile so that the writable content has to be re-written after each

power-on.

Not all register addresses are shown. These registers are reserved for further Bosch factory testing

and trimming.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Register Name** | **Register Address** | **Bit7** | **Bit6** | **Bit5** | **Bit4** | **Bit3** | **Bit2** | **Bit1** | **Bit0** | **Reset**  **State** |
| Out-xlsb | F8h | Adc-out-xlsb<7:3> | | | | | 0 | 0 | 0 | 00h |
| Out\_lsb | F7h | Adc\_out\_lsb<7:0> | | | | | | | | 00h |
| Out\_msb | F6h | Adc\_out\_msb<7:0> | | | | | | | | 80h |
| Ctrl\_meas | F4h | Oss<1:0> | | Measurement control | | | | | | 00h |
| Soft\_reset | E0h | reset | | | | | | | | 00h |
| id | D0h | Id<7:0> | | | | | | | | 55h |
| Calib21 downto calib0 | Bfh down to AAh | Calib21<7:0> down to calib0<7:0> | | | | | | | | n/a |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Resiters** | Control registers | Calibration registers | Data Registers | Fixed |
| **Type** | Read/write | Read only | Read only | Read only |

**Measurement control (register F4h <4:0>):** Controls measurements. Refer to Figure 6 for usage

details.

**Sco (register F4h <5>):** Start of conversion. The value of this bit stays “1” during conversion and is

reset to “0” after conversion is complete (data registers are filled).

**Oss (register F4h <7:6>):** controls the oversampling ratio of the pressure measurement (00b: single,

01b: 2 times, 10b: 4 times, 11b: 8 times).

**Soft reset (register E0h):** Write only register. If set to 0xB6, will perform the same sequence as

power on reset.

**Chip-id (register D0h):** This value is fixed to 0x55 and can be used to check whether

communication is functioning.

After conversion, data registers can be read out in any sequence (i.e. MSB first or LSB first). Using a

burst read is not mandatory.

**5.2 Device and register address**

The BMP180 module address is shown below. The LSB of the device address distinguishes

between read (1) and write (0) operation, corresponding to address 0xEF (read) and 0xEE (write).

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| A7 | A6 | A5 | A4 | A3 | A2 | A1 | W/R |
| 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0/1 |