# Register Map

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Addr (HEX)** | **Name** | **R/W** | **Bit 7** | **Bit 6** | | **Bit 5** | | **Bit 4** | | **Bit 3** | | | **Bit 2** | **Bit 1** | | **Bit 0** |
| 0x00 | IMU\_EN\_1 | R/W | IMU\_EN[31:24] | | | | | | | | | | | | | |
| 0x01 | IMU\_EN\_2 | R/W | IMU\_EN[23:16] | | | | | | | | | | | | | |
| 0x02 | IMU\_EN\_3 | R/W | IMU\_EN[15:8] | | | | | | | | | | | | | |
| 0x03 | IMU\_EN\_4 | R/W | IMU\_EN[7:0] | | | | | | | | | | | | | |
| 0x04 | IMU\_DAQ | R/W | OUTPUT\_RATE\_DIV[3:0] | | | | | | | SD\_OVERWRITE | | | IMU\_MODE[1:0] | | | DAQ\_EN |
| 0x05 | NOT\_USED | N/A | RESERVED | | | | | | | | | | | | | |
| 0x06 | IMU\_STAT | R | STATUS[7:0] | | | | | | | | | | | | | |
| 0x07 | DTHETA\_X\_1 | R | DELTA\_THETA\_X[31:24] | | | | | | | | | | | | | |
| 0x08 | DTHETA\_X\_2 | R | DELTA\_THETA\_X[23:16] | | | | | | | | | | | | | |
| 0x09 | DTHETA\_X\_3 | R | DELTA\_THETA\_X[15:8] | | | | | | | | | | | | | |
| 0x0A | DTHETA\_X\_4 | R | DELTA\_THETA\_X[7:0] | | | | | | | | | | | | | |
| 0x0B | DTHETA\_Y\_1 | R | DELTA\_THETA\_Y[31:24] | | | | | | | | | | | | | |
| 0x0C | DTHETA\_Y\_2 | R | DELTA\_THETA\_Y[23:16] | | | | | | | | | | | | | |
| 0x0D | DTHETA\_Y\_3 | R | DELTA\_THETA\_Y[15:8] | | | | | | | | | | | | | |
| 0x0E | DTHETA\_Y\_4 | R | DELTA\_THETA\_Y[7:0] | | | | | | | | | | | | | |
| 0x0F | DTHETA\_Z\_1 | R | DELTA\_THETA\_Z[31:24] | | | | | | | | | | | | | |
| 0x10 | DTHETA\_Z\_2 | R | DELTA\_THETA\_Z[23:16] | | | | | | | | | | | | | |
| 0x11 | DTHETA\_Z\_3 | R | DELTA\_THETA\_Z[15:8] | | | | | | | | | | | | | |
| 0x12 | DTHETA\_Z\_4 | R | DELTA\_THETA\_Z[7:0] | | | | | | | | | | | | | |
| 0x13 | DVEL\_X\_1 | R | DELTA\_VEL\_X[31:24] | | | | | | | | | | | | | |
| 0x14 | DVEL\_X\_2 | R | DELTA\_VEL\_X[23:16] | | | | | | | | | | | | | |
| 0x15 | DVEL\_X\_3 | R | DELTA\_VEL\_X[15:8] | | | | | | | | | | | | | |
| 0x16 | DVEL\_X\_4 | R | DELTA\_VEL\_X[7:0] | | | | | | | | | | | | | |
| 0x17 | DVEL\_Y\_1 | R | DELTA\_VEL\_Y[31:24] | | | | | | | | | | | | | |
| 0x18 | DVEL\_Y\_2 | R | DELTA\_VEL\_Y[23:16] | | | | | | | | | | | | | |
| 0x19 | DVEL\_Y\_3 | R | DELTA\_VEL\_Y[15:8] | | | | | | | | | | | | | |
| 0x1A | DVEL\_Y\_4 | R | DELTA\_VEL\_Y[7:0] | | | | | | | | | | | | | |
| 0x1B | DVEL\_Z\_1 | R | DELTA\_VEL\_Z[31:24] | | | | | | | | | | | | | |
| 0x1C | DVEL\_Z\_2 | R | DELTA\_VEL\_Z[23:16] | | | | | | | | | | | | | |
| 0x1D | DVEL\_Z\_3 | R | DELTA\_VEL\_Z[15:8] | | | | | | | | | | | | | |
| 0x1E | DVEL\_Z\_4 | R | DELTA\_VEL\_Z[7:0] | | | | | | | | | | | | | |
| 0x1F | IQUAT\_X\_1 | R | INT\_QUAT\_X[31:24] | | | | | | | | | | | | | |
| 0x20 | IQUAT\_X\_2 | R | INT\_QUAT\_X [23:16] | | | | | | | | | | | | | |
| 0x21 | IQUAT\_X\_3 | R | INT\_QUAT\_X[15:8] | | | | | | | | | | | | | |
| 0x22 | IQUAT\_X\_4 | R | INT\_QUAT\_X[7:0] | | | | | | | | | | | | | |
| 0x23 | IQUAT\_Y\_1 | R | INT\_QUAT\_Y[31:24] | | | | | | | | | | | | | |
| 0x24 | IQUAT\_Y\_2 | R | INT\_QUAT\_Y[23:16] | | | | | | | | | | | | | |
| 0x25 | IQUAT\_Y\_3 | R | INT\_QUAT\_Y[15:8] | | | | | | | | | | | | | |
| 0x26 | IQUAT\_Y\_4 | R | INT\_QUAT\_Y[7:0] | | | | | | | | | | | | | |
| 0x27 | IQUAT\_Z\_1 | R | INT\_QUAT\_Z[31:24] | | | | | | | | | | | | | |
| 0x28 | IQUAT\_Z\_2 | R | INT\_QUAT\_Z[23:16] | | | | | | | | | | | | | |
| 0x29 | IQUAT\_Z\_3 | R | INT\_QUAT\_Z[15:8] | | | | | | | | | | | | | |
| 0x2A | IQUAT\_Z\_4 | R | INT\_QUAT\_Z[7:0] | | | | | | | | | | | | | |
| 0x2B | IQUAT\_W\_1 | R | INT\_QUAT\_W[31:24] | | | | | | | | | | | | | |
| 0x2C | IQUAT\_W\_2 | R | INT\_QUAT\_W[23:16] | | | | | | | | | | | | | |
| 0x2D | IQUAT\_W\_3 | R | INT\_QUAT\_W[15:8] | | | | | | | | | | | | | |
| 0x2E | IQUAT\_W\_4 | R | INT\_QUAT\_W[7:0] | | | | | | | | | | | | | |
| 0x2F | TEMP\_1 | R | TEMPERATURE[31:24] | | | | | | | | | | | | | |
| 0x30 | TEMP\_2 | R | TEMPERATURE[23:16] | | | | | | | | | | | | | |
| 0x31 | TEMP\_3 | R | TEMPERATURE[15:8] | | | | | | | | | | | | | |
| 0x32 | TEMP\_4 | R | TEMPERATURE[7:0] | | | | | | | | | | | | | |
| 0x33 | ACC\_VEL\_X\_1 | R | ACC\_VEL\_X[31:24] | | | | | | | | | | | | | |
| 0x34 | ACC\_VEL\_X\_2 | R | ACC\_VEL\_X[23:16] | | | | | | | | | | | | | |
| 0x35 | ACC\_VEL\_X\_3 | R | ACC\_VEL\_X[15:8] | | | | | | | | | | | | | |
| 0x36 | ACC\_VEL\_X\_4 | R | ACC\_VEL\_X[7:0] | | | | | | | | | | | | | |
| 0x37 | ACC\_VEL\_Y\_1 | R | ACC\_VEL\_Y[31:24] | | | | | | | | | | | | | |
| **Addr (HEX)** | **Name** | **R/W** | **Bit 7** | | **Bit 6** | | **Bit 5** | | **Bit 4** | | **Bit 3** | **Bit 2** | | **Bit 1** | **Bit 0** | |
| 0x38 | ACC\_VEL\_Y\_2 | R | ACC\_VEL\_Y[23:16] | | | | | | | | | | | | | |
| 0x39 | ACC\_VEL\_Y\_3 | R | ACC\_VEL\_Y[15:8] | | | | | | | | | | | | | |
| 0x3A | ACC\_VEL\_Y\_4 | R | ACC\_VEL\_Y[7:0] | | | | | | | | | | | | | |
| 0x3B | ACC\_VEL\_Z\_1 | R | ACC\_VEL\_Z[31:24] | | | | | | | | | | | | | |
| 0x3C | ACC\_VEL\_Z\_2 | R | ACC\_VEL\_Z[23:16] | | | | | | | | | | | | | |
| 0x3D | ACC\_VEL\_Z\_3 | R | ACC\_VEL\_Z[15:8] | | | | | | | | | | | | | |
| 0x3E | ACC\_VEL\_Z\_4 | R | ACC\_VEL\_Z[7:0] | | | | | | | | | | | | | |
| 0x3F | TICK\_1 | R | TICK\_COUNT[31:24] | | | | | | | | | | | | | |
| 0x40 | TICK\_2 | R | TICK\_COUNT[23:16] | | | | | | | | | | | | | |
| 0x41 | TICK\_3 | R | TICK\_COUNT[15:8] | | | | | | | | | | | | | |
| 0x42 | TICK\_4 | R | TICK\_COUNT[7:0] | | | | | | | | | | | | | |
| 0x43 | ANG\_VEL\_X\_1 | R | ANG\_VEL\_X[31:24] | | | | | | | | | | | | | |
| 0x44 | ANG\_VEL\_X\_2 | R | ANG\_VEL\_X[23:16] | | | | | | | | | | | | | |
| 0x45 | ANG\_VEL\_X\_3 | R | ANG\_VEL\_X[15:8] | | | | | | | | | | | | | |
| 0x46 | ANG\_VEL\_X\_4 | R | ANG\_VEL\_X[7:0] | | | | | | | | | | | | | |
| 0x47 | ANG\_VEL\_Y\_1 | R | ANG\_VEL\_Y[31:24] | | | | | | | | | | | | | |
| 0x48 | ANG\_VEL\_Y\_2 | R | ANG\_VEL\_Y[23:16] | | | | | | | | | | | | | |
| 0x49 | ANG\_VEL\_Y\_3 | R | ANG\_VEL\_Y[15:8] | | | | | | | | | | | | | |
| 0x4A | ANG\_VEL\_Y\_4 | R | ANG\_VEL\_Y[7:0] | | | | | | | | | | | | | |
| 0x4B | ANG\_VEL\_Z\_1 | R | ANG\_VEL\_Z[31:24] | | | | | | | | | | | | | |
| 0x4C | ANG\_VEL\_Z\_2 | R | ANG\_VEL\_Z[23:16] | | | | | | | | | | | | | |
| 0x4D | ANG\_VEL\_Z\_3 | R | ANG\_VEL\_Z[15:8] | | | | | | | | | | | | | |
| 0x4E | ANG\_VEL\_Z\_4 | R | ANG\_VEL\_Z[7:0] | | | | | | | | | | | | | |
| 0x4F | SP\_FORCE\_X\_1 | R | SP\_FORCE\_X[31:24] | | | | | | | | | | | | | |
| 0x50 | SP\_FORCE\_X\_2 | R | SP\_FORCE\_X[23:16] | | | | | | | | | | | | | |
| 0x51 | SP\_FORCE\_X\_3 | R | SP\_FORCE\_X[15:8] | | | | | | | | | | | | | |
| 0x52 | SP\_FORCE\_X\_4 | R | SP\_FORCE\_X[7:0] | | | | | | | | | | | | | |
| 0x53 | SP\_FORCE\_Y\_1 | R | SP\_FORCE\_Y[31:24] | | | | | | | | | | | | | |
| 0x54 | SP\_FORCE\_Y\_2 | R | SP\_FORCE\_Y[23:16] | | | | | | | | | | | | | |
| 0x55 | SP\_FORCE\_Y\_3 | R | SP\_FORCE\_Y[15:8] | | | | | | | | | | | | | |
| 0x56 | SP\_FORCE\_Y\_4 | R | SP\_FORCE\_Y[7:0] | | | | | | | | | | | | | |
| 0x57 | SP\_FORCE\_Z\_1 | R | SP\_FORCE\_Z[31:24] | | | | | | | | | | | | | |
| 0x58 | SP\_FORCE\_Z\_2 | R | SP\_FORCE\_Z[23:16] | | | | | | | | | | | | | |
| 0x59 | SP\_FORCE\_Z\_3 | R | SP\_FORCE\_Z[15:8] | | | | | | | | | | | | | |
| 0x5A | SP\_FORCE\_Z\_4 | R | SP\_FORCE\_Z[7:0] | | | | | | | | | | | | | |
| 0x5B | SD\_STAT | R | RESERVED | | | | | | | | | | | SD\_EOF | SD\_READY | |
| 0x5C-0xDB | SD\_DATA | R | SD\_DATA[7:0] | | | | | | | | | | | | | |

# Register Descriptions

## IMU\_EN\_1, IMU\_EN\_2, IMU\_EN\_3, IMU\_EN\_4

**Description:** Enable flag for each of the 32 IMUs. The enable flags span four registers to cover all 32 IMUs. To enable an IMU and include it in the data acquisition loop, set the *n*-th bit to 1. If the bit is set to 0, the IMU is put into a sleep mode and removed from the data acquisition loop.

## IMU\_STAT

**Description:** System status flags. What these flags should be is yet to be determined. Possible ideas are setting thresholds for temperature or raising a flag when errors occur during data acquisition, SD card reads/writes, etc.

|  |  |  |
| --- | --- | --- |
| **Bit** | **Bit Name** | **Flag Description** |
| 0 | STATUS[0] | TBD |
| 1 | STATUS[1] | TBD |
| 2 | STATUS[2] | TBD |
| 3 | STATUS[3] | TBD |
| 4 | STATUS[4] | TBD |
| 5 | STATUS[5] | TBD |
| 6 | STATUS[6] | TBD |
| 7 | STATUS[7] | TBD |

## IMU\_DAQ

**Description:** Data acquisition settings.

|  |  |  |
| --- | --- | --- |
| **Bit** | **Bit Name** | **Flag Description** |
| 0 | DAQ\_EN | Set to 1 to enable data acquisition timer interrupt. Set to 0 to disable interrupt. |
| 1 | IMU\_MODE[0] | See *Operating Mode* table below |
| 2 | IMU\_MODE[1] |
| 3 | SD\_CLEAR | Clears the data in the active file on the SD card |
| 4 | SD\_FILE\_SUFFIX[0] | Integer suffix used in the SD card file. Allows the creation of eight separate files on the SD card. |
| 5 | SD\_FILE\_SUFFIX[1] |
| 6 | SD\_FILE\_SUFFIX[2] |
| 7 | SD\_FILE\_SUFFIX[3] |

|  |  |  |
| --- | --- | --- |
| **Operating Modes** | | |
| IMU\_MODE[1] | IMU\_MODE[0] | Description |
| 0 | 0 | *Nominal Mode* – IMU outputs are calibrated, averaged and conditioned. The IMU state is updated at a rate of SAMPLE\_RATE / UPDATE\_RATE\_DIV |
| 0 | 1 | *Experimental Mode A* – Calibration, averaging and conditioning is not performed on the IMU data. Only raw data is saved to SD card. |
| 1 | 0 | *Experimental Mode B* – Calibration, averaging and condition is performed on the IMU data. Both raw data and calibrated data are saved to the SD card. |
| 1 | 1 | *SD Card Read Mode – Opens up the file with suffix indicated by SD\_FILE\_SUFFIX for reading. When SD\_DATA register is read from, automatically copies new data into register. New data is loaded when SD\_DIRTY = 0* |

## IMU\_DIV

**Description:** Update rate and sample rate dividers

|  |  |  |
| --- | --- | --- |
| **Bit** | **Bit Name** | **Flag Description** |
| 0-3 | UPDATE\_RATE\_DIV | Gets or sets the update rate divider for Mode 1 operation. The update rate is defined as f = SAMPLE\_RATE / UPDATE\_RATE\_DIV. If UPDATE\_RATE\_DIV = 0x0, UPDATE\_RATE\_DIV is defaulted to 0x1. |
| 4-7 | SAMPLE\_RATE\_DIV | Gets or sets the IMU sample rate divider. This is the rate at which data is acquired from the IMUs. The sample rate is defined as f = 400 Hz / IMU\_SAMPLE\_RATE. If IMU\_SAMPLE\_RATE\_DIV = 0x0, IMU\_SAMPLE\_RATE\_DIV is defaulted to 0x1. |

## GYRO\_X\_1, GYRO\_X\_2, GYRO\_X\_3, GYRO\_X\_4

**Description:** ANG\_VEL\_X contains the X-component of the calibrated and averaged angular velocity vector (FLOAT32)

## GYRO\_Y\_1, GYRO\_Y\_2, GYRO\_Y\_3, GYRO\_Y\_4

**Description:** ANG\_VEL\_Y contains the Y-component of the calibrated and averaged angular velocity vector (FLOAT32)

## GYRO\_Z\_1, GYRO\_Z\_2, GYRO\_Z\_3, GYRO\_Z\_4

**Description:** ANG\_VEL\_Z contains the Z-component of the calibrated and averaged angular velocity vector (FLOAT32)

## ACCEL\_X\_1, ACCEL\_X\_2, ACCEL\_X\_3, ACCEL\_X\_4

**Description:** SPF\_X contains the X-component of the calibrated and averaged specific force vector (FLOAT32)

## ACCEL\_Y\_1, ACCEL\_Y\_2, ACCEL\_Y\_3, ACCEL\_Y\_4

**Description:** SPF\_Y contains the Y-component of the calibrated and averaged specific force vector (FLOAT32)

## ACCEL\_Z\_1, ACCEL\_Z\_2, ACCEL\_Z\_3, ACCEL\_Z\_4

**Description:** SPF\_Z contains the Z-component of the calibrated and averaged specific force vector (FLOAT32)

## IQUAT\_X\_1, IQUAT\_X\_2, IQUAT\_X\_3, IQUAT\_X\_4

**Description:** INT\_QUAT\_X contains the X-component of the integrated attitude quaternion (FLOAT32)

## IQUAT\_Y\_1, IQUAT\_Y\_2, IQUAT\_Y\_3, IQUAT\_Y\_4

**Description:** INT\_QUAT\_Y contains the Y-component of the integrated attitude quaternion (FLOAT32)

## IQUAT\_Z\_1, IQUAT\_Z\_2, IQUAT\_Z\_3, IQUAT\_Z\_4

**Description:** INT\_QUAT\_Z contains the Z-component of the integrated attitude quaternion (FLOAT32)

## IQUAT\_W\_1, IQUAT\_W\_2, IQUAT\_W\_3, IQUAT\_W\_4

**Description:** INT\_QUAT\_W contains the W-component of the integrated attitude quaternion (FLOAT32)

## IMU\_TMP\_1, IMU\_TMP\_2, IMU\_TMP\_3, IMU\_TMP\_4

**Description:** TEMPERATURE contains the averaged IMU temperature (FLOAT32)

## ACC\_VEL\_X\_1, ACC\_VEL\_X\_2, ACC\_VEL\_X\_3, ACC\_VEL\_X\_4

**Description:** ACC\_VEL\_X contains the X-component of the accumulated velocity vector (FLOAT32)

## ACC\_VEL\_Y\_1, ACC\_VEL\_Y\_2, ACC\_VEL\_Y\_3, ACC\_VEL\_Y\_4

**Description:** ACC\_VEL\_Y contains the Y-component of the accumulated velocity vector (FLOAT32)

## ACC\_VEL\_Z\_1, ACC\_VEL\_Z\_2, ACC\_VEL\_Z\_3, ACC\_VEL\_Z\_4

**Description:** ACC\_VEL\_Z contains the Z-component of the accumulated velocity vector (FLOAT32)

## TICK\_1, TICK\_2, TICK\_3, TICK\_4

**Description:** TICK\_COUNT contains the current tick count. One tick is equal to the inverse of the sampling rate (1/(400 Hz/SAMPLE\_RATE\_DIV)).