



# **IMU MODULE HARDWARE SPECIFICATION**

**Model No. FLT-A100**

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on behalf of FRUITION CO., LTD.**

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Full revision history and latest data sheets are available at  
<https://github.com/diracs-delta/fruition-specs/tree/master/FLT-A100-EN> .

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# 1 Product Overview

## 1.1 General Description

The FLT-A100 is Fruition's latest inertial measurement unit (IMU) module, an economical solution to any hardware application in need of gyroscopic or accelerometric measurements.

The FLT-A100 IMU module is a tri-axis accelerometer and gyroscope, integrated with an energy-efficient microprocessor suitable for low power applications. The module firmware also contains an advanced signal processing algorithm aimed at noise reduction. It also contains a sensor fusion algorithm that outputs its three principal axes, i.e. its roll, pitch, and yaw. The module also supports UART communication through its stamp half-hole patch interface.

Our module is especially suitable towards robotics industries necessitating modules that are space-efficient. The FLT-A100 IMU module is only  $15.2 \times 17.8$  mm in size, making it perfect for such applications.

## 1.2 Features

- Small size that is competitive with existing MEMS sensors.
- Integrated high-precision six-axis gyroscope.
- UART interface with high baud rate and I/O frequency.
- Accurate sensor fusion algorithm that calculates the roll, pitch, and yaw.
- High stability against thermal and vibrational fluctuation.
- Low power consumption.

## 1.3 Applications

- Inertial navigation system for all portable robots, such as flying drones, autonomous lawn mowers, or robot vacuums.

## 1.4 Module Dimensions

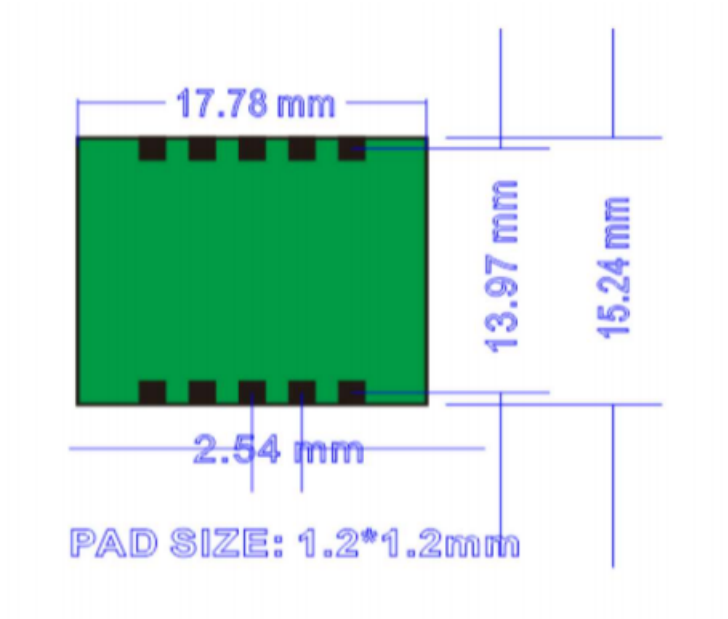


Figure 1.1: General dimensions of the FLT-A100 IMU module.

## 1.5 Operating Ranges

- Operating temperature range:  $-40/+85\text{ }^{\circ}\text{C}$ 
  - Recommended:  $-20/+70\text{ }^{\circ}\text{C}$ .
- Storage temperature range:  $-40/+125\text{ }^{\circ}\text{C}$ .
- Maximum working voltage (GND/VCC):  $-0.3\text{V}/+4.5\text{V}$ .
  - Recommended:  $-0.15\text{V}/3.3\text{V}$
- Maximum acceleration:  $\pm 40\text{ m/s}^2$  along any axis.
- Maximum angular velocity:  $\pm 1000$  degrees/second (dps) along any axis.
- Maximum pitch and roll:  $\pm 90$  degrees.
- Maximum yaw:  $\pm 180$  degrees.

## 1.6 Coordinate System Reference

The most sensitive axis of the FLT-A100 IMU module is perpendicular to the module's plane. This is labelled the Z axis. The roll, pitch, and yaw are all defined using the right-hand-rule, and are defined to be in the direction of rotation with respect to the X, Y, and Z axes, respectively.

## 2 Module I/O

### 2.1 General I/O Scheme

Figure 2.1: Flowchart depicting the I/O scheme of the FLT-A100 IMU module.

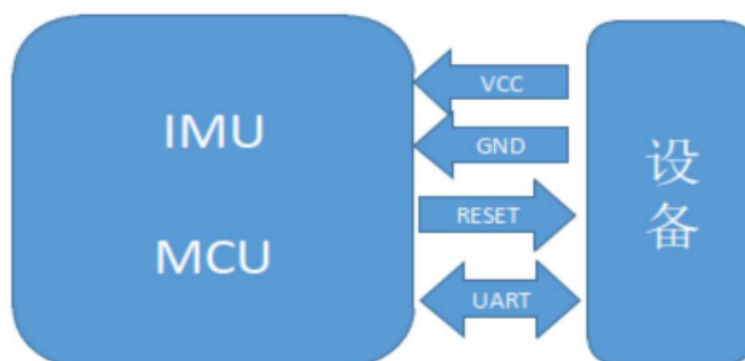


Figure 2.2: Location of pins on the FLT-A100 IMU module

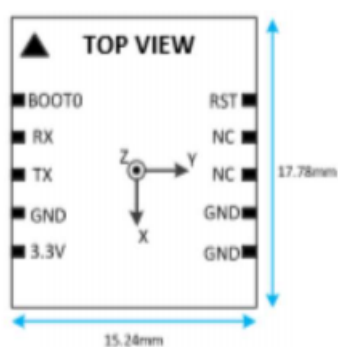
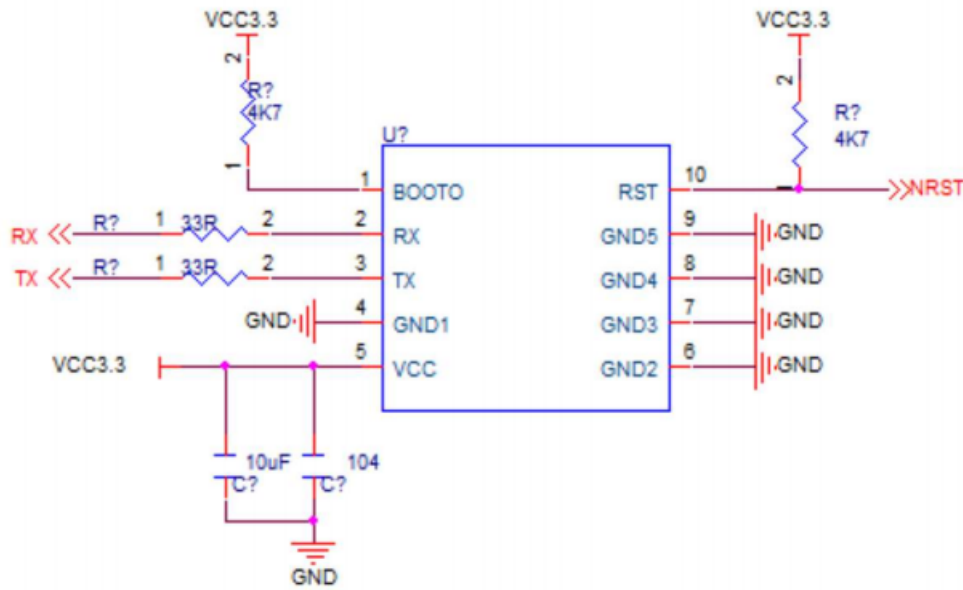


Figure 2.3: Circuit diagram of the FLT-A100 IMU module



## 2.2 Pin Definitions

Table 2.1: Pin definitions of the FLT-A100 IMU module.

Pin	Name	I/O	Function
1	BOOT0	I	"Start method (start from internal flash)"
2	RX	I	UART receive data
3	TX	O	UART send data
4	GND	–	Ground
5	3.3V	–	Power( 3.3V DC)
6	GND	–	Ground
7	GND	–	Ground
8	NC	–	Reserve
9	NC	–	Reserve
10	RST	I	System reset(active low valid)

## 2.3 Communication Protocol

The FLT-A100 IMU module utilizes the UART communication interface, configured as follows.

- Baud rate: 115200.

- 8-bit data length.
- No odd/even verification.
- 1-bit stop.

The FLT-A100 IMU module provides outputs data at 100 packets/second (Hz). The format of each data packet is as follows.

Table 2.2: Breakdown of the data packets output by the FLT-A100 IMU module. The units of the pitch, roll, yaw are in units of degrees. The units of the acceleration are in units of  $\text{m/s}^2$ . The units of angular velocity are in dps. The units of temperature are in  $^{\circ}\text{C}$ .

Output data	Byte No.	Description
Packet header	1-2	0xFFFFE
Index	3	0x00 0xFF
Pitch angle	4-5	Real angle multiplied by 100
Roll angle	6-7	Real angle multiplied by 100
Yaw angle	8-9	Real angle multiplied by 100
X-axis acceleration	10-11	Real acceleration multiplied by 100
Y-axis acceleration	12-13	Real acceleration multiplied by 100
Z-axis acceleration	14-15	Real acceleration multiplied by 100
X-axis angular velocity	16-17	Real angular velocity multiplied by 100
Y-axis angular velocity	18-19	Real angular velocity multiplied by 100
Z-axis angular velocity	20-21	Real angular velocity multiplied by 100
Temperature	22	Real temperature minus 30 and then multiplied by 2
Reserve	23	—
Status Byte	24	—
Checksum	25	Sum of all preceding bytes excluding the header

An example data packet may appear as the following.

0xFF FE 00 5E 05 02 00 5D26 34 01 4F 06 1E 0A 12 47F2 1A E4 B2 F4 00 00 89

The breakdown of this example packet is as follows.



Table 2.3: Interpretation of the above example data packet.

Output data	Interpretation
Index	0x00
Pitch angle	0x055E = 13.74 degrees
Roll angle	0x0002 = 0.02 degrees
Yaw angle	0x265D = 98.21 degrees
X-axis acceleration	0x0134 = 3.08 m/s <sup>2</sup>
Y-axis acceleration	0x064F = 16.15 m/s <sup>2</sup>
Z-axis acceleration	0x0A1E = 25.90 m/s <sup>2</sup>
X-axis angular velocity	0x4712 = 181.94 dps
Y-axis angular velocity	0x1AF2 = 68.98 dps
Z-axis angular velocity	0xB2E4 = 457.96 dps
Temperature	0xF4 = 24 °C
Status Byte	0x00 = 0
Checksum	0x89

### 2.3.1 Status Byte Interpretation

The status byte has three possible values.

- **Status = 0:** IMU Calibration successful. The data contained within this packet has the highest accuracy.
- **Status = 1:** Excessive tilt detected during IMU calibration. Please re-calibrate.
- **Status = 2:** Excessive motion detected during IMU calibration. Angular measurements remain accurate. Please re-calibrate.
- **Status = 3:** Excessive tilt and excessive motion detected during IMU calibration. Please re-calibrate.

### 3 Supplementary Information

UART Timing

Parameter	Command mode				Auto mode		Unit
	Normal mode		Burst mode				
	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	
t <sub>STALL</sub>	–	100	–	100	–	–	ms
t <sub>WRITESTALL</sub>	60	100	–	100	–	–	ms
t <sub>RELDRATE</sub> (9.6kbps)	6.250	–	17.709	–	–	–	ms
t <sub>RELDRATE</sub> (19.2kbps)	3.125	–	8.852	–	–	–	ms
t <sub>RELDRATE</sub> (38.4kbps)	1.563	–	4.427	–	–	–	ms
t <sub>RELDRATE</sub> (57.6kbps)	0.782	–	2.214	–	–	–	ms
t <sub>RELDRATE</sub> (115.2kbps)	391	–	1107	–	–	–	µs
t <sub>RELDRATE</sub> (230.4kbps)	195	–	554	–	–	–	µs
t <sub>RELDRATE</sub> (460.8kbps)	97	–	277	–	–	–	µs
t <sub>WRITERATE</sub> (9.6kbps)	3.125	–	–	–	–	–	ms
t <sub>WRITERATE</sub> (19.2kbps)	1.563	–	–	–	–	–	ms
t <sub>WRITERATE</sub> (38.4kbps)	782	–	–	–	–	–	µs
t <sub>WRITERATE</sub> (57.6kbps)	391	–	–	–	–	–	µs
t <sub>WRITERATE</sub> (115.2kbps)	195	–	–	–	–	–	µs
t <sub>WRITERATE</sub> (230.4kbps)	97	–	–	–	–	–	µs
t <sub>WRITERATE</sub> (460.8kbps)	49	–	–	–	–	–	µs
t <sub>RELDRATE</sub> (10Hz)	–	100	–	100	–	100	ms
t <sub>RELDRATE</sub> (25Hz)	–	40	–	40	–	40	ms
t <sub>RELDRATE</sub> (50Hz)	–	20	–	20	–	20	ms
t <sub>RELDRATE</sub> (100Hz)	–	10	–	10	–	10	ms
t <sub>RELDRATE</sub> (200Hz)	–	5	–	5	–	5	ms
t <sub>RELDRATE</sub> (500Hz)	–	2.5	–	2.5	–	2.5	ms
t <sub>RELDRATE</sub> (1000Hz)	–	1	–	1	–	1	ms



## 4 Legal

### 4.1 Safety Information

This device is sensitive to electrostatic discharge (ESD). Though the module comes with standard ESD circuit protection, the components may still malfunction if ESD occurs. Standard ESD precautions should be taken when handling this device.

### 4.2 Liability

**SHENZHEN FRUITION CO., LTD.** shall not be liable, under any circumstances, for any special, indirect, incidental, consequential, or contingent damages for any reason, whether or not the buyer has been advised of the possibility of such damage.