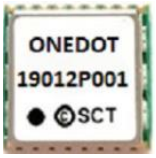
OneDot

User Manual



Abstract

This document introduces the OneDot attitude measurement module.

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1. Product Introduction

The OneDot MEMS attitude and status detection module is centered around a MEMS inertial sensor and integrates advanced algorithms such as quaternion-based Kalman attitude filtering, vibration frequency detection, and multi-dimensional motion state intelligent recognition. It can accurately detect three-dimensional angular changes as well as motion parameters in both time and frequency domains. The module comes in a compact 9.7 mm × 10.1 mm package.

1.1 Functional Overview

In terms of functionality, the OneDot module offers the following features:

- 3D attitude output
- Raw sensor data streaming
- Fast online calibration – ready for attitude measurement in as little as 10 s
- Quaternion-based filtering with inertial bias estimation
- Efficient FFT-based frequency-domain analysis
- Detection of sudden acceleration, deceleration, and sharp turns
- Recognition of collisions, rollovers, and falls

1.3 Pin Definition

The OneDot module uses an 18-pin package. The pin numbers are shown in Figure 1.1, and their specific definitions are detailed in Table 1.1.

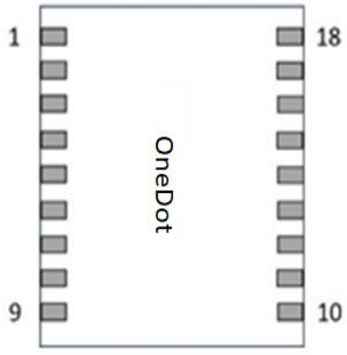

Figure 1.2 Pin Definition (Top View)

Note: Pin numbering and orientation are shown from the top view of the module

Table 1.1 Pin Assignment

No.	Name	I/O	Description
1	GND	I	Ground
2	TXD1	O	UART1 transmit, primary serial port
3	RXD1	I	UART1 receive, primary serial port
4	reserved	-	Reserved
5	NC (INT_OUT)	-	No Connection
6	Reserved	-	Reserved
7	NC	-	No Connection
8	VCC	I	Power supply 3.0V-3.6V
9	RESET_N	I	Reset
10	GND	I	Ground
11	Reserved (WT)	I	Reserved
12	GND	I	Ground
13	Reserved (FWD)	-	Reserved
14	Reverse	-	Reserved
15	NC	-	No Connection
16	RXD2	I	UART2 receive, reserved
17	TXD2	O	UART2 transmit, reserved
18	External PPS	I	Optionally pulse-per-second input

1.4 System Performance

Table 1.2 performance specifications

Hardware Specifications

Gyroscope	Maximum Range	±2000deg/s
	Angular Random Walk	0.2deg/$\sqrt{hr}$
	Bias Stability	3 deg/hr
	Bias Temperature Drift	±0.005 deg/s/°C
	Bias Repeatability (at 25 °C)	±3 deg/s
	Nonlinearity	±0.1%
Accelerometer	Maximum Range	±16g
	Velocity Random Walk	0.3mg /$\sqrt{hz}$
	Bias Stability	2.5mg
	Bias Temperature Drift	±0.1mg/°C
	Bias Repeatability (at 25 °C)	50mg
	Nonlinearity	±0.1%

Software Specifications

Attitude Accuracy (1σ)	Pitch	0.5°
	Roll	0.5°
	Yaw	1.5°

Data Output Rate	1 Hz (default), configurable up to 100 Hz
Online Sensor Calibration	< 10 s
Frequency Detection	Resolution 0.01 Hz, effective range 0.1 Hz – 100 Hz (high-frequency options customizable)

1.5 Electrical and Physical Characteristics

Table 1.3 Electrical and Physical Characteristics

Supply Voltage	3.0V – 3.6V
Power Consumption	10mA (typical)
Reflow Soldering Temp.	260℃
Dimensions	10.1mm×9.7mm×2.0mm
Operating Temperature	-40℃ - +85℃
Vibration Resistance	8g (20 – 2000Hz)
Shock Resistance	500g (20ms)

1.6 Software Data Interface

Table 1.4 data interface

I/O Interface	UART-1, Primary serial port: main data output, configuration, and firmware upgrade; baud rate: 115200 UART2, backup
Output Protocol	OneDot proprietary text protocol

1.7 Module Package Dimensions

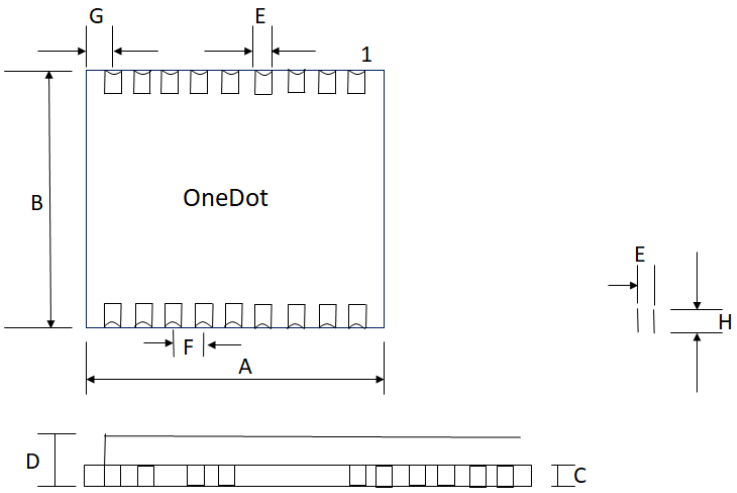

Figure 1.3 Module Package Dimensions (All dimensions in mm)

Table 1.5 Module Physical Dimensions

(All dimensions in mm, Tolerance: ±0.1 mm unless otherwise noted)

Dimension	Minimum (mm)	Nominal(mm)	Maximum (mm)
A	10.0	10.1	10.2
B	9.6	9.7	9.8
C	0.8	0.8	0.8
D	2.1	2.5	2.6
E	0.6	0.7	0.8
F	1.0	1.1	1.2
G	0.55	0.65	0.95
H	0.8	1.0	1.1

1.8 Hardware PCB Reference Design

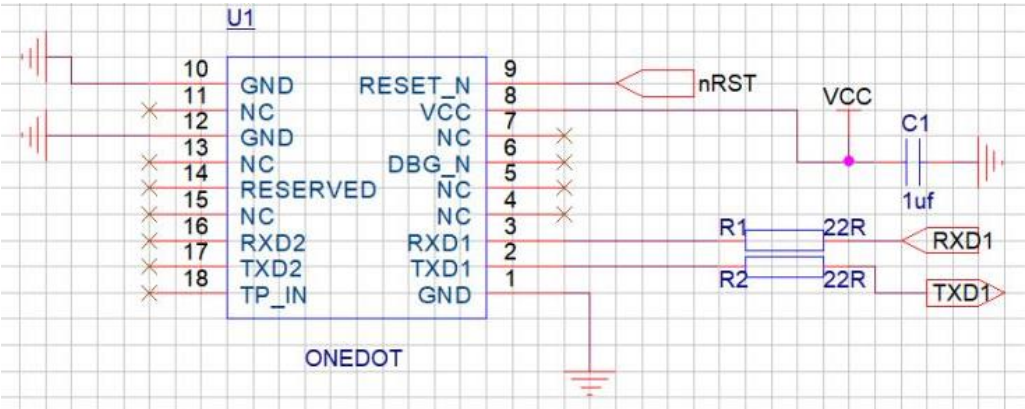

Figure 1.4 the recommended PCB design for the InsCore module

Note: When nRST is connected (controlled by another device or MCU), the RESET_N pin should be held high (external pull-up recommended). To reset the module, keep the pin low for at least 20 μs.

When nRST is not connected, it is recommended to leave the RESET_N pin floating.

2 Product Features

2.1 External Heading Input

By default, OneDot provides relative 3D attitude, initialized at 0° upon power-up. When external heading input is available, it can provide absolute heading angles. Please refer to the OneDot Input Data Protocol. There is no fixed frequency requirement for external heading input.

2.2 Quaternion Filtering

The module internally runs a quaternion Kalman filter algorithm to provide 3D attitude results. Various motion states of the carrier serve as constraints for the filter, improving accuracy.

2.3 Vibration Frequency Capture

The module internally runs an efficient, improved Fast Fourier Transform (FFT) to capture and identify the vehicle vibration frequencies, providing confidence levels for the identification. This feature facilitates the deployment of low-cost detection devices on a large scale.

2.4 Motion State Recognition

The module internally runs a progressive-learning motion state recognition algorithm, capable of identifying static and dynamic states, sudden acceleration or deceleration, sharp turns, as well as

unexpected conditions such as tipping, overturning, or falling. It also provides hardware pulse trigger outputs.

5. Precautions for Use

- After the VCC power is off, it should reliably drop below 0.7V and remain stable.
- Connect the GND pin to the ground.
- Connect the RF_IN signal to the antenna. The trace should maintain a 50-ohm impedance and be as short and smooth as possible.
- The peak power supply ripples should not exceed 50mV.
- Avoid routing traces directly underneath the module.
- The module is sensitive to temperature changes; be away from hot air currents and high-power heating components.
- The module is sensitive to radio frequency signal interference. Do not place it near sources of interference, such as communication module antennas, RF traces, crystals, large inductors, or high-frequency digital signal lines.
- An installation angle of less than 20 degrees along the pitch axis (radial direction) is recommended to ensure optimal navigation performance.
- When using the module on platforms like railways, subways, airborne platforms, or lawnmowers, a fixed-axis installation is required. The module's forward axis must align with the platform's defined forward direction.
- When a soldered module needs to be removed, it's recommended to use a soldering iron to melt the solder on both sides of the module's pins and then remove it with tweezers to avoid damaging the module.
- Decoupling capacitors should be placed close to the module's power pins, and the power traces should be at least 0.5mm wide. The RF trace from the module's RF port to the antenna connector should be at least 0.2mm to 0.3mm wide and maintain a 50Ω impedance.