YG-Lite

User Manual

Abstract

This document introduces the YG-Lite positioning and attitude module.

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1. Product Introduction

The YG-Lite is a GNSS/MEMS navigation and attitude measurement module built around MEMS inertial sensors and optimized for two-wheeled vehicles. With support for external GNSS input, it enables a low-power IMU/GNSS fusion positioning solution.

The module enhances fleet management of shared e-bikes and scooters in urban and campus environments by maintaining continuous positioning even in challenging areas such as indoors or under bridges. It also supports standardized 90-degree parking angle monitoring. Designed without the need for wheel-speed assistance, the YG-Lite comes in an ultra-compact 9.7 × 10.1 mm package

1.1 Functional Overview

With the rapid growth of shared e-bikes and scooters, urban and campus environments face increasing challenges in vehicle dispatching and parking management. The **YG-Lite** module leverages advanced MEMS inertial sensors combined with satellite navigation technology, employing multi-dimensional Extended Kalman Filtering (EKF) and other specialized algorithms to achieve full 3D navigation and attitude measurement in a compact device. This enables precise positioning and parking management for shared e-bikes and scooters. The system significantly improves fleet dispatch efficiency, supports standardized 90° parking, provides long-term fall detection alerts, ensures orderly parking, and maintains reliable coverage in traditional GNSS blind spots.

Key Features:

- Continuous positioning in challenging environments such as indoors, under tree cover, or beneath bridges

- Full-route uninterrupted positioning output

- Supports external NMEA GNSS input

- Parking angle monitoring

- Fall/tilt detection

- Flexible three-axis free-angle mounting

- Fast online calibration technology

- No reliance on odometer assistance

The YG-Lite module is well suited for micro-mobility platforms such as e-bikes, e-scooters, and self-balancing scooters.

1.2 Pin Definition

The YG-Lite 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.
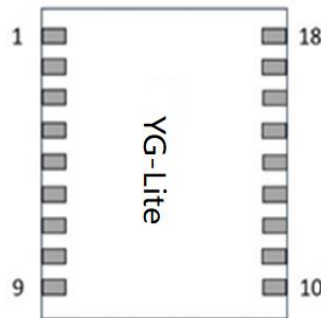
Figure 1.2 Pin Definition (Top View)

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

1.3 System Performance

Table 1.2 performance specifications

Position (1σ)	GNSS Outages	5s	2.5m
		30s	20.0m
		>60s	4.0% of travel distance
		Static Hold	>24hr
Attitude (1σ)	Roll	3.0^0	
	Pitch	3.0^0	
	Parking Heading	10.0^0	
Velocity (1σ)	0.3m/s		
On-line Calibration	< 20s		

1.4 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)

1.5 Software Data Interface

Table 1.4 data interface

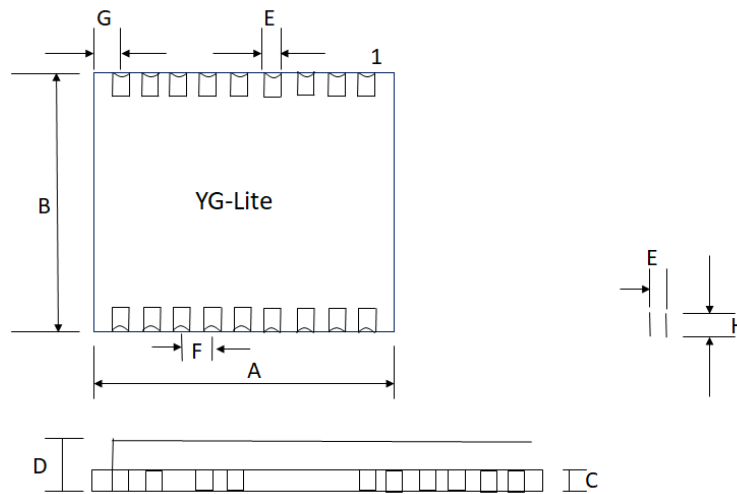|	
I/O Interface	UART-1, Primary serial port: main data output, configuration, and firmware upgrade; baud rate: 115200 UART2, backup
Output Protocol	proprietary text protocol

1.6 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

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G	0.55	0.65	0.95
H	0.8	1.0	1.1

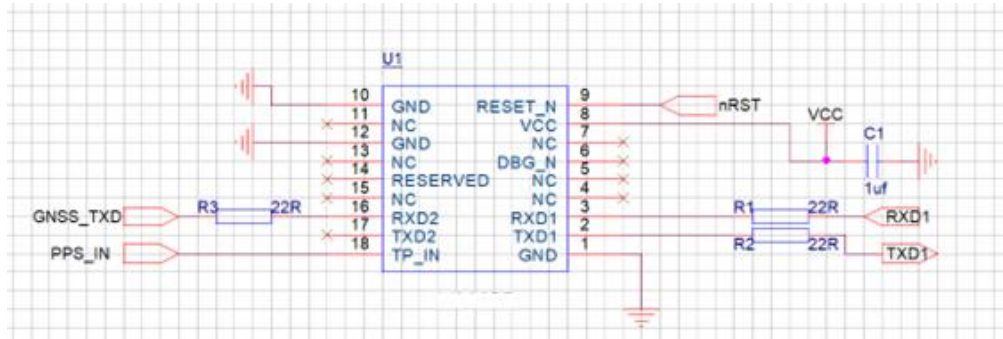## 1.7 Hardware PCB Reference Design

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 High-Precision GNSS Input

The YG-Lite module supports external high-precision GNSS input with a data rate of 1 Hz. The input data format follows NMEA 0183, unless otherwise specified. The required NMEA sentences are listed in Table 2.1.

Table 2.1 Input GNSS NMEA Sentences

Sentence	Description
GGA	Required
RMC	Required
GSA	Required
GSV	Required

The order of NMEA sentences for input is not mandatory. By default, the module receives sentences in the order GGA → RMC → GSA → GSV and extracts the corresponding information. If

the external input sequence differs from the default, configuration commands can be sent

according to the data protocol to specify the input order. For details, please refer to the data

protocol.

2.2 Fast Online Calibration

The bias of inertial sensors is one of the main error sources in integrated navigation systems.

Low-cost MEMS sensors often exhibit significant variations in zero-bias after each power-up,

making offline turntable calibration impractical and ineffective. The module's fast online

calibration technology does not require any special trajectory or maneuvers. Calibration can be

performed while the vehicle is in normal operation, enabling the system to quickly enter

integrated navigation mode.

2.3 Flexible Installation

The module imposes no restrictions on its mounting position and can be installed freely in any

orientation. Adaptive algorithms automatically detect and compensate for mounting

misalignment, filtering and estimating the installation angles within the inertial navigation

calculations. To ensure optimal system performance, it is recommended that, once installed, the

pitch angle between the module and the vehicle be less than 20° (no restriction on the roll

direction), so that the small-angle linearization assumptions in the mathematical model remain

valid.
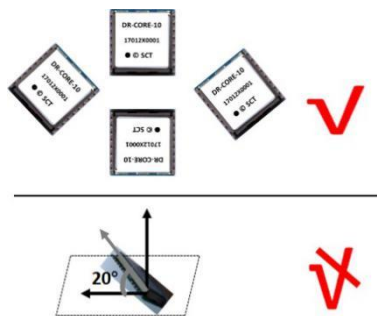
2.4 Low-Speed System Initialization

Low or very low speeds (<1 m/s) are common operating conditions. The YG-Lite module

incorporates specialized algorithms that allow the integrated system to quickly enter navigation

mode and provide full 3D attitude output even at low speeds. For scenarios where the vehicle

operates at low speeds throughout, it is recommended to include two stationary periods longer

than 20 seconds at the beginning of the trip.

For two-wheeled vehicle applications, the initialization conditions are: a continuous riding speed

of at least 2 m/s for 3 seconds or more. The re-calibration condition is: straight-line riding for 100

meters.

3 Product Packaging

3.1 Tape-and-Reel Appearance and Dimensions

The module is supplied in a tape-and-reel packaging format. The appearance of the tape-and-

reel is shown in Figure 3.1, where the position of Pin 1 on the module is indicated.
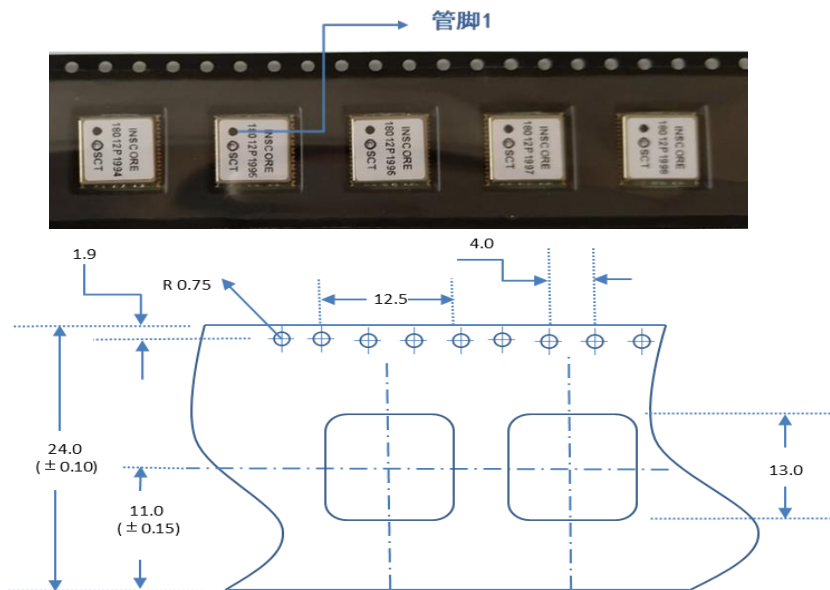

Figure 3.1 Tape-and-Reel Appearance, Dimensions, and Parameters

3.2 Packaging Specifications

The module is available in two packaging quantities: 250 pcs per package and 1000 pcs per package. The 1000 pcs package uses a reel format with a total reel diameter of 330 mm.

4. Installation and Handling Notes

- After power-off, VCC reliably drops below 0.7 V and remains stable.

- Connect the GND pin to ground.

- Ensure Serial Port 1 is stably connected to the external processor; this port is used for data transmission and firmware upgrades.

- Power supply ripple should not exceed 50 mV (peak-to-peak).

- Avoid routing traces directly underneath the module.

- The module is sensitive to temperature changes; keep it away from high-temperature airflow and high-power heat-generating components.

- To achieve optimal navigation performance, the module's radial (pitch) installation angle should be less than 20° (no requirement for radial orientation).

- When removing a soldered module, it is recommended to melt the solder on both sides with a soldering iron and then lift the module with tweezers to avoid damage.