LaneTo

User Manual

This document provides a user-centric introduction to the LaneTo™ RTK GNSS/MEMS integrated navigation module.

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1. Product Introduction

The LaneTo RTK GNSS/MEMS IMU navigation module integrates a 6-DoF MEMS sensor with dual-frequency RTK satellite navigation. The on-chip processor efficiently runs RTK algorithms, and an integrated navigation algorithm based on an extended Kalman filter. The module delivers a compact, low-power, high-precision solution that provides uninterrupted navigation, even in challenging environments like urban canyons and long tunnels, without requiring an odometer. The module is built in a compact 16 mm × 12 mm hardware package.

1.1 Functional Overview

The LaneTo module leverages advanced MEMS inertial sensors and Carrier Phase Differential (RTK) satellite navigation technology. It uses carrier phase information from satellite navigation and the relative angular and linear motion measurements from inertial components (3-axis gyroscopes and 3-axis accelerometers). By employing multi-dimensional extended Kalman filtering and other specific algorithms, it achieves high-precision 3D navigation and attitude measurement in a compact device.

The module offers the following key features:

- Provides open-sky RTK differential functionality for multiple satellite systems including GPS, BDS, Galileo, GLONASS, and QZSS, and multiple frequencies including L1, L5, B1I, B2a, E1c, and E5a.
- Maintains uninterrupted navigation output in complex scenarios like enclosed parking lots, tunnels, and urban canyons.
- Outputs 3D attitude (heading, pitch, roll), 3D positions and velocities, and continuous distance accumulation.
- Includes driving status alerts for sudden acceleration/deceleration, sharp turns, static conditions, and rollovers.
- Does not have a mandatory requirement for wheel speed or odometer assistance.

- Supports free-angle installation of the module.
- Navigation data rate can be configured up to 10Hz.
- Outputs GNSS channel raw observation data (carrier phase, pseudorange, satellite coordinates, etc.).

The LaneTo module is suitable for various applications, including smart driving, rail transit, smart agriculture, micro-mobility, and lawnmowers. Its package is pin-to-pin compatible with 16mm x 12mm universal modules on the market.

1.2 System Architecture

The system architecture of the LaneTo module is shown in the diagram below.

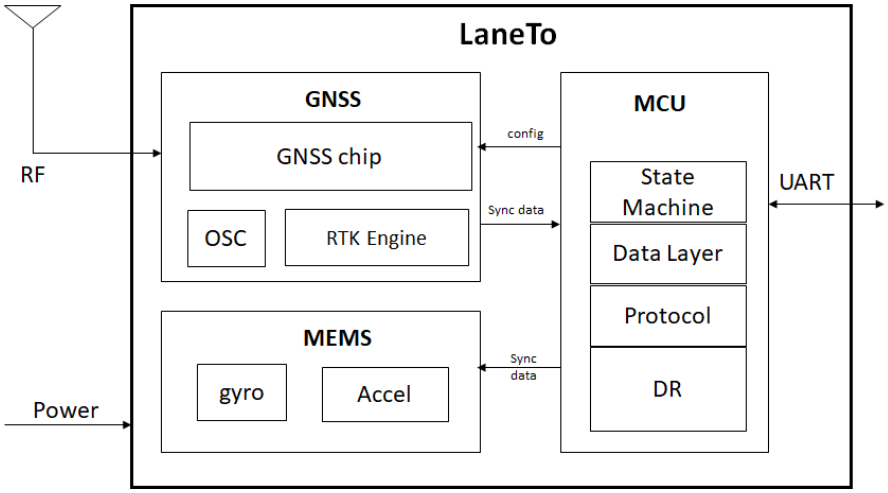

Figure.1. the system architecture of the LaneTo

1.3 System Performance Indicators

Table 1.1 performance specifications

Position（1σ）	Open Sky*	Standalone	1.5m
		RTK	0.1m
	Urban Canyon	5.0m	
	GPS Outages	60s	10m
		120s	25m
		>120s	5.0% of distance（no Odometer）
			3.0% of distance（with Odometer）

Attitude（1σ）	Roll	1.0^0
	Pitch	1.0^0
	Heading	2.0^0
Velocity（1σ）	0.15m/s	
Output Rate	1Hz （configurable to 5Hz/10Hz）	
Gyroscope	Stability 5°/hr	
Accelerometer	Stability 3mg	

*: specifications for satellite signal input strength greater than 43 dB-Hz.

**:specifications are for the LaneTo-EC model, which is designed for use in automobiles

1.4 Electrical and Physical Characteristics

Table 1.2 Electrical and Physical Characteristics

Supply Voltage	3.0V – 3.6V
Backup Supply Voltage	3.0V – 3.6V
Power Consumption	45mA(typical)
Reflow Soldering Temp.	260℃
Dimensions	16mm×12.2mm×2.4mm
Operating Temperature	-40℃ - +85℃
Vibration Resistance	8g (20 – 2000Hz)
Shock Resistance	500g (20ms)

1.5 Software Data Interface

Table 1.3 data interface

I/O Interface	UART (1 channel), used for output, configuration, and firmware upgrade; baud rate: 115200
RTK Input Protocol	MSM4
Output Protocol	NMEA 0183, and LaneTo proprietary text and binary protocol

1.6 Pin Definition

The LaneTo module uses a 24-pin package. The pin numbers are shown in Figure 1.2, and their specific definitions are detailed in Table 1.4.

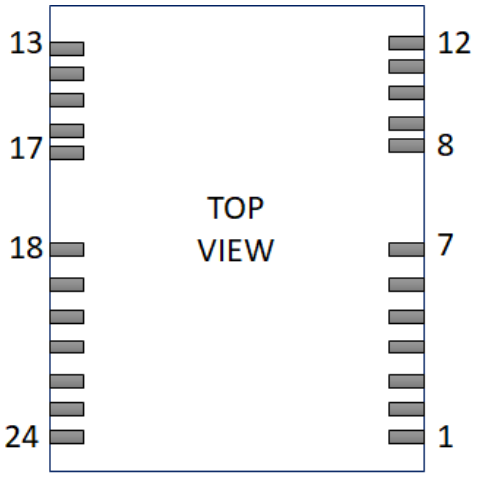

Figure 1.2 Pin Definition (Top View)

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

Table 1.4 Pin Assignment

No.	Name	I/O	Description
1	RESERVED	-	Reserved
2	RESERVED	-	Reserved
3	PPS	O	Pulse per second
4	RESERVED	-	Reserved
5	RESERVED	-	Reserved
6	RESERVED	-	Reserved
7	RESERVED	-	Reserved
8	RESET_N	I	Reset
9	RF_VCC	O	Antenna power output
10	GND	I	Ground
11	RF_IN	I	RF signal input
12	GND	I	Ground
13	GND	I	Ground

14	GPIO1	I/O	3.3V
15	RESERVED	-	Reserved
16	RESERVED	-	Reserved
17	RESERVED	-	Reserved
18	RESERVED	-	Reserved
19	RESERVED	-	Reserved
20	TXD1	O	UART1 for data, configuration, firmware upgrade
21	RXD1	I	UART1 for data, configuration, firmware upgrade
22	VBAT	I	Backup power input
23	VCC	I	Supply voltage 3.0 V – 3.6 V
24	GND	I	Ground

1.7 Module Package Dimensions

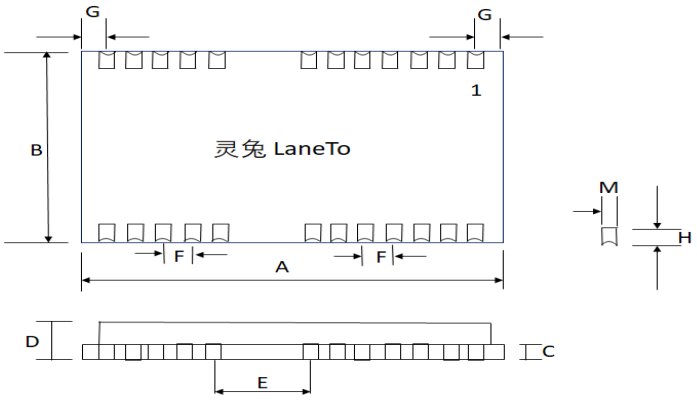

Figure 1.3 Module Package Dimensions (All dimensions in mm)

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	15.8	16.0	16.2
B	12.0	12.2	12.4

C	0.7	0.8	0.9
D	2.2	2.4	2.5
E	2.9	3.0	3.1
F	1.0	1.1	1.2
G	0.9	1.0	1.3
H	0.8	0.9	1.0
M	0.7	0.8	0.9

1.8 Hardware PCB Reference Design

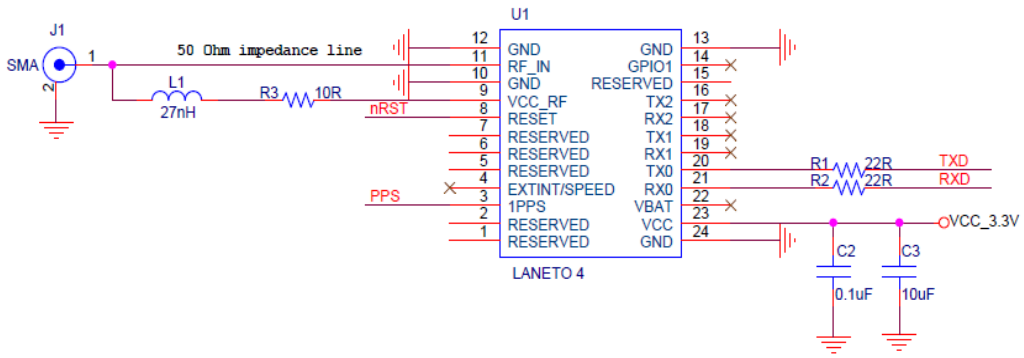

Figure 1.4 the recommended PCB design for the LaneTo module

2. Product Features

2.1 Multi-Mode Satellite Constellations

The module can simultaneously receive signals from multiple satellite constellation systems, including both primary systems and wide-area and regional satellite-based augmentation systems.

2.2 Augmentation Systems

The module uses a variety of augmentation methods to improve performance.

2.2.1 RTK

The LaneTo supports multi-mode dual-frequency (L1+L5, B1I+B2a) carrier phase differential functionality. The input base station information must follow the RTCM3.2 MSM4 protocol. The

module solves the integer ambiguity of the carrier phase to achieve a fixed solution (FIXED). If the integer ambiguity cannot be determined, it will provide a float solution (FLOAT) or a code-based differential (DGNSS) result.

2.2.2 Odometer

Unlike traditional DR products, the LaneTo doesn't have a mandatory requirement for an odometer connection. However, when used in vehicles, the module can accept odometer or wheel speed data inputs to further enhance accuracy. This input provides a forward constraint for the integrated navigation system, improving observability for the integrated filter and leading to an approximately 20-30% increase in speed, position, and heading accuracy.

2.3 Fast Online Calibration

Inertial sensor bias is a major source of error for integrated navigation systems. The LaneTo module uses an online calibration technique that does not require the vehicle to follow any specific or complex trajectory. Calibration can be completed under normal driving or riding conditions, allowing the system to enter the integrated navigation state.

2.4 Free-Angle Installation

The LaneTo module does not require a specific mounting position on the vehicle and can be installed at any 360-degree angle. An adaptive algorithm automatically identifies and estimates the installation angle error and compensates for it in the inertial navigation calculation. For optimal performance, it is recommended that the angle between the module's pitch axis and the vehicle's pitch axis be less than 20 degrees after installation (front-to-back direction is not restricted).

note: While the module supports free-angle installation, its performance depends on a rigid connection to the vehicle. Ensure the module is tightly secured and does not move or shake during use to maintain optimal performance.

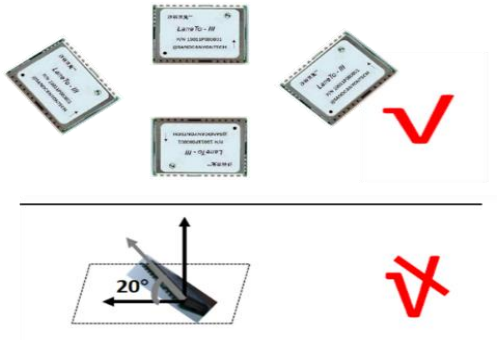

Figure 2.1 Recommended Installation Method

2.5 Navigation Data Rate

The module's navigation rate can be configured by the user to 1Hz, 5Hz, or 10Hz. The filter state of the integrated navigation system will change according to the configured rate. The navigation rate should be set based on the vehicle's dynamics. For applications that are not attitude-controlled platforms, a 1Hz navigation rate is recommended.

3. Default Data Output

The following are the default output settings for the module. Output content can be changed using configuration commands; refer to the data protocol for details.

Table 3.1 Default Output

Output Rate	1Hz
Baud Rate	115200
Protocol	NMEA0183 and Custom Text Format
NMEA0183	GGA、RMC、GSA、GSV

4. Product Packaging

4.1 Tape and Reel

The module is packaged in a tape and reel format.

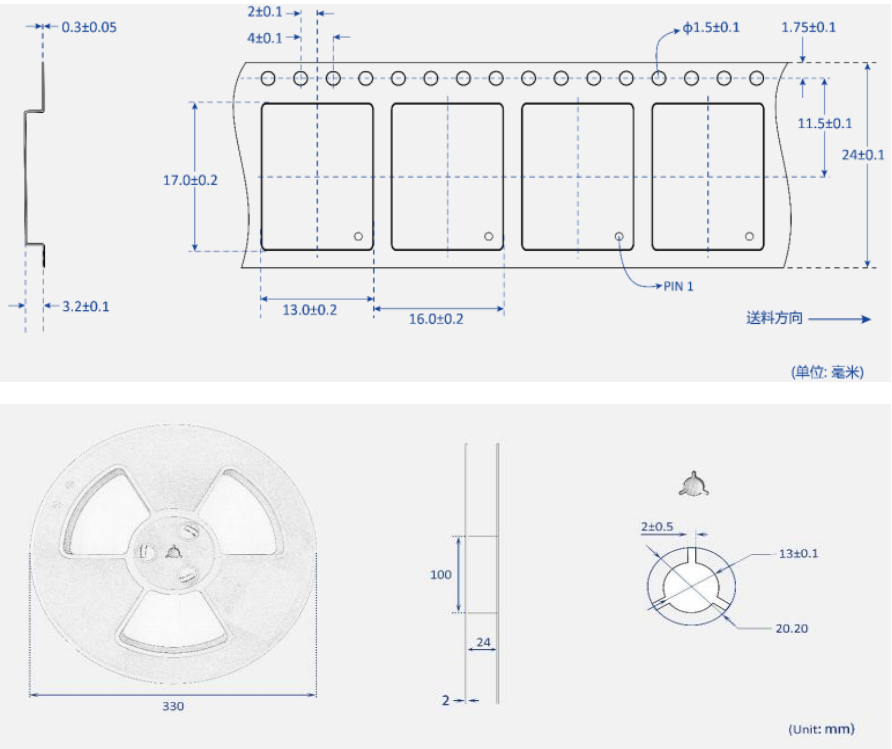

Figure 4.1 Packaging Specifications

The LaneTo is available in two packaging specifications: 250 pieces per bag and 800 pieces per reel. The 800-piece reel has a diameter of 33cm

4.2 Storage

To prevent moisture and electrostatic discharge, the product's sealed packaging bag contains a desiccant and a humidity indicator card. The humidity indicator card allows the user to check the humidity level of the environment. The product's moisture sensitivity level is MSL3. GNSS positioning modules contain highly sensitive electronic circuits and are considered electrostatic discharge sensitive devices (ESD).

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.