

LPMS-NAV2 Series Hardware Manual ver. 1.0



LPMS-NAV2 RS232



LPMS-NAV2 TTL



LPMS-NAV2 RS485



LPMS-NAV2 RS422



LPMS-NAV2 OEM

Version History

Date	Version	Details
2020-01-18	ver. 1.0	- Initial release

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1. Introduction

The LPMS-NAV2 series is a low cost MEMS-based miniature multi-purpose heading sensor with integrated high accuracy single axis gyroscope and 3-axis accelerometer. This fully self-contained series includes an onboard robust heading calculation algorithm to output accurate heading angle and angular rate with low bias drift and error. It also provides selectable baud rates and data output rates which are suitable for a wide range of embedded system with limited resources.

LPMS-NAV2 series contains 5 models with different enclosures and connectivity as listed in Table 1-1.

Main features:

- MEMS based miniature heading sensor
- Integration of high accuracy single axis gyroscope and 3-axis accelerometer
- Fully self-contained package with on-device heading calculation
- Using a robust and accurate algorithm
- Relative angle, angular rate and 3-axis acceleration output
- Low noise level
- Excellent bias stability over temperature and external vibration
- Multiple interface options (selectable baud rate and data output rate)
- Minimal requirements on host processor

Table 1-1. LPMS-NAV2 series part number information

Part Number	Communication Interface				Waterproof (IP67)
	UART(TTL)	RS232	RS485	RS422	
LPMS-NAV2 OEM	✓	✗	✗	✗	✗
LPMS-NAV2 RS232	✗	✓	✗	✗	✓
LPMS-NAV2 TTL	✓	✗	✗	✗	✓
LPMS-NAV2 RS485	✗	✗	✓	✗	✓
LPMS-NAV2 RS422	✗	✗	✗	✓	✓

2. System Overview

2.1 Sensor Structure

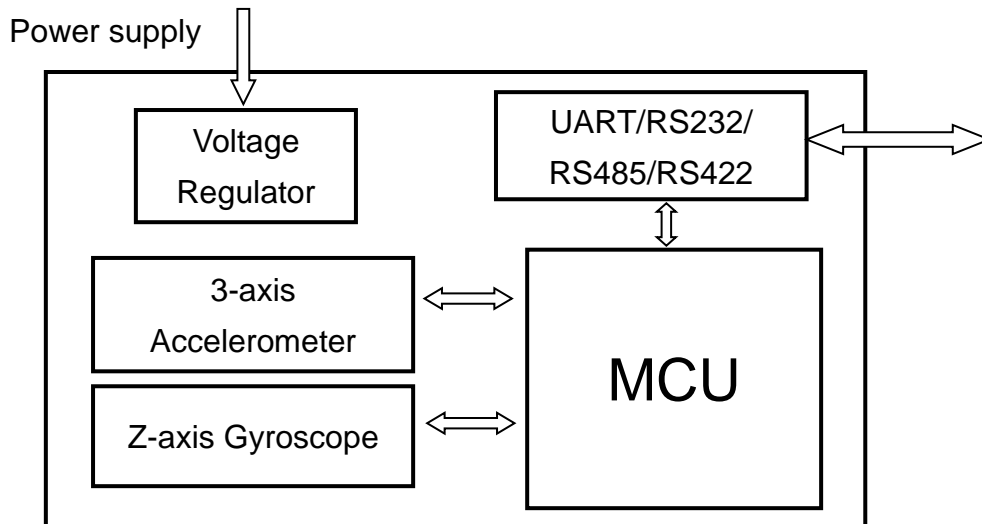


Fig. 2.1. LPMS-NAV2 series sensor structure

2.2 Pin Out Configuration

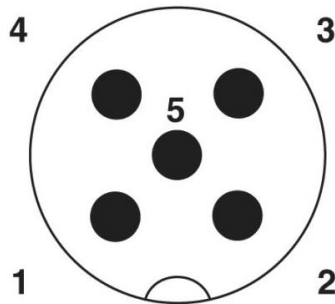


Fig. 2.2. Sensor waterproof connector for TTL/RS232/RS485 interfaces

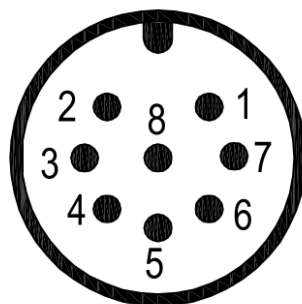


Fig. 2.3. Sensor waterproof connector for RS422 interface

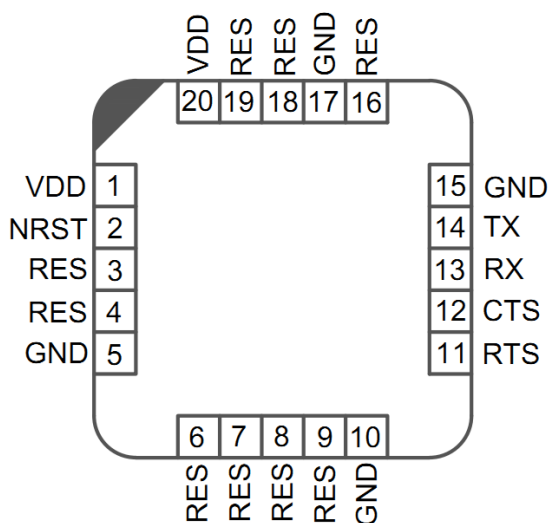


Fig. 2.4. Pin out of LPMS-NAV2 OEM

Table 2-1. Connector pin out signals for TTL/RS232/RS485 interfaces

Pin no.	Signal	Value	Paired Cable Color	Remark
1	NC		Brown	
2	VDD	RS485: +5V~24V TTL/RS232: +5V~18V	White	Power supply
3	GND		Blue	Signal ground
4	TX / A		Black	Data lines
5	RX / B		Grey	

Table 2-2. Connector pin out signals for RS422 interface

Pin no.	Signal	Value	Paired Cable Color	Remark
1	VDD	+5V~18V	White	Power supply
2	GND		Brown	Signal ground
3	A		Green	RX+
4	B		Yellow	RX-
5	RES	floating	Grey	Reserved
6	Y		Pink	TX+
7	Z		Blue	TX-
8	RES	floating	Red	Reserved



Table 2-3. Pin out signals for OEM version

Pin#	Name	Function	Description
1, 20	VDD	Power	Power input (3.3V~5.5V)
2	NRST	Reset pin	Active low. It must be pulled to high or floating for normal operation.
11	RTS	UART_RTS	
12	CTS	UART_CTS	
13	RX	UART_RX(TTL)	
14	TX	UART_TX(TTL)	
5, 10, 15, 17	GND	-	GND
3, 4, 6, 7, 8, 9, 16, 18, 19	RES	-	Reserved (floating)

Table 2-4. Definition of logic high and low level for OEM version

Item	Value	Unit
Logic low	0~0.99	V
Logic high	2.31~3.3	V

Communication setting in default: 115200bps, 8N1

2.3 Typical Application

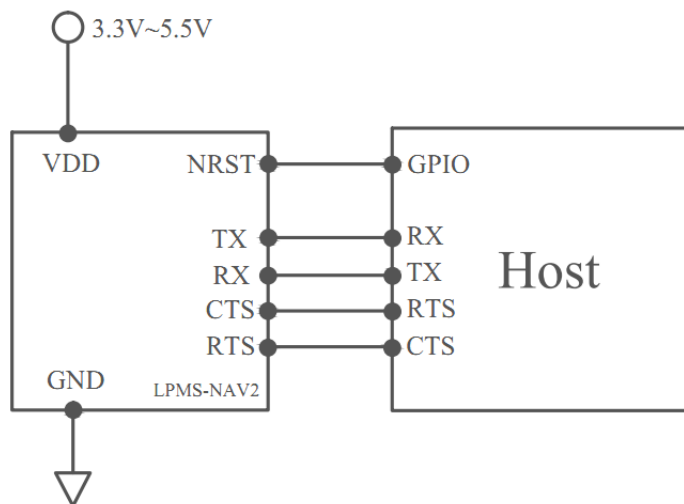


Fig. 2.5. Typical application for LPMS-NAV2 OEM

3. Coordinate

The LPMS sensor calculates the orientation difference between a fixed sensor coordinate system (**S**) and a global reference coordinate system (**G**). Both coordinate systems are defined as right-handed Cartesian coordinate systems. The sensor coordinate system (**S**) can be referred to the sticker information on the sensor enclosure.

The global reference coordinate system (**G**) can be divided into two different cases. While the orientation calculation is using all acceleration, gyroscope and magnetic data (sensor filter mode set at acc+gyr+mag), (**G**) system is defined as following:

- X positive when pointing to the magnetic north
- Y positive when pointing to the magnetic west
- Z positive when pointing up (gravity points vertically down with -1g)

While the orientation calculation is using only acceleration and gyroscope data (sensor filter mode set at acc+gyr), (**G**) system is defined as following:

- X positive aligned to ground plane horizontal projection of x axis of (**S**) when sensor powered on
- Y positive based on right-handed Cartesian coordinate definition
- Z positive when pointing up (gravity points vertically down with -1g)



Fig. 3.1. Sensor coordinate for TTL/RS232/RS485/RS422 models

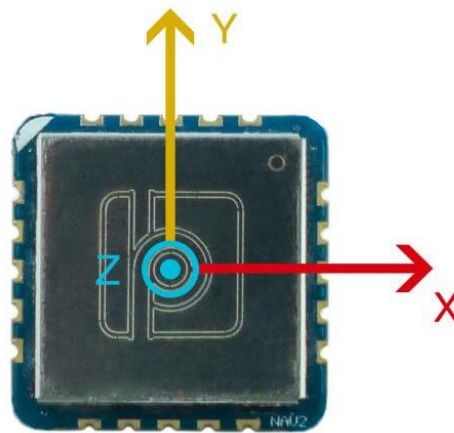


Fig. 3.2. Sensor coordinate of LPMS-NAV2 OEM



4. Specification

4.1 General Parameters

Table 4-1. Main specifications

Parameter		Value
Size	OEM	20.3x20.3x3.8mm
	TTL/RS232/RS422/RS485	50 x 42 x 25 mm
Weight	OEM	2.3g
	TTL/RS232/RS422/RS485	76.5 g
Power consumption	OEM	<u><36.5mW (@3.3V)</u>
	RS485	<u><50mW (@12V)</u>
	TTL/RS232/RS422	<u>≤160mW (@12V)</u>
Power supply	OEM	+3.3V~5.5V DC
	RS485	+5V~24V DC
	TTL/RS232/RS422	+5V~18V DC
Angle resolution		0.01°
Output angle range		± 180°
Internal sampling rate		1000Hz
Data output rate		100Hz (10~100Hz selectable)
Angular speed range		± 400 dps, 1 axis
Accelerometer range		± 4 g, 3 axis
UART baudrate		115200 bps
Heading linear error		< 0.1°/m
Angle random walk (f=10Hz)		0.18°/sqrt(h)
Gyro noise density		0.003(°/s)/sqrt(Hz)
Bias stability (f=10Hz)		< 5°/h
Work Temperature		-20 ~ 80°C
Stock Temperature		-40 ~ 85°C
Waterproof level		IP67
Housing material		Aluminum

Table 4-2. Gyroscope specifications

Parameter	Value	Unit
Measurement Range	±400 (z axis)	dps



Static Bias	±1	dps (0 LSB)
Bias Change/Temperature	±1	dps
Nonlinearity	±0.5	%FS
Sensitivity	±5	%

Table 4-3. Accelerometer specifications

Parameter	Value	Unit
Measurement Range	±4 (x, y, z axis)	g
Sensitivity	0.122	mg/LSB
Sensitivity Change/Temperature	0.01	%/°C
Bias	±30	mg
Bias Change/Temperature	±0.25	mg/°C

4.2 Allan Chart

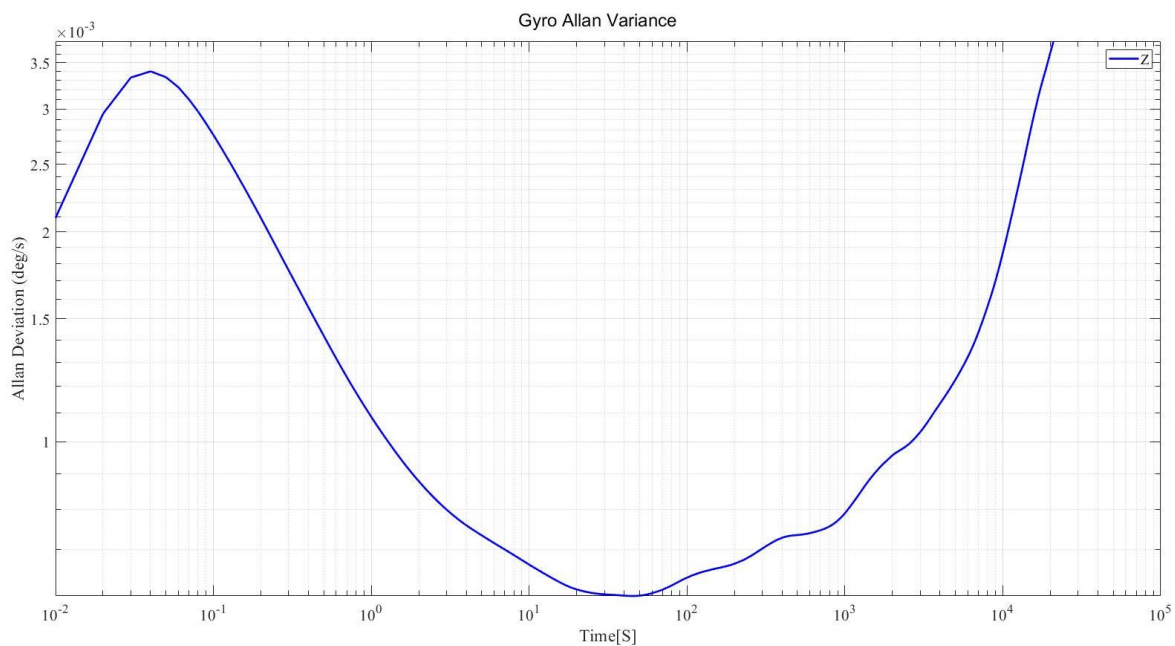


Fig. 4.1. Gyro Allan parameters

5. Mechanical Information

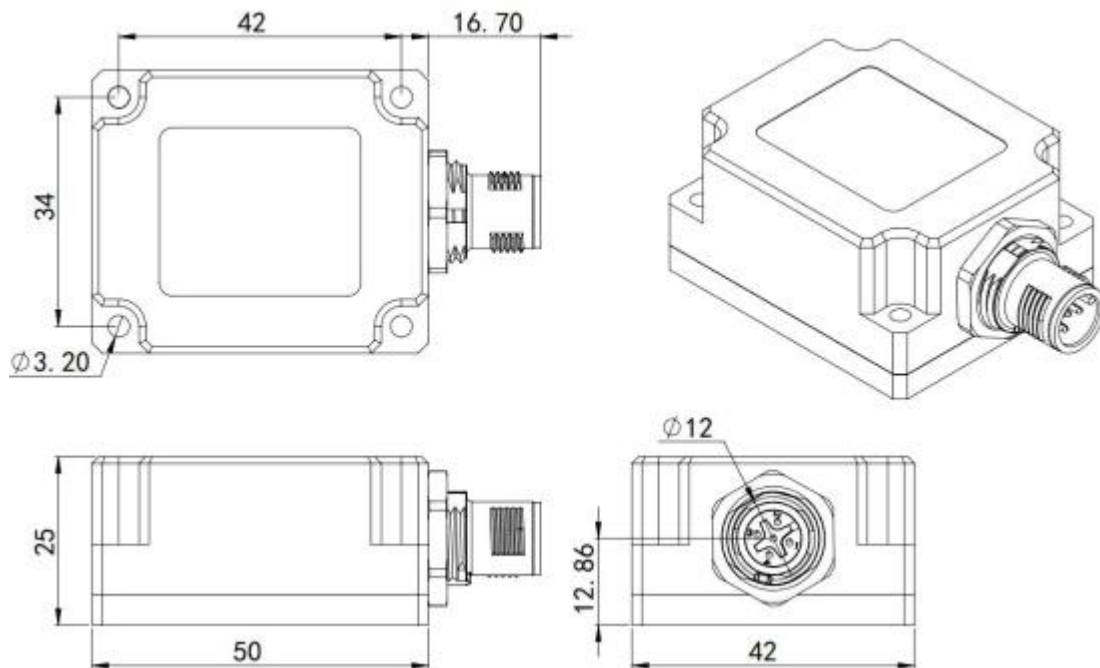


Fig. 5.1. Dimension of LPMS-NAV2 TTL/RS232/RS485/RS422

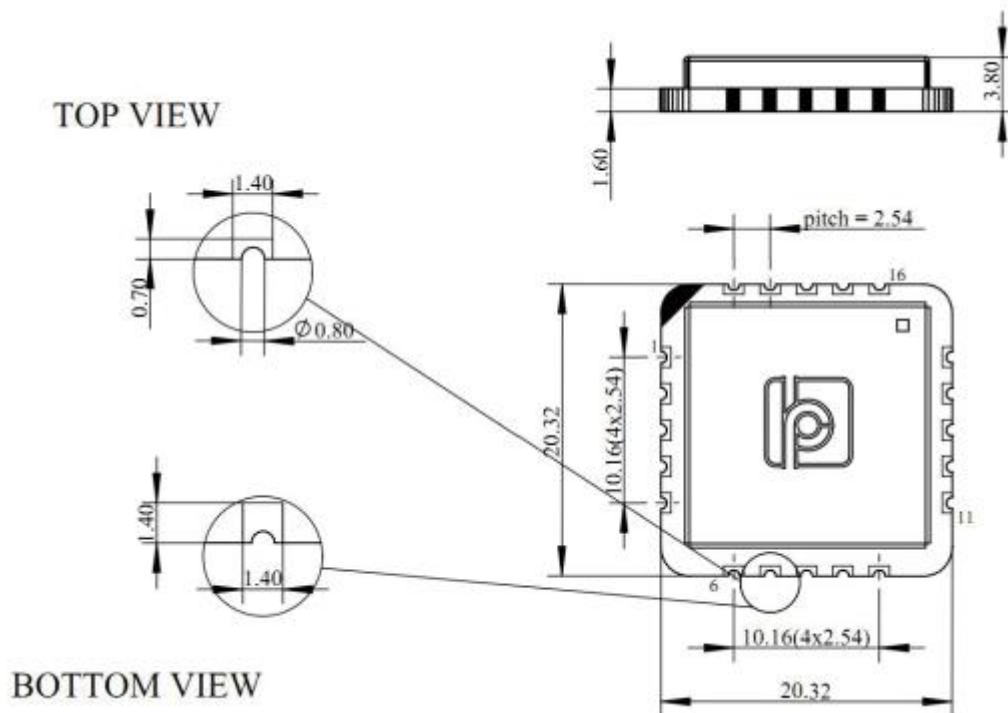


Fig. 5.2. Dimension of LPMS-NAV2 OEM

