

LPMS-IG1 Series Hardware Manual ver. 1.3



LPMS-IG1-CAN



LPMS-IG1P-CAN



LPMS-IG1-RS232



LPMS-IG1P-RS232



LPMS-IG1-RS485



LPMS-IG1P-RS485

Version History

Date	Version	Details
2020-05-21	ver. 1.3	<ul style="list-style-type: none">- add RS485 communication information- correct sensor coordinate information- add sensor part number of LPMS-IG1P CAN and LPMS-IG1P RS485
2020-01-21	ver. 1.2	<ul style="list-style-type: none">- revision on magnetometer parameters- update of cable data
2019-12-19	ver. 1.1	<ul style="list-style-type: none">- add detailed information of the waterproof connector
2019-05-23	ver. 1.0	<ul style="list-style-type: none">- Initial release, compatible with firmware version IG1-3.0.3-20190508 or above

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1. Introduction

LPMS-IG1 series include two models, LPMS-IG1 (without GPS) and LPMS-IG1P (with GPS). Both models offer the following communication methods: USB+RS232, USB+CAN, or USB+RS485. For details on how to use the communication interfaces, please refer to the relevant sections below. LPMS-IG1 series come in a waterproof metal housing with a flat bottom profile and mounting holes for easy installation.

For more information please refer to related datasheets and user manuals, available from the LP-RESEARCH website at the following address: <http://www.lp-research.com>.

Main features:

- High precision and stability
- Dual 3-axis general purpose gyroscope, 3-axis accelerometer, 3-axis magnetometer
- Gyrol: High precision 3-axis gyroscope
- Gyroll: 3-axis general purpose gyroscope
- Realtime output: Raw and calibrated sensor data, quaternion, Euler angles, temperature, GPS (LPMS-IG1P)
- Communication method : USB+RS232, USB+CAN, or USB+RS485

Table 1-1. LPMS-IG1 series part number information

Part Number	Communication Interface				GPS Antenna
	USB	RS232	CAN	RS485	
LPMS-IG1-RS232	✓	✓	✗	✗	✗
LPMS-IG1-CAN	✓	✗	✓	✗	✗
LPMS-IG1-RS485	✓	✗	✗	✓	✗
LPMS-IG1P-RS232	✓	✓	✗	✗	✓
LPMS-IG1P-CAN	✓	✗	✓	✗	✓
LPMS-IG1P-RS485	✓	✗	✗	✓	✓

2. System Overview

2.1 Sensor Structure

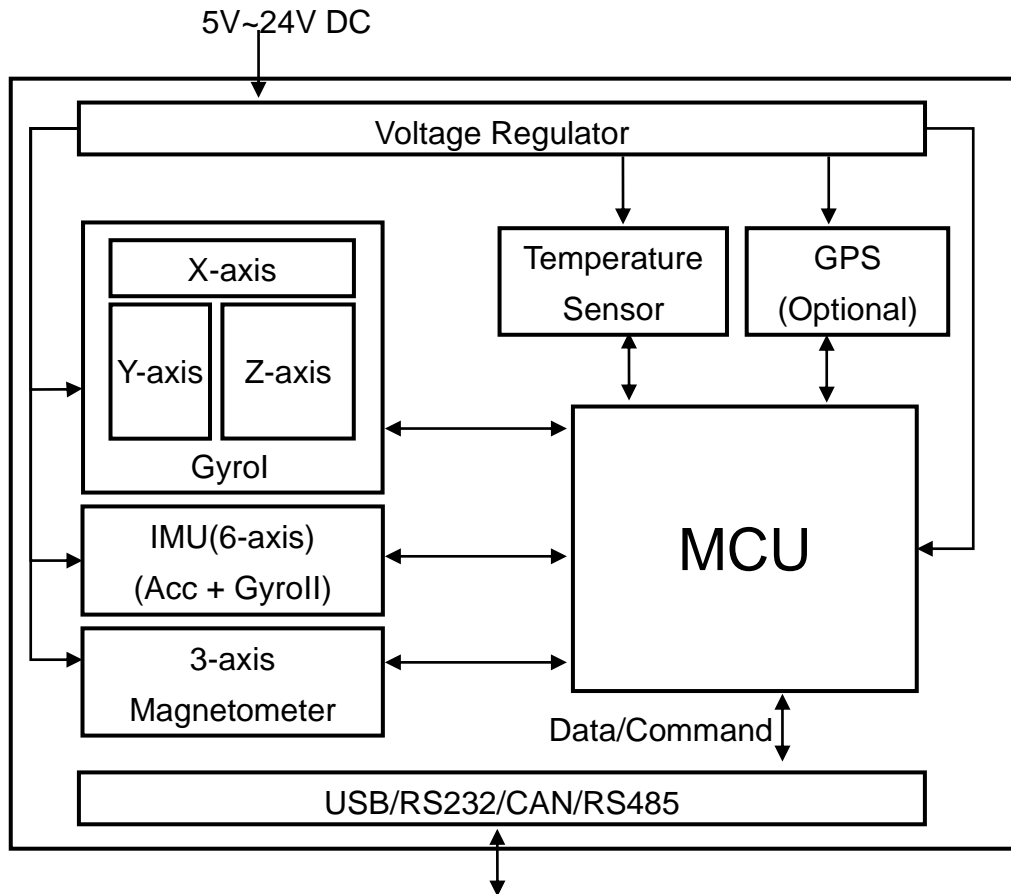


Fig. 2.1. LPMS-IG1 series sensor structure

2.2 Pin Out Configuration

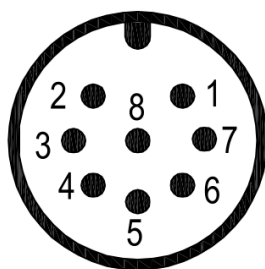


Fig. 2.2. Sensor waterproof connector pin out (M12 8-pin A-coded male connector)



Fig. 2.3. Paired cables (left: cable connections for RS232/CAN/RS485; right: USB connection)

Table 2-1. Connector pin out introduction

Pin No.	Signal	Name	Remark	Paired Cable Color
1	Power	VIN	+5V~+24V DC	White
2		GND	Ground	Brown
3	RS232/CAN/RS485	TX/CAN+/B	-	Green
4		RX/CAN-/A-	-	Yellow
5	-	RES	Float	-
6	USB	D-	-	-
7		D+	-	-
8	IO	EN	Sensor enabled floating: enable; pulled to ground: disabled	Red



Communication setting in default:

- CAN: 500kbps, no termination resistor
- USB: COM mode, 921600bps, 8N1
- RS232: 921600bps, 8N1
- RS485: Command mode, 115200bps, 8N1



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)



4. Specification

4.1 Overall Parameters

Table 4-1. Overall parameters

Parameter	Condition	Value			Unit
		Min.	Typ.	Max.	
Power supply		5	12	24	V
Size			51 x 45 x 24		mm
Wight	LPMS-IG1		74		g
	LPMS-IG1P		76		
Euler angle range	roll	-180		+180	deg
	pitch	-90		+90	deg
	yaw	-180		+180	deg
Angle resolution			0.01		deg
Power consumption *	LPMS-IG1		0.36 (0.03A@12V)		W
	LPMS-IG1P		0.48 (0.04A@12V)		W
Output data frequency		5	100	500	Hz
Working temperature		-20	20	80	°C
Waterproof level			IP67		
Gyro characteristics* (BW=10Hz)	Bias stability	< 400 dps		4	deg/hr
		> 400 dps		6	
	ARW	< 400 dps		0.12	deg/√hr
		> 400 dps		0.24	
	Noise density	< 400 dps		0.002	dps/√Hz
		> 400 dps		0.004	
	Noise RMS	< 400 dps		0.01	dps
		> 400 dps		0.03	
	P-P noise	< 400 dps		0.05	dps
		> 400 dps		0.15	
Bandwidth	< 400 dps		10	Hz	
	> 400 dps	5	10		92
Accelerometer characteristics* (BW=10Hz)	Bias stability		25		ug
	VRW		0.045		m/s/√hr
	Noise RMS		0.4		mg
	Noise		100		ug /√Hz



	density					
	Bandwidth		5	10	100	Hz

* Tests are under room temperature +25°C, and the reference values might be changed under different operation conditions.

4.2 Gyroscope Parameters

Table 4-2. Gyrol parameters**

Parameter	Condition	Value			Unit
		Min.	Typ.	Max.	
Scale factor	24bit		17920		LSB/dps
Scale factor error	+25°C	-2		+2	%
Scale factor change vs. temperature		-3		+3	%
Offset tolerance	+25°C	-1		+1	dps
Offset change vs. temperature		-1		+1	dps
Measurement range		-400		+400	dps
non-linearity	+25°C	-0.5		+0.5	%FS
Cross axis sensitivity	+25°C	-5		+5	%

Table 4-3. Gyroll parameters**

Parameter	Condition	Value			Unit
		Min.	Typ.	Max.	
Scale factor	1±1000dps		32.8		LSB/dps
	±2000dps		16.4		
Initial scale factor tolerance	+25°C		±1		%
Scale factor change vs. temperature			±2		%
Offset tolerance	+25°C		±1		dps
Offset change vs. temperature			±0.01		dps/°C
Measurement range			±2000		dps
non-linearity	+25°C		±0.1		%
Cross axis sensitivity			±1		%

** Tests are under room temperature +25°C, and the reference values might be changed under different operation conditions.



4.3 Accelerometer Parameters

Table 4-4. Accelerometer parameters*

Parameter	Condition	Value			Unit
		Min.	Typ.	Max.	
Scale factor	16bit, $\pm 2g$		16384		LSB/g
	16bit, $\pm 4g$		8192		LSB/g
	16bit, $\pm 8g$		4096		LSB/g
	16bit, $\pm 16g$		2048		LSB/g
Initial scale factor tolerance			± 1		%
Scale factor change vs. temperature			± 1.5		%
Offset tolerance			± 40		mg
Offset change vs. temperature	X, Y		± 0.5		mg/ $^{\circ}C$
	Z		± 1		mg/ $^{\circ}C$
Measurement range			± 2		g
			± 4		g
			± 8		g
			± 16		g
non-linearity	$+25^{\circ}C$		± 0.3		%
Cross axis sensitivity	$+25^{\circ}C$		± 1		%

4.4 Magnetometer Parameters

Table 4-5. Magnetometer parameters*

Parameter	Condition	Value			Unit
		Min.	Typ.	Max.	
Scale factor	16bit, $\pm 2G$		12000		LSB/G
	16bit, $\pm 8G$		3000		LSB/G
Scale factor change vs. temperature			100		LSB/ $^{\circ}C$
Offset tolerance			± 10		mG
Measurement range		-2		+2	Gauss
		-8		+8	Gauss
non-linearity	$\pm 2G$		0.1		%FS
Cross axis sensitivity	Cross field=1Gauss, $\pm 2G$		0.1		%/G
X-Y-Z orthogonality			90 ± 1		deg



* Tests are under room temperature +25°C, and the reference values might be changed under different operation conditions.

4.5 GPS Parameters

Only for modules LPMS-IG1P.

Table 4-6. GPS parameters

Parameter	Values
Receiver type	72-channel, GPS L1C/A, SBAS L1C/A, QZSS L1C/A, QZSS L1-SAIF, GLONASS L1OF, BeiDou B1I, Galileo E1B/C
Data update rate	1Hz
Max. horizontal position accuracy	2.5 m (Autonomous)
Velocity accuracy*	0.5 m/s (50% @ 30 m/s)
Heading accuracy*	1° (50% @ 30 m/s)
Cold start time**	30s (GPS)
Tracking sensitivity***	-160 dBm (GPS)
Max. operational altitude	50 km
Max. operational velocity	500 m/s

* 50% @ 30 m/s

** All satellites at -130 dBm, except Galileo at -127 dBm

*** Demonstrated with a good external LNA

4.6 Allan Chart

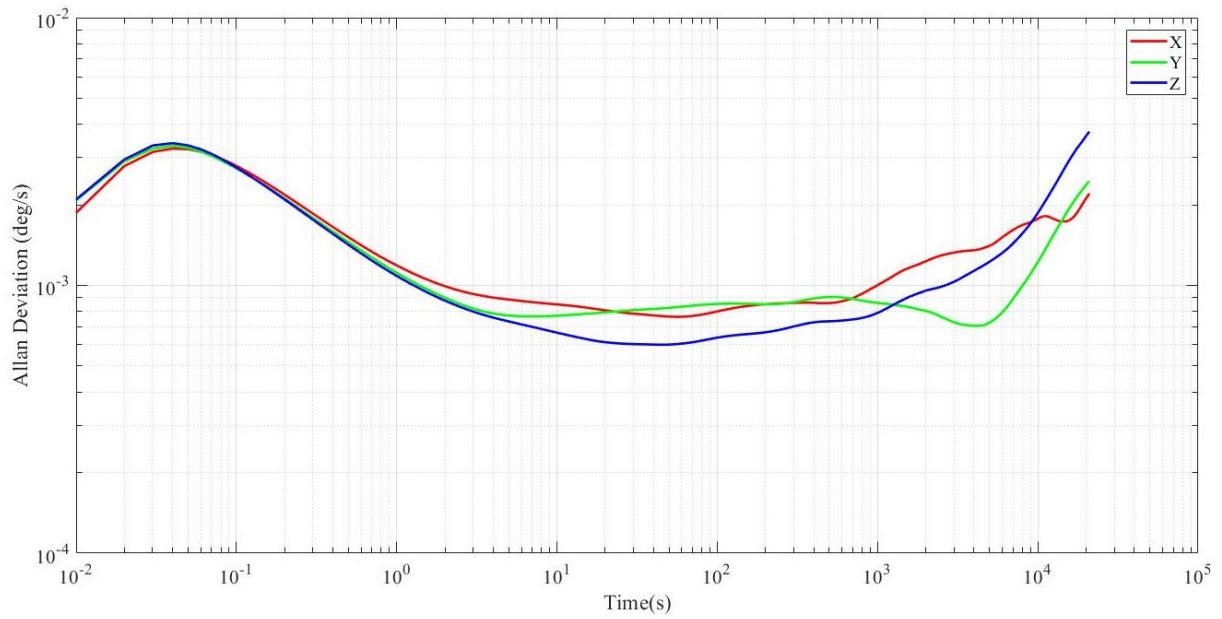


Fig. 4.1. Gyrol Allan parameters

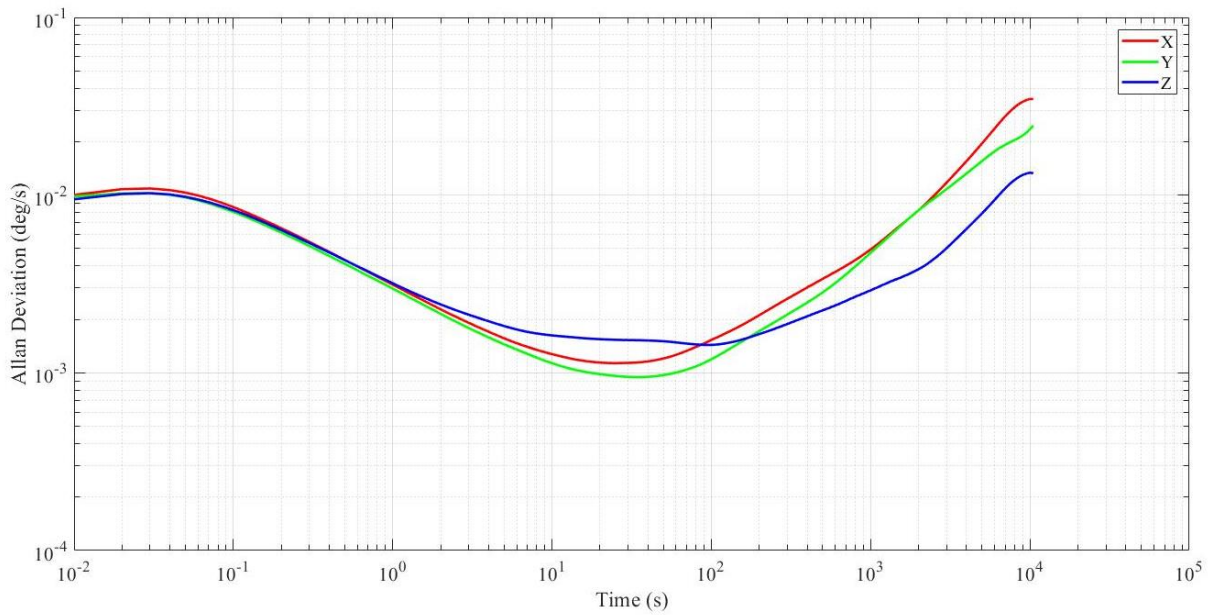


Fig. 4.2. Gyroll Allan parameters

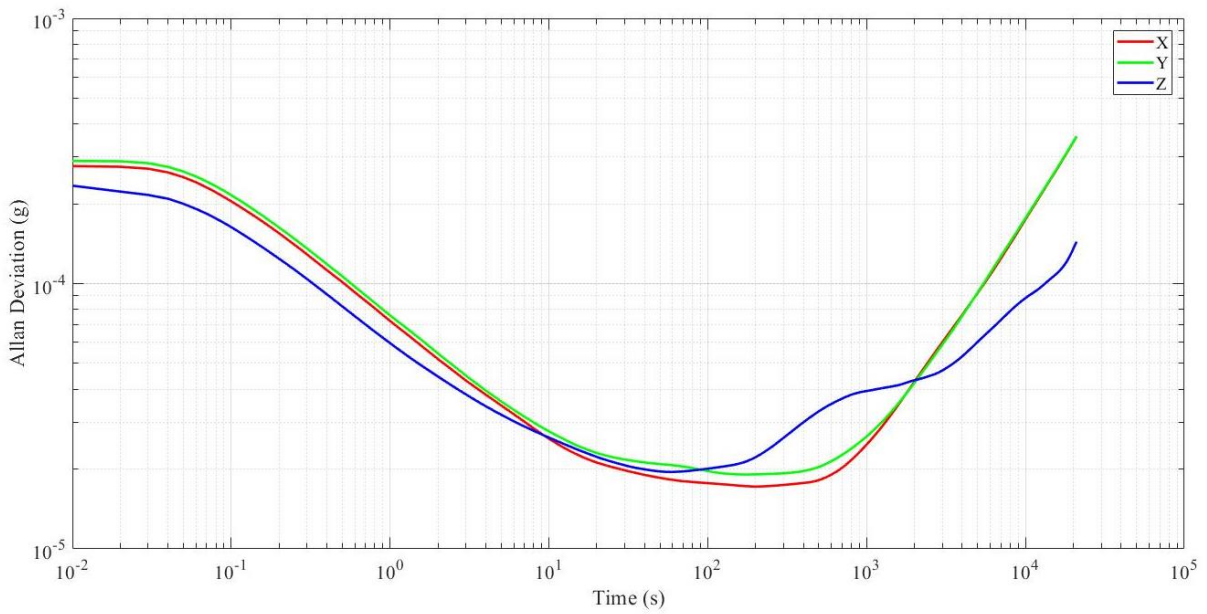


Fig. 4.3. Accelerometer Allan parameters

4.7 Temperature-Current-Voltage Characteristics

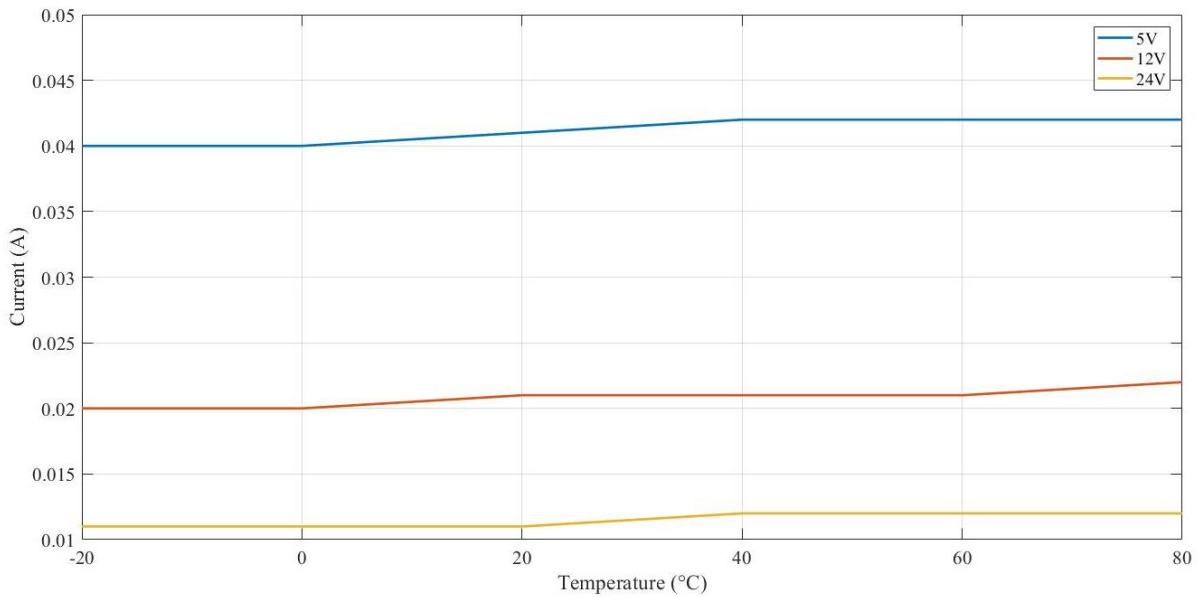


Fig. 4.4. LPMS-IG1 temperature-current-voltage characteristics

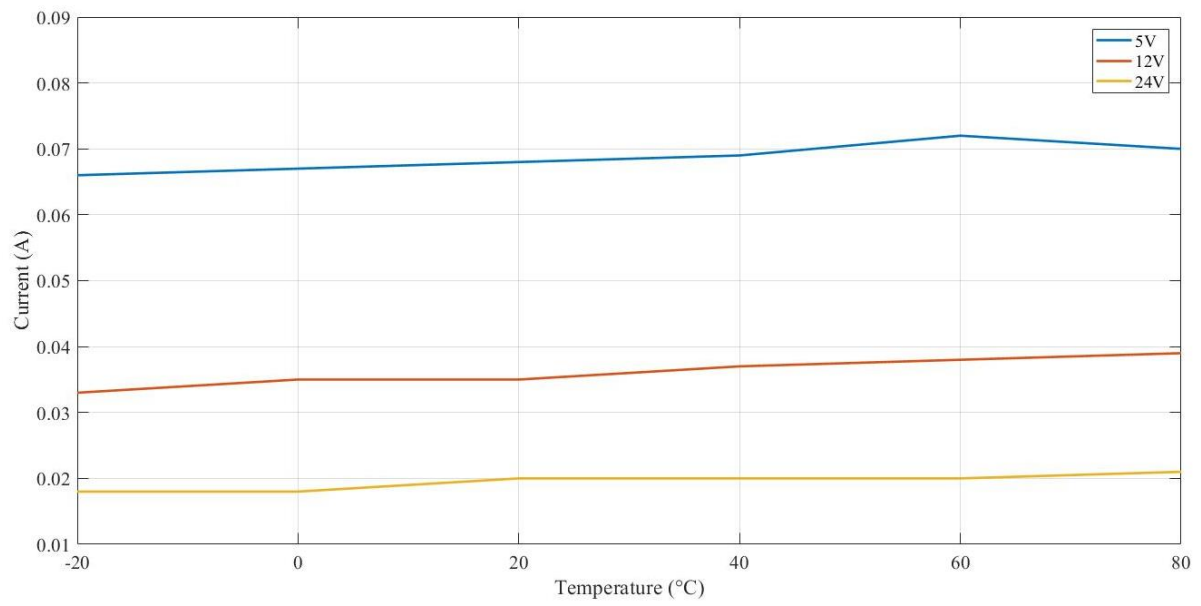


Fig. 4.5. LPMS-IG1 temperature-current-voltage characteristics

5. Mechanical Information

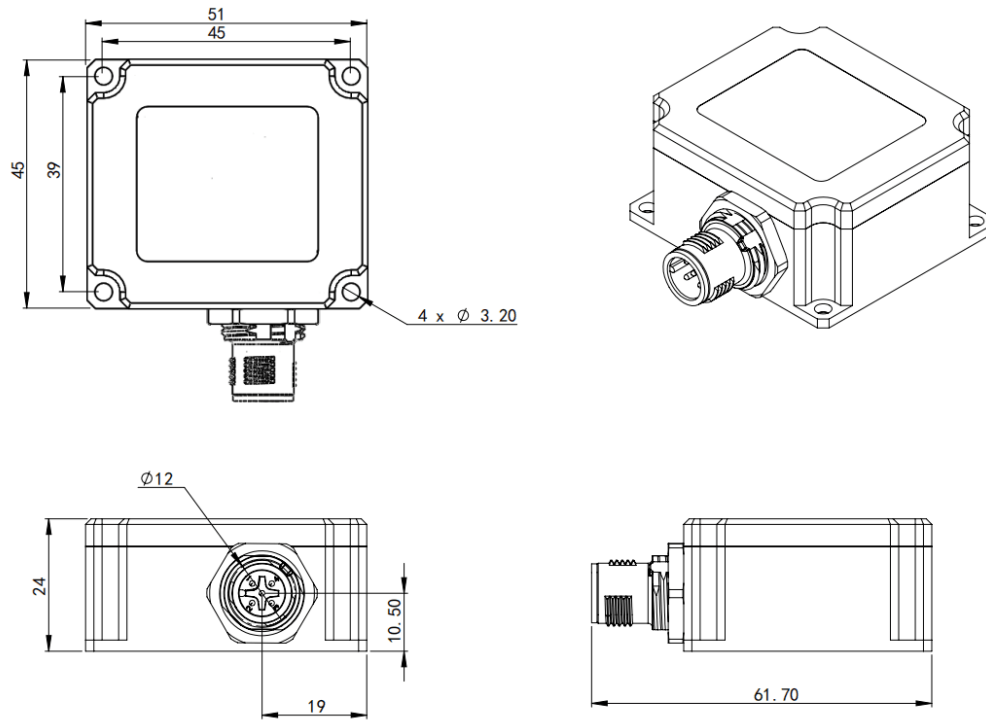


Fig. 5.1. LPMS-IG1 dimension (unit: mm)

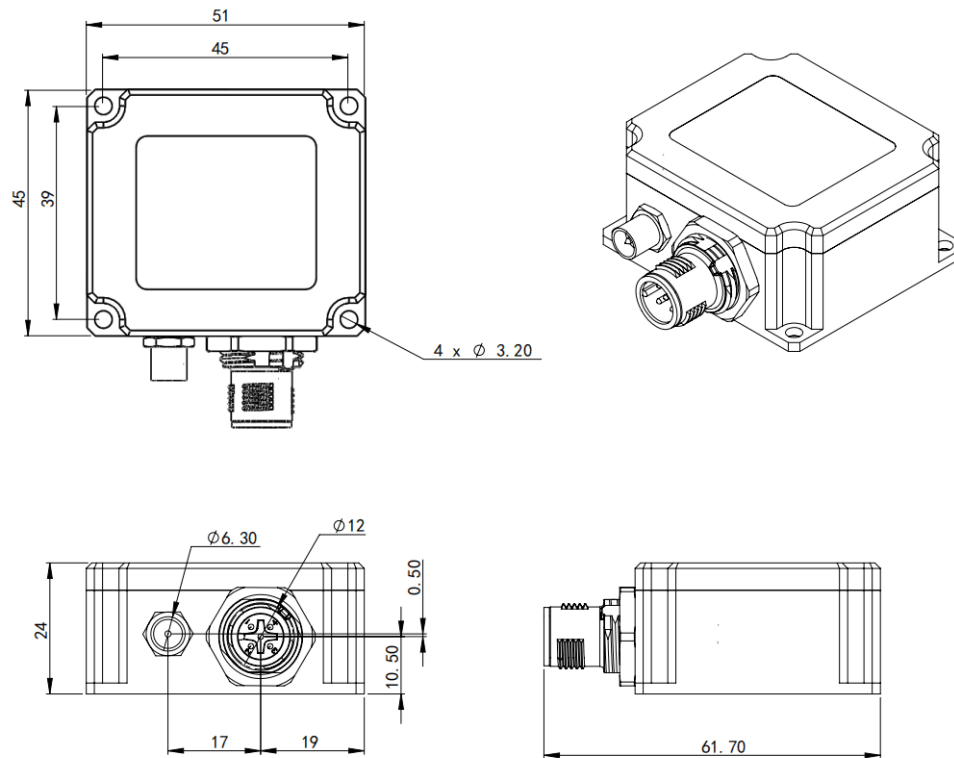


Fig. 5.2. LPMS-IG1P dimension (unit: mm)

