

Product name	Description	Version
LS23080-BVx	Dual-frequency multi-constellation GNSS mouse / 2m, PPS through USB	1.0
LS23082-BVx	Dual-frequency multi-constellation GNSS mouse / 2m, PS2	
LS23083-BVx	Dual-frequency multi-constellation GNSS mouse / 3m, RJ11	
LS23085-BVx	Dual-frequency multi-constellation GNSS mouse / 5m, PS2 with lock	
LS23086-BVx	Dual-frequency multi-constellation GNSS mouse / 3m, RJ11	

Note: LS23086-BVx is the most popular. We recommend customers to use for their new design.

Datasheet of GPS mouse, LS2308x-BVx series



1 Introduction

LS2308x-BVx series products are high-performance dual-band GNSS receivers (also known as GNSS mouse) that are capable of tracking all global civil navigation systems (GPS, GLONASS, BDS, GALILEO, QZSS and IRNSS). The GNSS mouse will acquire both L1 and L5 signals at a time while providing sub-meter position accuracy. It can provide you with fast Time-To-First-Fix, superior sensitivity and low power consumption. Its far-reaching capability meets the sensitivity requirements of car navigation as well as other location-based applications.

The RF front end of LS2308x-BV3 is specifically designed to comply with sensitivity specification contained in AIS 140 standard. It is the best solution to those customers that design tracking applications in compliance with AIS 140.

2 Features

- Sub-meter position accuracy
- Concurrent reception of L1 and L5 band signals
- Support GPS, GLONASS, BEIDOU, GALILEO, QZSS and IRNSS (NavIC)
- Supports BDS-3 signal
- Capable of SBAS (WAAS, EGNOS, MSAS, GAGAN)
- Fast TTFF at low signal level
- Up to 10 Hz update rate
- Smart jammer detection and suppression
- Support PPS through USB
- Build-in micro battery to reserve system data for rapid satellite acquisition

- LED indicator for GNSS fix or not fix
- Magnet for mounting on the car
- Waterproof

3 Application

- Personal positioning and navigation
- Automotive navigation
- Marine navigation
- High-quality NTP time server

4 GNSS specification

Frequency	LS2308x-BV2	GPS/QZSS: L1 C/A, L5C BEIDOU: B1I, B2a GALILEO: E1, E5a GLONASS: L1OF
	LS2308x-BV3	GPS/QZSS: L1 C/A, L5C BEIDOU: B1I, B2a GALILEO: E1, E5a IRNSS L5
Channels	40 channels	
Update rate	1Hz default, up to 10Hz	
Acquisition time	Hot start (Open Sky)	1s (typical)
	Cold Start (Open Sky)	28s (typical)
Position accuracy	GNSS	< 1m (CEP)
PPS signal accuracy	Typical $\pm 1\text{ms}$ for PPS through USB ⁽¹⁾	
Datum	WGS-84 (default)	
Max. altitude	< 18,000 m	
Max. velocity	< 515 m/s	
Protocol support	NMEA 0183 ver. 4.1	115200 bps ⁽²⁾ , 8 data bits, no parity, 1 stop bits (default)
		1Hz: GGA, GLL, GSA, GSV, RMC, VTG

Note 1: The user can get PPS by checking DCD status. PPS accuracy is limited to USB poll interval.

Note 2: Both baud rate and output message rate are configurable to be factory default.

5 Software interface

5.1 NMEA output message

Table 5.1-1 NMEA output message

NMEA record	Description
GGA	Global positioning system fixed data
GLL	Geographic position - latitude/longitude
GSA	GNSS DOP and active satellites
GSV	GNSS satellites in view
RMC	Recommended minimum specific GNSS data
VTG	Course over ground and ground speed

● GGA--- Global Positioning System Fixed Data

Table 5.1-2 contains the values for the following example:

\$GNGGA,091250.000,2503.71250,N,12138.74514,E,1,32,0.55,119.0,M,17.2,M,,*7E

Table 5.1-2 GGA Data Format

Name	Example	Units	Description
Message ID	\$GNGGA		GGA protocol header
UTC Time	091250.000		hhmmss.sss
Latitude	2503.71250		ddmm.mmmmm
N/S indicator	N		N=north or S=south
Longitude	12138.74514		dddmm.mmmmm
E/W Indicator	E		E=east or W=west
Position Fix Indicator	1		See Table 5.1-3
Satellites Used	32		Number of satellites in view
HDOP	0.55		Horizontal Dilution of Precision (meters)
MSL Altitude	119.0	meters	Antenna Altitude above/below mean-sea-level (geoid) (in meters)
Units	M	meters	Units of antenna altitude, meters
Geoidal Separation	17.2	meters	
Units	M	meters	Units of geoidal separation, meters
Age of diff. GNSS data		second	Null fields when DGPS is not used
Diff. Ref. Station ID			Differential reference station ID, 0000-1023
Checksum	*7E		Checksum
<CR> <LF>			End of message termination

Table 5.1-3 Position Fix Indicators

Value	Description
0	No position fix

1	Autonomous GNSS fix
2	Differential GNSS fix
4	RTK fixed
5	RTK float
6	Estimated/Dead reckoning fix

● GLL--- Geographic Position – Latitude/Longitude

Table 5.1-4 contains the values for the following example:

\$GNGLL,2503.71193,N,12138.74582,E,094450.000,A,A*47

Table 5.1-4 GLL Data Format

Name	Example	Units	Description
Message ID	\$GNGLL		GLL protocol header
Latitude	2503.71193		ddmm.mmmmm
N/S indicator	N		N=north or S=south
Longitude	12138.74582		dddmm.mmmmm
E/W indicator	E		E=east or W=west
UTC Time	094450.000		hhmmss.sss
Status	A		A=data valid or V=data not valid
Mode	A		N = No position fix A = Autonomous GNSS fix D = Differential GNSS fix R = RTK fixed F = RTK float E = Estimated/Dead reckoning fix
Checksum	*47		
<CR> <LF>			End of message termination

● GSA---GNSS DOP and Active Satellites

Table 5.1-5 contains the values for the following example:

\$GNGSA,A,3,11,195,194,199,08,07,01,27,16,09,23,,1.19,0.64,1.00,1*3F

\$GNGSA,A,3,87,81,76,,,,,,,,,1.19,0.64,1.00,2*0F

\$GNGSA,A,3,,,,,,,,,1.19,0.64,1.00,3*09

\$GNGSA,A,3,34,24,12,07,11,10,08,38,25,09,13,16,1.19,0.64,1.00,4*02

Table 5.1-5 GSA Data Format

Name	Example	Units	Description
Message ID	\$GNGSA		GSA protocol header
Mode 1	A		See Table 5.1-6

Mode 2	3		See Table 5.1-7
ID of satellite used	11		SV on Channel 1
ID of satellite used	195		SV on Channel 2
....			
ID of satellite used			SV on Channel 12
PDOP	1.19		Position Dilution of Precision
HDOP	0.64		Horizontal Dilution of Precision
VDOP	1.00		Vertical Dilution of Precision
GNSS system ID	4		See Table 5.1-8
Checksum	*3F		
<CR> <LF>			End of message termination

Table 5.1-6 Mode 1

Value	Description
M	Manually set to operate in 2D or 3D mode
A	Automatically switching between 2D or 3D mode

Table 5.1-7 Mode 2

Value	Description
1	No position fix
2	2D fix
3	3D fix

Table 5.1-8 GNSS system ID

Value	Description
1	GPS
2	GLONASS
3	GALILEO
4	BEIDOU
6	IRNSS

● GSV---GNSS Satellites in View

Table 5.1-9 contains the values for the following example:

\$GPGSV,3,1,09,8,71,268,47,27,63,18,49,11,44,191,46,4,41,237,46,1*54

\$GPGSV,3,2,09,16,38,42,42,9,32,279,39,26,22,70,38,31,15,131,36,1*56

\$GPGSV,3,3,09,7,15,320,40,1*6B

\$GPGSV,1,1,04,8,71,268,50,27,63,18,49,9,32,279,43,26,22,70,42,8*6C

\$GLGSV,2,1,05,82,63,47,47,83,56,182,36,80,47,9,42,79,33,85,45,1*71

\$GLGSV,2,2,05,81,15,27,37,1*71

\$GAGSV,1,1,03,31,47,342,44,1,42,62,45,26,30,49,40,6*79

\$GBGSV,5,1,17,12,80,182,47,24,64,5,51,7,58,355,44,3,57,205,45,1*7C

\$GBGSV,5,2,17,1,54,141,44,34,52,211,49,9,48,230,45,10,47,316,42,1*79

\$GBGSV,5,3,17,26,44,100,47,16,39,207,43,4,38,117,41,2,37,240,41,1*77

\$GBGSV,5,4,17,39,37,210,43,6,36,198,41,38,27,173,41,25,18,317,42,1*4E

\$GBGSV,5,5,17,35,16,39,40,1*7F

\$GBGSV,1,1,02,24,64,5,50,26,44,100,43,4*77

Table 5.1-9 GSV Data Format

Name	Example	Units	Description
Message ID	\$GPGSV		GSV protocol header. GP=GPS/QZSS, GL=GLONSS, GA=GALILEO, GB=BEIDOU, GI=IRNSS.
Total number of messages	3		Range 1 to 9
Message number	1		Range 1 to 9
Satellites in view	09		
Satellite ID	8		Channel 1
Elevation	71	degrees	Channel 1 (Range 00 to 90)
Azimuth	268	degrees	Channel 1 (Range 000 to 359)
SNR (C/No)	47	dB-Hz	Channel 1 (Range 00 to 99, null when not tracking)
....			
Satellite ID	4		Channel 4 (Range 01 to 196)
Elevation	41	degrees	Channel 4 (Range 00 to 90)
Azimuth	237	degrees	Channel 4 (Range 000 to 359)
SNR (C/No)	46	dB-Hz	Channel 4 (Range 00 to 99, null when not tracking)
Signal ID	1		GPS/QZSS: L1 C/A=1, L5Q=8 GLONASS: L1 C/A=1 GALILEO: E1=6, E5a=2 BEIDOU: B1=1, B2a=4 IRNSS: L6=1
Checksum	*54		
<CR> <LF>			End of message termination

● RMC---Recommended Minimum Specific GNSS Data

Table 5.1-10 contains the values for the following example:

\$GNRMC,070143.000,A,2503.71317,N,12138.74533,E,0.002,70.50,130220,,,A,V*01

Table 5.1-10 RMC Data Format

Name	Example	Units	Description
Message ID	\$GNRMC		RMC protocol header

UTC Time	070143.000		hhmmss.sss
Status	A		A=data valid or V=data not valid
Latitude	2503.7117		ddmm.mmmm
N/S Indicator	N		N=north or S=south
Longitude	12138.74533		dddmm.mmmmm
E/W Indicator	E		E=east or W=west
Speed over ground	0.002	knots	True
Course over ground	70.50	degrees	
Date	130220		ddmmyy
Magnetic variation		degrees	
Variation sense			E=east or W=west
Mode	A		N = No position fix A = Autonomous GNSS fix D = Differential GNSS fix R = RTK fixed F = RTK float E = Estimated/Dead reckoning fix
Navigational status indicator	V		S = Safe C = Caution U = Unsafe V = Void
Checksum	*01		
<CR> <LF>			End of message termination

● VTG---Course Over Ground and Ground Speed

Table 5.1-11 contains the values for the following example:

\$GNVTG,0.00,T,,M,0.003,N,0.006,K,A*26

Table 5.1-11 VTG Data Format

Name	Example	Units	Description
Message ID	\$GPVTG		VTG protocol header
Course over ground	0.00	degrees	Measured heading
Reference	T		True
Course over ground		degrees	Measured heading
Reference	M		Magnetic
Speed over ground	0.003	knots	Measured speed
Units	N		Knots
Speed over ground	0.006	km/hr	Measured speed

Units	K		Kilometer per hour
Mode	A		N = No position fix A = Autonomous GNSS fix D = Differential GNSS fix R = RTK fixed F = RTK float E = Estimated/Dead reckoning fix
Checksum	*26		
<CR> <LF>			End of message termination

5.2 Proprietary command sets

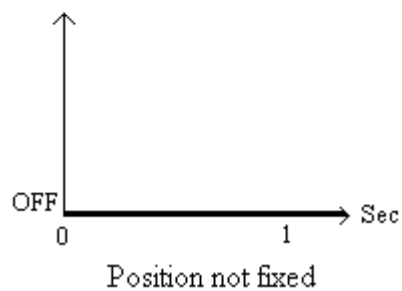
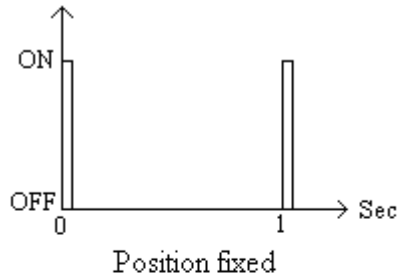
The following table shows the most common use proprietary command sets.

Table 5.2-1 The table below summarizes the set of proprietary command sets for the LS2308x-BVx

Command descriptions	Software command
Perform a Cold start	F1 D9 06 40 01 00 01 48 22
Perform a Warm start	F1 D9 06 40 01 00 02 49 23
Perform a Hot start	F1 D9 06 40 01 00 03 4A 24
Perform a Factory reset	F1 D9 06 09 08 00 02 00 00 00 FF FF FF FF 15 01
UART configures as 115200bps	F1 D9 06 00 08 00 00 00 00 00 00 C2 01 00 D1 E0
UART configures as 57600bps	F1 D9 06 00 08 00 00 00 00 00 00 E1 00 00 EF 3B
UART configures as 38400bps	F1 D9 06 00 08 00 00 00 00 00 00 96 00 00 A4 5A
UART configures as 19200bps	F1 D9 06 00 08 00 00 00 00 00 00 4B 00 00 59 79
UART configures as 9600bps	F1 D9 06 00 08 00 00 00 00 00 80 25 00 00 B3 07
Enable ZDA message	F1 D9 06 01 03 00 F0 07 01 02 1E
Disable ZDA message	F1 D9 06 01 03 00 F0 07 00 01 1D
Navigate with GPS +QZSS(L1+L5) only	F1 D9 06 0C 04 00 21 02 00 04 3D 2A
Navigate with GPS+GLONASS+GALILEO +QZSS (L1+L5) system	F1 D9 06 0C 04 00 33 02 10 04 5F 92
Navigate with GPS+GLONASS+GALILEO + BEIDOU+QZSS (L1+L5) system	F1 D9 06 0C 04 00 37 82 10 04 E3 22
Switch to Vehicle mode	F1 D9 06 0F 02 00 96 00 AD A3
Switch to Pedestrian mode	F1 D9 06 0F 02 00 00 00 17 77
Query firmware version	F1 D9 0A 05 00 00 0F 37

6 LED indicator

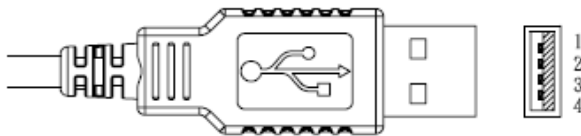
The red LED is an indicator of GPS positioning status. In continuous power mode, it flashes once per second when position is fixed. Otherwise it is off. The timing in detail is as below.



7 Pin assignment and descriptions

● LS23080-BVx

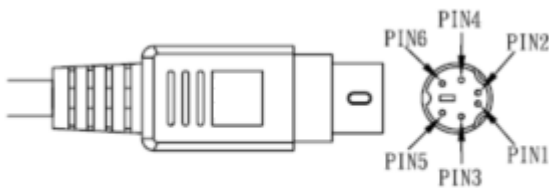
Pin #	Name	Type	Description
1	VBUS	P	USB power input
2	D-		D- line
3	D+		D+ line
4	GND	P	Ground



USB A-TYPE Plug

● LS23082-BVx

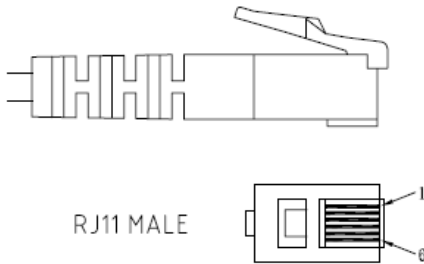
Pin #	Name	Type	Description
1	GND	P	Ground
2	VDD	P	Power input
3	NC		Not connect
4	RX	I	Data input (RS232 level)
5	TX	O	Data output (RS232 level)
6	NC		Not connect



PS2 MALE

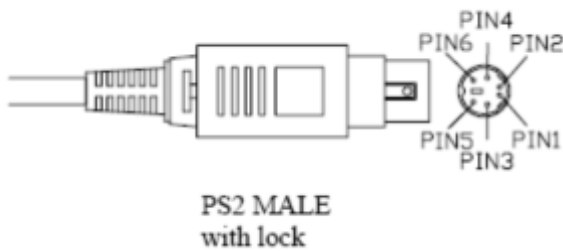
● LS23083-BVx

Pin #	Name	Type	Description
1	VDD	P	Power input
2	RX	I	Data input (RS232 level)
3	TX	O	Data output (RS232 level)
4	GND	P	Ground
5	NC		Not connect
6	NC		Not connect



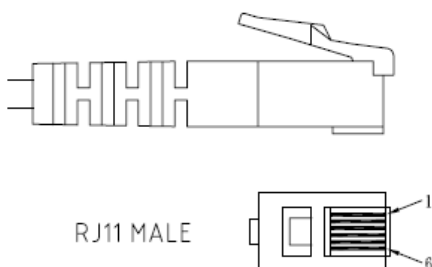
● LS23085-BVx

Pin #	Name	Type	Description
1	VDD	P	Power input
2	GND	P	Ground
3	NC		Not connect
4	TX	O	Data output (RS232 level)
5	RX	I	Data input (RS232 level)
6	NC		Not connect



● LS23086-BVx

Pin #	Name	Type	Description
1	NC		Not connect
2	GND	P	Ground
3	RX	I	Data input (RS232 level)
4	TX	O	Data output (RS232 level)
5	VDD	P	Power input
6	NC		Not connect



8 DC & Temperature characteristics

8.1 Power consumption (continuous mode)

Parameter	Symbol	Product	Min.	Typ.	Max.	Units
Input voltage	VCC	LS23080-BV _x	4.75	5	5.25	V
		LS23082-BV _x	4	5	6	
		LS23083-BV _x	4	5	6	
		LS23085-BV _x	4	5	6	
		LS23086-BV _x	4	5	6	
Input current	I _{cc}	LS23080-BV _x		54 ⁽¹⁾		mA
		LS23082-BV _x		45 ⁽¹⁾		
		LS23083-BV _x		45 ⁽¹⁾		
		LS23085-BV _x		45 ⁽¹⁾		
		LS23086-BV _x		45 ⁽¹⁾		

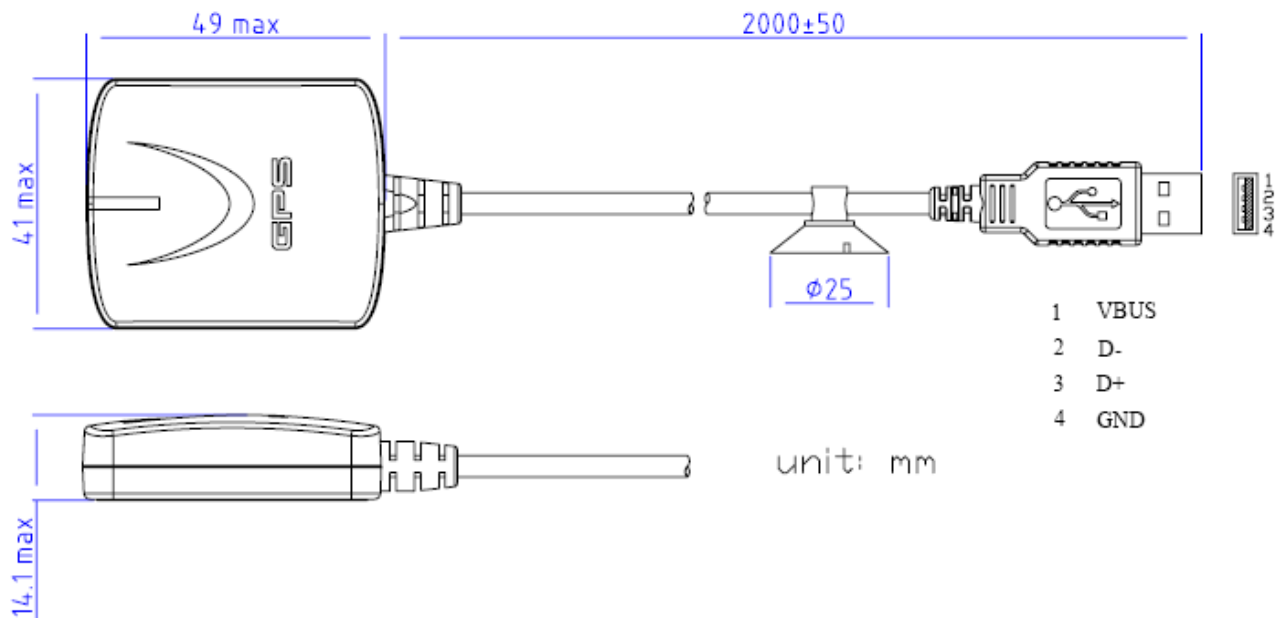
Note 1: Measured when position fix (1Hz) is available.

8.2 Temperature characteristics

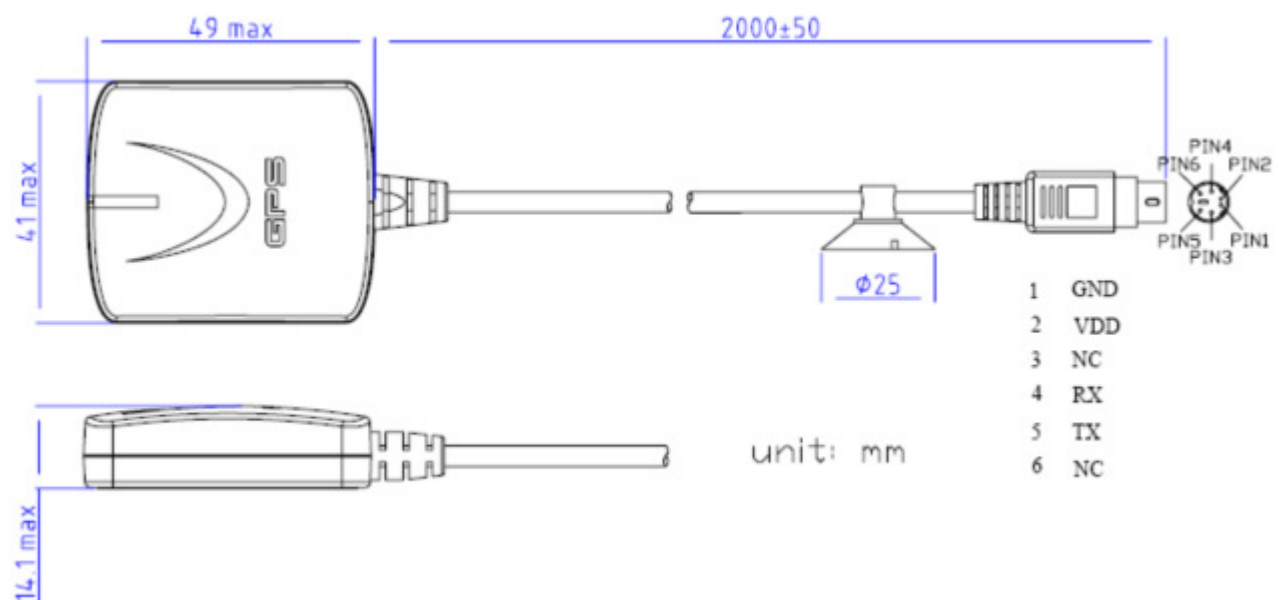
Parameter	Symbol	Min.	Typ.	Max.	Units
Operating Temperature	T _{opr}	-40	-	85	°C
Storage Temperature	T _{stg}	-40	25	85	°C

9 Mechanical specification

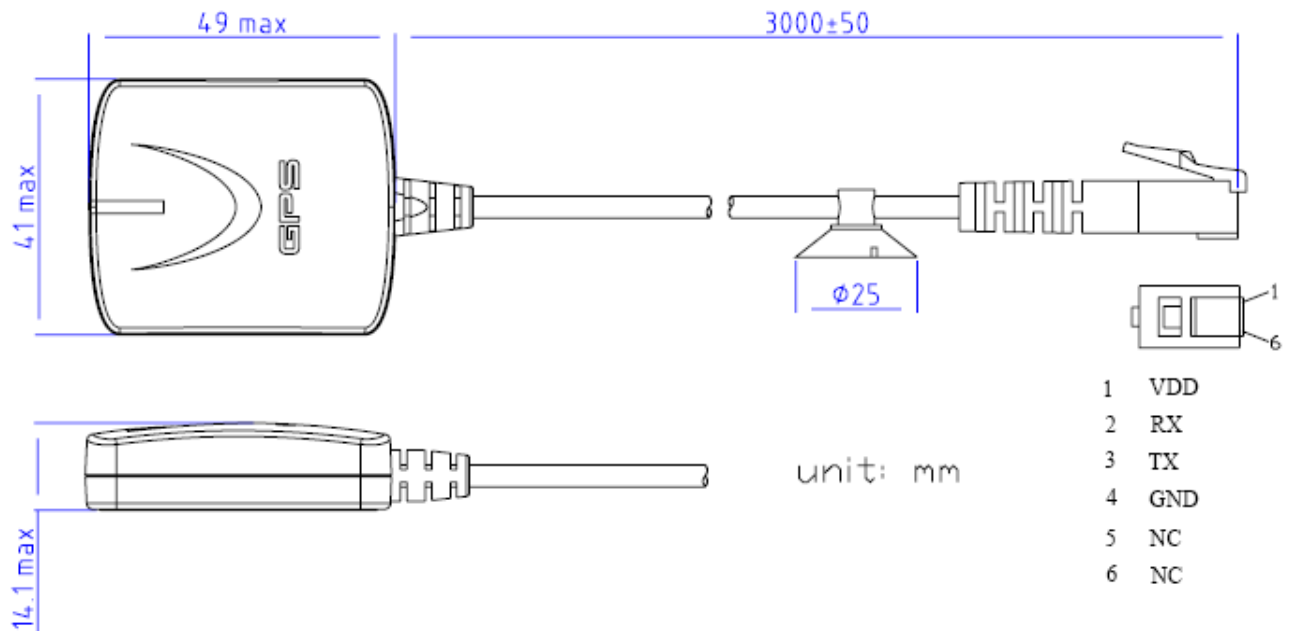
- **LS23080-BV_x (USB interface)**



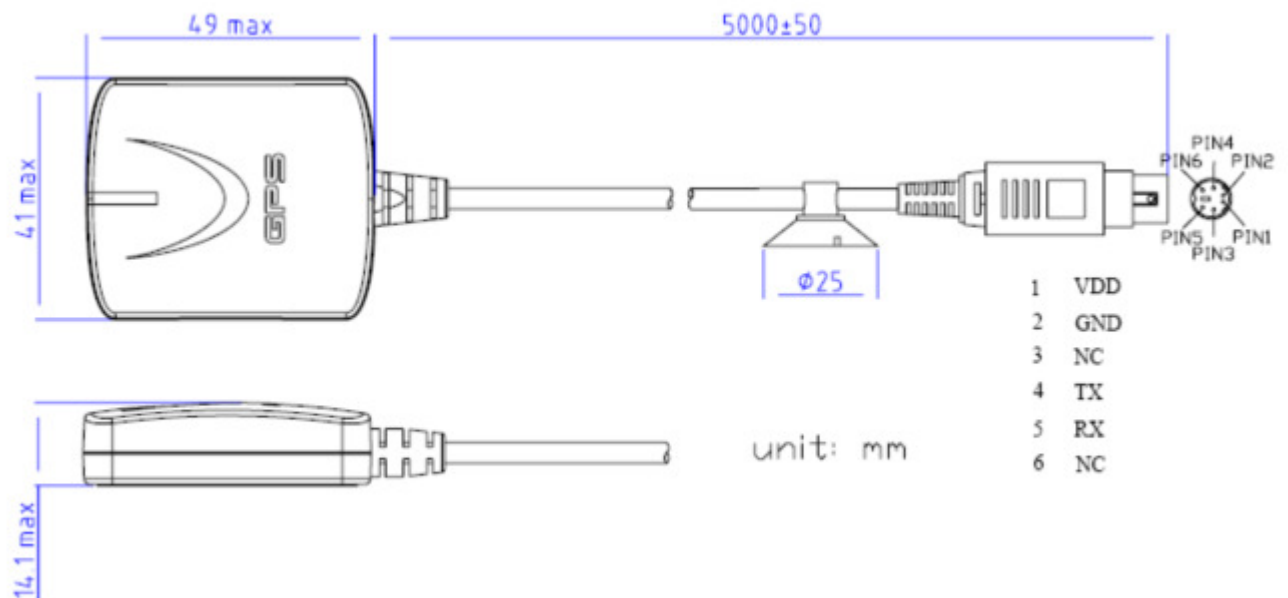
- **LS23082-BV_x (RS232 interface)**



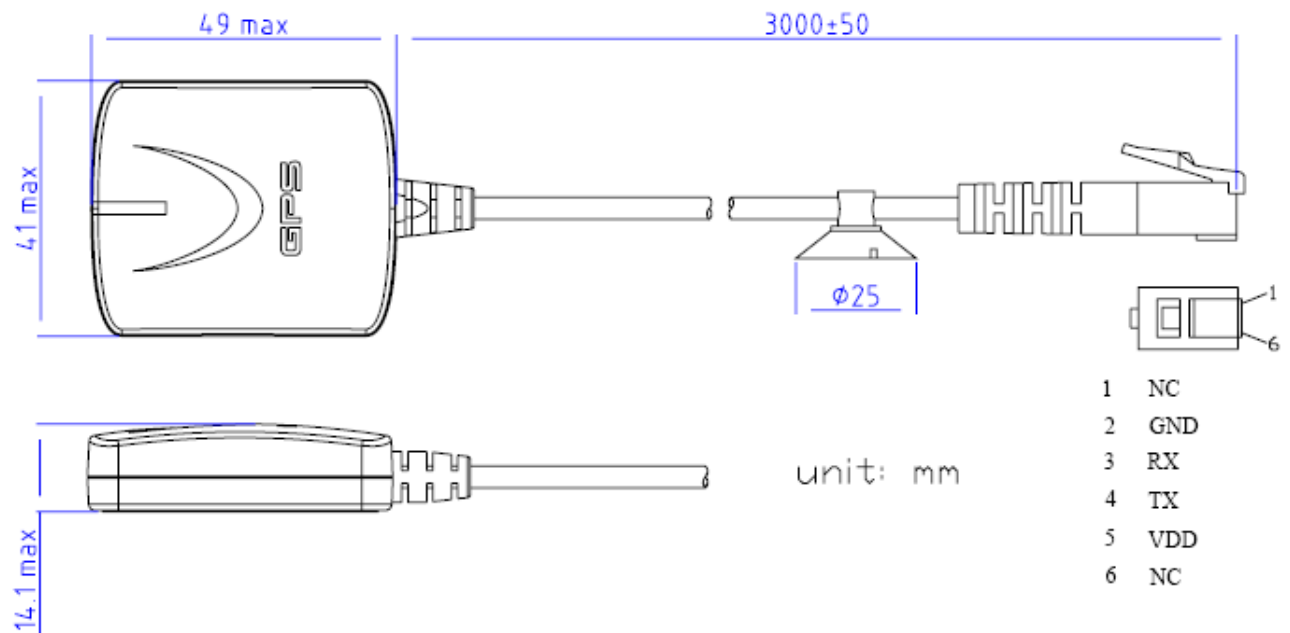
● LS23083-BVx (RS232 interface)



● LS23085-BVx (RS232 interface)



● LS23086-BVx (RS232 interface)



10 Ordering information

Product name	Description	Remark
LS23080-BV2	Dual-frequency multi-constellation GNSS mouse / 2m, PPS through USB	GPS, BEIDOU, GALILEO, QZSS, GLONASS
LS23080-BV3	Dual-frequency multi-constellation GNSS mouse / 2m, PPS through USB	GPS, BEIDOU, GALILEO, QZSS, IRNSS
LS23082-BV2	Dual-frequency multi-constellation GNSS mouse / 2m, PS2	GPS, BEIDOU, GALILEO, QZSS, GLONASS
LS23082-BV3	Dual-frequency multi-constellation GNSS mouse / 2m, PS2	GPS, BEIDOU, GALILEO, QZSS, IRNSS
LS23083-BV2	Dual-frequency multi-constellation GNSS mouse / 3m, RJ11	GPS, BEIDOU, GALILEO, QZSS, GLONASS
LS23083-BV3	Dual-frequency multi-constellation GNSS mouse / 3m, RJ11	GPS, BEIDOU, GALILEO, QZSS, IRNSS
LS23085-BV2	Dual-frequency multi-constellation GNSS mouse / 5m, PS2 with lock	GPS, BEIDOU, GALILEO, QZSS, GLONASS
LS23085-BV3	Dual-frequency multi-constellation GNSS mouse / 5m, PS2 with lock	GPS, BEIDOU, GALILEO, QZSS, IRNSS
LS23086-BV2	Dual-frequency multi-constellation GNSS mouse / 3m, RJ11	GPS, BEIDOU, GALILEO, QZSS, GLONASS
LS23086-BV3	Dual-frequency multi-constellation GNSS mouse / 3m, RJ11	GPS, BEIDOU, GALILEO, QZSS, IRNSS

Document change list

Revision 0.1

- Draft release on April 6, 2020.

Revision 0.2 (August 28, 2020)

- Added the description about AIS-140 in section 1.

Revision 0.3 (September 22, 2020)

- Added the proprietary command sets in section 5.2.

Revision 1.0 (October 30, 2020)

- Changed the cold start time from 27s to 28s.
- Changed the current of LS23080-BVx from 58 mA to 54 mA.