

Product name	Description	Version
LS23032-Vx	Dual-frequency multi-constellation GNSS mouse / 2m, PS2	1.1
LS23033-Vx	Dual-frequency multi-constellation GNSS mouse / 3m, RJ11	
LS23035-Vx	Dual-frequency multi-constellation GNSS mouse / 5m, PS2 with lock	
LS23036-Vx	Dual-frequency multi-constellation GNSS mouse / 3m, RJ11	

Note: LS23036-Vx is the most popular. We recommend customers to use for their new design.

Datasheet of GPS mouse, LS2303x-Vx series



1 Introduction

LS2303x-Vx 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 the better 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 receivers support hybrid ephemeris prediction to achieve faster cold start. One is self-generated ephemeris prediction (called EASY) that is no need of both network assistance and host CPU's intervention. This is valid for up to 3 days and updates automatically from time to time when GNSS module is powered on and satellites are available. The other is server-generated ephemeris prediction (called EPO) that gets from an internet server. This is valid for up to 14 days. Both ephemeris predictions are stored in the on-board flash memory and perform a cold start time less than 15 seconds.

The RF front ends of LS2303x-V3 are specifically designed to comply with sensitivity specification contained in AIS 140 standard. They are the best solution to those customers that design tracking applications in compliance with AIS 140.

2 Features

- Concurrent reception of L1 and L5 band signals
- Support GPS, GLONASS, BEIDOU, GALILEO, QZSS and IRNSS (NavIC)
- Capable of SBAS (WAAS, EGNOS, MSAS, GAGAN) and QZSS SLAS
- Support 135-channel GNSS

- Fast TTFF at low signal level
- Up to 10 Hz update rate
- Smart jammer detection and suppression
- 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	LS2303x-V2	GPS/QZSS: L1 C/A, L5C GLONASS: L1OF BEIDOU: B1I, B2a GALILEO: E1, E5a
	LS2303x-V3	GPS/QZSS: L1 C/A GLONASS: L1OF BEIDOU: B1I GALILEO: E1 IRNSS L5
Channels	Support 135 channels	
Update rate	1Hz default, up to 10Hz	
Acquisition time	Hot start (Open Sky)	1s (typical)
	Cold Start (Open Sky)	28s (typical) without AGPS
Position accuracy	LS2303x-V2	Autonomous: 1.5m (CEP)
	LS2303x-V3	Autonomous: 2.5m (CEP)
PPS signal accuracy	Typical ± 1 ms for PPS through USB ⁽¹⁾	
Datum	WGS-84 (default)	
Max. altitude	< 18,000 m	
Max. velocity	< 500m/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, GST

Note 1: 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
GST	Estimated error in position solution

● 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,1,1,04,08,48,300,43,03,47,025,45,13,36,309,42,05,06,061,34,7*79

\$GAGSV,1,1,04,08,48,300,43,03,47,025,47,13,36,309,43,05,06,061,33,1*7B

\$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=7, E5a=1 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

● GST---Estimated error in position solution

Table 5.1-12 contains the values for the following example:

\$GNGST,075707.000,2.9,1.8,1.5,113.3,1.6,1.8,5.9*7F

Table 5.1-12 GST Data Format

Name	Example	Units	Description
Message ID	\$GNGST		GST protocol header
UTC Time	075707.000		hhmmss.sss
RangeRMS	2.9	meters	RMS value of the standard deviation of the ranges
stdMajor	1.8	meters	Standard deviation of semi-major axis of error ellipse
stdMinor	1.5	meters	Standard deviation of semi-minor axis of error ellipse
Orient	113.3	degrees	Orientation of semi-major axis of error ellipse
stdLat	1.6	meters	Standard deviation of latitude error
stdLong	1.8	meters	Standard deviation of longitude error
stdAlt	5.9	meters	Standard deviation of altitude error
Checksum	*7F		
<CR> <LF>			End of message termination

5.2 Proprietary command sets

The commonly used commands are in the following.

5.2.1 ID: 001

[Description]

PAIR_ACK. Acknowledge of the input command.

[Return]

\$PAIR001,Command_ID,Result*CS<CR><LF>

Command_ID: The command / packet type the acknowledge responds.

Result: The result of the command.

0: The command was successfully sent.

1: The command is processing. You must wait for the result.

2: Sending the command failed.

3: This command ID is not supported.

4: Command parameter error. Out of range / some parameters were lost / checksum error.

5: Service is busy. You can try again soon.

[Example]

Send:

\$PAIR002*38\r\n

Response:

\$PAIR001,002,0*39\r\n ==> Success

5.2.2 ID: 002

[Description]

Power on the GNSS system. Include DSP/RF/Clock and other GNSS sections.

[Data Field]

\$PAIR002*CS<CR><LF>

[Return]

PAIR_ACK for send result.

[Example]

Send:

\$PAIR002*38\r\n

Response:

\$PAIR001,002,1*38\r\n ==> The power on process is running. Please wait a moment.

\$PAIR001,002,0*39\r\n ==> Power on was successful.

5.2.3 ID: 003

[Description]

Power off GNSS system. Include DSP/RF/Clock and other GNSS sections. The location service is not available after this command is executed. The module can still receive configuration commands.

[Data Field]

\$PAIR003*CS<CR><LF>

[Return]

PAIR_ACK for send result.

[Example]

Send:

\$PAIR003*39\r\n

Response:

\$PAIR001,003,1*39\r\n ==> The power off process is running. Please wait a moment.

\$PAIR001,003,0*38\r\n ==> Power off was successful.

5.2.4 ID: 004

[Description]

Hot Start. Use the available data in the NVRAM.

[Data Field]

\$PAIR004*CS<CR><LF>

[Return]

PAIR_ACK for send result.

[Example]

Send:

\$PAIR004*3E\r\n

Response:

\$PAIR001,004,0*3F\r\n ==> Success

5.2.5 ID: 005

[Description]

Warm Start. Not using Ephemeris data at the start.

[Data Field]

\$PAIR005*CS<CR><LF>

[Return]

PAIR_ACK for send result.

[Example]

Send:

\$PAIR005*3F\r\n

Response:

\$PAIR001,005,0*3E\r\n ==> Success

5.2.6 ID: 006

[Description]

Cold Start. Not using the Position, Almanac and Ephemeris data at the start.

[Data Field]

\$PAIR006*CS<CR><LF>

[Return]

PAIR_ACK for send result.

[Example]

Send:

\$PAIR006*3C\r\n

Response:

\$PAIR001,006,0*3D\r\n ==> Success

5.2.7 ID: 007

[Description]

Full Cold Start.

In addition to Cold start, this command clears the system/user configurations at the start.

It resets the GNSS module to the factory default.

[Data Field]

\$PAIR007*CS<CR><LF>

[Return]

PAIR_ACK for send result.

[Example]

Send:

\$PAIR007*3D\r\n

Response:

\$PAIR001,007,0*3C\r\n ==> Success

5.2.8 ID: 864

[Description]

Set baud rate configuration.

[Data Field]

\$PAIR864,<Port_Type>,<Port_Index>,<Baudrate>*CS<CR><LF>

Port_Type: HW Port Type.

0: UART

Port_Index: HW Port Index

0: UART0

Baudrate: the baud rate needs config.

Support 115200, 230400, 460800, 921600, 3000000

[Return]

PAIR_ACK for send result.

[Example]

Send:

\$PAIR864,0,0,115200*1B\r\n

Response:

\$PAIR001,864,0*31\r\n ==> Success

[Note]

The change will take effect after reboot.

5.2.9 ID: 050

[Description]

Set Position Fix Interval.

If set less than 1000 ms, ASCII NMEA will automatically increase the update interval in order to decrease IO throughput.

[Data Field]

\$PAIR050,<Fix_Interval>*CS<CR><LF>

Fix_Interval: Position fix interval in milliseconds (ms). [Range: 100 ~ 1000]

[Return]

PAIR_ACK for send result.

[Example]

Send:

\$PAIR050,1000*12\r\n

Response:

\$PAIR001,050,0*3E\r\n ==> Success

5.2.10 ID: 051

[Description]

Get Position Fix Interval.

[Data Field]

\$PAIR051*CS<CR><LF>

[Return]

1. PAIR_ACK for send result.

2. \$PAIR050,<Fix_Interval>*CS<CR><LF>

Fix_Interval: Position fix interval in milliseconds (ms). [Range: 100 ~ 1000]

[Example]

Send:

\$PAIR051*3E\r\n

Response:

\$PAIR001,051,0*3F\r\n ==> Success

\$PAIR051,1000*13\r\n

5.2.11 ID: 062**[Description]**

Set the NMEA sentence output interval of corresponding NMEA type.

[Data Field]

\$PAIR062,<Type>,<Output_Rate>*CS<CR><LF>

Type: NMEA Type

-1 Reset all sentence to default value.

0 NMEA_SEN_GGA, // GGA interval - GPS Fix Data

1 NMEA_SEN_GLL, // GLL interval - Geographic Position - Latitude longitude

2 NMEA_SEN_GSA, // GSA interval - GNSS DOPS and Active Satellites

3 NMEA_SEN_GSV, // GSV interval - GNSS Satellites in View

4 NMEA_SEN_RMC, // RMC interval - Recommended Minimum Specific GNSS Sentence

5 NMEA_SEN_VTG, // VTG interval - Course Over Ground and Ground Speed

6 NMEA_SEN_ZDA, // ZDA interval - Time & Date

7 NMEA_SEN_GRS, // GRS interval - GNSS Range Residuals

8 NMEA_SEN_GST, // GST Interval - GNSS Pseudorange Error Statistics

Output_Rate: Output interval setting (Valid range: 0~20)

0 - Disabled or not supported sentence

1 - Output once every one position fix

2 - Output once every two position fixes

3 - Output once every three position fixes

4 - Output once every four position fixes

5 - Output once every five position fixes

[Return]

PAIR_ACK for send result.

[Example]

Send:

\$PAIR062,0,3*3D\r\n

Response:

\$PAIR001,062,0*3F\r\n ==> Success

5.2.12 ID: 063

[Description]

Get the NMEA sentence output interval of corresponding NMEA type.

[Data Field]

\$PAIR063,<Type>*CS<CR><LF>

Type: NMEA Type

-1 return all sentence configuration.

0 NMEA_SEN_GGA, // GGA interval - GPS Fix Data

1 NMEA_SEN_GLL, // GLL interval - Geographic Position - Latitude longitude

2 NMEA_SEN_GSA, // GSA interval - GNSS DOPS and Active Satellites

3 NMEA_SEN_GSV, // GSV interval - GNSS Satellites in View

4 NMEA_SEN_RMC, // RMC interval - Recommended Minimum Specific GNSS

Sentence

5 NMEA_SEN_VTG, // VTG interval - Course Over Ground and Ground Speed

6 NMEA_SEN_ZDA, // ZDA interval - Time & Date

7 NMEA_SEN_GRS, // GRS interval - GNSS Range Residuals

8 NMEA_SEN_GST, // GST Interval - GNSS Pseudorange Error Statistics

[Return]

1. PAIR_ACK for send result.

2. \$PAIR063,<Type>,<Output_Rate>*CS<CR><LF>

Type: NMEA Type

0 NMEA_SEN_GGA, // GGA interval - GPS Fix Data

1 NMEA_SEN_GLL, // GLL interval - Geographic Position - Latitude longitude

2 NMEA_SEN_GSA, // GSA interval - GNSS DOPS and Active Satellites

3 NMEA_SEN_GSV, // GSV interval - GNSS Satellites in View

4 NMEA_SEN_RMC, // RMC interval - Recommended Minimum Specific GNSS

Sentence

5 NMEA_SEN_VTG, // VTG interval - Course Over Ground and Ground Speed

6 NMEA_SEN_ZDA, // ZDA interval - Time & Date

7 NMEA_SEN_GRS, // GRS interval - GNSS Range Residuals

8 NMEA_SEN_GST, // GST Interval - GNSS Pseudorange Error Statistics

Output_Rate: Output interval setting (Valid range: 0~20, default value: 1)

0 - Disabled or not supported sentence

1 - Output once every one position fix

2 - Output once every two position fixes

3 - Output once every three position fixes

4 - Output once every four position fixes

5 - Output once every five position fixes

[Example]

Send:

\$PAIR063,0*23\r\n

Response:

\$PAIR001,063,0*3E\r\n ==> Success

\$PAIR063,0,3*3C\r\n

5.2.13 ID: 070**[Description]**

Set the speed threshold for static navigation.

If the actual speed is less than the threshold, the output position remains the same and the output speed will be zero. If the threshold value is set to 0, this function is disabled.

[Data Field]

\$PAIR070,<Speed_threshold>*CS<CR><LF>

Speed_threshold. 0~20 dm/s. The maximum is 20 dm/s. 1 dm/s = 0.1m/s

[Return]

PAIR_ACK for send result.

[Example]

Send:

\$PAIR070,4*25\r\n

Response:

\$PAIR001,070,0*3C\r\n ==> Success

[Note]

For vehicle application, setting the threshold to 15 dm/s, i.e., 1.5 m/s can reduce the position drift when waiting for the traffic light.

\$PAIR070,15*15\r\n

5.2.14 ID: 071**[Description]**

Query the static navigation speed threshold.

[Data Field]

\$PAIR071*CS<CR><LF>

[Return]

1. PAIR_ACK for send result.

2. \$PAIR071,<Speed_threshold>*CS<CR><LF>

Speed_threshold: 0~2 m/s.

The maximum is 2.0 m/s.

[Example]

Send:

\$PAIR071*3C\r\n

Response:

\$PAIR001,071,0*3D\r\n ==> Success

\$PAIR071,0.4*3A\r\n

5.2.15 ID: 080

[Description]

Set navigation mode.

[Data Field]

\$PAIR080,<CmdType>*CS<CR><LF>

CmdType:

0. Normal mode: For general purpose
1. Fitness mode: For running and walking purpose so that the low-speed (< 5 m/s) movement will have more of an effect on the position calculation.
2. Reserved
3. Reserved
4. Stationary mode: For stationary applications with zero dynamics.
5. Reserved
6. Reserved
7. Swimming mode: For swimming purpose so that it smooths the trajectory and improves the accuracy of distance calculation.

[Return]

PAIR_ACK for send result.

[Example]

Send:

\$PAIR080,1*2F\r\n ==> Enter fitness mode.

Response:

\$PAIR001,080,0*33\r\n ==> Success

5.2.16 ID: 081

[Description]

Get navigation mode.

[Data Field]

\$PAIR081*CS<CR><LF>

[Return]

1. PAIR_ACK for send result.
2. \$PAIR081,<CmdType>*CS<CR><LF>

CmdType:

- '0' [Default Value] Normal mode: For general purpose
- '1' Fitness mode: For running and walking activities so that the low-speed (< 5 m/s) movement will have more of an effect on the position calculation.
- '2' Reserved
- '3' Reserved
- '4' Stationary mode: For stationary applications where a zero dynamic assumed.
- '5' Reserved
- '6' Reserved
- '7' Swimming mode: For swimming purpose so that it smooths the trajectory and improves the accuracy of distance calculation.

[Example]

Send:

\$PAIR081*33\r\n

Response:

\$PAIR001,081,0*32\r\n ==> Success

\$PAIR081,1*2E\r\n ==> Current is fitness mode.

5.2.17 ID: 400

[Description]

Set DGPS correction data source mode.

[Data Field]

\$PAIR400,<Mode> *CS<CR><LF>

Mode: DGPS data source mode.

- '0': No DGPS source
- '1': RTCM
- '2': SBAS (Include WAAS/EGNOS/GAGAN/MSAS)
- '3': QZSS SLAS

[Return]

PAIR_ACK for send result.

[Example]

Send:

\$PAIR400,2*20\r\n ==> Set SBAS Mode

Response:

\$PAIR001,400,0*3F\r\n ==> Success

5.2.18 ID: 401

[Description]

Query the DGPS data source mode.

[Data Field]

\$PAIR401*CS<CR><LF>

[Return]

1. PAIR_ACK for send result.
2. \$PAIR401,<Mode>*CS<CR><LF>

Mode: DGPS data source mode.

- '0': No DGPS source
- '1': RTCM
- '2': SBAS (Include WAAS/EGNOS/GAGAN/MSAS)
- '3': QZSS SLAS

[Example]

Send:

\$PAIR401*3F\r\n

Response:

\$PAIR001,401,0*3E\r\n ==> Success

\$PAIR401,2*21\r\n ==> SBAS Mode

5.2.19 ID: 410

[Description]

Enable searching a SBAS satellite or not.

When navigation mode is Fitness or Swimming mode, SBAS is not supported.

[Data Field]

\$PAIR410,<Enabled>*CS<CR><LF>

Enabled: Enable or disable

'0' = Disable

'1' = Enable

[Return]

PAIR_ACK for send result.

[Example]

Send:

\$PAIR410,1*22\r\n ==> Enable SBAS

Response:

\$PAIR001,410,0*3E\r\n ==> Success

5.2.20 ID: 411

[Description]

Query the status of SBAS to whether it is enabled.

[Data Field]

\$PAIR411*CS<CR><LF>

[Return]

1. PAIR_ACK for send result.
2. \$PAIR411,<Enabled>*CS<CR><LF>
Enabled: Enable or disable
'0' = Disable
'1' = Enable

[Example]

Send:

\$PAIR411*3E\r\n

Response:

\$PAIR001,411,0*3F\r\n ==> Success

\$PAIR411,1*23\r\n ==> Enable SBAS

5.2.21 ID: 420**[Description]**

Enable the QZSS SLAS (Sub-meter Level Augmentation Service) operation.

When navigation mode is Fitness or Swimming mode, QZSS SLAS is not supported.

[Data Field]

\$PAIR420,<Enabled>*CS<CR><LF>

Enabled: Enable or disable

'0' = Disable

'1' = Enable

[Return]

PAIR_ACK for send result.

[Example]

Send:

\$PAIR420,1*21\r\n ==> Enable QZSS SLAS

Response:

\$PAIR001,420,0*3D\r\n ==> Success

5.2.22 ID: 421**[Description]**

Query the status of SLAS to check whether it is enabled.

[Data Field]

\$PAIR421*CS<CR><LF>

[Return]

1. PAIR_ACK for send result.
2. \$PAIR421,<Enabled>*CS<CR><LF>

Enabled: Enable or disable

'0' = Disable

'1' = Enable

[Example]

Send:

\$PAIR421*3D\r\n

Response:

\$PAIR001,421,0*3C\r\n ==> Success

\$PAIR421,1*20\r\n ==> The status of QZSS SLAS is enabled

5.2.23 ID: 513

[Description]

Save the current configuration from RTC RAM to flash.

[Data Field]

\$PAIR513*CS<CR><LF>

[Return]

PAIR_ACK for send result.

[Example]

Send:

\$PAIR513*3D\r\n

Response:

\$PAIR001,513,0*3C\r\n

[Note]

The changes of the configuration are kept in the RTC RAM that is powered from V_BCKP pin. If the power from V_BCKP pin is not kept, the changes will be lost after system reboot. The user can use this command to save the changes into the non-volatile flash memory.

5.2.24 ID: 514

[Description]

Clear the current configuration and restore the factory default settings. This function does not support run time restore when GNSS is power on. Please send \$PAIR003 command to power off GNSS before using this command.

[Data Field]

\$PAIR514*CS<CR><LF>

[Return]

PAIR_ACK for send result.

[Example]

Send:

\$PAIR514*3A\r\n

Response:

\$PAIR001,514,0*3B\r\n

6 LED indicator

The red LED is an indicator of GNSS 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.

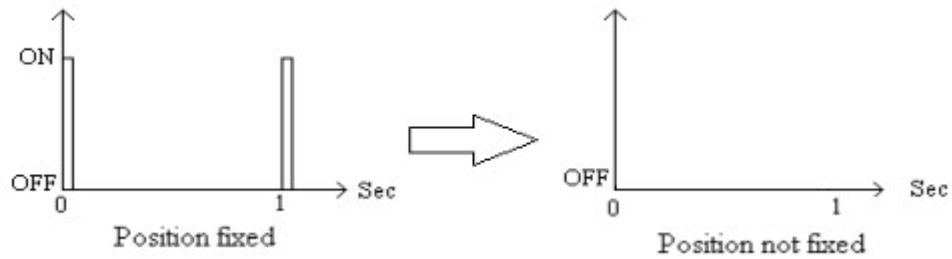
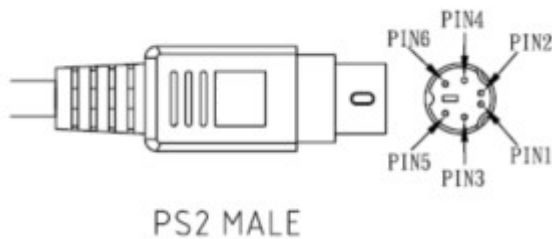


Fig 6.1 LED indicator of positioning status

7 Pin assignment and descriptions

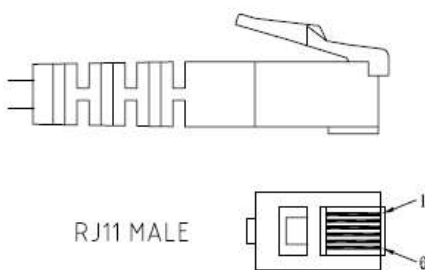
● LS23032-Vx

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



● LS23033-Vx

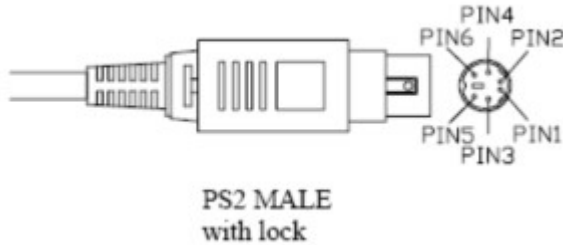
Pin #	Name	Type	Description
1	VDD	P	Power input
2	RX	I	Data input (RS232 level)
3	TX	O	Data output (RS232 level)
4	GND	P	Ground
5	NC		Not connect
6	NC		Not connect



● LS23035-Vx

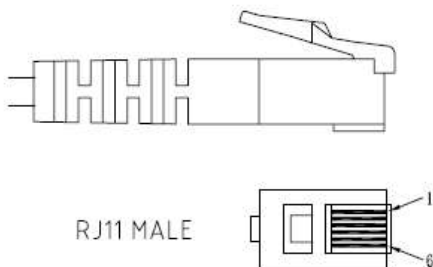
Pin #	Name	Type	Description
1	VDD	P	Power input
2	GND	P	Ground
3	NC		Not connect
4	TX	O	Data output (RS232 level)

5	RX	I	Data input (RS232 level)
6	NC		Not connect



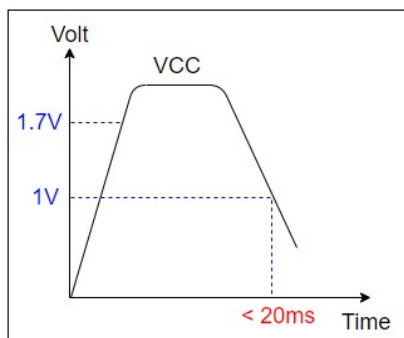
● LS23036-Vx

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



<Note>

1. The input voltage from 0 to its working voltage must be a stable rising slope. Avoid powering the module at the same time during mechanical contact of the connector. The mechanical contact bounce may result in the following voltage waveform. This may make the module not work even if the correct voltage is input again. When this happens, the user has to disconnect the power and wait a few days until the built-in micro battery is exhausted.



8 DC & Temperature characteristics

8.1 Power consumption (continuous mode)

Parameter	Symbol	Product	Min.	Typ.	Max.	Units
Input voltage	VCC	LS23032-Vx	4	5	6	V
		LS23033-Vx	4	5	6	
		LS23035-Vx	4	5	6	
		LS23036-Vx	4	5	6	
Input current	Icc	LS23032-V2		65		mA
		LS23033-V2		65		
		LS23035-V2		65		
		LS23036-V2		65		
		LS23032-V3		41		
		LS23033-V3		41		
		LS23035-V3		41		
		LS23036-V3		41		

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

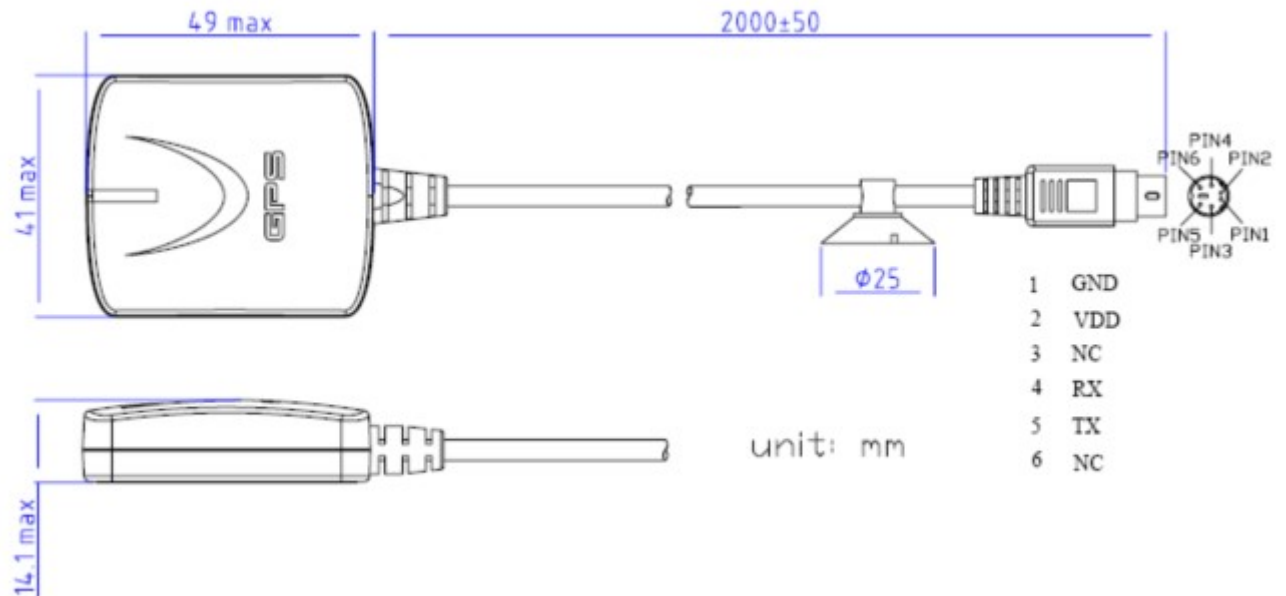
8.2 Temperature characteristics

Parameter	Symbol	Min.	Typ.	Max.	Units
Operating Temperature	Topr	-40	-	85	°C
Storage Temperature	Tstg	-40	25	85	°C

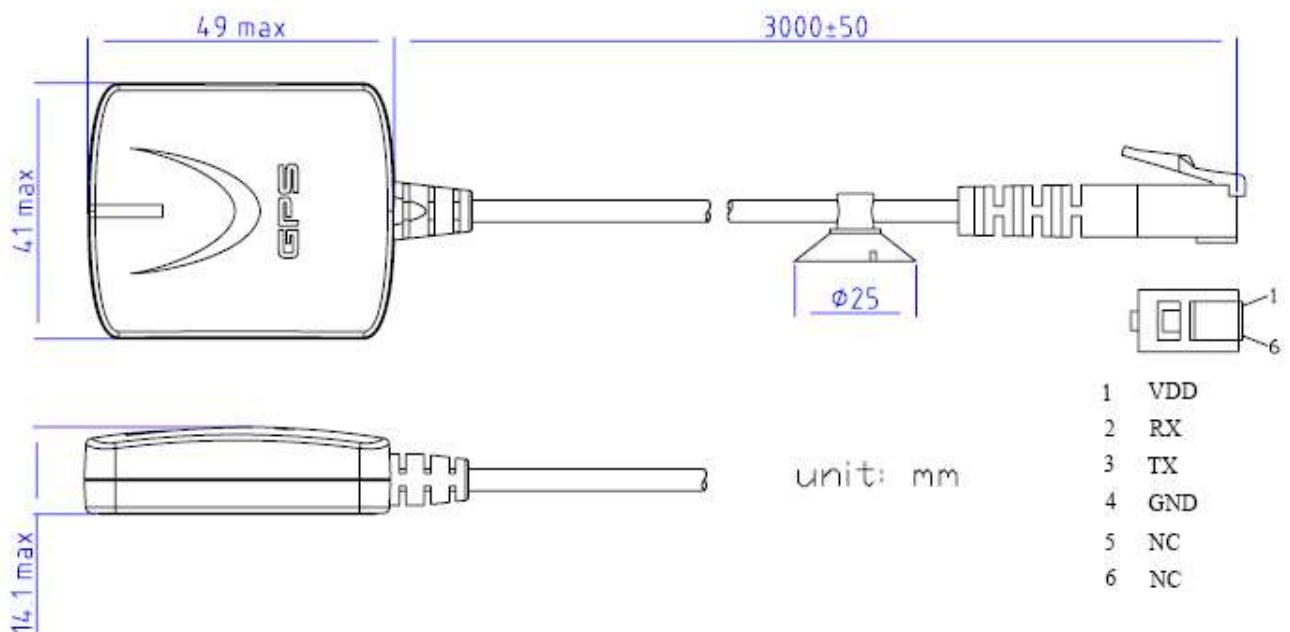
Note: The operating and storage temperature of the built-in micro battery are -20 ~ +60 °C and -40 ~ +60 °C, respectively. GNSS module will still work even the micro battery is broken or short due to temperature or other issues.

9 Mechanical specification

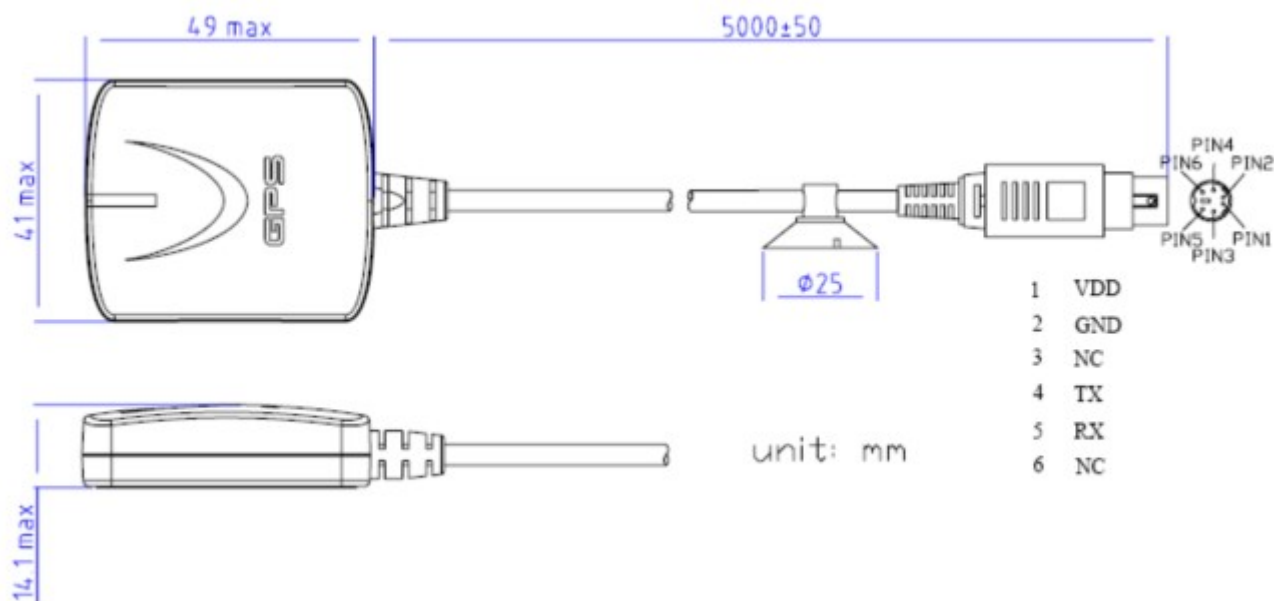
- LS23032-Vx (RS232 interface)



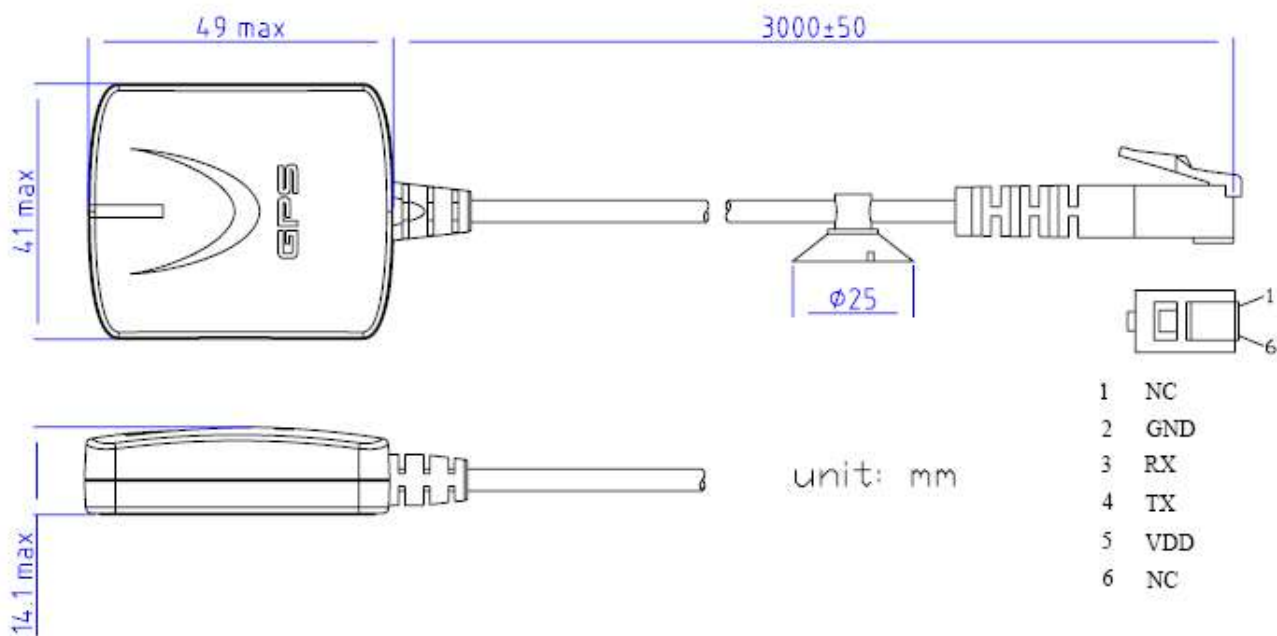
- LS23033-Vx (RS232 interface)



- LS23035-Vx (RS232 interface)



- LS23036-Vx (RS232 interface)



10 Ordering information

Product name	Description	Remark
LS23032-V2	Dual-frequency multi-constellation GNSS mouse / 2m, PS2	GPS/QZSS: L1 C/A, L5C GLONASS: L1OF BEIDOU: B1I, B2a GALILEO: E1, E5a
LS23033-V2	Dual-frequency multi-constellation GNSS mouse / 3m, RJ11	
LS23035-V2	Dual-frequency multi-constellation GNSS mouse / 5m, PS2 with lock	
LS23036-V2	Dual-frequency multi-constellation GNSS mouse / 3m, RJ11	
LS23032-V3	Dual-frequency multi-constellation GNSS mouse / 2m, PS2	GPS/QZSS: L1 C/A GLONASS: L1OF BEIDOU: B1I GALILEO: E1 IRNSS: L5
LS23033-V3	Dual-frequency multi-constellation GNSS mouse / 3m, RJ11	
LS23035-V3	Dual-frequency multi-constellation GNSS mouse / 5m, PS2 with lock	
LS23036-V3	Dual-frequency multi-constellation GNSS mouse / 3m, RJ11	

Document change list

Revision 0.1

- Draft release on September 22, 2020.

Revision 0.2 (September 24, 2020)

- Added the proprietary command sets in section 5.2.

Revision 0.3 (April 27, 2021)

- Remove sub-meter position accuracy in section 2
- Added support of QZSS SLAS
- Changed the max. velocity from 515 m/s to 500 m/s in section 4
- Changed autonomous position accuracy from 1m CEP to 1.5m CEP
- Added GST to default output message
- Revised the input current in section 8.1

Revision 0.4 (April 28, 2021)

- Revised the proprietary command in section 5.2.

Revision 1.0 (August 23, 2021)

- Official release.

Revision 1.1 (December 8, 2021)

- Removed LS23030-Vx
- Added the note for VCC pin in section 7.
- Changed the current of LS23032-V2, LS23033-V2, LS23035-V2 and LS23036-V2 from 63mA to 65mA in section 8.1.
- Added the note in section 8.2