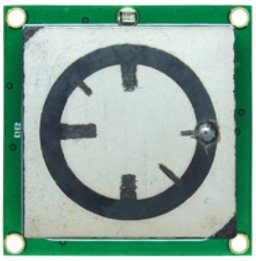
LOCOSYS Technology Inc.
20F.-13, No.79, Sec. 1, Xintai 5th Rd.,
Xizhi Dist., New Taipei City 22101, Taiwan
☎ 886-2-8698-3698
886-2-8698-3699
www.locosystech.com/

Product name	Description	Version
LS20030-Vx	Dual-frequency multi-constellation GNSS smart antenna, PPS through USB	1.1
LS20031-Vx	Dual-frequency multi-constellation GNSS smart antenna, TTL	
LS20032-Vx	Dual-frequency multi-constellation GNSS smart antenna, RS232	



Antenna side

LS20030-Vx

LS20031-Vx

LS20032-Vx

1 Introduction

LS2003x-Vx series products are high-performance dual-band GNSS smart antenna modules, including an embedded antenna and GNSS receiver circuits, designed for a broad spectrum of OEM system applications. The GNSS smart antenna will acquire both L1 and L5 signals at a time while providing the better standalone 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 modules 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 LS20030-V3, LS20031-V3 and LS20032-V3 are specifically designed to comply with sensitivity specification contained in AIS 140 standard. They are the best solutions 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
- Free hybrid ephemeris prediction to achieve faster cold start
- Up to 10 Hz update rate

© 2020 LOCOSYS Technology Inc.

LOCOSYS Technology Inc.
20F.-13, No.79, Sec. 1, Xintai 5th Rd.,
Xizhi Dist., New Taipei City 22101, Taiwan
☏ 886-2-8698-3698
886-2-8698-3699
www.locosystech.com/

- 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

3 Application

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

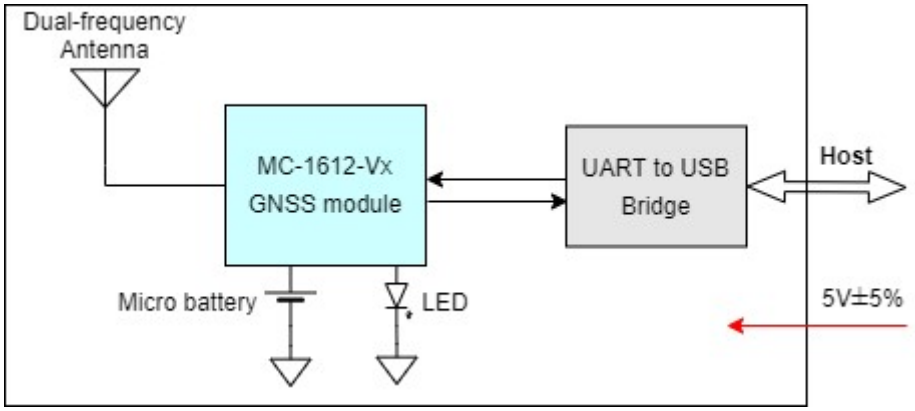


Fig 3-1 System block diagram of LS20030-Vx

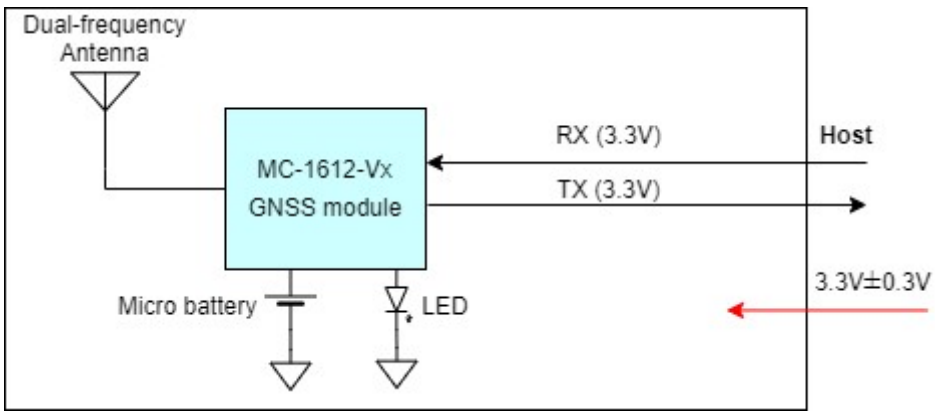


Fig 3-2 System block diagram of LS20031-Vx

© 2020 LOCOSYS Technology Inc.

LOCOSYS Technology Inc.
20F.-13, No.79, Sec. 1, Xintai 5th Rd.,
Xizhi Dist., New Taipei City 22101, Taiwan
☎ 886-2-8698-3698
886-2-8698-3699
www.locosystech.com/

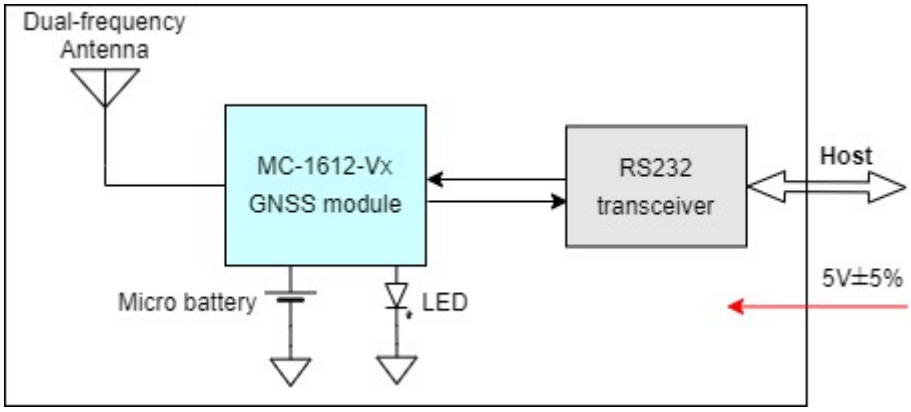


Fig 3-3 System block diagram of LS20032-Vx

4 GNSS receiver

Frequency	LS20030-V2 LS20031-V2 LS20032-V2	GPS/QZSS: L1 C/A, L5C GLONASS: L1OF BEIDOU: B1I, B2a GALILEO: E1, E5a
	LS20030-V3 LS20031-V3 LS20032-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	LS20030-V2 LS20031-V2 LS20032-V2	Autonomous: 1.5m (CEP)
	LS20030-V3 LS20031-V3 LS20032-V3	Autonomous: 2.5m (CEP)
PPS signal accuracy	Typical ±1ms for PPS through USB (1)	
Datum	WGS-84 (default)	
Max. Altitude	< 18,000 m	
Max. Velocity	< 500 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, GST

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

© 2020 LOCOSYS Technology Inc.

LOCOSYS Technology Inc.
20F.-13, No.79, Sec. 1, Xintai 5th Rd.,
Xizhi Dist., New Taipei City 22101, Taiwan
☏ 886-2-8698-3698
886-2-8698-3699
www.locosystech.com/

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
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

© 2020 LOCOSYS Technology Inc.

LOCOSYS Technology Inc.
20F.-13, No.79, Sec. 1, Xintai 5th Rd.,
Xizhi Dist., New Taipei City 22101, Taiwan
☏ 886-2-8698-3698
886-2-8698-3699
www.locosystech.com/

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

© 2020 LOCOSYS Technology Inc.

LOCOSYS Technology Inc.
20F.-13, No.79, Sec. 1, Xintai 5th Rd.,
Xizhi Dist., New Taipei City 22101, Taiwan
☎ 886-2-8698-3698
886-2-8698-3699
www.locosystech.com/

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

© 2020 LOCOSYS Technology Inc.

$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:

© 2020 LOCOSYS Technology Inc.

$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

© 2020 LOCOSYS Technology Inc.

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

© 2020 LOCOSYS Technology Inc.

LOCOSYS Technology Inc.
20F.-13, No.79, Sec. 1, Xintai 5th Rd.,
Xizhi Dist., New Taipei City 22101, Taiwan
☏ 886-2-8698-3698
886-2-8698-3699
www.locosystech.com/

5.2 Proprietary command

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]

© 2020 LOCOSYS Technology Inc.

LOCOSYS Technology Inc.
20F.-13, No.79, Sec. 1, Xintai 5th Rd.,
Xizhi Dist., New Taipei City 22101, Taiwan
☏ 886-2-8698-3698
886-2-8698-3699
www.locosystech.com/

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:

© 2020 LOCOSYS Technology Inc.

LOCOSYS Technology Inc.
20F.-13, No.79, Sec. 1, Xintai 5th Rd.,
Xizhi Dist., New Taipei City 22101, Taiwan
☏ 886-2-8698-3698
886-2-8698-3699
www.locosystech.com/

$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

© 2020 LOCOSYS Technology Inc.

LOCOSYS Technology Inc.
20F.-13, No.79, Sec. 1, Xintai 5th Rd.,
Xizhi Dist., New Taipei City 22101, Taiwan
☏ 886-2-8698-3698
886-2-8698-3699
www.locosystech.com/

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]

© 2020 LOCOSYS Technology Inc.

LOCOSYS Technology Inc.
20F.-13, No.79, Sec. 1, Xintai 5th Rd.,
Xizhi Dist., New Taipei City 22101, Taiwan
☏ 886-2-8698-3698
886-2-8698-3699
www.locosystech.com/

[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

© 2020 LOCOSYS Technology Inc.

LOCOSYS Technology Inc.
20F.-13, No.79, Sec. 1, Xintai 5th Rd.,
Xizhi Dist., New Taipei City 22101, Taiwan
☏ 886-2-8698-3698
886-2-8698-3699
www.locosystech.com/

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

© 2020 LOCOSYS Technology Inc.

LOCOSYS Technology Inc.
20F.-13, No.79, Sec. 1, Xintai 5th Rd.,
Xizhi Dist., New Taipei City 22101, Taiwan
☏ 886-2-8698-3698
886-2-8698-3699
www.locosystech.com/

[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]

© 2020 LOCOSYS Technology Inc.

LOCOSYS Technology Inc.
20F.-13, No.79, Sec. 1, Xintai 5th Rd.,
Xizhi Dist., New Taipei City 22101, Taiwan
☏ 886-2-8698-3698
886-2-8698-3699
www.locosystech.com/

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>

© 2020 LOCOSYS Technology Inc.

LOCOSYS Technology Inc.
20F.-13, No.79, Sec. 1, Xintai 5th Rd.,
Xizhi Dist., New Taipei City 22101, Taiwan
☏ 886-2-8698-3698
886-2-8698-3699
www.locosystech.com/

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]

© 2020 LOCOSYS Technology Inc.

LOCOSYS Technology Inc.
20F.-13, No.79, Sec. 1, Xintai 5th Rd.,
Xizhi Dist., New Taipei City 22101, Taiwan
☏ 886-2-8698-3698
886-2-8698-3699
www.locosystech.com/

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.

© 2020 LOCOSYS Technology Inc.

LOCOSYS Technology Inc.
20F.-13, No.79, Sec. 1, Xintai 5th Rd.,
Xizhi Dist., New Taipei City 22101, Taiwan
☏ 886-2-8698-3698
886-2-8698-3699
www.locosystech.com/

[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]

© 2020 LOCOSYS Technology Inc.

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.

© 2020 LOCOSYS Technology Inc.

LOCOSYS Technology Inc.
20F.-13, No.79, Sec. 1, Xintai 5th Rd.,
Xizhi Dist., New Taipei City 22101, Taiwan
☏ 886-2-8698-3698
886-2-8698-3699
www.locosystech.com/

[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.

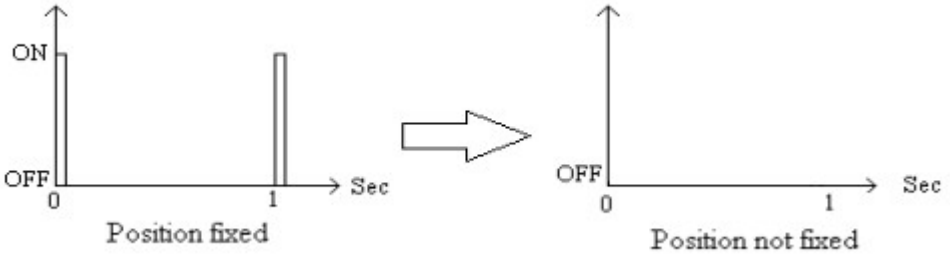
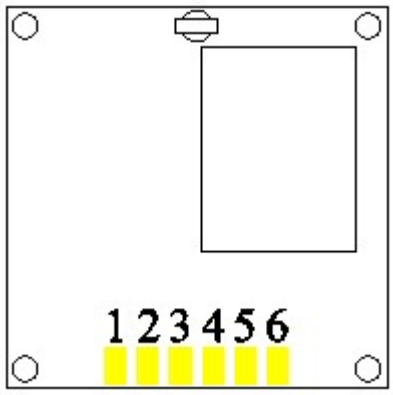


Fig 6.1 LED indicator of positioning status

7 Pin assignment and descriptions



- **LS20030-Vx**

Pin #	Name	Type	Description
1	VCC	I	DC supply input.
2	USB_DM		USB D-
3	USB_DP		USB D+
4	GND	P	Ground
5	TIMEPULSE	O	PPS, default 100ms pulse/sec when 3D fix is available
6	NC		Not connected

© 2020 LOCOSYS Technology Inc.

LOCOSYS Technology Inc.
20F.-13, No.79, Sec. 1, Xintai 5th Rd.,
Xizhi Dist., New Taipei City 22101, Taiwan
☏ 886-2-8698-3698
886-2-8698-3699
www.locosystech.com/

- **LS20031-Vx**

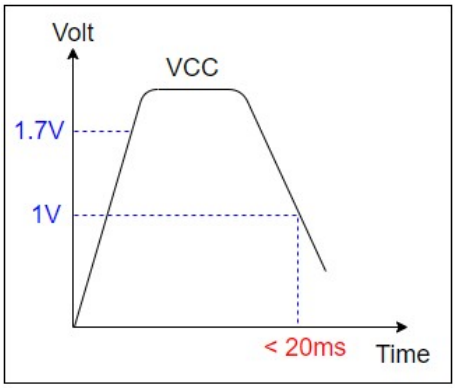
Pin #	Name	Type	Description
1	VCC	I	DC supply input. Must be clean and stable.
2	RX	I	Data input (TTL level)
3	TX	O	Data output (TTL level)
4	GND	P	Ground
5	TIMEPULSE	O	PPS, default 100ms pulse/sec when 3D fix is available
6	NC		Not connected

- **LS20032-Vx**

Pin #	Name	Type	Description
1	VCC	I	DC supply input.
2	RX_232	I	Data input (RS232 level)
3	TX_232	O	Data output (RS232 level)
4	GND	P	Ground
5	TIMEPULSE	O	PPS, default 100ms pulse/sec when 3D fix is available
6	NC		Not connected

<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. 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, there are two ways to solve the problem. One is to wait a few days until the micro battery is exhausted, and the other is to short 22nd pin of GNSS module (MC-1612a-V2b) to ground.



© 2020 LOCOSYS Technology Inc.

LOCOSYS Technology Inc.
20F.-13, No.79, Sec. 1, Xintai 5th Rd.,
Xizhi Dist., New Taipei City 22101, Taiwan
☎ 886-2-8698-3698
886-2-8698-3699
www.locosystech.com/

8 DC & Temperature characteristics

8.1 DC Electrical characteristics

Parameter	Symbol	Product	Min.	Typ.	Max.	Units
Input voltage	VCC	LS20030-Vx LS20031-Vx LS20032-Vx	4.75 3.0 4.75	5.0 3.3 5.0	5.25 3.6 5.25	V
Input current(1)	Icc	LS20030-V2 LS20031-V2 LS20032-V2		72 60 65		mA
		LS20030-V3 LS20031-V3 LS20032-V3		50 38 41		
High Level Input Voltage	V_{IH}	LS20031-Vx	0.7*VCC		VCC	V
Low Level Input Voltage	V_{IL}	LS20031-Vx	0		0.2*VCC	V
High Level Output Voltage	V_{OH}	LS20031-Vx	VCC-0.4			V
Low Level Output Voltage	V_{OL}	LS20031-Vx			0.4	V
High Level Output Current	I_{OH}	LS20031-Vx		4		mA
Low Level Output Current	I_{OL}	LS20031-Vx		4		mA

Note 1: Measured when position fix (1Hz) is available, the function of self-generated ephemeris prediction is inactive.

8.2 Temperature characteristics

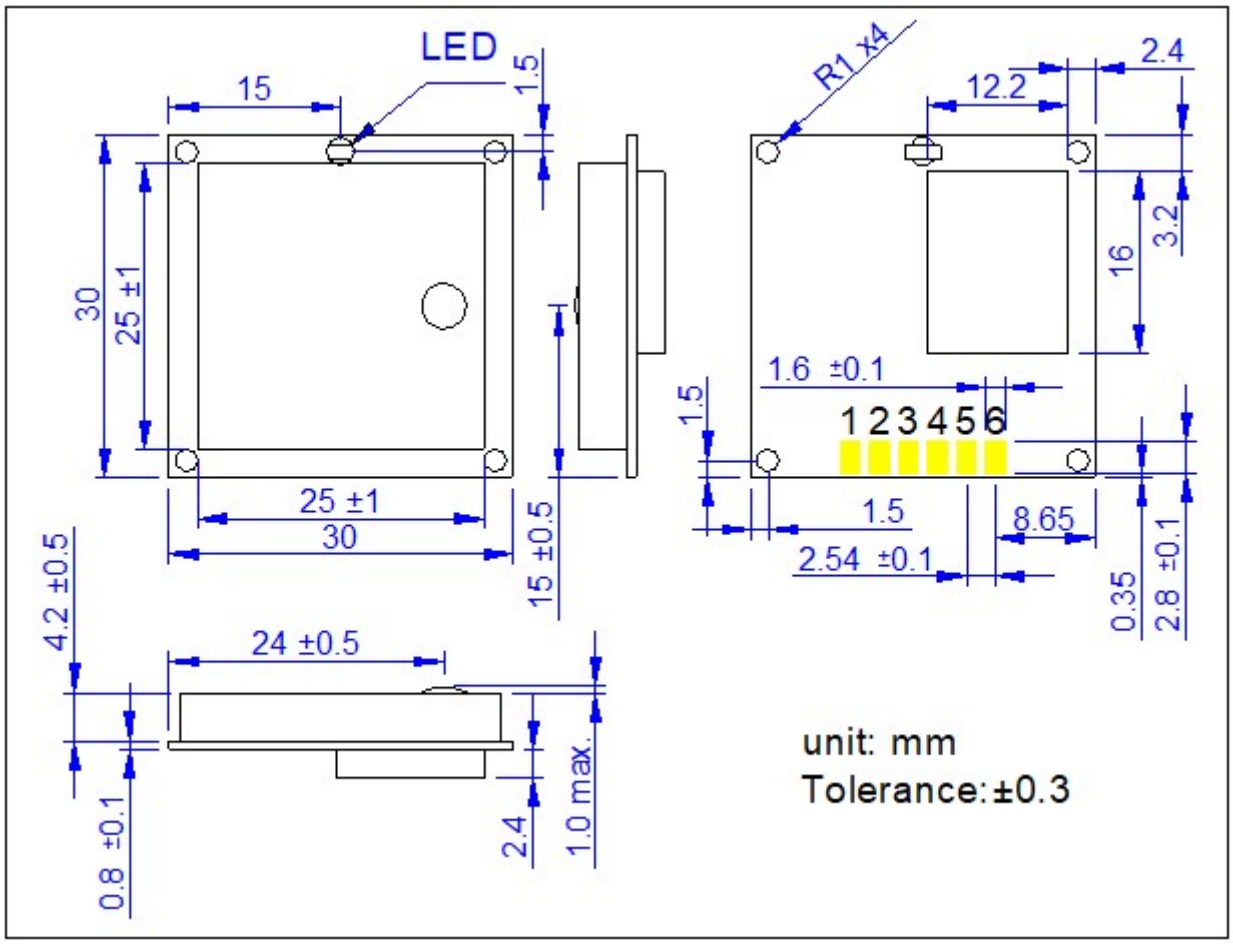
Parameter	Symbol	Product	Min.	Typ.	Max.	Units
Operating Temperature	Topr	LS20030-Vx LS20031-Vx LS20032-Vx	-40	-	85	℃
Storage Temperature	Tstg	LS20030-Vx LS20031-Vx LS20032-Vx	-40	25	85	℃

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

© 2020 LOCOSYS Technology Inc.

LOCOSYS Technology Inc.
20F.-13, No.79, Sec. 1, Xintai 5th Rd.,
Xizhi Dist., New Taipei City 22101, Taiwan
☏ 886-2-8698-3698
886-2-8698-3699
www.locosystech.com/

9 Mechanical specification



© 2020 LOCOSYS Technology Inc.

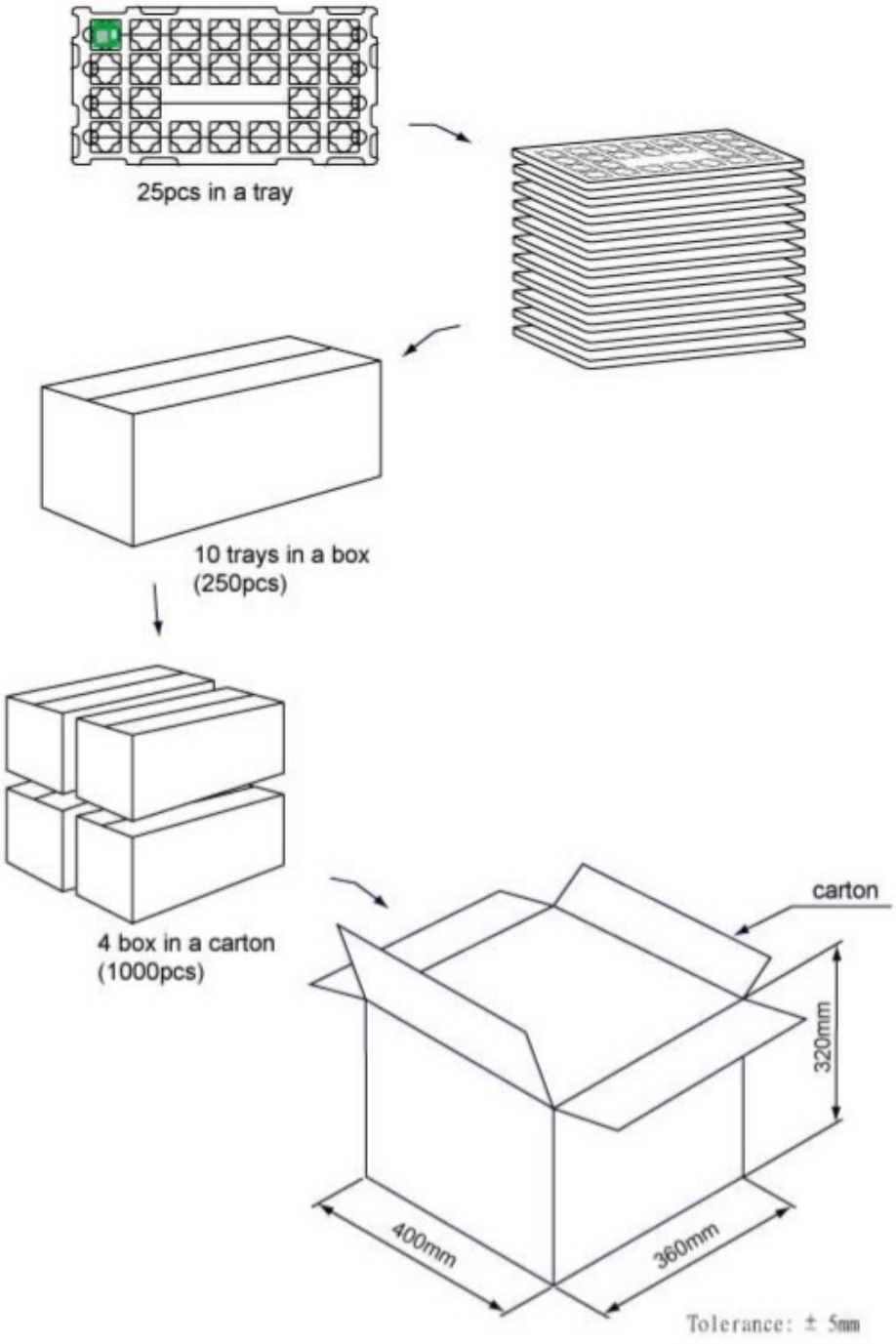
LOCOSYS Technology Inc.
20F.-13, No.79, Sec. 1, Xintai 5th Rd.,
Xizhi Dist., New Taipei City 22101, Taiwan
☎ 886-2-8698-3698
886-2-8698-3699
www.locosystech.com/

10 Product handling

10.1 ESD precaution

GNSS modules are electrostatic sensitive devices. Handling the modules without proper ESD protection may result in severe damage to them. ESD protection must be implemented throughout the processing, handling and even when the modules are being returned for repair.

10.2 Packaging



© 2020 LOCOSYS Technology Inc.

LOCOSYS Technology Inc.
20F.-13, No.79, Sec. 1, Xintai 5th Rd.,
Xizhi Dist., New Taipei City 22101, Taiwan
☏ 886-2-8698-3698
886-2-8698-3699
www.locosystech.com/

10.3 Storage

We recommend storing the smart antenna module in a dry place, such as moisture-proof cabinet. The shelf life of the module package is about 6 months from the packaging date when it is stored in a non-condensing storage environment (<30°C/60% RH).

11 Ordering information

Product name	Description	Remark
LS20030-V2	Dual-frequency multi-constellation GNSS smart antenna, PPS through USB	GPS/QZSS: L1 C/A, L5C GLONASS: L1OF BEIDOU: B1I, B2a GALILEO: E1, E5a
LS20031-V2	Dual-frequency multi-constellation GNSS smart antenna, TTL	
LS20032-V2	Dual-frequency multi-constellation GNSS smart antenna, RS232	
LS20030-V3	Dual-frequency multi-constellation GNSS smart antenna, PPS through USB	GPS/QZSS: L1 C/A GLONASS: L1OF BEIDOU: B1I GALILEO: E1 IRNSS: L5
LS20031-V3	Dual-frequency multi-constellation GNSS smart antenna, TTL	
LS20032-V3	Dual-frequency multi-constellation GNSS smart antenna, RS232	

© 2020 LOCOSYS Technology Inc.

LOCOSYS

LOCOSYS Technology Inc.
20F.-13, No.79, Sec. 1, Xintai 5th Rd.,
Xizhi Dist., New Taipei City 22101, Taiwan
☏ 886-2-8698-3698
886-2-8698-3699
www.locosystech.com/

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)

- Changed the product picture on page 1
- 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
- Revised the dimension in section 9.

Revision 0.4 (April 28, 2021)

- Revised the proprietary command in section 5.2.

Revision 1.0 (August 23, 2021)

- Official release.

Revision1.1 (December8, 2021)

- Added the note for VCC pin in section 7.
- Changed the current of LS20032-V2 from 63mA to 65mA in section 8.1
- Added the note in section 8.2

© 2020 LOCOSYS Technology Inc.