LOCOSYS Technology Inc.
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Product name	Description	Version
LS26030-52Q	GNSS module of PCIe Full-Mini card	0.1
LS26031-52Q	GNSS module of PCIe Half-Mini card	

LS26030-52Q LS26031-52Q

1 Introduction

LS26030-52Q and LS26031-52Q are GNSS modules incorporated into the PCIe Full-Mini card or PCIe Half-Mini card. These GNSS modules can provide superior sensitivity and performance even in urban canyon and dense foliage environment. Besides, the USB interface makes these modules easy to integrate into the laptop.

These modules support hybrid ephemeris prediction to achieve faster cold start. One is self-generated ephemeris prediction 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 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.

2 Features

- USB interface
- Support GPS/QZSS, GLONASS, GALILEO and BEIDOU
- Capable of SBAS (WAAS, EGNOS, MSAS, GAGAN) and QZSS SLAS
- Low power consumption
- Fast TTFF at low signal level
- Up to 20 Hz update rate
- Support PPS through USB
- Built-in micro battery to reserve system data for rapid satellite acquisition

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3 Application

- Laptop with GNSS function
- IPC with GNSS function

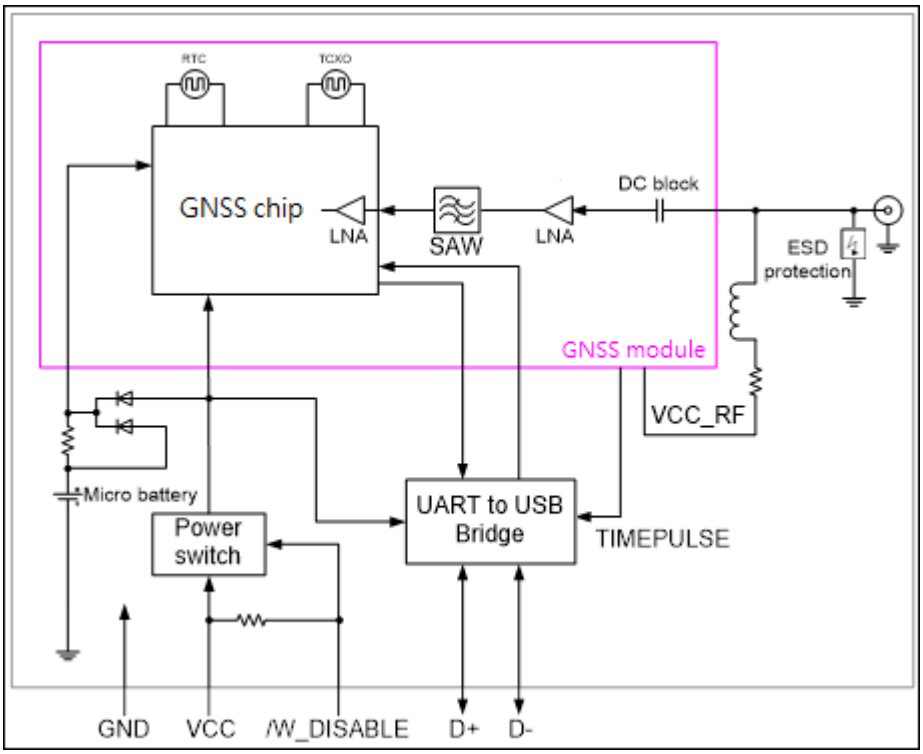

Fig 3-1 System block diagram.

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4 GNSS receiver

Frequency	GPS/QZSS: L1 C/A, L1C GLONASS: L1OF GALILEO: E1 BEIDOU: B1I, B1C	
Channels	Support 47 channels	
Update rate	1Hz default, up to 20Hz	
Sensitivity	Tracking	Up to -165dBm (with external active antenna)
	Cold start	Up to -149dBm (with external active antenna)
Acquisition Time	Hot start (Open Sky)	1s (typical)
	Cold Start (Open Sky)	28s (typical) without AGPS
		< 15s (typical) with AGPS (ephemeris prediction)
Position Accuracy	Autonomous: 2m (CEP) (1)	
Max. Altitude	< 18,000 m (2)	
Max. Velocity	< 500 m/s	
Protocol Support	NMEA 0183 ver. 4.1	115200 bps (3), 8 data bits, no parity, 1 stop bits (default) 1Hz: GGA, GLL, GSA, GSV, RMC, VTG, GST

<Note>

1. Open sky, demonstrated with a good external LNA.
2. The maximum altitude of the balloon mode is 80,000 m.
3. 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,061300.000,2503.71255,N,12138.74493,E,2,38,0.44,121.12,M,15.32,M,,*7E

Table5.1- 2 GGA Data Format

Name	**Example**	**Units**	**Description**
Message ID	$GNGGA		GGA protocol header
UTC Time	061300.000		hhmmss.sss
Latitude	2503.71255		ddmm.mmmmm
N/S indicator	N		N=north or S=south
Longitude	12138.74493		dddmm.mmmmm
E/W Indicator	E		E=east or W=west
Position Fix Indicator	2		See Table 5.1-3
Satellites Used	38		Number of satellites in use
HDOP	0.44		Horizontal Dilution of Precision (meters)
MSL Altitude	121.12	meters	Antenna Altitude above/below mean-sea-level (geoid) (in meters)
Units	M	meters	Units of antenna altitude, meters
Geoidal Separation	15.32	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,2503.71255,N,12138.74493,E,061300.000,A,D*42

Table 5.1-4 GLL Data Format

Name	**Example**	**Units**	**Description**
Message ID	$GNGLL		GLL protocol header
Latitude	2503.71255		ddmm.mmmmm

N/S indicator	N		N=north or S=south
Longitude	12138.7493		dddmm.mmmmm
E/W indicator	E		E=east or W=west
UTC Time	061300.000		hhmmss.sss
Status	A		A=data valid or V=data not valid
Mode	D		N = No position fix A = Autonomous GNSS fix D = Differential GNSS fix R = RTK fixed F = RTK float E = Estimated/Dead reckoning fix
Checksum	*42		
<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,3,19,195,17,06,20,11,09,02,194,12,05,04,0.81,0.44,0.68,1*04

$GNGSA,A,3,14,,,,,,,,,,,,0.81,0.44,0.68,1*03

$GNGSA,A,3,66,81,88,65,79,82,,,,,,,0.81,0.44,0.68,2*0B

$GNGSA,A,3,03,15,34,27,30,,,,,,,,0.81,0.44,0.68,3*02

$GNGSA,A,3,33,40,07,10,38,28,08,41,13,14,43,42,0.81,0.44,0.68,4*0B

$GNGSA,A,3,11,39,,,,,,,,,,,0.81,0.44,0.68,4*09

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	19		SV on Channel 1
ID of satellite used	195		SV on Channel 2
….			….
ID of satellite used			SV on Channel 12
PDOP	0.81		Position Dilution of Precision
HDOP	0.44		Horizontal Dilution of Precision
VDOP	0.68		Vertical Dilution of Precision
GNSS system ID	1		See Table 5.1-8
Checksum	*04		
<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,4,1,15,196,73,108,46,19,72,077,47,195,71,061,47,199,59,164,22,1*5B

$GPGSV,4,2,15,17,54,115,47,06,49,003,48,20,44,248,47,11,36,306,46,1*6E

$GPGSV,4,3,15,09,35,079,45,02,31,307,45,194,28,175,43,12,25,302,43,1*52

$GPGSV,4,4,15,05,14,230,38,04,14,051,38,14,11,173,43,1*53

$GLGSV,2,1,07,66,71,107,44,81,39,356,48,88,36,067,47,67,33,187,,1*7B

$GLGSV,2,2,07,65,25,033,46,79,17,262,47,82,08,315,43,1*46

$GAGSV,2,1,05,03,49,122,45,15,47,342,45,34,37,056,43,27,33,273,43,7*7B

$GAGSV,2,2,05,30,30,208,41,7*49

$GBGSV,4,1,14,33,72,072,50,40,63,187,48,07,63,217,45,10,63,251,45,1*74

$GBGSV,4,2,14,38,58,328,48,28,56,353,49,08,52,306,44,41,47,200,48,1*75

$GBGSV,4,3,14,13,47,291,45,14,45,047,45,43,44,092,47,42,20,040,42,1*71

$GBGSV,4,4,14,11,20,105,41,39,11,172,42,1*78

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	4		Range 1 to 9

Message number	1		Range 1 to 9
Satellites in view	15		
Satellite ID	196		Channel 1
Elevation	73	degrees	Channel 1 (Range 00 to 90)
Azimuth	108	degrees	Channel 1 (Range 000 to 359)
SNR (C/No)	46	dB-Hz	Channel 1 (Range 00 to 99, null when not tracking)
….			….
Satellite ID	199		Channel 4
Elevation	59	degrees	Channel 4 (Range 00 to 90)
Azimuth	164	degrees	Channel 4 (Range 000 to 359)
SNR (C/No)	22	dB-Hz	Channel 4 (Range 00 to 99, null when not tracking)
Signal ID	1		GPS/QZSS: L1 C/A=1 GLONASS: L1 C/A=1 GALILEO: E1=7 BEIDOU: B1=1, B1C=3
Checksum	*5B		
<CR> <LF>			End of message termination

● RMC---Recommended Minimum Specific GNSS Data

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

$GNRMC,061300.000,A,2503.71255,N,12138.74493,E,0.01,30.70,150622,,,D,V*38

Table 5.1-10 RMC Data Format

Name	**Example**	**Units**	**Description**
Message ID	$GNRMC		RMC protocol header
UTC Time	061300.000		hhmmss.sss
Status	A		A=data valid or V=data not valid
Latitude	2503.71255		ddmm.mmmm
N/S Indicator	N		N=north or S=south
Longitude	12138.74493		dddmm.mmmmm
E/W Indicator	E		E=east or W=west
Speed over ground	0.001	knots	True
Course over ground	30.70	degrees	
Date	150622		ddmmyy
Magnetic variation		degrees	
Variation sense			E=east or W=west
Mode	D		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	*38		
<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,30.70,T,,M,0.01,N,0.01,K,D*12

Table 5.1-11 VTG Data Format

Name	**Example**	**Units**	**Description**
Message ID	$GPVTG		VTG protocol header
Course over ground	30.70	degrees	Measured heading
Reference	T		True
Course over ground		degrees	Measured heading
Reference	M		Magnetic
Speed over ground	0.001	knots	Measured speed
Units	N		Knots
Speed over ground	0.001	km/hr	Measured speed
Units	K		Kilometer per hour
Mode	D		N = No position fix A = Autonomous GNSS fix D = Differential GNSS fix R = RTK fixed F = RTK float E = Estimated/Dead reckoning fix
Checksum	*12		
<CR> <LF>			End of message termination

● GST---Estimated error in position solution

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

$GNGST,061300.000,2.6,1.9,1.6,169.8,1.9,1.6,6.8*71

Table 5.1-12 GST Data Format

Name	Example	Units	Description
Message ID	$GNGST		GST protocol header
UTC Time	061300.000		hhmmss.sss
RangeRMS	2.6	meters	RMS value of the standard deviation of the ranges
stdMajor	1.9	meters	Standard deviation of semi-major axis of error ellipse
stdMinor	1.6	Meters	Standard deviation of semi-minor axis of error ellipse
Orient	169.8	degrees	Orientation of semi-major axis of error ellipse
stdLat	1.9	meters	Standard deviation of latitude error
stdLong	1.6	meters	Standard deviation of longitude error
stdAlt	6.8	meters	Standard deviation of altitude error
Checksum	*71		
<CR> <LF>			End of message termination

5.2 Proprietary commands

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

[Note]

20Hz is available only for drone mode and cannot be set by the command. Please contact us.

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 static navigation speed threshold.

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_thresholld>*CS<CR><LF>

Speed_threshold. 0~20 dm/s. Default value is 0 dm/s.

The minimum is 1 dm/s, the maximum is 20 dm/s.

1 dm/s = 0.1m/s

[Return]

1. PAIR_ACK for send result.

[Example]

Send:

$PAIR070,4*25\r\n

Response:

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

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. Balloon mode: For high-altitude balloon purpose that the vertical movement will have more effect on the position calculation.
4. Stationary mode: For stationary applications with zero dynamics.
5. Drone mode: used for drone applications with equivalent dynamics range and vertical application on different flight phase. (Ex. Hovering, cruising, etc.)
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. Balloon mode: For high-altitude balloon purpose that the vertical movement will have more effect on the position calculation.
4. Stationary mode: For stationary applications where a zero dynamic assumed.
5. Drone mode: Used for drone applications with equivalent dynamics range and vertical acceleration on different flight phase. (Ex. hovering, cruising, etc.) (Note: The precision of NMEA automatically changes to 7 decimal places for latitude/longitude, and 3 decimal places for altitude.)
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: 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

5.2.21 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. When the update rate is greater than 1Hz, this command can only be set when the GNSS system is powered off.

5.2.22 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

5.2.23 ID: 066

[Description]

Configure the receiver to start searching for satellites. The setting is available when the NVRAM data is valid.

The device restarts when it receives this command.

Support constellation: GPS, GPS+GLONASS, GPS+GALILEO, GPS+BEIDOU, GPS+GLONASS+GALILEO+BEIDOU.

QZSS is always switchable.

[Data Field]

$PAIR066,<GPS_Enabled>,<GLONASS_Enabled>,<Galileo_Enabled>,<BeiDou_Enabled>,<QZSS_Enabled>,<NavIC_Enabled>*CS<CR><LF>

GPS_Enabled:

"0", disable (DO NOT search GPS satellites).

"1", search GPS satellites.

GLONASS_Enabled:

"0", disable (DO NOT search GLONASS satellites).

"1", search GLONASS satellites.

Galileo_Enabled:

"0", disable (DO NOT search Galileo satellites).

"1", search Galileo satellites.

BeiDou_Enabled:

"0", disable (DO NOT search BeiDou satellites).

"1", search BeiDou satellites.

QZSS_Enabled:

"0", disable (DO NOT search QZSS satellites).

"1", search QZSS satellites.

NavIC_Enabled:

"0", disable (DO NOT search NavIC satellites).

"1", search NavIC satellites.

[Return]

PAIR_ACK for send result.

[Example]

Send:

$PAIR066,1,0,0,0,0,0*3B\r\n ==> Search GPS satellites only.

Response:

$PAIR001,066,0*3B\r\n ==> Success

Send:

$PAIR066,1,0,1,0,1,0*3B\r\n ==> Search GPS, GALILEO and QZSS satellites.

Response:

$PAIR001,066,0*3B\r\n ==> Success

5.2.24 ID: 154

[Description]

Enable to output Return Link Message from navigation data.

[Data Field]

$PAIR154,<Enable>*CS<CR><LF>

Enable:

0: disable

1: enable

[Return]

PAIR_ACK for send result.

[Example]

Send:

$PAIR154,1*27\r\n

Response:

$PAIR001,154,0*3B\r\n ==> Success

5.2.25 ID: 155

[Description]

Query output Return Link Message status.

[Data Field]

$PAIR155*CS<CR><LF>

Enable:

0: disable

1: enable

[Return]

1. PAIR_ACK for send result.
2. $PAIR155,<Enable>*CS<CR><LF>

Enable:

0: Disable

1: Enable

[Example]

Send:

$PAIR155*3B\r\n

Response:

$PAIR001,155,0*3A\r\n ==> Success

$PAIR155,1*26\r\n

5.2.26 ID: 158

[Description]

Enable B1C.

[Data Field]

$PAIR158,<Enable>*CS<CR><LF>

Enable:

0: disable

1: enable

[Return]

PAIR_ACK for send result.

[Example]

Send:

$PAIR158,1*2B\r\n

Response:

$PAIR001,158,0*37\r\n ==> Success

5.2.27 ID: 159

[Description]

Query output B1C enable status.

[Data Field]

$PAIR159*CS<CR><LF>

Enable:

0: disable

1: enable

[Return]

1. PAIR_ACK for send result.
2. $PAIR155,<Enable>*CS<CR><LF>

Enable:

0: Disable

1: Enable

[Example]

Send:

$PAIR159*37\r\n

Response:

$PAIR001,159,0*36\r\n ==> Success

$PAIR159,1*2A\r\n

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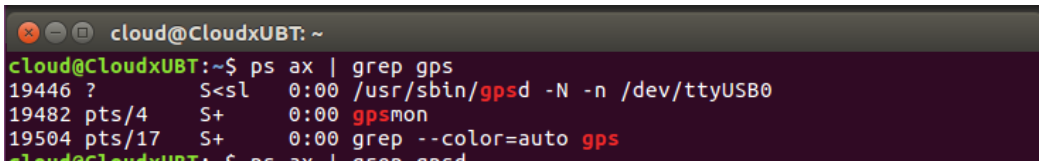
6 How to make sure PPS through USB is working on Linux Ubuntu?

GPSD is a daemon used to handle NMEA and PPS information on Linux system. GPSD client application called "gpsmon" could be used to check if PPS is working on Linux Ubuntu. "gpsmon" is a monitor that watches packets coming from a GPS receiver and displays them along with diagnostic information. Here provides steps for GPSD installation and PPS performance on Linux system.

The user can check if a GPSD program has been installed by using the following command.

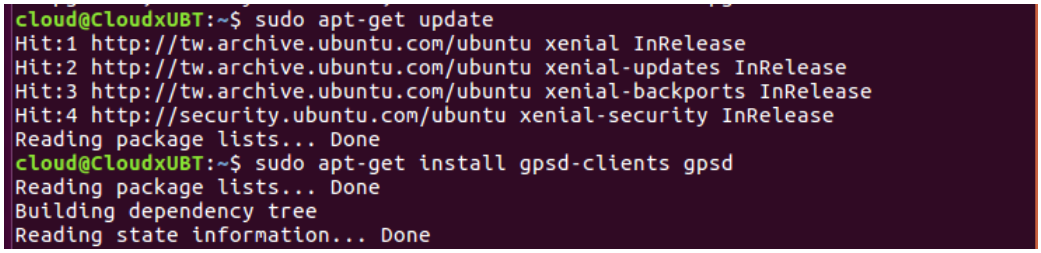
$ps ax | grep gps



The user can install GPSD package by the following commands if it is not yet installed.

$sudo apt-get update

$sudo apt-get install gpsd-clients gpsd



Before starting GPSD, the user should connect GNSS module to USB port. Linux system normally enumerates a USB device such as "/dev/ttyUSB0" in this case. The user can use the following command to check if GNSS module is connected.

$ls /dev/ttyU*

Now the user gets the device name as "/dev/ttyUSB0". Using the following command to configure GPSD file.

$sudo gedit /etc/default/gpsd

Please set the device name as **DEVICE="/dev/ttyUSB0"** and GPSD options with no wait parameter as **GPSD_OPTIONS="-n"**.

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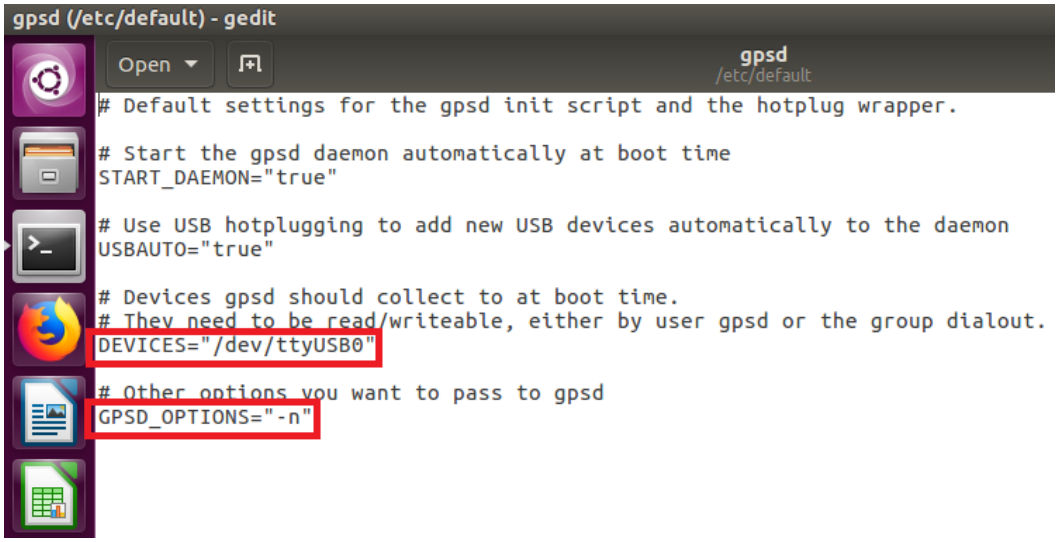
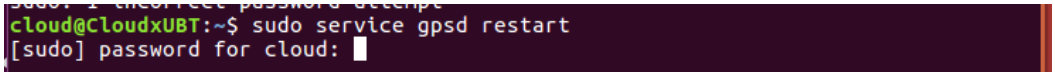


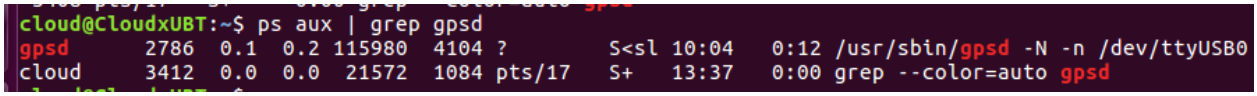
Then restart GPSD service by the following command.

$sudo service gpsd restart



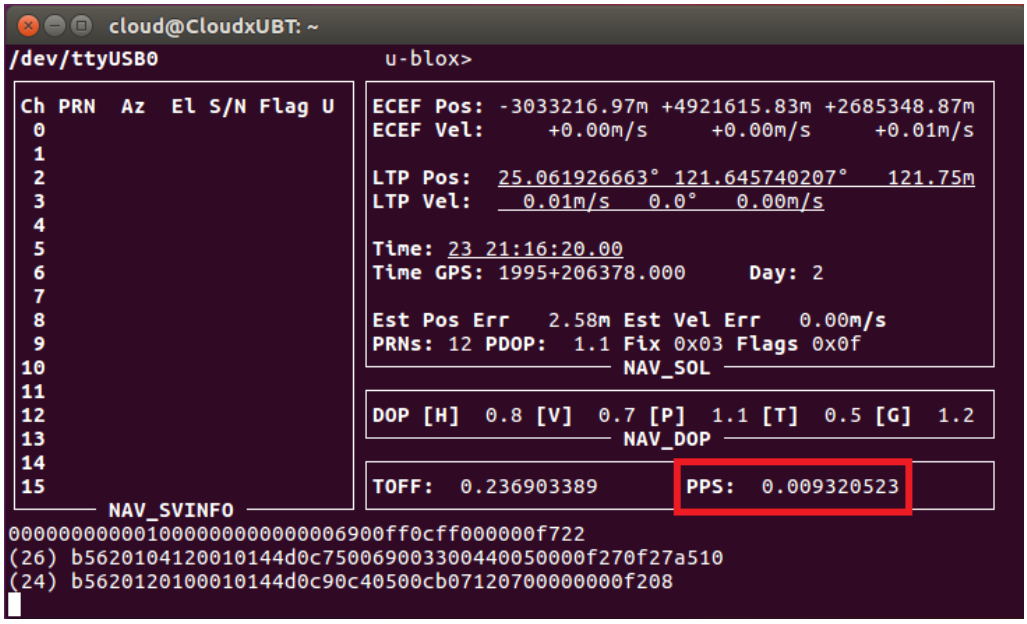
Using the following command to check if GPSD is working as expected. (“-n” and “/dev/ttyUSB0” parameters)

$ps aux | grep gpsd



Execute the GPSD client program.

$gpsmon



As shown above, PPS is detected with delay of 0.009320523 seconds to the local clock while delay of GPS is 0.236903389 seconds (shown by TOFF)

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7 Pin assignment and descriptions

Table 6-1 Pin descriptions of PCIe Mini card

Pin #	Name	Type	Description	Note
1	NC			
2	NC			
3	NC			
4	GND	P	Ground	
5	NC			
6	NC			
7	NC			
8	NC			
9	GND	P	Ground	
10	NC			
11	NC			
12	NC			
13	NC			
14	NC			
15	GND	P	Ground	
16	NC			
17	NC			
18	GND	P	Ground	
19	NC			
20	/W_DISABLE	I	Power control input pin. Internal pull-up resistor. High: power on; Low: power off	
21	GND	P	Ground	
22	NC			
23	NC			
24	NC			
25	NC			
26	GND	P	Ground	
27	GND	P	Ground	
28	NC			
29	GND	P	Ground	
30	NC			
31	NC			
32	NC			
33	NC			

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34	GND	P	Ground	
35	GND	P	Ground	
36	USB_D-		USB D- line	
37	GND	P	Ground	
38	USB_D+		USB D+ line	
39	NC			
40	GND	P	Ground	
41	NC			
42	NC			
43	GND	P	Ground	
44	NC			
45	NC			
46	NC			
47	NC			
48	NC			
49	NC			
50	GND	P	Ground	
51	NC			
52	VCC	P	DC supply input. Must be clean and stable.	

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8 DC & Temperature characteristics

8.1 DC Electrical characteristics

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Input Voltage	VCC		3.0		3.6	V
Supply Current	Iss	VCC = 3.3V, Peak Tracking Power off		 51 (2) < 1 (3)	150 (1)	 mA mA uA
High Level Input Voltage	V_{IH}	/W_DISABLE pin	1.3		VCC	V
Low Level Input Voltage	V_{IL}	/W_DISABLE pin			0.25	V

<Note>

1. Measured with 1MHz sampling rate.
2. Measured when position fix (1Hz) is available and input voltage is 3.3V.
3. Measured when /W_DISABLE pin is at low level.

8.2 Temperature characteristics

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

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

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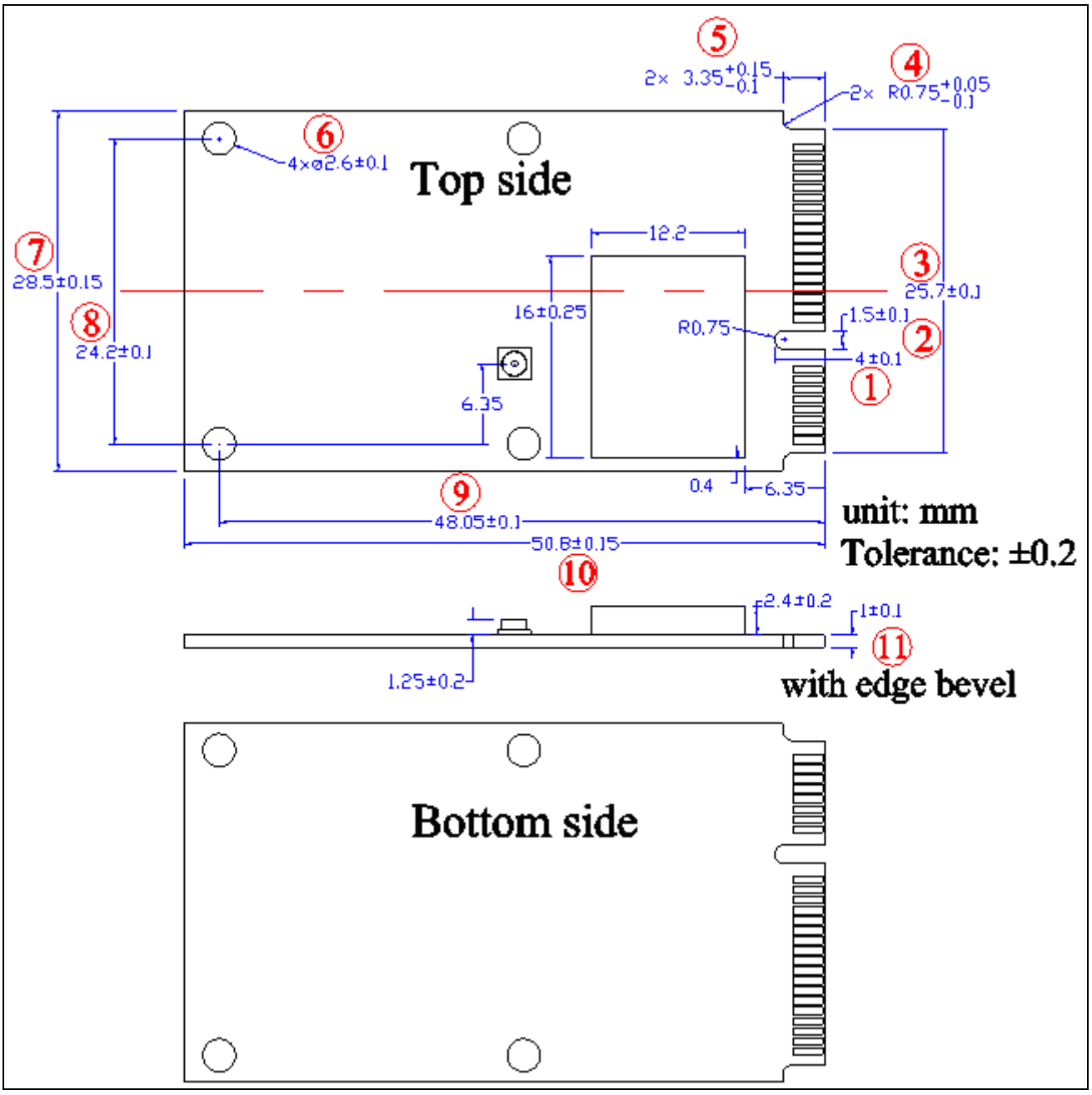
9 Mechanical specification

The dimension and pin definition are compliant with PCI Express Mini Card Revision 1.2.

9.1 Outline dimensions of LS26030-52Q



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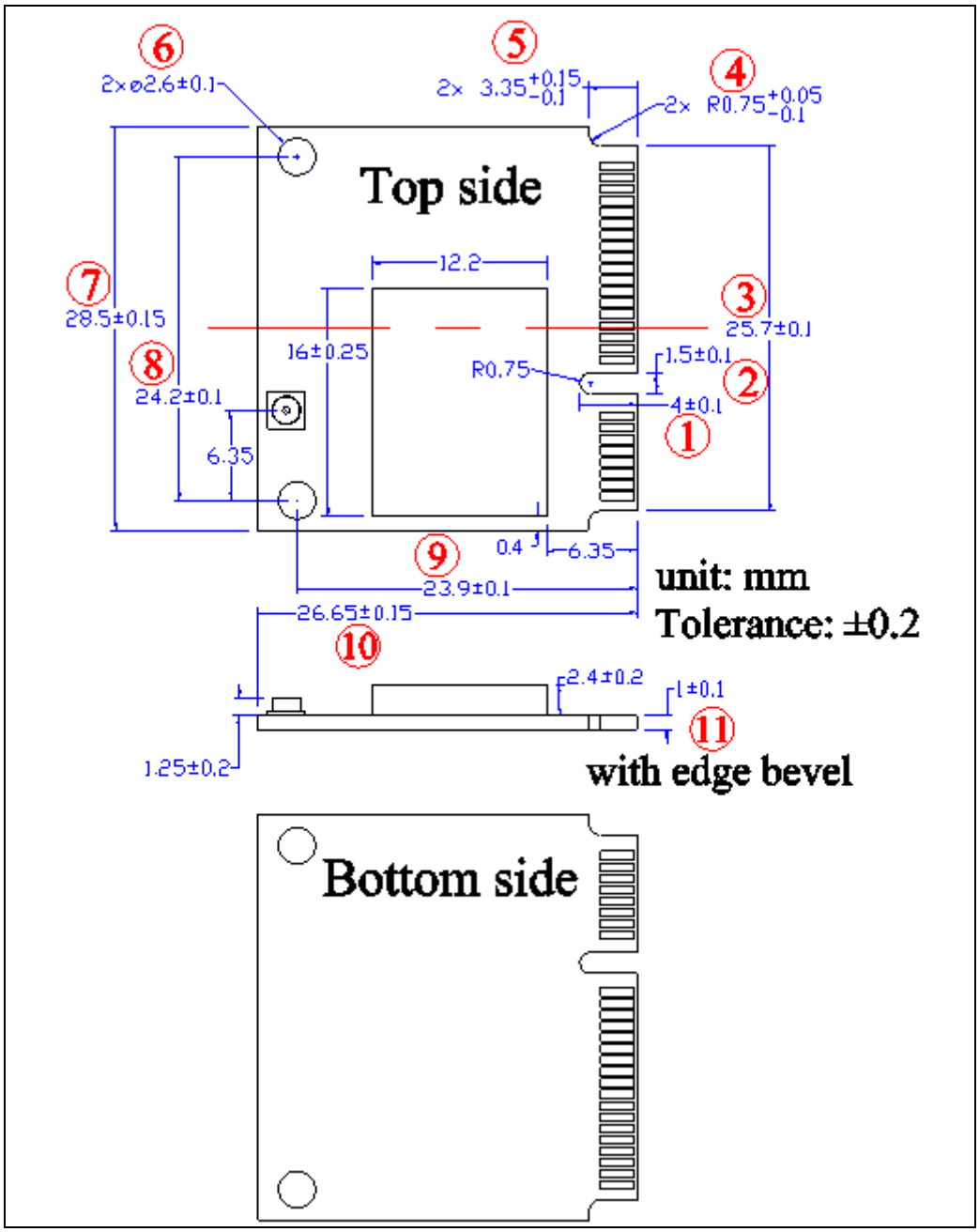
9.2 Outline dimensions of LS26031-52Q



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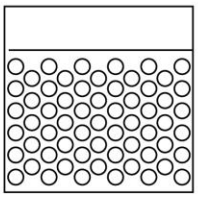
10 Packing information

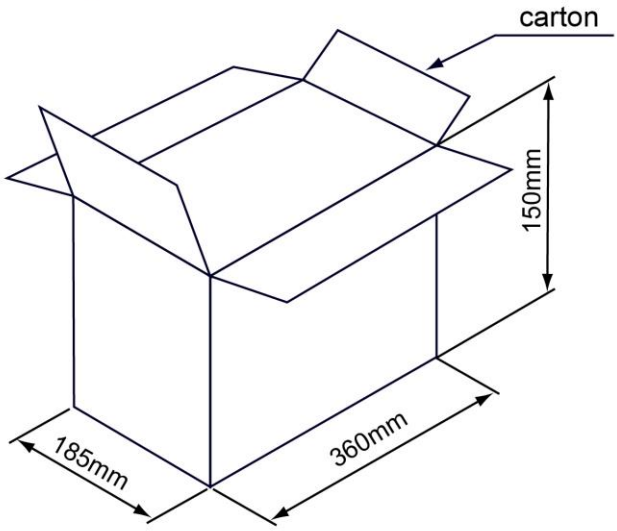
Both LS26030-52Q and LS26031-52Q use the same package.

1pcs in an antistatic bag



6pcs in a bubble bag

30 bubble bags in a carton
(180pcs)



Tolerance: ±10 mm

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Document change list

Revision 0.1

- Draft release on July 9, 2024.