Data Sheet / GM-U01

Easy to Use,

Compact,

High Performance,

u-blox M10 GNSS

Smart Antenna Module

RoHS Compliant

Version 1.0

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Revision History

Ver.	Date	Description
1.0	Dec. 22nd, 2023	Initial draft

Contents

1 Introduction

1.1 Overview

GM-U01 is a compact, low-power, ultra-high performance, easy to use GNSS smart antenna module designed with u-blox's 10th generation GNSS engine.

It supports concurrent tracking of all 4 L1 GNSS navigation systems, GPS/GLONASS/Galileo/BEIDOU. It also tracks QZSS and SBAS satellites. Thanks to this capability, maximum number of satellites are visible and thus maximum position availability and better accuracy even in typical GPS difficult environments.

Especially, this plug and play smart antenna module is achieved in a small and compact dimension while keeping exceptional performance.

This feature rich GNSS smart antenna module not only minimizes the design efforts but also enables the rapid deployment of AVL, timing, and other location based applications. It supports different electrical interfaces such as USB, RS232, UART TTL etc..

The power control feature is very convenient to turn on/off power just via GPIO control pin. It's especially useful to turn off power as the GNSS function is not needed in the host applications.

1.2 Main Features

Not only handheld but also any other GNSS applications can share the following major features of GM-U01.

- Easy adoption with best performance
- Built-in 25x25x4 (mm) patch antenna
- Built-in battery or backup power input for faster position fix.
- External backup power option via I/O pin is available for special application of high working temperature.
- USB/UART-TTL/RS232 interface support
- Minimum RF and EMI efforts, excellent EMI protection
- Time pulse support option for timing application

- High tracking sensitivity of -167 dBm/-148dBm acquisition (GPS)
- Low power consumption of 16mA (TTL, 29SVs) / 19mA (RS232, 29SVs) / 56mA (USB, 29SVs) for average tracking
- Hardware power saving control pin option allowing power on/off GNSS via GPIO
- RTCM support in the future
- Concurrent tracking of multi-satellite navigation systems
  1. GPS/GALILEO/GLONASS/BEIDOU/QZSS
  2. SBAS (WAAS, EGNOS, MSAS, GAGAN)
- Higher update rate option (default 1Hz), up to
  1. 5 Hz for GPS+GAL+GLO+BDS B1C
  2. 8 Hz for GPS+GAL+BDS B1C
  3. 5 Hz for GPS+GAL+BDS B1I
  4. 7 Hz for GPS+GAL+GLO
  5. 10 Hz for GPS+GAL
  6. 18 Hz for GPS only
- LED for position fix indication
- Augmentation support:
  1. SBAS (WAAS, EGNOS, MSAS, GAGAN),
  2. QZSS (L1S SLAS, Sub-meter Level Augmentation Service)
- **Anti-jamming**, RF interference and jamming detection and reporting
- **Anti-spoofing**, Spoofing detection and reporting
- Windows/Linux/Android support
- Fully EMI shielded
- Industrial operating temperature range: -40 ~ 85℃

1.3 Receiver Specifications

Features	Specifications[!]
GPS/QZSS receiver type	u-blox M10 engine GPS, SBAS: L1 C/A: 1575.42MHz, QZSS: L1 C/A/S: 1575.42MHz Galileo: E1 B/C: 1575.42MHz, GLONASS: L1OF:1598.0625~1605.375MHz BeiDou: B1I: 1561.098 MHz; B1C: 1575.42 MHz SBAS:WAAS, EGNOS, MSAS, GAGAN
Horizontal Position Accuracy	1.5m (GPS+QZSS+SBAS) (CEP, 50%, 24hr static, -130dBm, 6+ SVs for each system)
Velocity Accuracy	<0.05m/s (speed)

	<0.3° (heading) (50%@30m/s)
Accuracy of Time pulse Signal	RMS: 30ns 99%: <60ns
TTFF (Time to First Fix) (50%, -130dBm, autonomous)	Hot Start: 1sec Cold Start: 28 s: GPS+GAL 23s: GPS+GAL+GLO 27s: GPS+GAL+BDS B1I (default) 28s: GPS+GAL+BDS B1C 23s: GPS+GAL+GLO+BDS B1C
Sensitivity dBm (Autonomous)	Acquisition: -148 (GPS & Galileo or more) Tracking: -167 (GPS & Galileo or more)
Measurement data output	UART: N,8,1; bauds 4800, 9600, 19200, 38400 (default), 57600, 115200, 230400, 460800, 921600 bps; NMEA versions 2.1, 2.3, 4.0, 4.10, and 4.11 (default) UBX (u-blox proprietary) GGA, GLL, GSA, GSV, RMC, VTG, TXT Datum: WGS-84
Navigation. Update Rate	Default 1Hz, 5 Hz for GPS+GAL+GLO+BDS B1C 8 Hz for GPS+GAL+BDS B1C 5 Hz for GPS+GAL+BDS B1I 7 Hz for GPS+GAL+GLO 10 Hz for GPS+GAL 18 Hz for GPS only
Max. Altitude	< 80,000 m
Max. Velocity	< 500 m/s
Augmentation Support	SBAS (WAAS, EGNOS, MSAS, GAGAN), QZSS (L1S SLAS)
Dynamics	< 4g
Power consumption Acquisition / Tracking	(29 GNSS SVs fixed for tracking) USB: 59 / 56 mA RS232: 22 / 19 mA TTL: 19 / 16 mA
Power supply	3.3 ~ 5.5 V
Backup power	3.3V
Dimension	26 (W) x 28 (L) x 7.9 (H) (mm)
Operating temperature	-40°C ~ +85°C (-20~60℃ for backup battery)
Storage temperature	-40°C ~ +85°C (-40~60℃ for backup battery)

Note: [1] Data is from chip vendor;

1.4 Protocols

The NMEA protocol is supported via serial UART/RS232 (RX/TX) or USB (DM/DP) I/O port. The default supported protocol is NMEA protocol.

1. Serial communication channel – UART/RS232
    i. No parity, 8-data bit, 1-stop bit (N-8-1)
    ii. Baud rate: 4800, 9600, 19200, 38400 (default), 57600, 115200, 230400, 460800, 921600 bps.
    Please make sure the output data size per second would be smaller than the port's speed. If the amount of data to output is bigger than a port's speed (e.g. all NMEA messages and multiple update rate output on a UART port with a baud rate of 9600 bps), the buffer will fill up. Once the buffer space is exceeded, new messages to be sent will be dropped. To prevent message losses, the baud rate, update rate, and the number of enabled messages should be selected so that the expected number of bytes can be transmitted in less than one second.
2. NMEA versions 2.1, 2.3, 4.0, 4.10, and 4.11 (default)
    i. Default GGA, GSA, GSV, GLL, RMC, VTG and TXT
3. u-blox binary protocol (UBX)
4. RTCM would be supported in the future

1.5 QZSS SLAS

QZSS SLAS (Sub-meter Level Augmentation Service) is an augmentation technology, which provides correction data for pseudo-ranges of GPS, QZSS, and other major GNSS satellites. The correction stream is transmitted on the L1S signal at the L1 frequency (1575.42 MHz).For more information on QZSS SLAS, visit qzss.go.jp/en/.

Multiple QZSS SLAS signals can be received simultaneously. When receiving QZSS SLAS correction data, GM-U01 will autonomously select the best QZSS satellite. The selection strategy is determined by the quality of the QZSS L1S signals, the receiver configuration (test mode allowed or not), and the location of the receiver with respect to the QZSS SLAS coverage area. When outside of this coverage area, the receiver will likely fall back to using SBAS corrections.

If QZSS SLAS corrections are used in the navigation solution, the differential status will be indicated in several output messages such as UBX-NAV-PVT, UBX-NAV-STATUS, UBX-NAV-SAT, NMEAGGA, NMEA-GLL, NMEA-RMC, and NMEA-GNS. The UBX-NAV-SLAS message provides detailed information about which corrections are available and applied.

Refer to the interface description UBX-21035062 for a detailed description of the messages.

1.6 1PPS

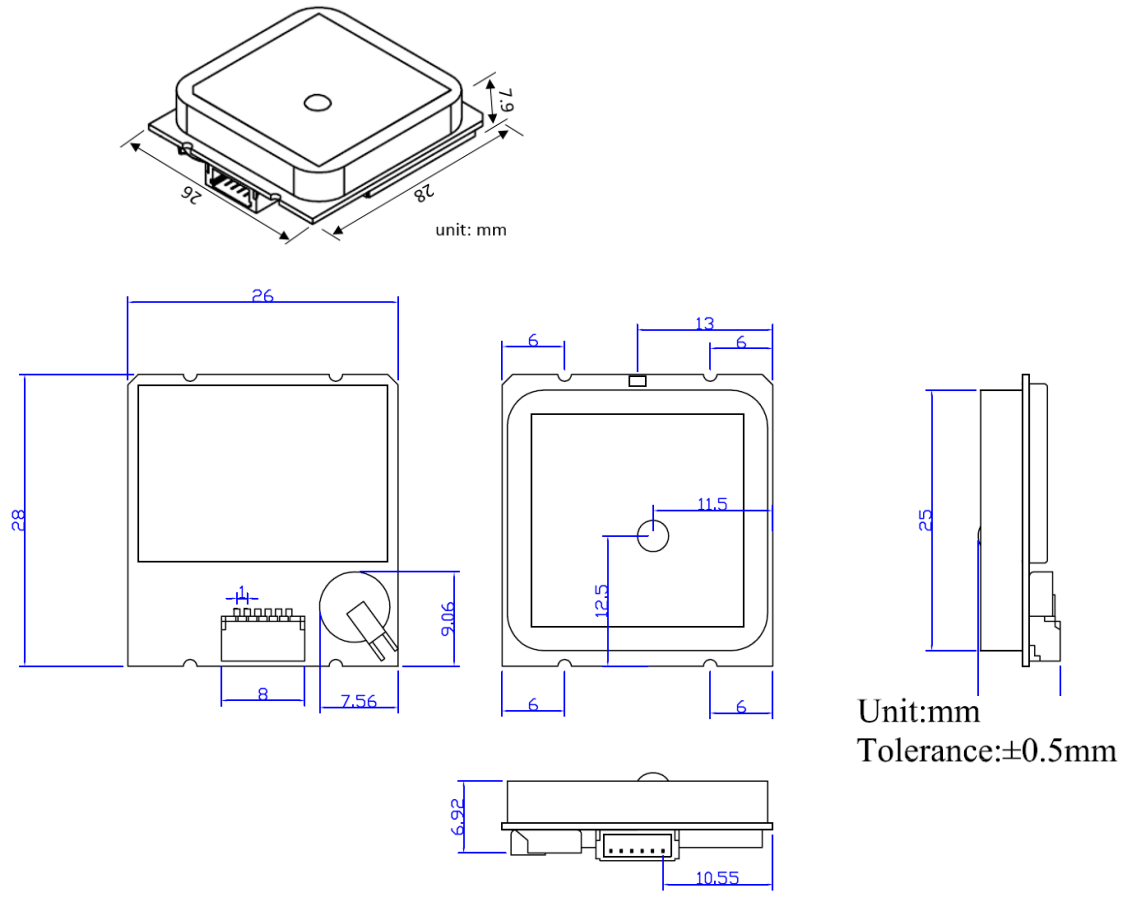
The GNSS 1PPS is a pulse delivered at the top of each GPS second with accuracy of 30ns (RMS) or 60ns (99%). This signal allows devices all over the world to be accurately synchronized to a common time base.

GM-U01R/GM-U01T provides 1PPS on pin 5 of the connector.

2 Hardware Interface

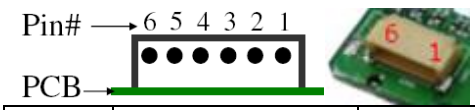
2.1 Module Dimension

The dimension of GM-U01 is 26 mm (W) x 28 mm (L) x 7.9 mm (H) as shown below.



2.2 Pin Assignment

6-pin Interface, pitch 1.0mm



Pin	Name	Function	I/O
1	GND	Ground	Input
2	VCC	Power supply (3.3 ~ 5.5 VDC)	Input
3	TX$ / D+	Serial data output or USB D+	Output
4	RX$ / D-	Serial data input or USB D-	Input

5	PPS [$&] (VBAT, option)	Pulse Per Second TIMEPULSE signal (External backup power if backup battery is not built-in) Leave this pin open if it is not used.	Output (Input)
6	PWR_CTRL	Power control, internally pull high. High/open: ON, low: OFF Leave this pin open if it is not used.	Input

[$] TTL or RS232 depending on the model number

[&] Please be noted that the RS232 line transceiver would introduce 0.3us pulse skew to the PPS signal of RS232 model. TTL level customization is available.

[!] Pin 5 is by default PPS. For VBAT demand, specify explicitly when order.

To Extend Operating Temperature Range

GM-U01 without backup battery is with operating temperature range of -40~85℃. However, the built-in backup battery is with -20~60℃. The power backup function does not function out of the backup battery working temperature range. In case, wider temperature range is required, please specify sub-models Q/S/V [see section 4.4].

Connect the backup power with wider operating range to pin 5.

Power Saving

GM-U01 supports the power saving mechanism by controlling pin 6. Pin 6 is internally pull high. To control the power of GM-U01, connect the **PWR_CTRL** pin to a GPIO of micro-processor directly. To save the power of GM-U01 (VCC is always connected to power source), just pull the PWR_CTRL pin low (in this case, GM-U01 only keeps power of RTC and RAM). During normal run, pull it high or leave it floating (in this case, GM-U01 is fully powered).

3 Software Interface

GM-U01 supports both NMEA text messages and UBX binary messages. For the UBX binary messages, please refer to u-blox Receiver Description Protocol Spec. In this section, the NMEA output messages are discussed.

3.1 NMEA Output Messages

Multi-talker IDs are used in GNSS multi-satellite positioning systems.

- Talker ID is 'GP' for GPS,SBAS-specific sentences since NMEA 2.3
- Talker ID is 'GL' for GLONASS-specific sentences since NMEA 2.3
- Talker ID is 'GA' for Galileo-specific sentences since NMEA 4.10
- Talker ID is 'GB' for BEIDOU-specific sentences since NMEA 4.10
- Talker ID is 'GQ' for QZSS-specific sentences since NMEA 4.11 ('GP' for NMEA 2.3~4.10)
- Talker ID is 'GN' is used for generic GNSS sentences

System\Sentence	GGA	GLL	GSA	GSV	RMC	VTG
GPS	GPGGA	GPGLL	GPGSA	GPGSV	GPRMC	GPVTG
GLONASS	GLGGA	GLGLL	GLGSA	GLGSV	GLRMC	GLVTG
BEIDOU	GBGGA	GBGLL	GBGSA	GBGSV	GBRMC	GBVTG
Galileo	GAGGA	GAGLL	GAGSA	GAGSV	GARMC	GAVTG
QZSS	-	-	-	GQGSV	-	-
Multi-	GNGGA	GNGLL	GNGSA	Mix of above	GNRMC	GNVTG

The NMEA-0183 Output Messages are shown as below:

NMEA Record	Descriptions
GxGGA	Global positioning system fixed data: time, position, fixed type
GxGLL	Geographic position: latitude, longitude, UTC time of position fix and status
GxGSA	GPS receiver operating mode, active satellites, and DOP values
GxGSV	GNSS satellites in view: ID number, elevation, azimuth, and SNR values
GxRMC	Recommended minimum specific GNSS data: time, date, position, course, speed
GxVTG	Course over ground and ground speed
GxGNS	GNSS fix data

GxGRS	GNSS range residuals
GxGST	GNSS pseudo range error statistics
GxZDA	Time and date message
GxTXT	u-blox message

The GM-U01 adopts interface protocol of National Marine Electronics Association's NMEA-0183 Version up to 4.11. GM-U01 supports multiple types of NMEA sentences (GxGGA, GxGLL, GxGSA, GxGSV, GxRMC, GxVTG, GxGNS, GxGRS, GxGST, GxZDA, and GxTXT).

The default output sentences are RMC, VTG, GGA, GSA, GSV, GLL.

The default UART communication parameters are 38400 bps, 8 data bits, 1 stop bit, and no parity. Other baud rate and related configurations could be requested based on MOQ.

GNSS Configuration

Individual navigation systems could be enabled/disabled. There is a limit on BEIDOU bands. If all 4 navigation systems were chosen, only the B1C band of BEIDOU is available. Otherwise, B1I band is available. That is to say,

- GPS, GALIELO, BEIDOU B1I (Default configuration)
- GPS, GLONASS, GALIELO, BEIDOU B1C

GPS + GLONASS + Galileo + BEIDOU B1C message examples:

$GNRMC,082749.00,A,2446.41883,N,12100.43526,E,0.004,,201223,,,A,V*16
$GNVTG,,T,,M,0.004,N,0.008,K,A*31
$GNGGA,082749.00,2446.41883,N,12100.43526,E,1,12,0.53,130.7,M,16.3,M,,*40
$GNGSA,A,3,02,04,08,09,16,21,26,27,31,07,,,1.06,0.53,0.92,1*0C
$GNGSA,A,3,78,88,87,81,,,,,,,,1.06,0.53,0.92,2*01
$GNGSA,A,3,13,15,19,21,26,27,04,,,,,1.06,0.53,0.92,3*01
$GNGSA,A,3,,,,,,,,,,,,,1.06,0.53,0.92,4*0E
$GNGSA,A,3,02,03,07,04,,,,,,,,1.06,0.53,0.92,5*0D
$GPGSV,3,1,11,02,21,180,35,04,43,232,37,07,15,319,30,08,67,255,42,1*6A
$GPGSV,3,2,11,09,33,280,36,16,38,043,37,21,29,172,36,26,25,070,33,1*61
$GPGSV,3,3,11,27,62,023,42,31,25,129,36,50,60,166,37,1*5E
$GPGSV,1,1,04,18,01,037,,28,03,135,,40,13,259,,41,39,242,,0*60
$GLGSV,2,1,07,77,,,30,78,39,350,36,81,27,186,36,87,32,037,36,1*40
$GLGSV,2,2,07,88,68,118,43,,,,33,,,,33,1*4E
$GLGSV,1,1,02,69,09,313,,79,05,310,,0*75

$GAGSV,2,1,08,04,06,319,30,13,43,120,37,14,65,234,39,15,25,058,33,7*77
$GAGSV,2,2,08,19,40,269,31,21,49,336,37,26,19,177,33,27,36,052,36,7*7B
$GAGSV,1,1,01,07,04,167,,0*46
$GBGSV,6,1,22,01,50,136,,02,39,240,,03,57,203,,04,37,119,,0*77
$GBGSV,6,2,22,04,37,119,,05,16,257,,06,86,216,,07,61,282,,0*7D
$GBGSV,6,3,22,07,61,282,,09,69,317,,10,51,268,,16,85,189,,0*7A
$GBGSV,6,4,22,16,85,189,,19,05,195,,21,04,291,,22,12,244,,0*73
$GBGSV,6,5,22,22,12,244,,27,10,038,,29,57,192,,30,58,057,,0*75
$GBGSV,6,6,22,30,58,057,,36,62,031,,0*78
$GQGSV,1,1,04,02,63,044,38,03,54,132,39,04,22,174,33,07,60,166,34,1*64
$GNGLL,2446.41883,N,12100.43526,E,082749.00,A,A*71
$GNGST,082749.00,15,3.2,2.9,123,1.2,1.3,3.1*74
$GNZDA,082749.00,20,12,2023,00,00*7A

Known Bug

There is a known bug of B1C band GBGSV message, yellow marked above, in current release of u-blox M10. The SNR item is missing. Nevertheless, the satellite information was used normally by the M10 chip. It does not affect the receiver performance. This bug is scheduled to be fixed in year 2024 chip revision.

GPS + Galileo + BEIDOU B1I message examples:

$GNRMC,082646.00,A,2446.41705,N,12100.43453,E,0.001,,201223,,,D,V*1A
$GNVTG,,T,,M,0.001,N,0.002,K,D*3B
$GNGGA,082646.00,2446.41705,N,12100.43453,E,2,12,0.51,127.7,M,16.3,M,,*4B
$GNGSA,A,3,08,09,16,21,27,31,26,07,02,04,,,0.92,0.51,0.77,1*09
$GNGSA,A,3,19,15,26,13,27,21,,,,,,,0.92,0.51,0.77,3*00
$GNGSA,A,3,06,07,09,16,29,30,36,39,40,10,46,45,0.92,0.51,0.77,4*05
$GNGSA,A,3,07,03,04,,,,,,,,,,0.92,0.51,0.77,5*0A
$GPGSV,3,1,11,02,20,180,35,04,44,233,36,07,14,319,30,08,66,253,41,1*69
$GPGSV,3,2,11,09,33,281,35,16,39,042,37,21,28,172,35,26,25,069,34,1*6E
$GPGSV,3,3,11,27,63,023,41,31,25,128,36,50,60,166,37,1*5D
$GPGSV,1,1,04,18,02,038,,28,03,135,,40,13,259,,41,39,242,,0*6C
$GAGSV,2,1,07,13,43,120,37,14,64,234,39,15,25,058,32,19,40,269,31,7*71
$GAGSV,2,2,07,21,49,336,37,26,19,177,31,27,36,052,36,7*45
$GAGSV,1,1,02,04,06,319,,07,04,167,,0*7C
$GBGSV,5,1,18,01,50,136,35,03,57,203,34,04,37,119,32,06,86,217,36,1*7B
$GBGSV,5,2,18,07,61,282,33,09,69,317,35,10,51,268,32,16,85,189,38,1*7C
$GBGSV,5,3,18,22,12,244,30,27,10,038,18,29,57,192,38,30,58,057,39,1*73
$GBGSV,5,4,18,36,62,030,39,39,75,172,38,40,67,299,37,45,29,319,33,1*73

$GBGSV,5,5,18,46,32,096,34,59,53,142,37,1*7D

$GBGSV,1,1,04,02,39,240,,05,16,257,,19,05,196,,21,04,291,,0*71

$GQGSV,1,1,04,02,63,043,39,03,54,132,39,04,22,174,32,07,60,166,34,1*63

$GNGLL,2446.41705,N,12100.43453,E,082646.00,A,D*78

$GNGST,082646.00,13,1.1,0.87,158,0.43,0.37,0.96*7A

$GNZDA,082646.00,20,12,2023,00,00*74

3.2 GxGGA - Global Positioning System Fix Data

- Example

  $GPGGA,065500.00,2447.65027,N,12100.78318,E,2,12,0.91,69.8,M,16.3,M,,*65

- Explanation

Contents	Example	Unit	Explanation
Message ID	$GPGGA		GGA protocol header
UTC Time	065500.00		hhmmss.ss hh: hour, mm: minute, ss: second
Latitude	2447.65027		ddmm.mmmmm dd: degree, mm.mmmmm: minute
North/South	N		N: North Latitude, S: South Latitude
Longitude	12100.78318		dddmm.mmmmm dd: degree, mm.mmmmm: minute
East/West	E		E: East Longitude, W: West Longitude
Position Fix Indicator	2		0: Fix not available or invalid, 1: GPS SPS Mode, fix valid, 2: Differential GPS, SPS Mode, fix valid, 3~5: Not supported, 6: Dead Reckoning Mode, fix valid
Satellites Used	12		Number of satellites used in positioning calculation (0 to 12)
HDOP	0.91		Horizontal Dilution of Precision
MSL Altitude	69.8	meters	
Unit	M		Meters
Geoidal separation	16.3	meters	
Units	M		Meters
Age of Diff. Corr.		second	Null fields when DGPS is not used
Diff. Ref. Station ID			
checksum	*65		
<CR><LF>			End of sentence

3.3 GxGLL - Geographic Position - Latitude / Longitude

- Example

  $GPGLL,2447.65027,N,12100.78318,E,065500.00,A,D*6E

- Explanation

Contents	Example	Unit	Explanation
Message ID	$GPGLL		GLL protocol header
Latitude	2447.65027		ddmm.mmmmm

			dd: degree, mm.mmmmm: minute
North/South	N		N: North Latitude, S: South Latitude
Longitude	12100.78318		dddmm.mmmmm dd: degree, mm.mmmmm: minute
East/West	E		E: East Longitude, W: West Longitude
UTC Time	065500.00		hhmmss.ss hh: hour, mm: minute, ss: second
Status	A		A: Data valid, V: Data invalid
Mode Indicator	D		A: Autonomous, D: DGPS, E: DR
checksum	*6E		
<CR><LF>			End of sentence

3.4 GxGSA - GNSS DOP and Active Satellites

- Example

  $GNGSA,A,3,08,09,16,21,27,31,26,07,02,04,,,0.92,0.51,0.77,1*09

- Explanation

Contents	Example	Explanation
Message ID	$GNGSA	GSA protocol header
Mode 1	A	M: Manual—forced to operate in 2D or 3D mode A: 2D Automatic—allowed to automatically switch 2D/3D
Mode 2	3	1: Fix not available 2: 2D (<= 4 Satellites used) 3: 3D (>= 4 Satellites used)
Satellite used in solution	08	Satellite on Channel 1
Satellite used in solution	09	Satellite on Channel 2
…		Display of quantity used (12 max) If less than 12 SVs are used for navigation, the remaining fields are left empty. If more than 12 SVs are used for navigation, only the IDs of the first 12 are output.
PDOP	0.92	Position Dilution of Precision
HDOP	0.51	Horizontal Dilution of Precision
VDOP	0.77	Vertical Dilution of Precision
checksum	*09	
<CR><LF>		End of sentence

3.5 GxGSV - GNSS Satellites in View

- Example

  $GPGSV,3,1,11,02,20,180,35,04,44,233,36,07,14,319,30,08,66,253,41,1*69

  $GPGSV,3,2,11,09,33,281,35,16,39,042,37,21,28,172,35,26,25,069,34,1*6E

  $GPGSV,3,3,11,27,63,023,41,31,25,128,36,50,60,166,37,1*5D

  $GPGSV,1,1,04,18,02,038,,28,03,135,,40,13,259,,41,39,242,,0*6C

- Explanation

Contents	Example	Unit	Explanation
Message ID	$GPGSV		GSV protocol header
Number of messages	3		Range 1 to 4
Message number	1		Range 1 to 4
Satellites in view	11		Number of satellites visible from receiver

Satellite ID number	02		Channel 2 (Range 1 to 64) The satellite ID numbers are in the range of 1 to 32 for GPS satellites, and 33 to 64 for SBAS satellites (ID=120-PRN; e.g. SV ID 33 is SBAS PRN 120, 34 is SBAS PRN 121, and so on)
Elevation	20	degrees	Elevation angle of satellite as seen from receiver channel 1 (00 to 90)
Azimuth	180	degrees	Satellite azimuth as seen from receiver channel 1 (000 to 359)
SNR (C/No)	35	dBHz	Received signal level C/No from receiver channel 1 (00 to 99, null when not tracking)
…			
Satellite ID number	08		Channel 4 (Range 1 to 32)
Elevation	66	degrees	Elevation angle of satellite as seen from receiver channel 4 (00 to 90)
Azimuth	253	degrees	Satellite azimuth as seen from receiver channel 4 (000 to 359)
SNR (C/No)	41	dBHz	Received signal level C/No from receiver channel 4 (00 to 99, null when not tracking)
Signal Id[!]	1		1: GPS L1, SBAS L1, BeiDou B1I, QZSS L1 C/A, GLONASS L1 2: Galileo E5 bI, E5bQ 3: GLONASS L2, BeiDou B1C 4: QZSS L1S 5: GPS L2 CM, QZSS L2CM 6: GPS L2 CL, QZSS L2CL 7: GPS L5I, Galileo E1 C, E1 B 8. QZSS L5Q 11: BeiDou B2I
checksum	*69		
<CR><LF>			End of sentence

[!] Signal Id of 0 means unknown, because of the known bug, B1C is also expressed as 0.

3.6 GxRMC - Recommended Minimum Specific GNSS Data

- Example

  $GNRMC,082646.00,A,2446.41705,N,12100.43453,E,0.001,,201223,,,D,V*1A

- Explanation

Contents	Example	Unit	Explanation
Message ID	$GPRMC		RMC protocol header
UTC Time	082646.00		hhmmss.ss hh: hour, mm: minute, ss: second
Status	A		A: Data valid, V: Data invalid
Latitude	2446.41705		ddmm.mmmmm dd: degree, mm.mmmmm: minute
North/South	N		N: North Latitude, S: South Latitude
Longitude	12100.43453		dddmm.mmmmm dd: degree, mm.mmmmm: minute
East/West	E		E: East Longitude, W: West Longitude
Speed over ground	0.001	knots	Receiver's speed
Course over ground		degrees	Receiver's direction of travel Moving clockwise starting at due north
Date	201223		ddmmyy dd: Day, mm: Month, yy: Year

Magnetic variation		degrees	This receiver does not support magnetic declination. All “course over ground” data are geodetic WGS84 directions.
Mode Indicator	D		A: Autonomous M: Manual D: DGPS S: Simulation E: Dead Reckoning N: Data Invalid
Navigation Status	V		V (Equipment is not providing navigational status information, fixed field, only available in NMEA 4.10 and later)
checksum	*1A		
<CR><LF>			End of sentence

3.7 GxVTG - Course over Ground and Ground Speed

- Example

  $GNVTG,,T,,M,0.001,N,0.002,K,D*3B

Explanation

Contents	Example	Unit	Explanation
Message ID	$GNVTG		VTG protocol header
Course over ground		degrees	Receiver’s direction of travel Moving clockwise starting at due north (geodetic WGS84 directions)
Reference	T		True
Course over ground		degrees	Receiver’s direction of travel
Reference	M		Magnetic
Speed over ground	10.001	knots	Measured horizontal speed
Unit	N		Knots
Speed over ground	0.002	km/hr	Measured horizontal speed
Unit	K		km/hr
Mode Indicator	D		A: Autonomous, D: DGPS, E: DR
checksum	*3B		
<CR><LF>			End of sentence

3.8 GxGNS – GNSS Fix Data

- Example

$GNGNS,025015.00,2446.41433,N,12100.43602,E,DDDD,28,0.51,122.6,16.3,,0000,V*18

Explanation

Contents	Example	Unit	Explanation
Message ID	$GNGNS		GNS protocol header
Time	025015.00		hhmmss.ss hh: hour, mm: minute, ss: second
Latitude	2446.41433		ddmm.mmmmm dd: degree, mm.mmmmm: minute
North/South	N		N: North Latitude, S: South Latitude
Longitude	12100.43602		dddmm.mmmmm dd: degree, mm.mmmmm: minute
East/West	E		E: East Longitude, W: West Longitude
Position Mode	DDDD		A: Autonomous GNSS fix N: No position fix D: Differential GNSS fix

			E: Estimated/Dead reckoning fix F: RTK float R: RTK fixed First character for GPS, second one for GLONASS, Third one for Galileo, Fourth one for BeiDou
Satellites Used	28		Number of satellites used in positioning calculation (0 to 99)
HDOP	0.51		Horizontal Dilution of Precision
Altitude	122.6	meters	Altitude above mean sea level
Separation	16.3	meters	Geoid separation: difference between ellipsoid and mean sea level
Differential Age	-		Age of differential corrections (null when DGPS is not used)
Differential Station	0000		ID of station providing differential corrections (null when DGPS is not used)
Navigation Status	V		V (Equipment is not providing navigational status information, fixed field, only available in NMEA 4.10 and later)
Checksum	*18		Checksum
<CR><LF>			End of sentence

3.9 GxGRS – GNSS Range Residuals

This messages relates to associated GGA and GSA messages. If less than 12 SVs are available, the remaining fields are output empty. If more than 12 SVs are used, only the residuals of the first 12 SVs are output, in order to remain consistent with the NMEA standard. **In a multi-GNSS system this message will be output multiple times, once for each GNSS.**

- Example

  $GNGRS,025015.00,1,-0.3,0.0,0.0,1.2,-1.2,0.5,-0.4,0.5,,,,,1,1*79

  $GNGRS,025015.00,1,,,,,,,0.0,,,,,,1,5*79

  $GNGRS,025015.00,1,-0.4,,-0.9,-0.5,-1.5,-0.6,,-0.1,,,,,1,6*5F

  $GNGRS,025015.00,1,-0.7,-4.0,4.1,4.4,1.3,-1.7,-5.3,,,,,,2,1*7A

  $GNGRS,025015.00,1,-0.1,-1.8,2.6,2.3,-0.3,-4.1,-1.2,,,,,,2,3*59

  $GNGRS,025015.00,1,-0.1,0.3,-0.2,0.4,-0.2,,,,,,,,3,2*57

  $GNGRS,025015.00,1,0.8,0.3,0.5,0.7,0.8,,,,,,,,3,7*78

  $GNGRS,025015.00,1,0.7,-0.4,-1.2,-1.5,0.8,-0.1,0.1,0.6,,,,,4,1*5C

  $GNGRS,025015.00,1,-0.1,,-0.4,-0.3,0.0,-1.8,-1.7,,,,,,4,3*70

Explanation

Contents	Example	Unit	Explanation
Message ID	$GNGRS		GRS protocol header
Time	025015.00		hhmmss.ss hh: hour, mm: minute, ss: second
Mode	1		Computation method used: 1: Residuals were recomputed after the GGA position was computed (fixed)

Residual 1	-0.3	meters	Range residuals for SVs used in navigation. The SV order matches the order from the GSA sentence
Residual 2	0.0	meters	Same as above
Residual 3	0.0	meters	Same as above
Residual 4	1.2	meters	Same as above
Residual 5	-1.2	meters	Same as above
Residual 6	0.5	meters	Same as above
Residual 7	-0.4	meters	Same as above
Residual 8	0.5	meters	Same as above
Residual 9	-	meters	Same as above
Residual 10	-	meters	Same as above
Residual 11	-	meters	Same as above
Residual 12	-	meters	Same as above
System Id	1		1: GPS/SBAS, 2: GLONASS 3: Galileo, 4: BeiDou 5: QZSS
Signal Id	1		1: GPS L1, SBAS L1, BeiDou B1I, QZSS L1 C/A, GLONASS L1 2: Galileo E5 bI, E5bQ 3: GLONASS L2 4: QZSS L1S 5: GPS L2 CM, QZSS L2CM 6: GPS L2 CL, QZSS L2CL 7: Galileo E1 C, E1 B 11: BeiDou B2I
Checksum	*79		Checksum
<CR><LF>			End of sentence

3.10 GxGST – GNSS Pseudo Range Error Statistics

- Example

  $GNGST,025029.00,15,0.92,0.78,43,0.34,0.34,0.91*7A

Explanation

Contents	Example	Unit	Explanation
Message ID	$GNGST		GST protocol header
Time	025029.00		hhmmss.ss hh: hour, mm: minute, ss: second
Range of RMS	15	meters	RMS value of the standard deviation of the ranges
Standard Deviation of Semi-Major Axis	0.92	meters	Standard deviation of semi-major axis (only supported in ADR 4.10 and later)
Standard Deviation of Semi-Minor Axis	0.78	meters	Standard deviation of semi-minor axis (only supported in ADR 4.10 and later)
Orientation	43	degrees	Orientation of semi-major axis (only supported in ADR 4.10 and later)
Standard deviation of latitude error	0.34	meters	Standard deviation of latitude error
Standard deviation of longitude error	0.34	meters	Standard deviation of longitude error
Standard deviation of altitude error	0.91	meters	Standard deviation of altitude error

Checksum	*7A		Checksum
<CR><LF>			End of sentence

3.11 GxZDA – GNSS Time and Date

- Example

  $GNZDA,082645.00,20,12,2023,00,00*77

Explanation

Contents	Example	Unit	Explanation
Message ID	$GNZDA		ZDA protocol header
UTC time	082645.00		hhmmss.ss hh: hour, mm: minute, ss.sss: second
Day	20		Day according to UTC time (01 to 31)
Month	12		Month according to UTC time (01 to 12)
Year	2023		Year according to UTC time (1980 to 2079)
Local zone hour	00	hour	Offset from UTC (set to 00)
Local zone minutes	00	minute	Offset from UTC (set to 00)
checksum	*77		
<CR><LF>			End of sentence

3.12 GxTXT – Text Transmission

- Example

  $GPTXT,01,01,02,u-blox ag - www.u-blox.com*50

Explanation

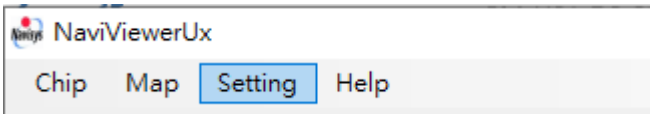
Contents	Example	Unit	Explanation
Message ID	$GPTXT		TXT protocol header
Number of messages	01		Total number of messages in this transmission, 01..99
Message number	01		Message number in this transmission, range 01..xx
Message type	02		Text identifier, u-blox GPS receivers specify the type of the message with this number. 00: Error 01: Warning 02: Notice 07: User
Text	u-blox ag - www.u-blox.com		Any ASCII text
Checksum	*50		Checksum
<CR><LF>			End of sentence

3.13 GNSS Configuration

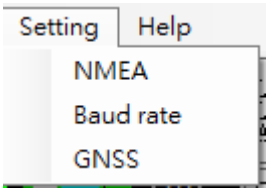
- Higher update rate is required for high-speed moving application. If power consumption is not a major concern, higher update rate could be configured following the spec

described in sec 1.2.

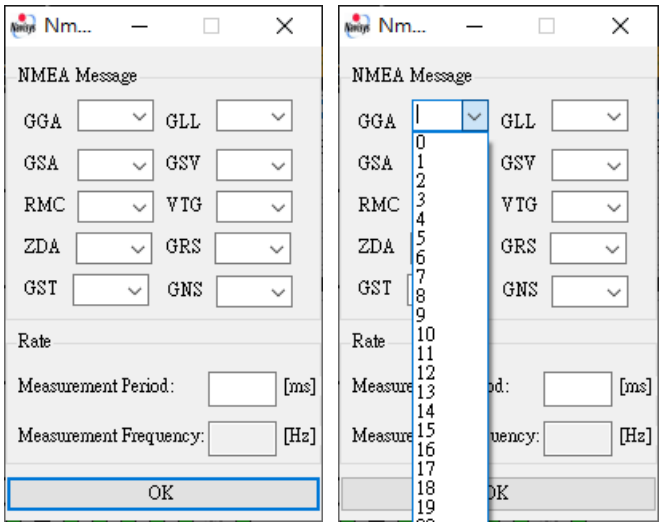
- If power consumption is a major concern, one may want to reduce the used satellite systems or update rate.
- Higher update and more used satellite systems will output more data. That is to say, higher baud rate would be required.
- If the focus is only on the position itself, one can have high update, just output only limited NMEA sentence, say GGA only. In this case, small baud rate is ok.
- To support configuration change for above mentioned purposes, one can use u-blox's u-center tool or just download NaviViewerUx from Navisys support page to perform the configuration management.
- Configured by NaviViewerUx: Click the Setting menu bar of it,



One can see 3 sets of functions for above mentioned configuration management.

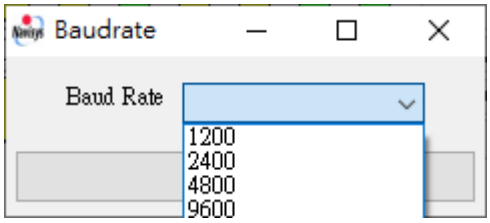


  - NMEA is for a) enable/disable a NMEA sentence and/or b) change the update rate:



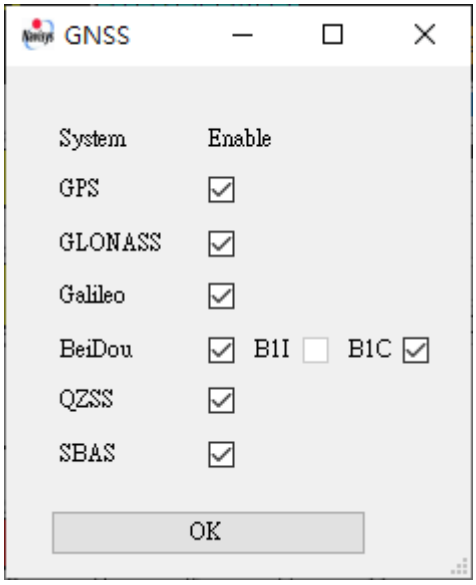
➔Please be noted that send OK leaving NMEA Message **blank** would cause **null output** of NMEA messages. In case of update rate change, please remember to also check NMEA sentences.

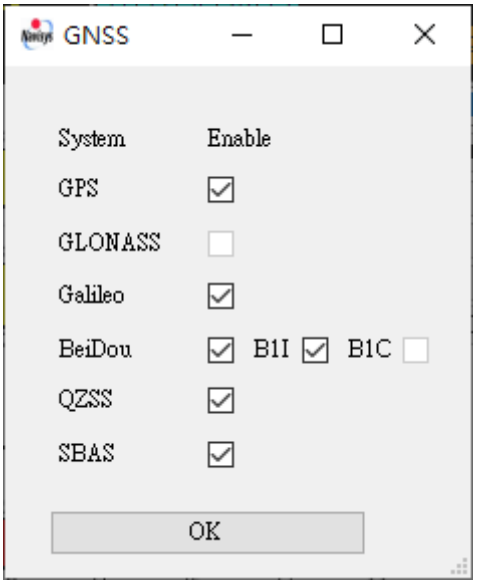
  - Baud rate is for changing the baud rate.



Please remember to reconnect if baud rate has been changed.

- GNSS is for enable/disable satellite systems.





OK will send the command.

4 Evaluation Information

4.1 Overview

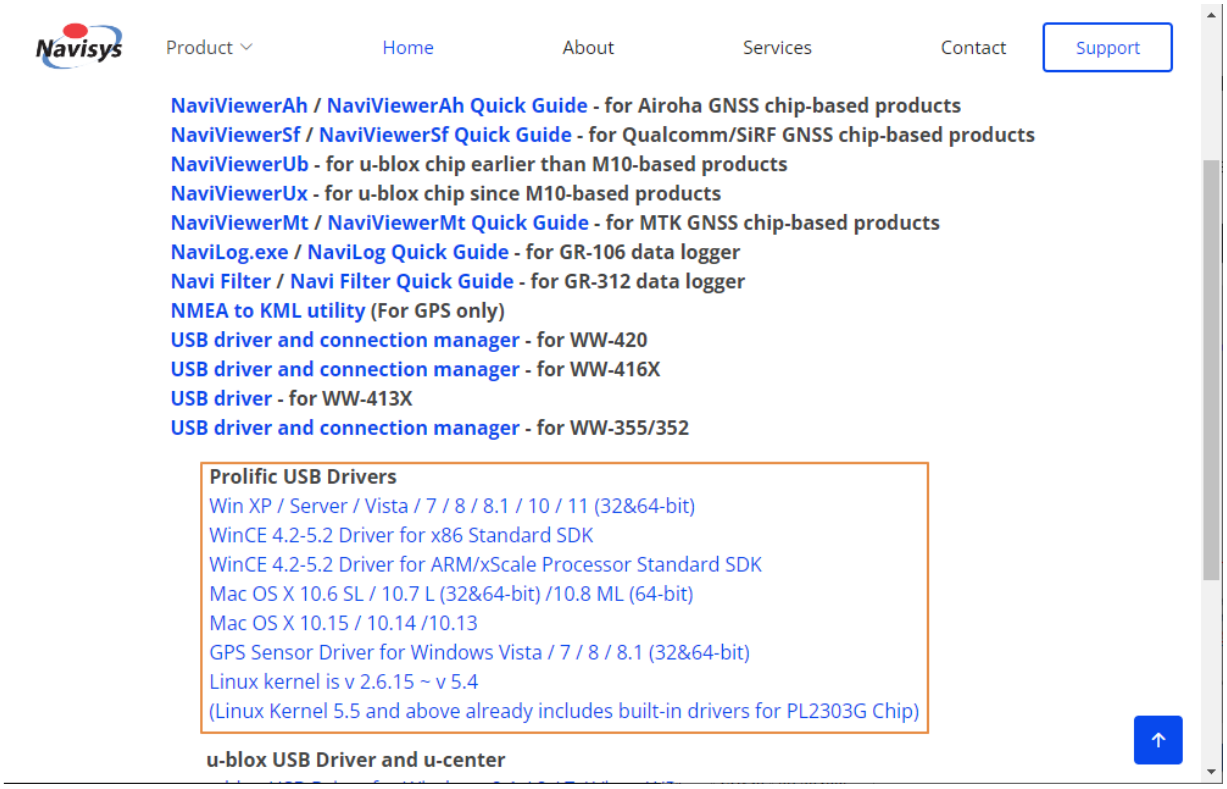
It's easy to connect the 6-pin I/O connector for checking the performance or doing power saving control.

Additional USB cable from Navisys for checking performance on PC is available for order.

- The USB cable is built-with Prolific USB Bridge.

4.2 USB Drivers

USB drivers are available from Navisys support page https://www.navisys.com.tw/Support. Please be noted that Prolific USB Drivers should be used for all models.



4.3 Tips in Designing

The GNSS signal is pretty low, less than -130 dBm, which is easily interfered by the EMI of application circuit, and its working frequency might be shifted due to the housing material of host.

Interference checking

1. Check the signal reception status of GNSS module standalone with GNSS viewer tool.
2. Observe the performance when the receiver moves around the host machine.
3. If you want to find a location for installing GNSS unit, choose the location with best signal reception displayed by NaviViewerUx.
4. If the location of the receiver has determined, this tool could be used to check the interference severity.

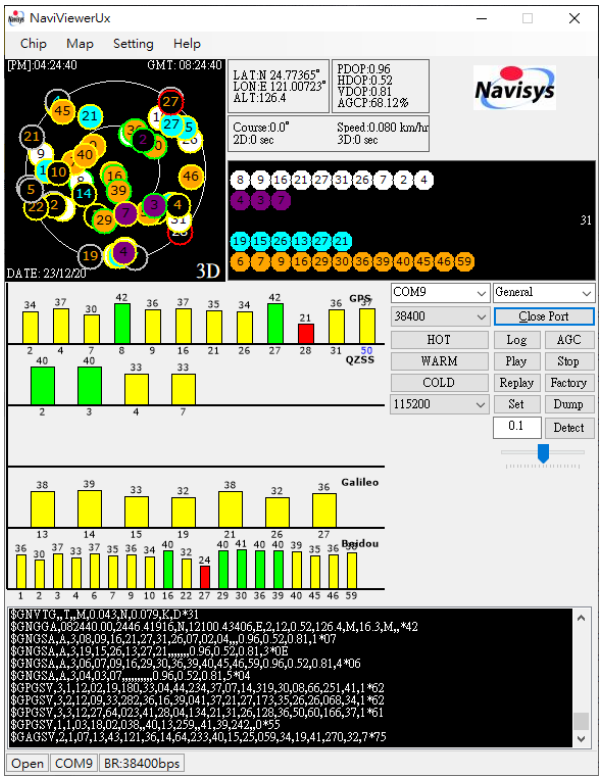
For more interesting news, please visit Navisys web page, https://www.navisys.com.tw.

Antenna working frequency checking

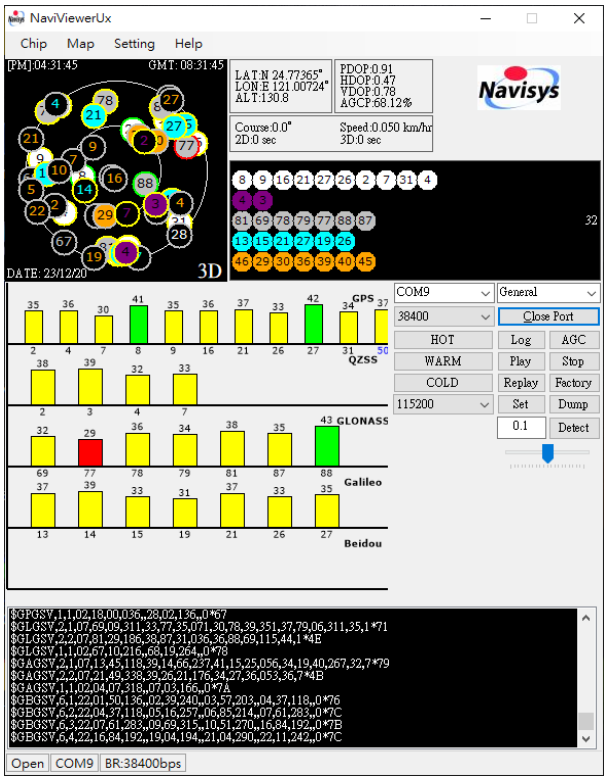
1. Compare the GNSS sensitivity with and without host's housing.
2. If the GNSS signal is degraded significantly, the GNSS antenna needs to fine tune to match the housing material to achieve the optimum central frequency and field pattern.
3. Please note that there is MOQ request for antenna customization.

NaviViewerUx GNSS Viewer Tool

GPS+GALILEO+BEIDOU B1I



GPS+ GLONASS+GALILEO+BEIDOU B1C²



1. Signal strength is represented by the bar length and color
   - Blue: ≧ 50, green: ≧ 40, yellow: ≧ 30, red: < 30
2. The Beidou B1C bar charts are missing because of above mentioned known bug.

4.4 Ordering Information

GM-U01X

(A) Models w/ built-in backup battery

Where X=	R	T	U
RS232	Y	-	-
TTL	-	Y	-
USB	-	-	Y

(B) Models w/o built-in backup battery (connect external backup power to pin 5 (VBAT)

Where X=	Q	S	V
RS232	Y	-	-
TTL	-	Y	-
USB	-	-	Y

Please contact our sales window directly or email to sales@navisys.com.tw if any customization is needed.

5 Electrical and Environmental Data

Electrical Data

Power Supply (VDC)	3.3 ~ 5.5
Power Consumption Acquisition/Average Tracking (29 SVs)	USB: 59/ 56 mA RS232: 22/ 19 mA TTL: 19/ 16 mA
Backup power	3.3 V
Digital I/O (V)	V_{IH}: ≥ 2.25V, V_{IL}: ≤ 0.63V V_{OH}: ≥ 2.9V, $V_{OL:}$ ≤ 0.4V
Protocols	NMEA (default)

Environmental Data

Operating temperature	-40 ~ 85℃
Storage temperature	-40 ~ 85℃
Vibration	5Hz to 500Hz, 5g
Shock	Half sine 30g/11ms
RoHS compliant	Yes

6 Package Information

1000 pcs per carton box -

- 40 pcs in one tray plate

- 5 tray plates in one vacuum bag, totally 200pcs

- 5 vacuum bags in one carton box, totally 1000pcs

- Carton box size is 503x353x234 in mm.
- Total weight with 1000pcs is 15Kg per carton box.