Data Sheet / GE-A12

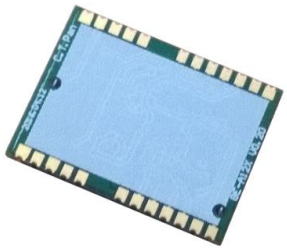
SiRFstarV

Tiny,

SMT-Mountable,

Ultra-High Performance,

GNSS Engine Board



RoHS
Compliant

Version 1.1

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Revision History

Ver.	Date	Description
1.0	Aug. 1st, 2016	Initial release
1.1	Oct. 3rd , 2016	Support web page update

Contents

1 Introduction

1.1 Overview

As shown in above pictures, NaviSys GE-A12 is a thin, low-power, ultra-high performance, SMT-Mountable, easy to use GNSS engine board based on SiRF's 5th generation single chip. It fixes position based on multi-constellation satellite systems – GPS, GLONASS, QZSS, BEIDOU and also SBAS (WAAS, EGNOS, MSAS, GAGAN).

Its low power consumption and high performance enables the adoption of various applications. The thin design allows it to be used in size-demanding device while still keeps its outstanding performance.

Antenna short circuit protection prevents it from incidental damage. Both active & passive antennas are supported. It is very easy to power active antenna – just connect pin 9 to antenna power is enough, external RLC circuit is not required. Fast adoption and high yield production becomes possible.

1.2 Main Features

Not only portable devices but also any other GNSS applications can share the following major features of GE-A12.

- Multi-constellation support: GPS/GLONASS/QZSS/BEIDOU
- SBAS (WAAS, EGNOS, MSAS, GAGAN) support
- Small: **12.2 (W) x 16.0 (L) x 2 (H)** (mm)
- Fully implementation of ultra-high performance **SiRFstarV** single chip architecture
- High tracking sensitivity of **-165dBm**
- Low power consumption of **26mA** at full tracking (42dB-Hz, 8 SVs)
- Up to 5Hz update rate
- Local ephemeris prediction
- Built-in flash for firmware upgrade/customization
- External backup power by pin V_BAT for faster position fix.

- Support both passive and active antennas
  - Built-in filtered power for active antenna. Do not need external filtering circuit (**RLC components**).
  - It's ok if there is external filtering circuit.
- External active antenna **short circuit protection**
- Easy adoption with best performance
- Minimum RF and EMI efforts
- Multi-mode AGNSS support

1.3 Receiver Specifications

Features	Specifications[!]
GPS receiver type	52 channels, GPS/QZSS: L1 1575.42MHz GLONASS: L1OF 1598.0625 ~ 1605.375 MHz BEIDOU: 1561.098MHz
Horizontal Position Accuracy	< 2.5m (Autonomous) (50% 24hr static, -130dBm)
Velocity Accuracy	<0.01 m/s (speed) <0.01° (heading) (50%@30m/s)
Time accuracy	1μs or less
TTFF (Time to First Fix) (50%, -130dBm, autonomous)	Hot Start: 1s Warm Start: 26s Cold Start: 28s
Sensitivity (Autonomous)	Tracking: –165dBm Acquisition: -146dBm
Datum	WGS-84 (default)
Measurement data output	Update time: 1 second NMEA output protocol: V.4.00 Baud rate: 9600 (default), 19200, 38400, 115200 bps Datum: WGS-84 Default: GGA, GSA, GSV, RMC, VTG Other options: GLL, ZDA, or OSP protocol
Max. Altitude	<18,000 m
Max. Velocity	<1,852 km/hr
SBAS Support	WAAS, EGNOS, MSAS, GAGAN
Dynamics	<4g
Power consumption	26mA, continuous tracking mode, (42dB-Hz, 8 SVs)
Power supply	V_BAT: 2.6~3.4V

	VCC: 2.6~V_BAT+0.3 or 3.3~4.4 V if V_BAT is not connected
Dimension (mm)	12.6 (W) x 16.0 (L) x 2 (H)
Operating temperature	-40°C ~ +85°C
Storage temperature	-40°C ~ +85°C

[1]Note. Data is from chip vendor.

1.4 Protocols

Both NMEA and OSP protocols could be supported via serial UART I/O port – RXD/TXD. The default supported protocol is NMEA protocol.

1. Serial communication channel
    i. No parity, 8-data bit, 1-stop bit (N-8-1)
    ii. User selectable baud rates among 1200, 2400, 4800, 9600 (default), 19200, 38400, 57600, 115200 bps.
2. NMEA 0183 Version 4.00 ASCII output
    i. Default GGA (1 sec), GSA (1 sec), GSV (5 sec), RMC (1 sec), VTG(1sec)
    ii. Optional GLL, ZDA
3. Baud rate, NMEA sentences, and update rate
    i. The baud rate of UART port is limited. More NMEA sentences or higher update rates may require higher baud rate. E.g.
        1. 4800bps is ok for GPS only output: GGA, GSA, RMC, VTG@1Hz, GSV@1/5Hz. However, the speed is too low to output GPS & GLONASS information simultaneously. In this case, at least 9600bps is required.
        2. Similarly, if 3 position updates per second is required in above GNSS example, baud rate of above 38400bps is suggested.

1.5 Antenna

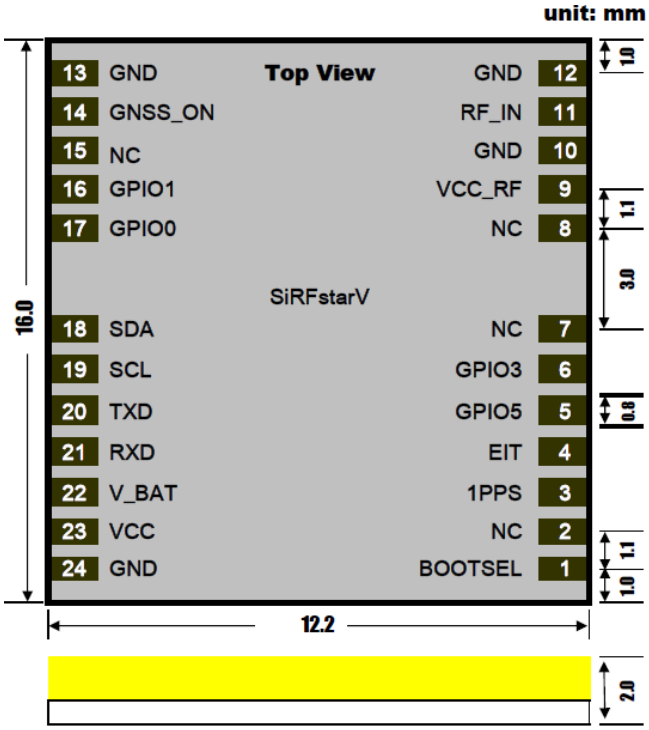
GE-A12 supports both active and passive antennas. For active antenna, suggest use

- gain between 16 and 30 dB
    - Gain of 16 dB is ok for cable length below 1m
    - For cable length of 3m or longer, suggest gain of above 26 dB
- noise figure less than 1.5 dB

2 Hardware Interface

2.1 Dimension

12.2 mm (W) x 16.0 mm (L) x 2 mm (H)



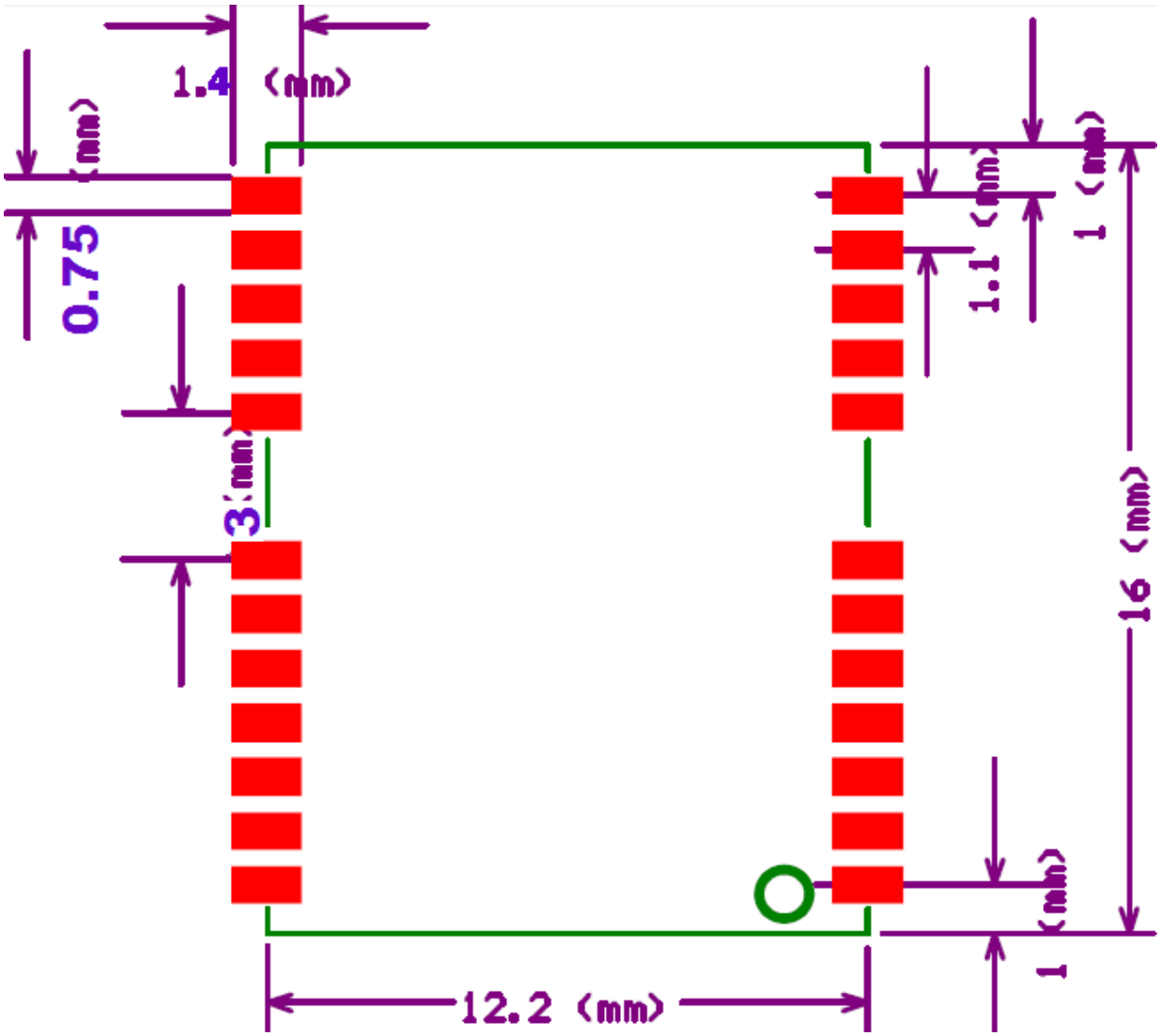
2.2 Pin Assignment

48-pin Interface

Pin	Name	Function	I/O
1	BOOTSEL	“NC” or “L” for normal run; “H”: for firmware upgrade	Input
2	NC	No connection	-
3	1PPS	One Pulse Per Second signal Leave it open if it is not used.	Output
4	EIT	External interrupt input Leave it open if it is not used.	Input
5	GPIO5	General Purpose I/O control pin 5 Leave it open if it is not used.	I/O
6	GPIO3	General Purpose I/O control pin 3 Leave it open if it is not used.	I/O
7	NC	No connection	-

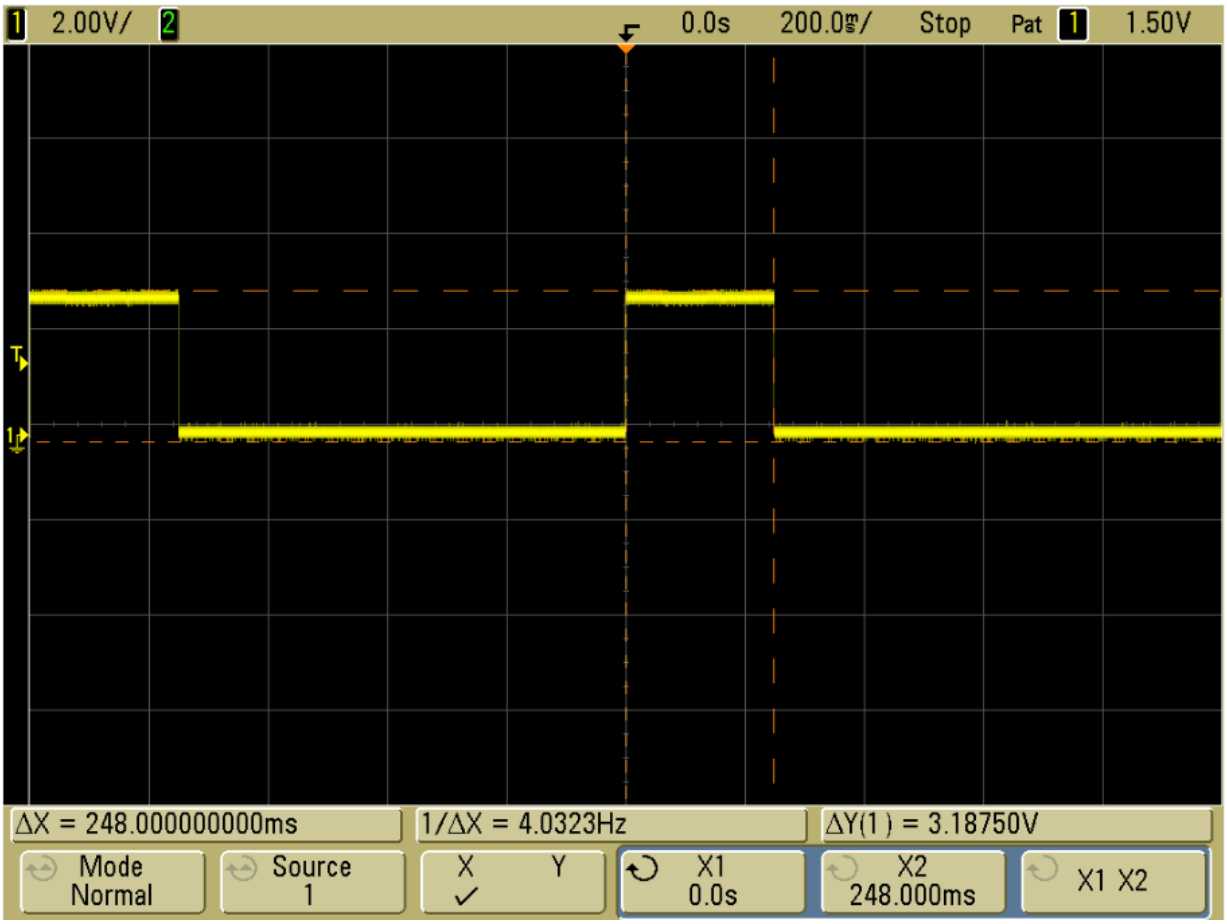
8	NC	No connection	-
9	VCC_RF	VCC antenna power supply option. Leave it open if this pin is not used, e.g. passive antenna is adopted.	Output
10	GND	Ground	Input
11	RF_IN	GNSS signal from antenna	Input
12	GND	Ground	Input
13	GND	Ground	Input
14	GNSS_ON	RF ON indication, high/1: RF ON, low/0: RF OFF Leave it open if it is not used.	Output
15	NC	No connection	-
16	GPIO1	General Purpose I/O control pin 1 Leave it open if it is not used.	I/O
17	GPIO0	General Purpose I/O control pin 0 Leave it open if it is not used.	I/O
18	SDA	I2C data for MEMS Leave it open if it is not used.	I/O
19	SCL	I2C clock for MEMS Leave it open if it is not used.	Output
20	TXD	Serial data output (from GNSS)	Output
21	RXD	Serial data input (to GNSS)	Input
22	V_BAT	Backup power connection	Input
23	VCC	Power supply	Input
24	GND	Ground	Input

2.3 Layout Suggestion



2.4 1PPS

In addition to the time synchronization function, the 1PPS signal could also be used to drive a LED for indicating the position fix status.


1 2.00V/ 2
0.0s
200.0ms/
Stop
Pat 1 1.50V
ΔX = 248.000000000ms
1/ΔX = 4.0323Hz
ΔY(1) = 3.18750V
Mode Normal
Source 1
X Y
X1 0.0s
X2 248.000ms
X1 X2

3 Software Interface

3.1 NMEA Output Messages

The NMEA-0183 Output Messages are shown as below:

NMEA Record	Descriptions
GGA	Global positioning system fixed data: time, position, fixed type
GNS	GNSS fix data
GLL	Geographic position: latitude, longitude, UTC time of position fix and status
GSA	GNSS receiver operating mode, active satellites, and DOP values
GSV	GNSS satellites in view: ID number, elevation, azimuth, and SNR values
RMC	Recommended minimum specific GNSS data: time, date, position, course, speed
VTG	Course over ground and ground speed
ZDA	PPS timing message (synchronized to PPS)

The GE-A12 adopts interface protocol of National Marine Electronics Association's NMEA-0183 Version 4.00 interface specification. GE-A12 supports 8 types of NMEA sentences (GGA, GNS, GLL, GSA, GSV, RMC, VTG, and ZDA).

The default output sentences are GGA, GSA, GSV, RMC and VTG. The UART communication parameters are 9600 bps, 8 data bits, 1 stop bit, and no parity. Other output sentences, baud rate, and related configurations could be requested based on MOQ.

Single message example

$GPGGA,062335.000,2446.4233,N,12100.4403,E,1,10,0.9,121.7,M,15.0,M,,0000*57

$GNGNS,033205.000,2446.4210,N,12100.4416,E,ANNA,11,0.8,121.5,15.0,,0000*62

$GLGGA,062335.000,2446.4233,N,12100.4403,E,1,01,0.9,121.7,M,15.0,M,,0000*4B

$GNGLL,2446.4233,N,12100.4403,E,062335.000,A,A*45

$GNGSA,A,3,16,23,27,03,13,19,11,57,07,31,,,1.6,0.9,1.4*2A

$GNGSA,A,3,87,,,,,,,,,,,,1.6,0.9,1.4*28

$GPGSV,4,1,13,16,39,040,41,23,39,232,40,27,62,020,40,03,72,316,39*71

$GPGSV,4,2,13,13,40,276,38,19,76,255,37,11,29,192,36,57,26,146,33*7D

$GPGSV,4,3,13,07,18,321,33,31,13,132,26,30,24,070,,01,06,190,*7B

$GPGSV,4,4,13,21,02,040,*4E

$GLGSV,2,1,06,87,41,026,20,88,82,221,23,81,24,209,22,77,56,059,*6D

$GLGSV,2,2,06,78,31,341,,76,21,115,*6F

$GBGSV,3,1,10,156,50,230,36,148,61,162,36,150,61,179,36,153,44,263,34*6F

$GBGSV,3,2,10,154,31,297,35,155,24,173,34,157,43,312,35,151,42,120,*64

$GBGSV,3,3,10,149,40,241,,152,13,258,*6E

$GNRMC,062335.000,A,2446.4233,N,12100.4403,E,0.00,265.29,110614,,,A*7B

$GNVTG,265.29,T,,M,0.00,N,0.0,K,A*19

$GNZDA,062336.000,11,06,2014,,*4B

3.2 GGA - Global Positioning System Fix Data

- Example

  $GPGGA,062335.000,2446.4233,N,12100.4403,E,1,10,0.9,121.7,M,15.0,M,,0000*57

  $GLGGA,062335.000,2446.4233,N,12100.4403,E,1,01,0.9,121.7,M,15.0,M,,0000*4B

- Explanation

Contents	Example	Unit	Explanation
Message ID	$GPGGA $GLGGA		GGA protocol header GPGGA: Data is from GPS only GLGGA: Data is from GLONASS only GBGGA: Data is from BDS only GNGGA: Data is from multiple constellations
UTC Time	064427.000		hhmmss.sss hh: hour, mm: minute, ss: second
Latitude	2446.4669		ddmm.mmmm dd: degree, mm.mmmm: minute
North/South	N		N: North Latitude, S: South Latitude
Longitude	12100.4261		dddmm.mmmm dd: degree, mm.mmmm: minute
East/West	E		E: East Longitude, W: West Longitude
Position Fix Indicator	1		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	07		Number of satellites used in positioning calculation (0 to 12)
HDOP	1.2		Horizontal Dilution of Precision
MSL Altitude	251.0	meters	
Unit	M		Meters
Geoidal separation	15.0	meters	Geoid-to-ellipsoid separation. Ellipsoid altitude: Geoid MSL altitude – Geoid separation
Units	M		Meters
Age of Diff. Corr.		second	Null fields when DGPS is not used
Diff. Ref. Station ID	0000		Range is 0 to 1023. Null fields when DGPS is not used.
checksum	*53		
<CR><LF>			End of sentence

3.3 GNS – GNSS Fix Data

- Example

  $GNGNS,033205.000,2446.4210,N,12100.4416,E,ANNA,11,0.8,121.5,15.0,,0000*62

- Explanation

Contents	Example	Unit	Explanation
Message ID	$GNGNS		GNS protocol header GPGNS: Data is from GPS only GLGNS: Data is from GLONASS only GBGNS: Data is from BDS only GNGNS: Data is from multiple constellations
UTC Time	033205.000		hhmmss.sss hh: hour, mm: minute, ss: second
Latitude	2446.4210		ddmm.mmmm dd: degree, mm.mmmm: minute
North/South	N		N: North Latitude, S: South Latitude
Longitude	12100.4416		dddmm.mmmm dd: degree, mm.mmmm: minute
East/West	E		E: East Longitude, W: West Longitude
Mode Indicator	ANNA		Variable length valid character field type. The first character indicates the use of GPS satellites, the second character indicates the use of GLONASS satellites, and the fourth character indicates the use of BEIDOU satellites. The third one is reserved. Characters are: A: Autonomous D: Differential E: Estimated F: Float RTK M: Manual Input

			N: No fix P: Precise R: Real Time Kinematic S: Simulator
Satellites Used	11		Number of satellites used in the fix. Range is 0 to 99.
HDOP	0.8		Horizontal Dilution of Precision
MSL Altitude	121.5	meters	Mean Sea Level altitude
Geoid Separation	15.0	meters	Geoid-to-ellipsoid separation. Ellipsoid altitude: Geoid MSL altitude - Geoid separation
Age of Diff. Data		second	Null fields when DGPS is not used.
Diff. Ref. Station ID	0000		Null fields when DGPS is not used.
checksum	*62		
<CR><LF>			End of sentence

3.4 GLL - Geographic Position - Latitude / Longitude

- Example

  $GNGLL,2446.4233,N,12100.4403,E,062335.000,A,A*45

- Explanation

Contents	Example	Unit	Explanation
Message ID	$GNGLL		GLL protocol header GPGLL: Data is from GPS only GLGLL: Data is from GLONASS only GBGLL: Data is from BDS only GNGLL: Data is from multiple constellations
Latitude	2446.8619		ddmm.mmmm dd: degree, mm.mmmm: minute
North/South	N		N: North Latitude, S: South Latitude
Longitude	12100.2579		dddmm.mmmm dd: degree, mm.mmmm: minute
East/West	E		E: East Longitude, W: West Longitude
UTC Time	060725.000		hhmmss.sss hh: hour, mm: minute, ss: second
Status	A		A: Data valid, V: Data invalid
Mode Indicator	A		A: Autonomous M: Manual D: DGPS S: Simulation E: Dead Reckoning N: Data Invalid
checksum	*7E		
<CR><LF>			End of sentence

3.5 GSA - GNSS DOP and Active Satellites

- Example

  $GNGSA,A,3,16,23,27,03,13,19,11,57,07,31,,,1.6,0.9,1.4*2A

  $GNGSA,A,3,87,,,,,,,,,,,,1.6,0.9,1.4*28

- Explanation

Contents	Example	Explanation
Message ID	$GNGSA	GSA protocol header GPGSA: Data is from GPS only GLGSA: Data is from GLONASS only GBGSA: Data is from BDS only GNGSA: Data is from multiple constellations
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 (> 3 Satellite s used)
Satellite used in solution	05	Satellite on Channel 1
Satellite used in solution	02	Satellite on Channel 2
…		Display of quantity used (12 max)
PDOP	1.8	Position Dilution of Precision
HDOP	1.0	Horizontal Dilution of Precision
VDOP	1.5	Vertical Dilution of Precision
checksum	*11	
<CR><LF>		End of sentence

- Satellite ID Mapping

Value	Constellation	Description
1 to 32	GPS	Satellite PRN code
33 to 51	SBAS	PRN - 87
52 to 56	QZSS SAIF	PRN - 131
57 to 61	QZSS IMES	PRN - 136
65 to 96	GLONASS	Slot # + 64
121 to 147	BEIDOU IGSO/MEO (PRNs 11 to 37)	PRN + 110
148 to 152	BEIDOU GEO (PRNs 1 to 5)	PRN + 147
153 to 157	BEIDOU IGSO/MEO (PRNs 6 to 10)	PRN + 147
205 to 254	Galileo	PRN + 204

3.6 GSV - GNSS Satellites in View

- Example

  $GPGSV,4,1,13,16,39,040,41,23,39,232,40,27,62,020,40,03,72,316,39*71

  $GPGSV,4,2,13,13,40,276,38,19,76,255,37,11,29,192,36,57,26,146,33*7D

  $GPGSV,4,3,13,07,18,321,33,31,13,132,26,30,24,070,,01,06,190,*7B

$GPGSV,4,4,13,21,02,040,*4E

$GLGSV,2,1,06,87,41,026,20,88,82,221,23,81,24,209,22,77,56,059,*6D

$GLGSV,2,2,06,78,31,341,,76,21,115,*6F

$GBGSV,3,1,10,148,61,162,36,150,61,179,36,153,45,263,33,154,31,296,35*63

$GBGSV,3,2,10,155,24,173,34,156,35,186,36,157,43,312,35,151,42,120,*62

$GBGSV,3,3,10,149,40,241,,152,13,258,*6E

- Explanation

Contents	Example	Unit	Explanation
Message ID	$GPGSV $GLGSV $GBGSV		GSV protocol header GPGSV: GPS SV list GLGSV: GLONASS SV list GBGSV: BDS SV list
Number of messages	2		Total number of GSV messages to be sent in this Group
Message number	1		Message number in this group of GSV messages
Satellites in view	07		Number of satellites visible from receiver
Satellite ID number	07		Channel 1 (GPS: Range 1 to 32)
Elevation	79	degrees	Elevation angle of satellite as seen from receiver channel 1 (00 to 90)
Azimuth	048	degrees	Satellite azimuth as seen from receiver channel 1 (000 to 359)
SNR (C/No)	42	dBHz	Received signal level C/No from receiver channel 1 (00 to 99, null when not tracking)
…			
Satellite ID number	27		Channel 4 (GPS: Range 1 to 32)
Elevation	27	degrees	Elevation angle of satellite as seen from receiver channel 4 (00 to 90)
Azimuth	138	degrees	Satellite azimuth as seen from receiver channel 4 (000 to 359)
SNR (C/No)	42	dBHz	Received signal level C/No from receiver channel 4 (00 to 99, null when not tracking)
checksum	*71		
<CR><LF>			End of sentence

3.7 RMC - Recommended Minimum Specific GNSS Data

- Example

$GNRMC,062335.000,A,2446.4233,N,12100.4403,E,0.00,265.29,110614,,,A*7B

- Explanation

Contents	Example	Unit	Explanation
Message ID	$GNRMC		RMC protocol header GPRMC: Data is from GPS only GLRMC: Data is from GLONASS only GBRMC: Data is from BDS only

			GNRMC: Dats is from multiple constellations
UTC Time	151229.487		hhmmss.sss hh: hour, mm: minute, ss: second
Status	A		A: Data valid, V: Data invalid
Latitude	3723.2475		ddmm.mmmm dd: degree, mm.mmmm: minute
North/South	N		N: North Latitude, S: South Latitude
Longitude	12148.3416		dddmm.mmmm dd: degree, mm.mmmm: minute
East/West	W		E: East Longitude, W: West Longitude
Speed over ground	0.13	knots	Receiver's speed
Course over ground	309.62	degrees	Receiver's direction of travel Moving clockwise starting at due north
Date	120598		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	A		A: Autonomous M: Manual D: DGPS S: Simulation E: Dead Reckoning N: Data Invalid
checksum	*5F		
<CR><LF>			End of sentence

3.8 VTG - Course over Ground and Ground Speed

- Example

  $GNVTG,346.57,T,,M,1.96,N,3.6,K,A*1B

- Explanation

Contents	Example	Unit	Explanation
Message ID	$GNVTG		VTG protocol header GPVTG: Data is from GPS only GLVTG: Data is from GLONASS only GBVTG: Data is from BDS only GNVTG: Data is from multiple constellations
Course over ground	346.57	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	1.96	knots	Measured horizontal speed
Unit	N		Knots
Speed over ground	3.6	km/hr	Measured horizontal speed
Unit	K		km/hr

Mode Indicator	A		A: Autonomous M: Manual D: DGPS S: Simulation E: Dead Reckoning N: Data Invalid
checksum	*1B		
<CR><LF>			End of sentence

3.9 ZDA - SiRF Timing Message

- Example

  $GNZDA,062336.000,11,06,2014,,*4B

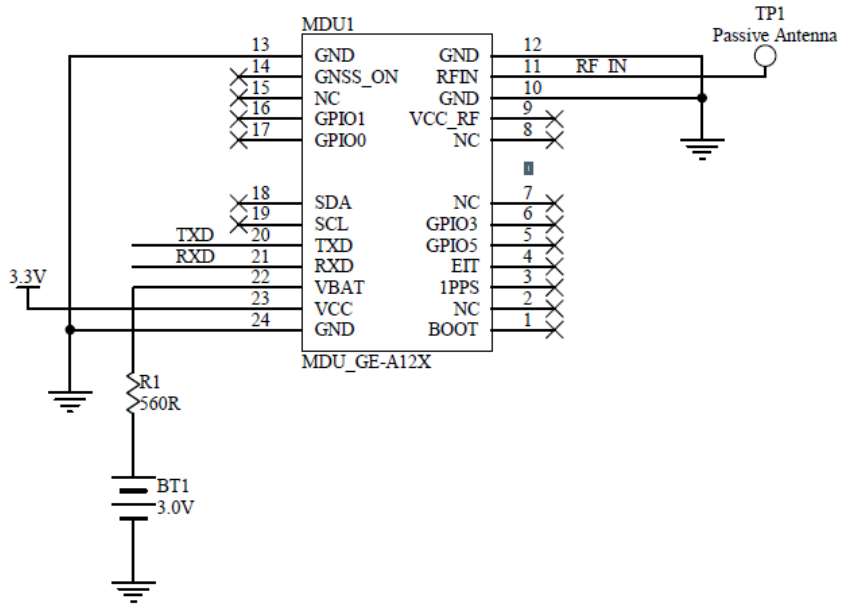
- Explanation

Contents	Example	Unit	Explanation
Message ID	$GNZDA		ZDA protocol header
UTC time	062336.000		Either using valid IONO/UTC or estimated from default leap seconds
Day	11		Day according to UTC time (01 to 31)
Month	06		Month according to UTC time (01 to 12)
Year	2014		Year according to UTC time (1980 to 2079)
Local zone hour		hour	Offset from UTC (set to 00)
Local zone minutes		minute	Offset from UTC (set to 00)
checksum	*4B		
<CR><LF>			End of sentence

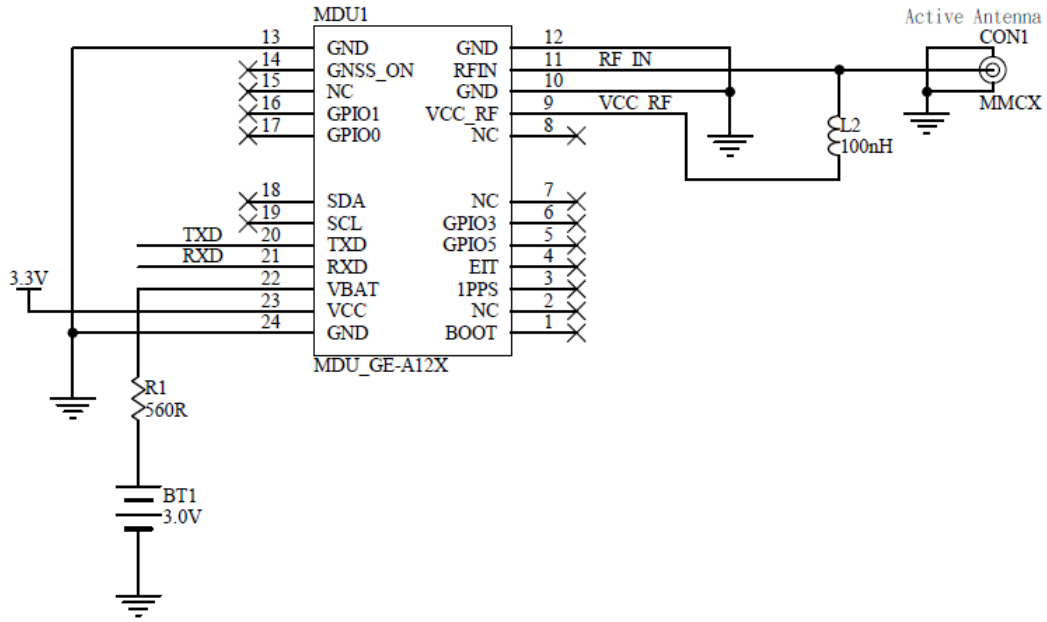
4 Applications

4.1 Application of Passive Antenna

Connect RF_IN pin to a passive antenna, e.g. patch antenna. Please note that the signal from passive antenna is very weak and thus the path should be well protected from noise signal and the length should be as short as possible.



4.2 Application of Active Antenna

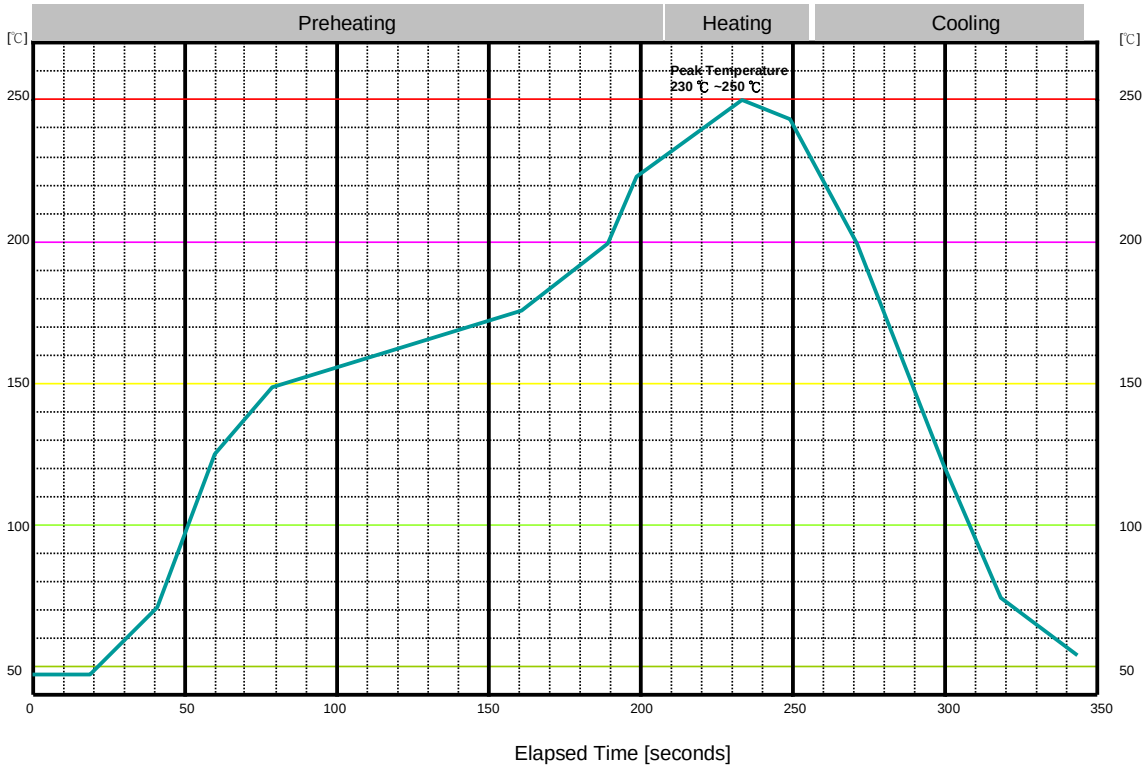


With our special design, it's very easy to power an external active antenna with the internal power (derived from VCC) of GE-A12. Just connecting VCC_RF (pin 14) and V_ANT (pin 15) is enough to power an external active antenna. The working voltage of external antenna is same as VCC. In addition, external active antenna short circuit protection is provided.

4.3 Reference Soldering Profile

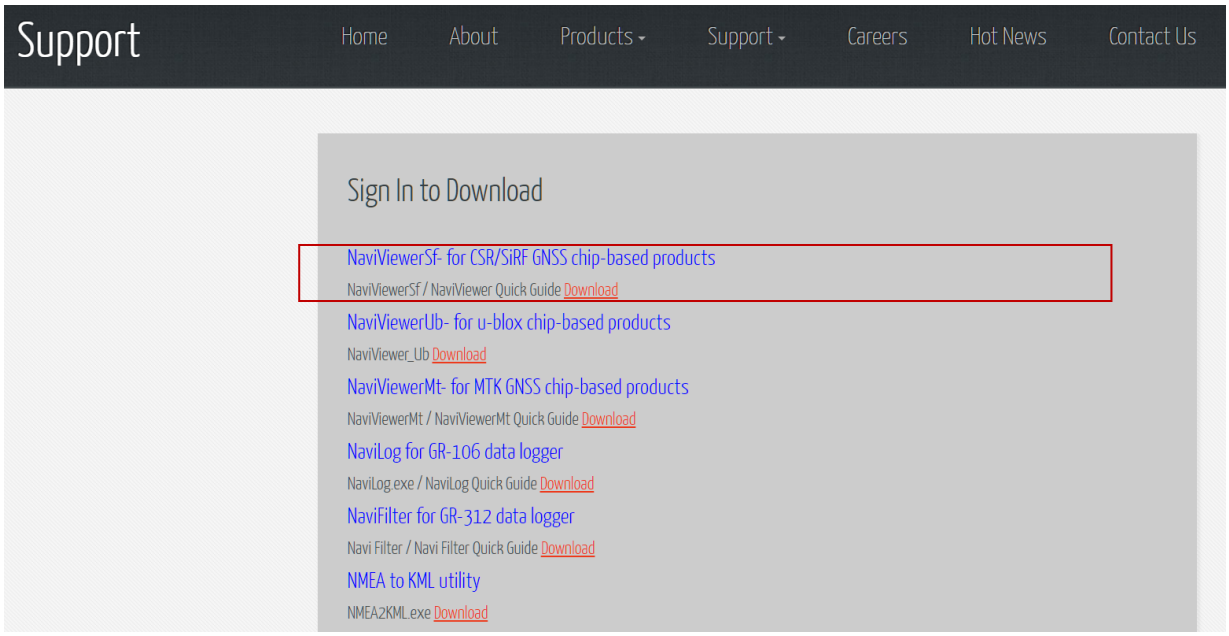
The following soldering profile is for the reference purpose only. The best profile depends on the reflow equipment.

Reference Lead-free Soldering Profile



4.4 Navisys GNSS Viewer Tool

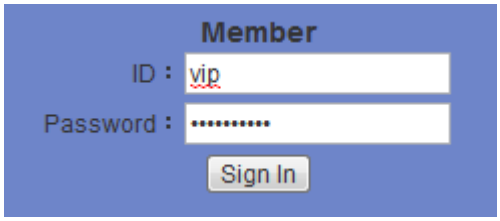
The GNSS viewer tool, **NaviViewerSf,** is ready for download from Navisys support web page - http://www.navisys.com.tw/support.html.

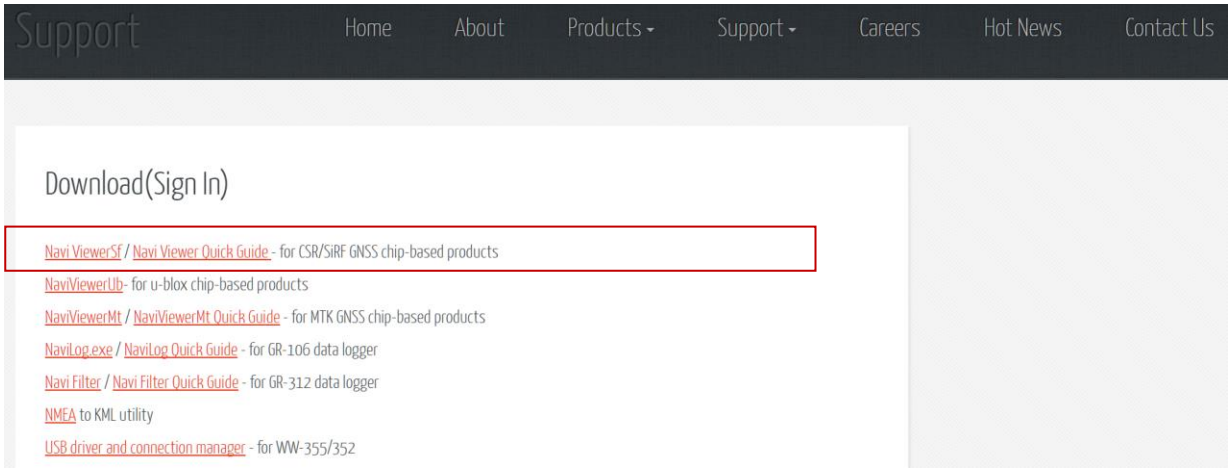


Please sign in to download the NaviViewerSf with

ID: vip

Password: navi-utility





NaviViewerSf GNSS Viewer Tool

GPS+GLONASS **GPS+BEIDOU**

1. Signal strength is represented by the bar length and color
   - Blue: ≧ 50, green: ≧ 40, yellow: ≧ 30, red: < 30
2. Satellites of different systems are displayed by different bar colors:
   - GPS: one color
   - QZSS: purple rectangle at the bottom
   - GLONASS: cyan rectangle at the bottom
   - BEIDOU(Compass): brown rectangle at the bottom

5 Electrical and Environmental Data

Electrical Data

Power Supply	V_BAT: 2.6 ~ 3.4 VDC VCC: 2.6 ~ V_BAT + 0.3 or VCC: 3.3 ~ 4.4 VDC if V_BAT is not connected. e.g. V_BAT=3.3V, VCC=3.3V
Power Consumption (VCC at 3.3V)	VCC: 26 mA/average tracking (42dB-Hz, 8 SVs) V_BAT: 41.3 uA
Digital I/O	V_{IH}: 0.7 x V_BAT ~ 3.6V, V_{IL}: 0 ~ 0.4V V_{OH}: ≧ 0.75 x V_BAT, V_{OL}: ≦ 0.4V
Protocols	NMEA V4.00 (default), OSP

Environmental Data

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

6 Ordering Information

Each product has a default configuration. Customer is highly advised to check the product configuration before ordering.

GE-A12N	9600bps GGA, GSA, RMC, VTG@1Hz, GSV@1/5Hz