

| Product name | Description | Version |
|--------------|---|---------|
| LS2009G-G-T | GNSS smart antenna module/TTL,9600BPS,30x30mm | V1.0 |
| LS2009G-G-R | GNSS smart antenna module/RS232,9600BPS,30x30mm | |

Datasheet of GNSS smart antenna module, LS2009G-G



Top View



LS2009G-G-T



LS2009G-G-R

1 Introduction

LS2009G-G series products are complete standalone GNSS smart antenna modules, including an embedded antenna and GNSS receiver circuits, designed for a broad spectrum of OEM system applications. The product is based on the proven technology found in LOCOSYS GNSS SMD type receiver ST-1612-G that uses STMicroelectronics chip solution. It can simultaneously acquire and track multiple satellite constellations that include GPS, GLONASS, GALILEO, QZSS and SBAS. Besides, it can provide you with superior sensitivity and performance even in urban canyon and dense foliage environment. Its far-reaching capability meets the sensitivity requirements of car navigation as well as other location-based applications.

2 Features

- STMicroelectronics high sensitivity solution
- Support GPS, GLONASS, GALILEO and QZSS
- Capable of SBAS (WAAS, EGNOS, MSAS, GAGAN)
- 32 tracking channels and 2 fast acquisition channels
- Low power consumption
- Fast TTFF at low signal level
- Build-in micro battery to reserve system data for rapid satellite acquisition
- LED indicator for position fix or not fix

3 Application

- Personal positioning and navigation
- Automotive navigation
- Marine navigation

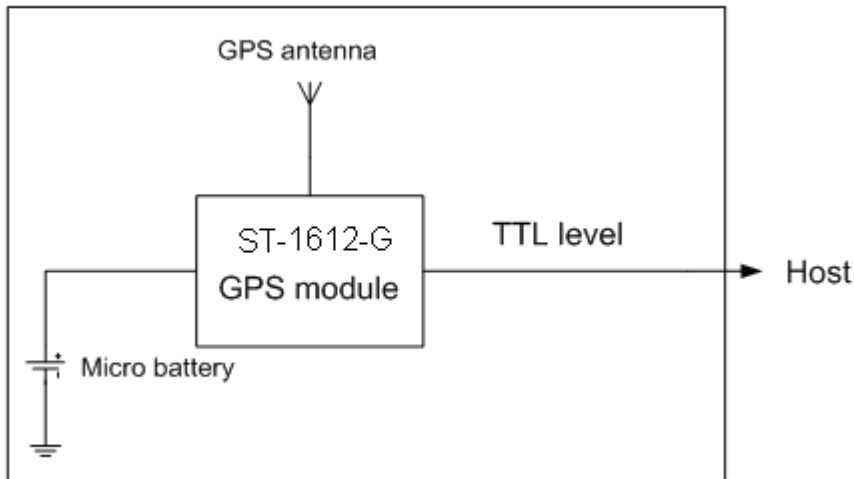


Fig 3-1 System block diagram of LS2009G-G-T

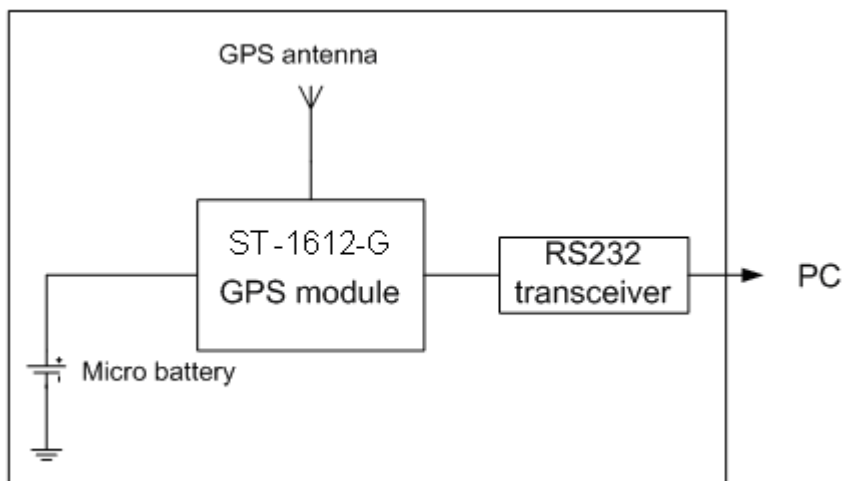


Fig 3-2 System block diagram of LS2009G-G-R

4 GNSS receiver

| | | |
|-------------------|--|--|
| GPS Chip | STMicroelectronics high quality chip | |
| Frequency | GPS: L1 1575.42MHz, C/A code GLONASS: L1 1598.0625MHz ~ 1605.375MHz, C/A code | |
| Channels | 32 tracking channels and 2 fast acquisition channels | |
| Update rate | 1Hz | |
| Acquisition Time | 35s (Cold Start ,Open Sky) | |
| Position Accuracy | Autonomous | < 1.6m (CEP) |
| Max. Altitude | 18000 m (60000 ft) max | |
| Max. Velocity | 515 m/sec (1000 knots) max | |
| Protocol Support | NMEA 0183 ver 3.0 | 9600 bps, 8 data bits, no parity, 1 stop bits (default) 1Hz: GGA, GLL, GSA, GSV, RMC, VTG |

5 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.

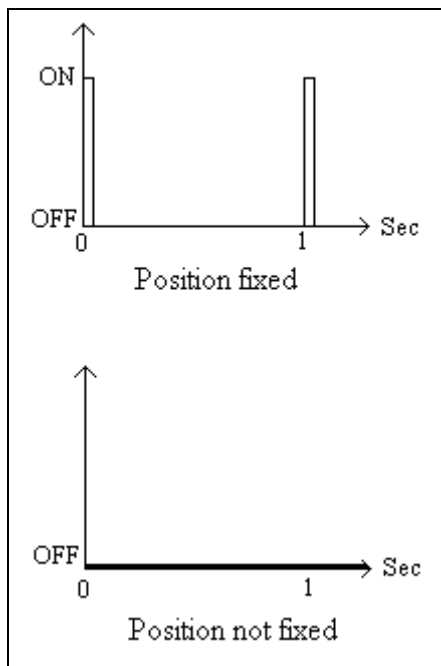


Fig 5.1 LED indicator of positioning status

6 Pin assignment and descriptions

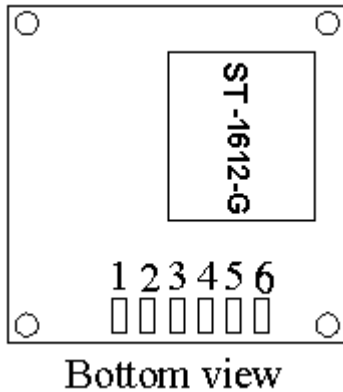


Fig 6.1 Pin assignment of LS2009G-G-T, LS2009G-G-R

● **LS2009G-G-T**

| Pin # | Name | Type | Description |
|-------|---------------------|------|-------------------------------|
| 1 | VCC | P | Power input |
| 2 | RX | I | Data input (TTL level) |
| 3 | TX | O | Data output (TTL level) |
| 4 | GND | P | Ground |
| 5 | 1PPS Output | O | 1PPS output , 100ms pulse/sec |
| 6 | RTCM ⁽¹⁾ | I | RTCM data input |

1. It supports these RTCM message types: type 1, 2, 3, and 9. These four message types were all defined in RTCM SC-104 v2.0 spec, and also the same in v2.1, v2.2, v2.3 and v3.0.

● **LS2009G-G-R**

| Pin # | Name | Type | Description |
|-------|---------------------|------|-------------------------------|
| 1 | VCC | P | Power input |
| 2 | RX | I | Data input (RS232 level) |
| 3 | TX | O | Data output (RS232 level) |
| 4 | GND | P | Ground |
| 5 | 1PPS Output | O | 1PPS output , 100ms pulse/sec |
| 6 | RTCM ⁽¹⁾ | I | RTCM data input |

1. It supports these RTCM message types: type 1, 2, 3, and 9. These four message types were all defined in RTCM SC-104 v2.0 spec, and also the same in v2.1, v2.2, v2.3 and v3.0.

7 DC & Temperature characteristics

7.1 DC Electrical characteristics

| Parameter | Symbol | Product | Min. | Typ. | Max. | Units |
|---------------------------|-----------------|-------------|------|-------------------|------|-------|
| Input voltage | VCC | LS2009G-G-T | 3 | 3.3 | 4.3 | V |
| | | LS2009G-G-R | 4 | 5 | 6 | |
| Input current | Icc | LS2009G-G-T | | 52 ⁽¹⁾ | | mA |
| | | LS2009G-G-R | | 56 ⁽¹⁾ | | |
| High Level Input Voltage | V _{IH} | LS2009G-G-T | 2.0 | | 3.6 | V |
| Low Level Input Voltage | V _{IL} | LS2009G-G-T | -0.3 | | 0.8 | V |
| High Level Input Current | I _{IH} | LS2009G-G-T | -1 | | 1 | uA |
| Low Level Input Current | I _{IL} | LS2009G-G-T | -1 | | 1 | uA |
| High Level Output Voltage | V _{OH} | LS2009G-G-T | 2.4 | | 3.3 | V |
| Low Level Output Voltage | V _{OL} | LS2009G-G-T | | | 0.4 | V |
| High Level Output Current | I _{OH} | LS2009G-G-T | | 2 | | mA |
| Low Level Output Current | I _{OL} | LS2009G-G-T | | 2 | | mA |

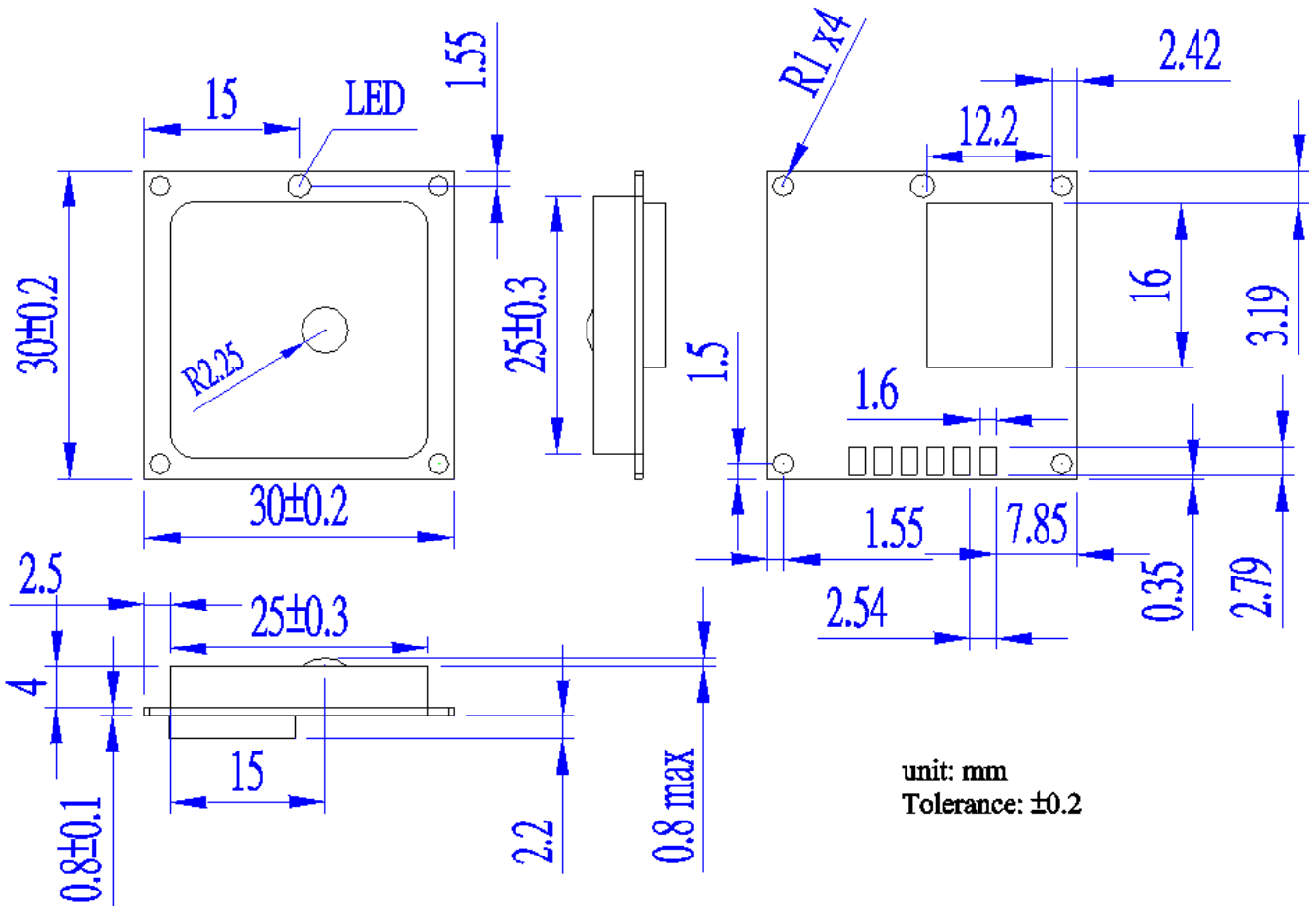
1. Measured when position fix is available.

7.2 Temperature characteristics

| Parameter | Symbol | Product | Min. | Typ. | Max. | Units |
|-----------------------|--------|-------------|------|------|------|-------|
| Operating Temperature | Topr | LS2009G-G-T | -40 | - | 85 | °C |
| | | LS2009G-G-R | | | | |
| Storage Temperature | Tstg | LS2009G-G-T | -40 | 25 | 85 | °C |
| | | LS2009G-G-R | | | | |

8 Mechanical specification

- LS2009G-G-T, LS2009G-G-R



9 software interface

9.1 NMEA output message

Table 9-1 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 |

● GGA--- Global Positioning System Fixed Data

Table 9-2 contains the values for the following example:

\$GPGGA,110830.000,2503.71293,N,12138.74423,E,1,17,0.7,116.10,M,15.3,M,,*63

Table9- 2 GGA Data Format

| Name | Example | Units | Description |
|-----------------------|-------------|--------|---|
| Message ID | \$GPGGA | | GGA protocol header |
| UTC Time | 110830.000 | | hhmmss.sss |
| Latitude | 2503.71293 | | ddmm.mmmmm |
| N/S indicator | N | | N=north or S=south |
| Longitude | 12138.74423 | | dddmm.mmmmm |
| E/W Indicator | E | | E=east or W=west |
| GPSQuality | 1 | | See Table 5-3 |
| Satellites Used | 17 | | Range 0 to 24 |
| HDOP | 0.7 | | Horizontal Dilution of Precision, max:99.0 |
| MSL Altitude | 116.10 | meters | Max: 999.99 |
| Units | M | meters | |
| Geoid Separation | 15.3 | meters | Range -9999.9 to 9999.9 |
| Units | M | meters | |
| Age of Diff. Corr. | | second | Null fields when DGPS is not used |
| Diff. Ref. Station ID | | | Null fields when Reference Station ID is not used |
| Checksum | *63 | | |
| <CR> <LF> | | | End of message termination |

Table 9-3 Position Fix Indicators

| Value | Description |
|-------|------------------|
| 0 | invalid |
| 1 | GPS |
| 2 | Differential GPS |

● GLL--- Geographic Position – Latitude/Longitude

Table 9-4 contains the values for the following example:

\$GPGLL,2503.71293,N,12138.74423,E,110830.000,A,A*57

Table 9-4 GLL Data Format

| Name | Example | Units | Description |
|---------------|-------------|-------|--|
| Message ID | \$GPGLL | | GLL protocol header |
| Latitude | 2503.71293 | | ddmm.mmmmm |
| N/S indicator | N | | N=north or S=south |
| Longitude | 12138.74423 | | dddmm.mmm |
| E/W indicator | E | | E=east or W=west |
| UTC Time | 110830.000 | | hhmmss.sss |
| Status | A | | A=data valid or V=data not valid |
| Mode | A | | A=autonomous, D=differential, N=Data not valid |
| Checksum | *57 | | |
| <CR> <LF> | | | End of message termination |
| Message ID | \$GPGLL | | GLL protocol header |

● **GSA---GNSS DOP and Active Satellites**

Table 9-5,5-6,5-7 contains the values for the following examples:

\$GNGSA,A,3,19,08,07,17,01,11,20,28,32,,,,,1.3,0.7,1.1*20

\$GNGSA,A,3,78,66,77,79,65,88,81,,,,,1.3,0.7,1.1*22

\$GNGSA,A,3,193,,,,,,,,,,,,,1.3,0.7,1.1*12

Table 9-5 GSA Data Format

| Name | Example | Units | Description |
|----------------------|-----------------|-------|---|
| Message ID | \$GNGSA | | GSA protocol |
| Mode 1 | A | | See Table 5-8 |
| Mode 2 | 3 | | See Table 5-9 |
| ID of satellite used | 19,08,07,17,... | | PRNs of satellites used for fix (space for 12 satellites) |
| PDOP | 1.3 | | Position Dilution of Precision, max:99.0 |
| HDOP | 0.7 | | Horizontal Dilution of Precision, max:99.0 |
| VDOP | 1.1 | | Vertical Dilution of Precision, max:99.0 |
| Checksum | *20 | | |
| <CR> <LF> | | | End of message termination |

Table 9-6 GSA Data Format for GLONASS

| Value | Description |
|----------------------|-----------------|
| Message ID | \$GNGSA |
| Mode 1 | A |
| Mode 2 | 3 |
| ID of satellite used | 78,66,77,79,... |
| PDOP | 1.3 |
| HDOP | 0.7 |
| VDOP | 1.1 |
| Checksum | *22 |
| <CR> <LF> | |

Table 9-7 GSA Data Format for QZSS

| Value | Description |
|------------|-------------|
| Message ID | \$GNGSA |
| Mode 1 | A |
| Mode 2 | 3 |

| | |
|----------------------|-----|
| ID of satellite used | 193 |
| PDOP | 1.3 |
| HDOP | 0.7 |
| VDOP | 1.1 |
| Checksum | *12 |
| <CR> <LF> | |

Table 9-8 Mode 1

| Value | Description |
|-------|---|
| M | Manual- forced to operate in 2D or 3D mode |
| A | Automatic-allowed to automatically switch 2D/3D |

Table 9-9 Mode 2

| Value | Description |
|-------|-------------------|
| 1 | Fix not available |
| 2 | 2D fix |
| 3 | 3D fix |

● GSV---GNSS Satellites in View

Table 9-10 contains the values for the following example:

```
$GNGSV,6,1,23,03,77,354,46,06,64,029,44,07,11,319,43,11,15,194,45*6F
$GNGSV,6,2,23,13,34,300,44,16,44,026,44,19,58,221,49,21,08,048*69
$GNGSV,6,3,23,23,46,259,48,24,16,172,30,30,058,35,31,21,125,44,*6B
$GNGSV,6,4,23,32,00,202,,82,48,028,39,73,30,339,41,84,18,208,41*62
$GNGSV,6,5,23,83,74,205,43,70,00,233,,80,56,047,42,79,29,108,*6A
$GNGSV,6,6,23,71,01,279,36,33,00,000,,193,00,000,41,,,,*66
```

Table 9-10 GSV Data Format

| Name | Example | Units | Description |
|---------------------------------------|---------|---------|--|
| Message ID | \$GNGSV | | GSV protocol header |
| Total number of messages ¹ | 6 | | Range 1 to 6 |
| Message number ¹ | 1 | | Range 1 to 6 |
| Satellites in view | 23 | | |
| Satellite ID | 03 | | Channe01(Range 01 to 99) |
| Elevation | 77 | degrees | Channe01 (Range 00 to 90) |
| Azimuth | 354 | degrees | Channe01(Range 000 to 359) |
| SNR (C/No) | 46 | dB-Hz | Channe01(Range 00 to 99, null when not tracking) |
| ... | | | |
| Satellite ID | 11 | | Channe04(Range 01 to 99) |
| Elevation | 15 | degrees | Channe04 (Range 00 to 90) |
| Azimuth | 194 | degrees | Channe04(Range 000 to 359) |
| SNR (C/No) | 45 | dB-Hz | Channe04(Range 00 to 99, null when not tracking) |
| Checksum | *6F | | |

| | | | |
|-----------|--|--|----------------------------|
| <CR> <LF> | | | End of message termination |
|-----------|--|--|----------------------------|

Note:

1) Depending on the number of satellites tracked, multiple messages of GSV data may be required

● RMC---Recommended Minimum Specific GNSS Data

Table 9-11 contains the values for the following example:

```
$GPRMC,110829.000,A,2503.71293,N,12138.74423,E,0.1,0.0,230412,,A*62
```

Table 9-11 RMC Data Format

| Name | Example | Units | Description |
|---------------------|-------------|---------|--|
| Message ID | \$GPRMC | | RMC protocol header |
| UTC Time | 110829.000 | | hhmmss.sss |
| Status | A | | A=data valid or V=warning |
| Latitude | 2503.71293 | | ddmm.mmmmm |
| N/S Indicator | N | | N=north or S=south |
| Longitude | 12138.74423 | | dddmm.mmmmm |
| E/W Indicator | E | | E=east or W=west |
| Speed over ground | 0.1 | knots | max. 999.9 |
| Trackgood | 0.0 | degrees | max. 999.9 |
| Date | 230412 | | Ddmmyy |
| Magnetic variation | | degrees | max.090.0 (Not shown) |
| Variation direction | | | E=east or W=west (Not shown) |
| Mode | A | | A=autonomous, D=differential, N=Data not valid |
| Checksum | *6F | | |
| <CR> <LF> | | | End of message termination |

● VTG---Course Over Ground and Ground Speed

Table 9-12 contains the values for the following example:

```
$GPVTG,0.0,T,,M,0.1,N,0.0,K,A*0C
```

Table 9-12 VTG Data Format

| Name | Example | Units | Description |
|-------------------|---------|---------|--|
| Message ID | \$GPVTG | | VTG protocol header |
| TMGT | 0.0 | degrees | Track in reference to “true” earth poles |
| Reference | T | | True |
| TMGM | | degrees | Track in reference to “magnetic” earth poles (Not shown) |
| Reference | M | | Magnetic |
| Speed over ground | 0.1 | knots | Measured speed |
| Units | N | | Knots |
| Speed over ground | 0.0 | km/hr | Measured speed |
| Units | K | | Kilometer per hour |
| Mode | A | | A=autonomous, D=differential, N=Data not valid |
| Checksum | *0C | | |
| <CR> <LF> | | | End of message termination |

9.2 Proprietary NMEA input message

| Command | Description |
|--------------------|-----------------------|
| \$PSTMCOLD<CR><LF> | Perform a COLD start. |
| \$PSTMWARM<CR><LF> | Perform a WARM start. |
| \$PSTMHOT<CR><LF> | Perform a HOT start. |

Document change list

Revision 1.0

- First release on Sept.30. , 2014.