

| Product name | Description | Version |
|--------------|--------------------------------------------|---------|
| AH-1613 | Datasheet of AH-1613 host-based GPS module | 1.0 |

1 Introduction

LOCOSYS AH-1613 is a host-based GPS module that features high sensitivity, low power and faster location fix. This GPS module is powered by ATHEROS, it can provide you with superior sensitivity and performance even in urban canyon and dense foliage environment. With ATHEROS ESP (Ephemeris Self-Prediction) technology, it reliably predicts satellite positions for up to 5 days and delivers ESP-start time of less than 15 seconds under most conditions, without any network assistance.

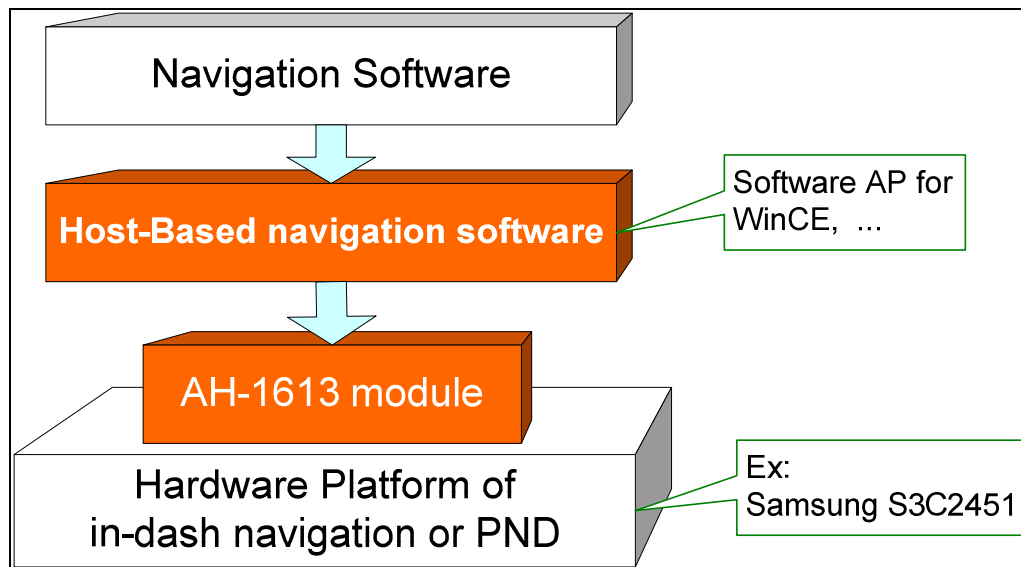


Fig 1-1 Operational diagram of AH-1613 module on an in-dash navigation platform.

2 Features

- ATHEROS high sensitivity host-based GPS solution
- No real time operation system requirement on host CPU
- Easy software integration for WinCE, Linux and Android
- Support 80-channel GPS
- Fast TTFF at low signal level
- Free ESP technology to get faster location fix
- Support SUPL
- Capable of SBAS
- SMD type with stamp holes; RoHS compliant

3 Application

- Personal positioning and navigation
- Automotive navigation
- Marine navigation

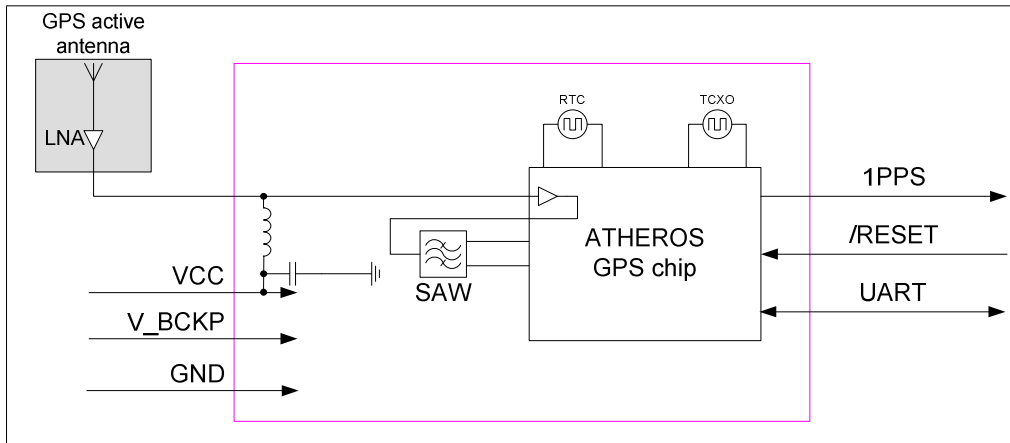


Fig 3-1 System block diagram.

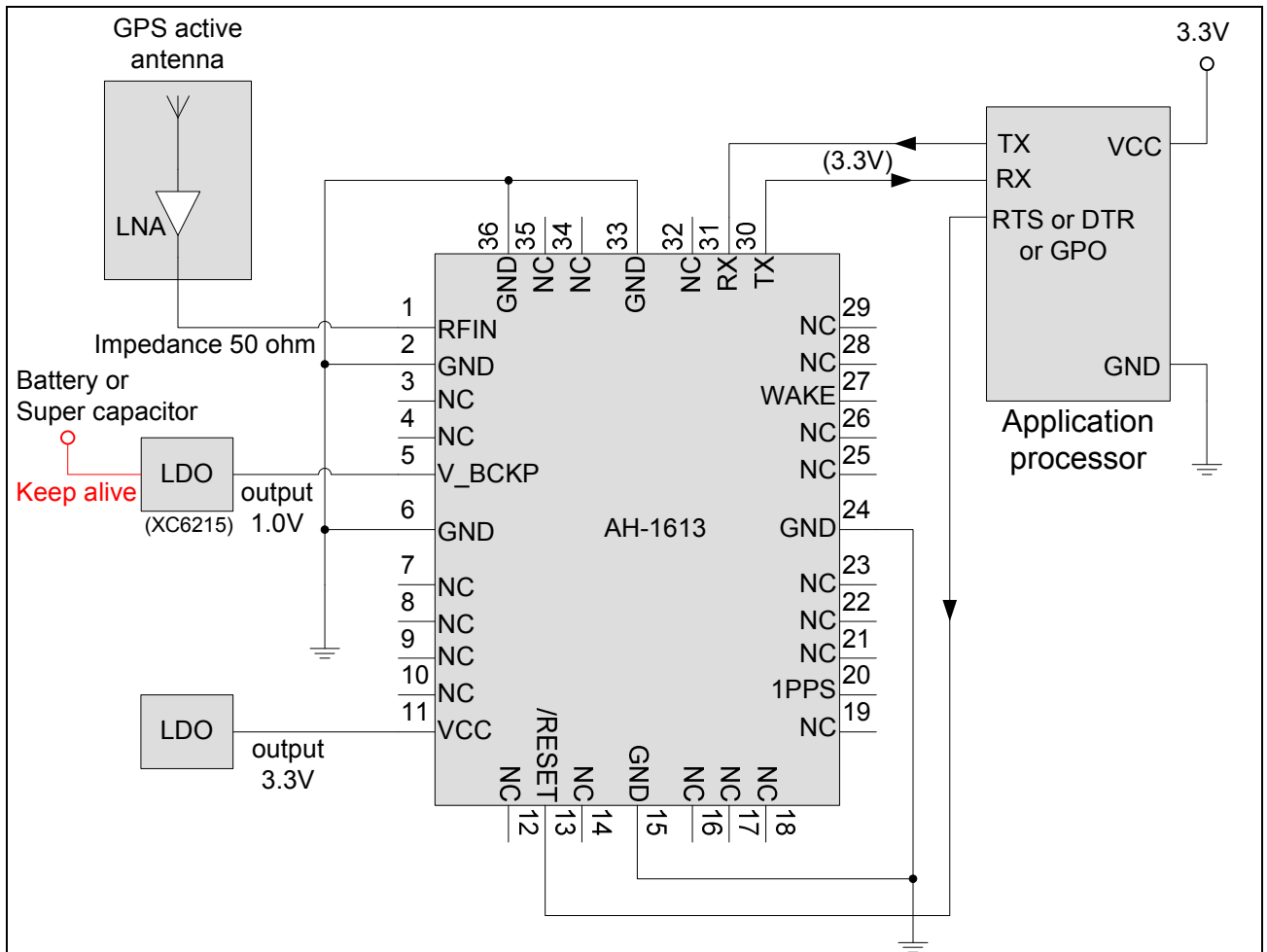


Fig 3-2 Typical application circuit

4 GPS receiver

| | | |
|----------------------------|-----------------------------------|------------------------------------------------|
| Chip | ATHEROS AR1520A | |
| Frequency | L1 1575.42MHz, C/A code | |
| Channels | Support 80 channels (16 Tracking) | |
| Update rate | 1Hz | |
| Sensitivity | Tracking | up to -161dBm (with external LNA) |
| | Cold start | up to -147dBm (with external LNA) |
| Acquisition Time | Hot start (Open Sky) | < 2s (typical) |
| | Hot start (Indoor) | < 30s |
| | Cold Start (Open Sky) | 33s (typical) |
| < 15s (typical), ESP-start | | |
| Position Accuracy | Autonomous | 3m (2D RMS) |
| | WAAS | 2.5m (depends on accuracy of correction data). |
| Max. Altitude | < 18,000 m | |
| Max. Velocity | < 515 m/s | |
| Protocol Support | NMEA 0183 ver 3.0 | Virtual COM Port ⁽¹⁾ |
| | | 1Hz: GGA, GLL, GSA, GSV, RMC, VTG |

Note 1: Application software can access AH-1613 with any baud rate.

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 |

● GGA--- Global Positioning System Fixed Data

Table 5.1-2 contains the values for the following example:

\$GPGGA,053740.000,2503.6319,N,12136.0099,E,1,08,1.1,63.8,M,15.2,M,,0000*64

Table 5.1-2 GGA Data Format

| Name | Example | Units | Description |
|------------|---------|-------|---------------------|
| Message ID | \$GPGGA | | GGA protocol header |

| | | | |
|------------------------|------------|--------|-----------------------------------|
| UTC Time | 053740.000 | | hhmmss.sss |
| Latitude | 2503.6319 | | ddmm.mmmm |
| N/S indicator | N | | N=north or S=south |
| Longitude | 12136.0099 | | dddmm.mmmm |
| E/W Indicator | E | | E=east or W=west |
| Position Fix Indicator | 1 | | See Table 5.1-3 |
| Satellites Used | 08 | | Range 0 to 12 |
| HDOP | 1.1 | | Horizontal Dilution of Precision |
| MSL Altitude | 63.8 | mters | |
| Units | M | mters | |
| Geoid Separation | 15.2 | mters | |
| Units | M | mters | |
| Age of Diff. Corr. | | second | Null fields when DGPS is not used |
| Diff. Ref. Station ID | 0000 | | |
| Checksum | *64 | | |
| <CR> <LF> | | | End of message termination |

Table 5.1-3 Position Fix Indicators

| Value | Description |
|-------|---------------------------------------|
| 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 |

● GLL--- Geographic Position – Latitude/Longitude

Table 5.1-4 contains the values for the following example:

\$GPGLL,2503.6319,N,12136.0099,E,053740.000,A,A*52

Table 5.1-4 GLL Data Format

| Name | Example | Units | Description |
|---------------|------------|-------|----------------------------------|
| Message ID | \$GPGLL | | GLL protocol header |
| Latitude | 2503.6319 | | ddmm.mmmm |
| N/S indicator | N | | N=north or S=south |
| Longitude | 12136.0099 | | dddmm.mmmm |
| E/W indicator | E | | E=east or W=west |
| UTC Time | 053740.000 | | hhmmss.sss |
| Status | A | | A=data valid or V=data not valid |

| | | | |
|-----------|-----|--|----------------------------|
| Mode | A | | A=autonomous, D=DGPS, E=DR |
| Checksum | *52 | | |
| <CR> <LF> | | | End of message termination |

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

Table 5.1-5 contains the values for the following example:

\$GPGSA,A,3,24,07,17,11,28,08,20,04,,,,,2.0,1.1,1.7*35

Table 5.1-5 GSA Data Format

| Name | Example | Units | Description |
|----------------------|---------|-------|----------------------------------|
| Message ID | \$GPGSA | | GSA protocol header |
| Mode 1 | A | | See Table 5.1-6 |
| Mode 2 | 3 | | See Table 5.1-7 |
| ID of satellite used | 24 | | Sv on Channel 1 |
| ID of satellite used | 07 | | Sv on Channel 2 |
| | | | |
| ID of satellite used | | | Sv on Channel 12 |
| PDOP | 2.0 | | Position Dilution of Precision |
| HDOP | 1.1 | | Horizontal Dilution of Precision |
| VDOP | 1.7 | | Vertical Dilution of Precision |
| Checksum | *35 | | |
| <CR> <LF> | | | End of message termination |

Table 5.1-6 Mode 1

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

Table 5.1-7 Mode 2

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

● **GSV---GNSS Satellites in View**

Table 5.1-8 contains the values for the following example:

\$GPGSV,3,1,12,28,81,285,42,24,67,302,46,31,54,354,,20,51,077,46*73

\$GPGSV,3,2,12,17,41,328,45,07,32,315,45,04,31,250,40,11,25,046,41*75

\$GPGSV,3,3,12,08,22,214,38,27,08,190,16,19,05,092,33,23,04,127,*7B

Table 5.1-8 GSV Data Format

| Name | Example | Units | Description |
|---------------------------------------|---------|---------|----------------------------------------------------|
| Message ID | \$GPGSV | | GSV protocol header |
| Total number of messages ¹ | 3 | | Range 1 to 3 |
| Message number ¹ | 1 | | Range 1 to 3 |
| Satellites in view | 12 | | |
| Satellite ID | 28 | | Channel 1 (Range 01 to 32) |
| Elevation | 81 | degrees | Channel 1 (Range 00 to 90) |
| Azimuth | 285 | degrees | Channel 1 (Range 000 to 359) |
| SNR (C/No) | 42 | dB-Hz | Channel 1 (Range 00 to 99, null when not tracking) |
| Satellite ID | 20 | | Channel 4 (Range 01 to 32) |
| Elevation | 51 | degrees | Channel 4 (Range 00 to 90) |
| Azimuth | 077 | degrees | Channel 4 (Range 000 to 359) |
| SNR (C/No) | 46 | dB-Hz | Channel 4 (Range 00 to 99, null when not tracking) |
| Checksum | *73 | | |
| <CR> <LF> | | | End of message termination |

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

● RMC---Recommended Minimum Specific GNSS Data

Table 5.1-9 contains the values for the following example:

\$GPRMC,053740.000,A,2503.6319,N,12136.0099,E,2.69,79.65,100106,,A*53

Table 5.1-9 RMC Data Format

| Name | Example | Units | Description |
|--------------------|------------|---------|----------------------------------|
| Message ID | \$GPRMC | | RMC protocol header |
| UTC Time | 053740.000 | | hhmmss.sss |
| Status | A | | A=data valid or V=data not valid |
| Latitude | 2503.6319 | | ddmm.mmmm |
| N/S Indicator | N | | N=north or S=south |
| Longitude | 12136.0099 | | dddmm.mmmm |
| E/W Indicator | E | | E=east or W=west |
| Speed over ground | 2.69 | knots | True |
| Course over ground | 79.65 | degrees | |
| Date | 100106 | | ddmmyy |
| Magnetic variation | | degrees | |
| Variation sense | | | E=east or W=west (Not shown) |
| Mode | A | | A=autonomous, D=DGPS, E=DR |
| Checksum | *53 | | |
| <CR> <LF> | | | End of message termination |

● **VTG---Course Over Ground and Ground Speed**

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

\$GPVTG,79.65,T,,M,2.69,N,5.0,K,A*38

Table 5.1-10 VTG Data Format

| Name | Example | Units | Description |
|--------------------|---------|---------|----------------------------|
| Message ID | \$GPVTG | | VTG protocol header |
| Course over ground | 79.65 | degrees | Measured heading |
| Reference | T | | True |
| Course over ground | | degrees | Measured heading |
| Reference | M | | Magnetic |
| Speed over ground | 2.69 | knots | Measured speed |
| Units | N | | Knots |
| Speed over ground | 5.0 | km/hr | Measured speed |
| Units | K | | Kilometer per hour |
| Mode | A | | A=autonomous, D=DGPS, E=DR |
| Checksum | *38 | | |
| <CR> <LF> | | | End of message termination |

5.2 Proprietary NMEA input message

Please refer to ATHEROS proprietary message.

6 Pin assignment and descriptions

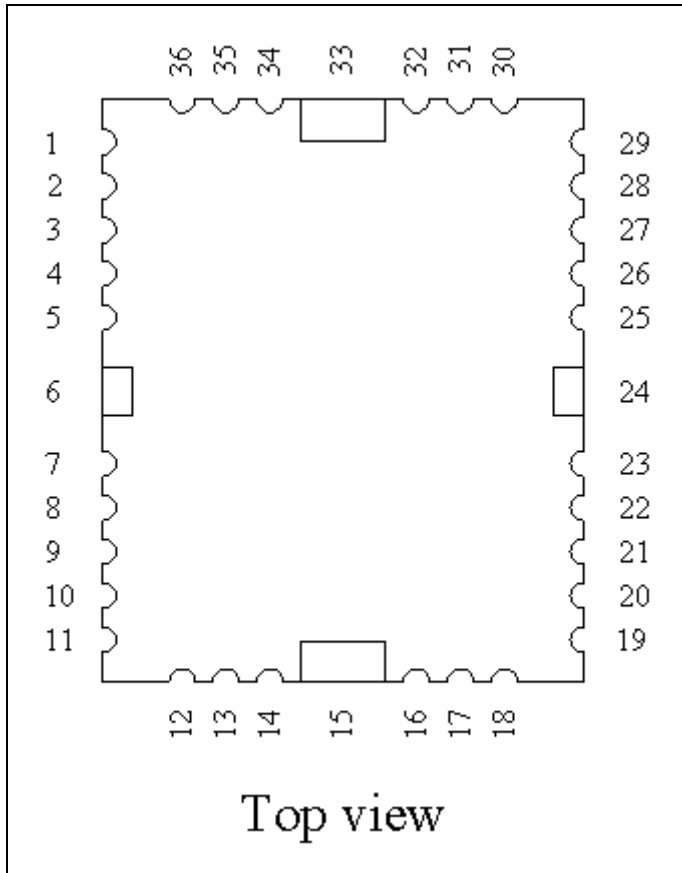


Table 6-1 Pin descriptions

| Pin # | Name | Type | Description | Note |
|-------|--------|------|----------------------------------------------------------------------------------------|------|
| 1 | RFIN | I | GPS RF signal input | 1 |
| 2 | GND | P | Ground | |
| 3 | NC | | Not connected | |
| 4 | NC | | Not connected | |
| 5 | V_BCKP | P | Backup battery supply voltage | 2 |
| 6 | GND | P | Ground | |
| 7 | NC | | Not connected | |
| 8 | NC | | Not connected | |
| 9 | NC | | Not connected | |
| 10 | NC | | Not connected | |
| 11 | VCC | P | DC supply voltage | |
| 12 | NC | | Not connected | |
| 13 | /RESET | I | Reset input. Connect this pin to RTS or DTR or output pin of application processor. | |

| | | | | |
|----|------|---|-------------------------------------|--|
| 14 | NC | | Not connected | |
| 15 | GND | P | Ground | |
| 16 | NC | | Not connected | |
| 17 | NC | | Not connected | |
| 18 | NC | | Not connected | |
| 19 | NC | | Not connected | |
| 20 | 1PPS | O | Pulse per second (default disabled) | |
| 21 | NC | | Not connected | |
| 22 | NC | | Not connected | |
| 23 | NC | | Not connected | |
| 24 | GND | P | Ground | |
| 25 | NC | | Not connected | |
| 26 | NC | | Not connected | |
| 27 | WAKE | I | Wake up input. Do not connect. | |
| 28 | NC | | Not connected | |
| 29 | NC | | Not connected | |
| 30 | TX | O | Serial output (Default NMEA) | |
| 31 | RX | I | Serial input (Default NMEA) | |
| 32 | NC | | Not connected | |
| 33 | GND | P | Ground | |
| 34 | NC | | Not connected | |
| 35 | NC | | Not connected | |
| 36 | GND | P | Ground | |

<Note>

1. No short circuit protection is inside the module.
2. In order to get Hot Start and free ESP advantage, this pin must be always powered during the period of effective ESP.

7 DC & Temperature characteristics

7.1 Absolute maximum ratings

| Parameter | Symbol | Ratings | Units |
|------------------------------|--------|----------|-------|
| Input Voltage | VCC | 3.6 | V |
| Input Backup Battery Voltage | V_BCKP | 1.5 | V |
| Operating Temperature Range | TAopr | -40 ~ 85 | °C |
| Storage Temperature Range | TAstg | -40 ~ 85 | °C |

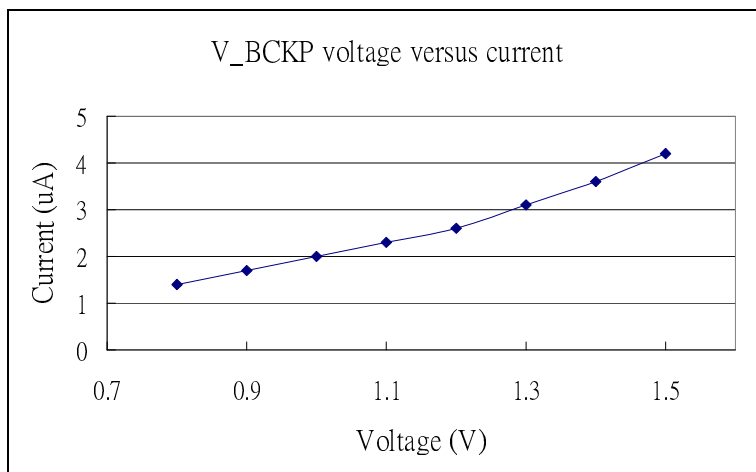
7.2 DC Electrical characteristics

| Parameter | Symbol | Conditions | Min. | Typ. | Max. | Units |
|------------------------------|---------------------|--------------------------------------------------------------------------------|---------|------------------|--------------------|-------|
| Input Voltage | VCC | | 2.7 | | 3.6 | V |
| Input Backup Battery Voltage | V_BCKP | | 0.8 | | 1.5 | V |
| Supply Current | I _{SS} | VIN = 3.3V, w/o active antenna, Peak Acquisition Tracking Sleep | | | 120 | mA |
| | | | | | 34 | mA |
| | | | | | 34 ⁽¹⁾ | mA |
| | | | | | 181 ⁽²⁾ | uA |
| Backup Battery Current | I _{bat} | VIN = 0V V_BCKP = 1V | | 2 ⁽³⁾ | | uA |
| High Level Input Voltage | V _{IH} | | 0.7*VCC | | 3.6 | V |
| Low Level Input Voltage | V _{IL} | | | | 0.3*VCC | V |
| High Level Output Voltage | V _{OH} | | 0.8*VCC | | VCC | V |
| Low Level Output Voltage | V _{OL} | | | | 0.2*VCC | V |
| High Level Output Current | I _{OH} | | | 2 | | mA |
| Low Level Output Current | I _{OL} | | | 2 | | mA |
| /RESET Pulse Width | T _{/RESET} | Active low | 5 | | | uS |

Note 1: Measured when position fix is available and input voltage is 3.3V.

Note 2: Going into and waking up from sleep mode are both controlled by software command.

Note 3: Please see below chart for backup battery voltage versus current

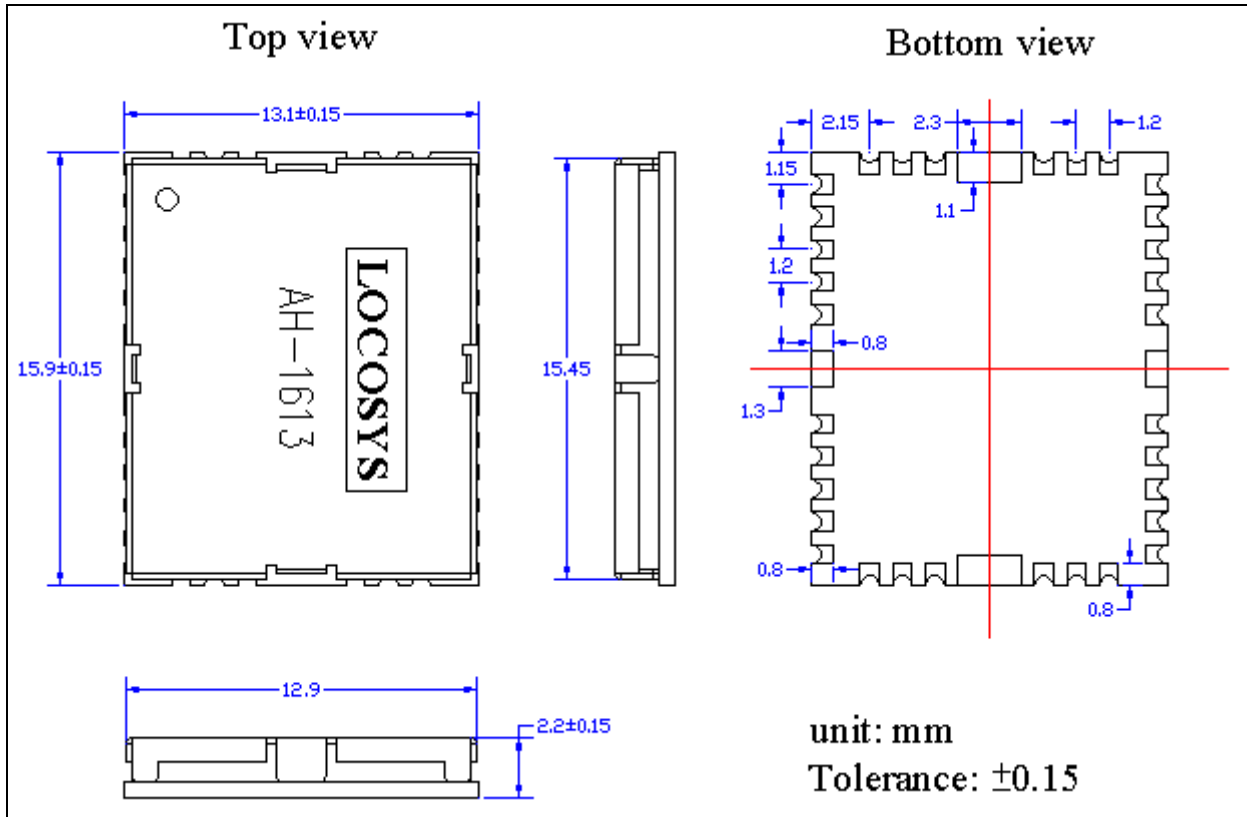


7.3 Temperature characteristics

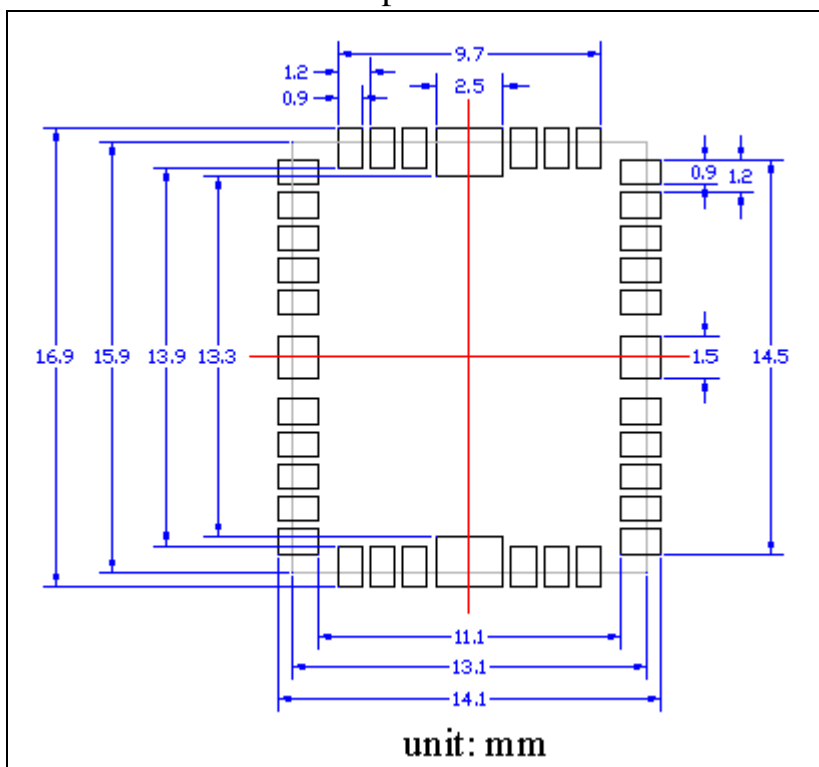
| Parameter | Symbol | Min. | Typ. | Max. | Units |
|-----------------------|------------------|------|------|------|-------|
| Operating Temperature | T _{opr} | -30 | - | 85 | °C |
| Storage Temperature | T _{stg} | -40 | 25 | 85 | °C |

8 Mechanical specification

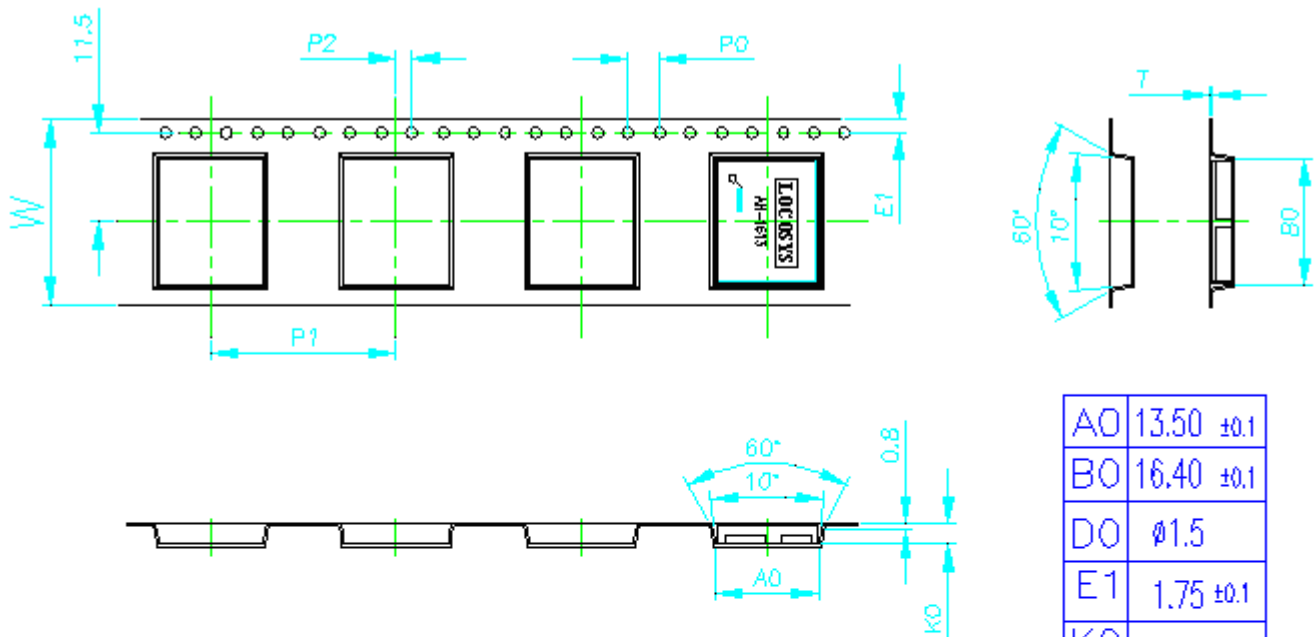
8.1 Outline dimensions



8.2 Recommended land pattern dimensions



9 Reel Packing information



| | |
|----|-----------------|
| A0 | 13.50 ± 0.1 |
| B0 | 16.40 ± 0.1 |
| D0 | $\phi 1.5$ |
| E1 | 1.75 ± 0.1 |
| K0 | 2.70 ± 0.1 |
| P0 | 4.0 ± 0.1 |
| P1 | 24.00 ± 0.1 |
| P2 | 2.0 ± 0.10 |
| T | 0.3 ± 0.10 |
| W | 24.0 ± 0.30 |

1. 10 sprocket hole pitch cumulative tolerance ± 0.2
2. Camber not to exceed 1mm in 100mm
3. A0 and B0 measured on a plane 0.3mm above the bottom of the pocket
4. K0 measured from a plane on the inside bottom of the pocket to the top surface of the carrier .
5. pocket position relative to sprocket hole measured as true position of pocket, not pocket hole.
6. Component load per 13" reel: 1000 pcs
7. Packing length per 22" reel: 75 M

Document change list

Revision 1.0

- First release on Sep. 23, 2010.