# GPS+ GLONASS Engine Board

Hardware Data Sheet

Product No : MT-5531G

Version 0.1

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| Issue Date | APPR | CHECK | PREPARE |
|---|---|---|---|
| 2012/12 | | | Luwalk Lee |

# Product Description

## Product Description

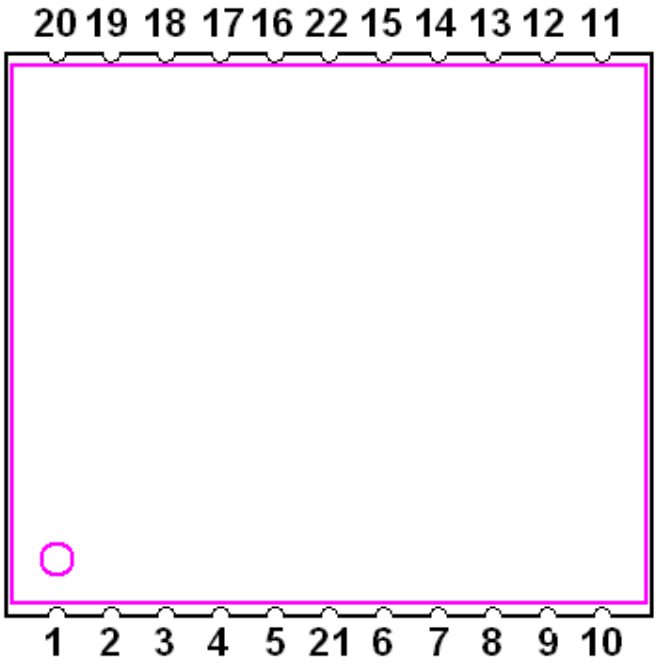
MT-5531G is a compact, high performance, and low power consumption GPS + GLONASS engine board. This GPS module is powered by MediaTek, it can provide you with superior sensitivity and performance even in urban canyon and dense foliage environment. The miniature size makes the module easy and the best choice to integrate into portable device like mobile phone, PDAs, camera and vehicle locators. Automotive navigation

- Personal positioning
- Fleet management
- Mobile phone navigation
- Marine navigation

## Product Features

- MediaTek high sensitivity solution
- Support 66-channel GPS
- Very high sensitivity (Tracking Sensitivity: -164 dBm)
- Extremely fast TTFF (Time To First Fix) at low signal level
- Support USB and Serial port NMEA output
- Built-in LNA
- Compact size (15.0mm * 13.0 mm * 2.4mm) suitable for space-sensitive application
- One size component, easy to mount on another PCB board
- Support NMEA 0183 V4.0 (Output: GGA, GSA, GSV, RMC**,** VTG, GLL, ZDA)

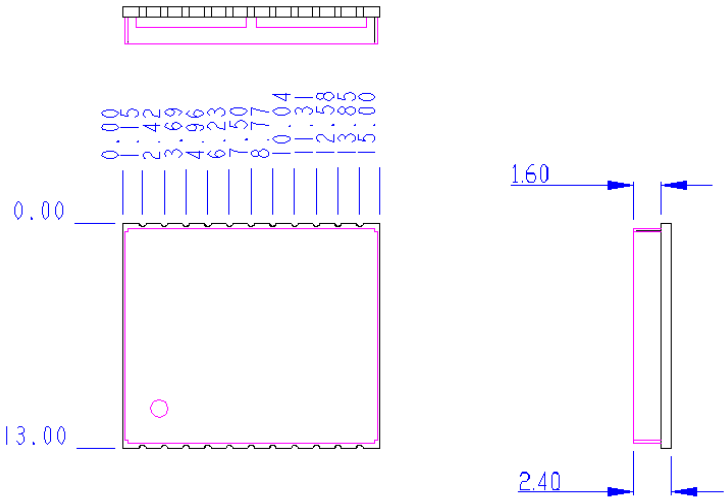
## Product Pin Description




| PIN Number(s) | Name | Type | Description | Note |
|---|---|---|---|---|
| 1, | RXB | I | Serial input (default null) | |
| 2 | TXB | O | Serial output (default null) | |
| 3 | TIMEPULSE | O | One pulse per second output.(1PPS) | |
| 4 | TxD | O | This is the main transmits channel for outputting navigation and measurement data to user's navigation software or user written software. Output TTL level, 0V ~ 2.85V. | |
| 5 | RxD | I | This is the main receive channel for receiving software commands to the engine board user written software. | |
| 6, 9,10,16 | NC | | | |
| 7 | GPIO_6 | I/O | LED Output | |
| 8 | MR | I | MT-5531G Reset input. | |
| 11 | V_BAT | P | Backup battery supply voltage | |
| 12 | VCC | P | Main power supply to the engine board. | |
| 13 | GPIO_8 | I/O | General purpose I/O | |
| 14 | GPIO_9 | I/O | General purpose I/O | |
| 15 | GPIO_10 | I/O | General purpose I/O | |
| 17 | VCC_RF | O | Supply Antenna Bias voltage (V=VCC) | |
| 18,20,21,22 | GND | P | Ground. | |

| | | | | |
|---|---|---|---|---|
| 19 | RF IN | RF | GPS antenna input | |

## Package Dimensions




Unit: mm

| | |
|---|---|
| **Type** | **22-pin stamp holes** |
| **Dimensions** | **15.0mm X 13.0mm X 2.4mm (±0.2mm)** |

# Electrical Specification

## Absolute Maximums Ratings

| Parameter | Min. | Typ. | Max. | Conditions | Unit |
|---|---|---|---|---|---|
| POWER Supply | | | | | |
| Main power supply | 3.1 | 3.3 | 3.5 | | V |
| Backup battery supply | 2.0 | | 3.5 | | V |
| Main power supply Current | | 23 | | | mA |
| Backup battery supply Current | 4.5 | 5 | 5.5 | | uA |
| Interface (VCC = 3.3V, VBAT= 3.3V, Operation Temp.= 25℃) | | | | | |
| High Level input Voltage | 0.7*VDD | | 3.5 | | V |
| Low Level input Voltage | -0.3 | | 0.3*VDD | | V |
| High Level input Current | -10 | | 10<br>60 | (V=2.85V)<br>(with Pull Low) | uA |
| Low Level input Current | -10 | | 10<br>-60 | (V=0V)<br>(with Pull High) | uA |
| High Level output Voltage | 0.75*VDD | | | | V |
| Low Level output Voltage | | | 0.25*VDD | | V |
| RF Input | | | | | |
| Input Impedance | | 50 | | | Ω |
| Operating Frequency | | 1.575 | | | Ghz |

☆ VDD is 2.85V for MTK CHIP

## Environmental Characteristics

| Parameter | Min | Typ | Max | Unit |
|---|---|---|---|---|
| Humidity Range | 5 | | 95 | % non-condensing |
| Operation Temperature | -40 | 25 | 85 | ℃ |
| Storage Temperature | -40 | | 85 | ℃ |

Receiver Performance

| | | |
|---|---|---|
| **Sensitivity** | **Tracking :**<br>**Autonomous acquisition :** | **-164dBm**<br>**-147 dBm** |
| **Time-To-First-Fix** | **Cold Start – Autonomous**<br>**Warm Start – Autonomous**<br>**Hot Start – Autonomous** | **< 35s**<br>**< 35s**<br>**< 1s** |
| **Horizontal Position accuracy** | **Autonomous**<br>**SBAS** | **< 3m (2D RMS)**<br>**< 2.0m** |
| **Velocity Accuracy** | **Speed**<br>**Heading** | **< 0.01 m/s**<br>**< 0.01 degrees** |
| **Reacquisition** | **0.1 second, average** | |
| **Max Update Rate** | **5 Hz** | |
| **Maximum Altitude** | **< 18,000 meter** | |
| **Maximum Velocity** | **< 515 meter/ second** | |
| **Maximum Acceleration** | **< 4G** | |

<Note>

1. -142 dBm ≈ 28dB-Hz with 4 dB noise figure
2. 50% -130dBm Fu 0.5ppm Tu ±2s Pu 30Km
3. 50% 24hr static, -130dBm
4. 50% @ 30m/s

# SOFTWARE COMMAND

## NMEA Output Command

NMEA Output Data Sentence:

Its output signal level is TTL: 11520000bps (default), 8 bit data, 1 stop bit and no parity. It supports NMEA-0183 V4.0 Protocol and the following. Messages: GGA, GSA, GSV and RMC.

NMEA Output Messages: the module board outputs the following messages as shown in Table1.

*Table 1* NMEA-0183 Output Messages

| NMEA Command | Description |
|---|---|
| GGA | Global positioning system fixed data |
| GSA | GNSS DOP and active satellites |
| GSV | GNSS satellites in view |
| RMC | Recommended minimum specific GNSS data |

## GGA - Global Positioning System Fixed Data

Table2 contains the values for the following example:

**$GPGGA,161229.487,3723.2475,N,12158.3416,W,1,07,1.0,9.0,M,-34.2,M,,0000*18**

Table 2 GGA Data Format

| Name | Example | Units | Description |
|---|---|---|---|
| Message ID | $GPGGA | | GGA protocol header |
| UTC Time | 161229.487 | | hhmmss.sss |
| Latitude | 3723.2475 | | ddmm.mmmm |
| N/S Indicator | N | | N=north or S=south |
| Longitude | 12158.3416 | | dddmm.mmmm |
| E/W Indicator | W | | E=east or W=west |
| Position Fix Indicator | 1 | | See Table 2-1 |
| Satellites Used | 07 | | Range 0 to 12 |
| HDOP | 1.0 | | Horizontal Dilution of Precision |
| MSL Altitude | 9.0 | meters | |
| Units | M | meters | |
| Geoid Separation[1] | -34.2 | meters | Geoid-to-ellipsoid separation.<br>Ellipsoid altitude=MSL Altitude + Geoid Separation |
| Units | M | meters | |
| Age of Diff. Corr. | | second | Null fields when DGPS is not used |
| Diff. Ref. Station ID | 0000 | | |

| | | | |
|---|---|---|---|
| Checksum | *18 | | |
| <CR><LF> | | | End of message termination |

Table 2-1 Position Fix Indicator

| Value | Description |
|---|---|
| 0 | Fix not available or invalid |
| 1 | GPS SPS Mode, fix valid |
| 2 | Differential GPS, SPS Mode , fix valid |
| 3 | Not supported |
| *6* | *Dead Reckoning Mode, fix valid* |

Note:
A valid status is derived from all the parameters set in the software. This includes the minimum number of satellites required, any DOP mask setting, presence of DGPS corrections, etc. If the default or current software setting requires that a factor is met, then if that factor is not met the solution will be marked as invalid.

## GLL - Geographic Position-Latitude/Longitude

Table3 contains the values for the following example:
**$GPGLL,3723.2475,N,12158.3416,W,161229.487,A,A*41**

Table3 GLL Data Format

| Name | Example | Units | Description |
|---|---|---|---|
| Message ID | $GPGLL | | GLL protocol header |
| Latitude | 3723.2475 | | ddmm.mmmm |
| N/S Indicator | n | | N=north or S=south |
| Longitude | 12158.3416 | | dddmm.mmmm |
| E/W Indicator | W | | E=east or W=west |
| UTC Position | 161229.487 | | hhmmss.sss |
| Status | A | | A=data valid or V=data not valid |
| *Mode* | *A* | | *A=Autonomous, D=DGPS,*<br>*E=DR*<br>*N=Output Data Not Valid*<br>*R= Coarse Position*[1]<br>*S=Simulator* |
| Checksum | *41 | | |
| <CR><LF> | | | End of message termination |

1. Position was calculated based on one or more of the SVs having their states derived from almanac parameters, as opposed to ephemerides.

## GSA - GNSS DOP and Active Satellites

Table 4 contains the values for the following example:

**$GPGSA,A,3,07,02,26,27,09,04,15,,,,,,1.8,1.0,1.5*33**

Table 4 GSA Data Format

| Name | Example | Units | Description |
|---|---|---|---|
| Message ID | $GPGSA | | GSA protocol header |
| Mode 1 | A | | See Table 4-1 |
| Mode 2 | 3 | | See Table 4-2 |
| Satellite Used[1] | 07 | | Sv on Channel 1 |
| Satellite Used[1] | 02 | | Sv on Channel 2 |
| ….. | | | |
| Satellite Used[1] | | | Sv on Channel 12 |
| PDOP[2] | 1.8 | | Position dilution of Precision |
| HDOP[2] | 1.0 | | Horizontal dilution of Precision |
| VDOP[2] | 1.5 | | Vertical dilution of Precision |
| Checksum | *33 | | |
| <CR><LF> | | | End of message termination |

1. Satellite used in solution.
2. Maximum DOP value reported is 50. When 50 is reported, the actual DOP may be much larger.

Table 4-1 Mode1

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

Table 4-2 Mode 2

| Value | Description |
|---|---|
| 1 | Fix Not Available |
| 2 | 2D (<4 SVs used) |
| 3 | 3D (>3 SVs used) |

## GSV - GNSS Satellites in View

Table 5 contains the values for the following example:

**$GPGSV,2,1,07,07,79,048,42,02,51,062,43,26,36,256,42,27,27,138,42*71**

**$GPGSV,2,2,07,09,23,313,42,04,19,159,41,15,12,041,42*41**

Table 5 GSV Data Format

| Name | Example | Units | Description |
|---|---|---|---|
| Message ID | $GPGSV | | GSV protocol header |
| Number of Messages[1] | 2 | | Range 1 to 3 |
| Message Number[1] | 1 | | Range 1 to 3 |
| Satellites in View[1] | 07 | | |
| Satellite ID | 07 | | Channel 1(Range 1 to 32) |
| Elevation | 79 | degrees | Channel 1(Maximum90) |
| Azimuth | 048 | degrees | Channel 1(True, Range 0 to 359) |
| SNR(C/No) | 42 | dBHz | Range 0 to 99,null when not tracking |
| ……. | | | ……. |
| Satellite ID | 27 | | Channel 4 (Range 1 to 32) |
| Elevation | 27 | Degrees | Channel 4(Maximum90) |
| Azimuth | 138 | Degrees | Channel 4(True, Range 0 to 359) |
| SNR(C/No) | 42 | dBHz | Range 0 to 99,null when not tracking |
| Checksum | *71 | | |
| <CR><LF> | | | End of message termination |

1. Depending on the number of satellites tracked, multiple messages of GSV data may be required. In some software versions, the maximum number of satellites reported as visible is limited to 12, even though more may be visible.

## RMC - Recommended Minimum Specific GNSS Data

Table 6 contains the values for the following example:

**$GPRMC,161229.487,A,3723.2475,N,12158.3416,W,0.13,309.62,120598,,,A*10**

Table 6 RMC Data Format

| Name | Example | Units | Description |
|---|---|---|---|
| Message ID | $GPRMC | | RMC protocol header |
| UTC Time | 161229.487 | | hhmmss.sss |
| Status[1] | A | | A=data valid or V=data not valid |
| Latitude | 3723.2475 | | ddmm.mmmm |
| N/S Indicator | N | | N=north or S=south |
| Longitude | 12158.3416 | | dddmm.mmmm |
| E/W Indicator | W | | E=east or W=west |
| Speed Over Ground | 0.13 | knots | |
| Course Over Ground | 309.62 | degrees | True |
| Date | 120598 | | ddmmyy |
| Magnetic Variation[2] | | degrees | E=east or W=west |
| East/West Indicator[2] | E | | E=east |
| *Mode* | *A* | | *A=Autonomous, D=DGPS,*<br>*E=DR*<br>*N=Output Data Not Valid*<br>*R= Coarse Position[3]*<br>*S=Simulator* |
| Checksum | *10 | | |
| <CR><LF> | | | End of message termination |

1. A valid status is derived from all the parameters set in the software. This includes the minimum number of satellites required, any DOP mask setting, presence of DGPS corrections, etc. If the default or current software setting requires that a factor is met, then if that factor is not met the solution will be marked as invalid.
2. Position was calculated based on one or more of the SVs having their states derived from almanac parameters, as opposed to ephemerides.

## VTG - Course Over Ground and Ground Speed

Table 7 contains the values for the following example:

**$GPVTG,309.62,T,,M,0.13,N,0.2,K,A*23**

Table 7 VTG Data Format

| Name | Example | Units | Description |
|---|---|---|---|
| Message ID | $GPVTG | | VTG protocol header |
| Course | 309.62 | degrees | Measured heading |
| Reference | T | | True |
| Course | | degrees | Measured heading |
| Reference | M | | Magnetic[1] |
| Speed | 0.13 | knots | Measured horizontal speed |
| Units | N | | Knots |
| Speed | 0.2 | Km/hr | Measured horizontal speed |
| Units | K | | Kilometers per hour |
| *Mode* | *A* | | *A=Autonomous, D=DGPS,*<br>*E=DR*<br>*N=Output Data Not Valid*<br>*R= Coarse Position[2]*<br>*S=Simulator* |
| Checksum | *23 | | |
| <CR><LF> | | | End of message termination |

1. Position was calculated based on one or more of the SVs having their states derived from almanac parameters, as opposed to ephemerides.

## ZDA - Time and Date

This message is included only with systems which support a time-mark output pulse identified as "1PPS". Outputs the time associated with the current 1PPS pulse. Each message is output within a few hundred ms after the 1PPS pulse is output and tells the time of the pulse that just occurred.

Table 8 contains the values for the following example:

$GPZDA,181813,14,10,2003,,*4F<CR><LF>

Table 8: ZDA Data Format

| Name | Example | Unit | Description |
|---|---|---|---|
| Message ID | $GPZDA | | ZDA protocol header |
| UTC Time | 181813 | hhmmss | The UTC time units are: hh=UTC hours from 00 to 23 mm=UTC minutes from 00 to 59 ss=UTC seconds from 00 to 59 Either using valid IONO/UTC or estimated from default leap seconds |
| Day | 14 | | Day of the month, range 1 to 31 |
| Month | 10 | | Month of the year, range 1 to 12 |
| Year | 2003 | | Year |
| Local zone hour[1] | | hour | Offset from UTC (set to 00) |
| Local zone minutes[1] | | minute | Offset from UTC (set to 00) |
| Checksum | *4F | | |
| <CR><LF> | | | End of message termination |

1. Not supported by CSR, reported as 00.

## NMEA 2.0 & NMEA 4.0 format compare

**NMEA 4.0 format**

| NMEA Message | Talker identifiers | example |
|---|---|---|
| GGA | GP | $GPGGA |
| GSA | GP,GL,GN | $GPGSA,$GLGSA,$GNGSA |
| GSV | GP,GL | $GPGSV,$GLGSV |
| VTG | GN | $GNVTG |
| RMC | GN | $GNRMC |

GPXXX: GPS mode

GLXXX: Glonass mode

GNXXX: GPS/Glonass mode

**NMEA 2.0 format**

| NMEA Message | Talker identifiers | example |
|---|---|---|
| GGA | GP | $GPGGA |
| GSA | GP, | $GPGSA, |
| GSV | GP | $GPGSV, |
| VTG | GP | $GPVTG |
| RMC | GP | $GPRMC |

**Example :**

NMEA ver 2.0

$GPRMC,150133.000,A,2450.5023,N,12100.7648,E,000.0,000.0,080611,,,A*6D

$GPGGA,150133.000,2450.5023,N,12100.7648,E,2,09,00.7,00060.89,M,0025.64,M,,0000*6E

$GPGSA,A,3,4,8,10,11,17,20,24,28,32,69,70,74,01.3,00.7,01.1*08

$GPGSV,6,1,24,10,18,198,40,74,21,223,39,84,37,038,37,11,10,061,37*78

$GPGSV,6,2,24,04,39,265,45,70,52,144,47,20,49,063,47,76,,,34*48

$GPGSV,6,3,24,68,,,44,32,24,047,42,28,79,214,48,17,46,338,48*49

$GPGSV,6,4,24,08,12,199,35,75,26,281,39,24,18,044,41,69,43,055,44*74

NMEA ver 4.0

$GNRMC,145623.000,A,2450.5025,N,12100.7649,E,000.0,221.6,080611,,,A*71

$GNGGA,145623.000,2450.5025,N,12100.7649,E,1,10,00.6,00057.48,M,0025.64,M,,0000*76

$GNGSA,A,3,4,8,10,11,17,20,23,24,28,32,,,01.2,00.6,01.0*1D

$GNGSA,A,3,69,70,74,75,83,84,85,,,,,,01.2,00.6,01.0*1B

$GPGSV,3,1,10,11,12,059,40,17,45,335,49,04,37,262,46,10,16,198,41*79

$GPGSV,3,2,10,23,07,115,28,32,25,049,44,24,20,043,43,08,14,201,42*77

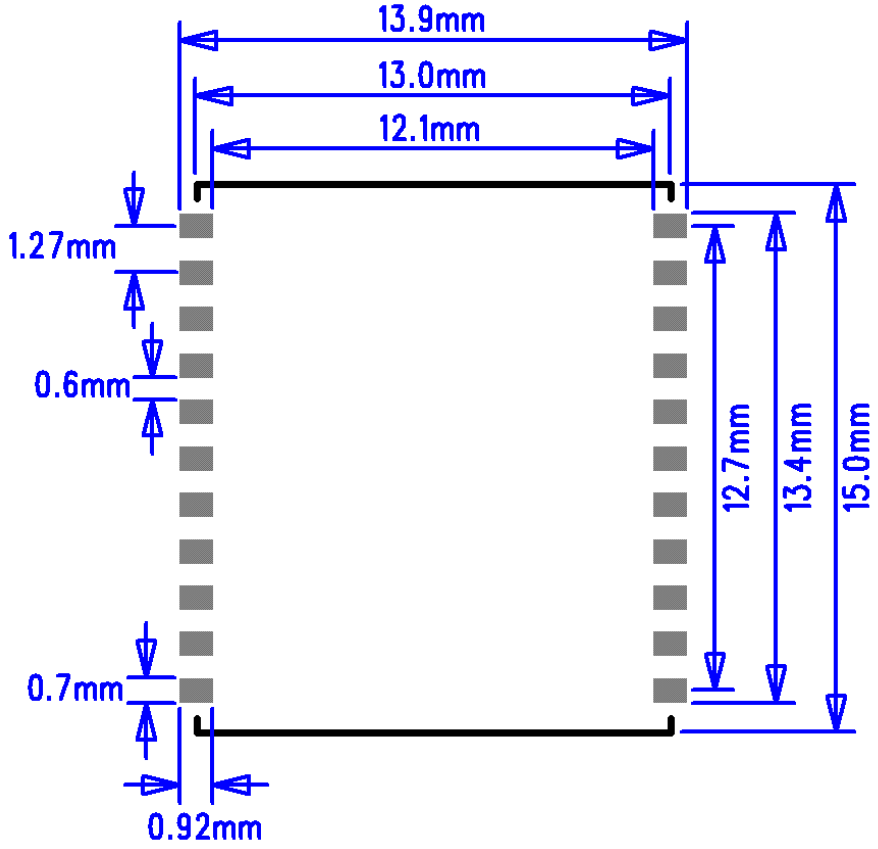
$GPGSV,3,3,10,20,50,066,49,28,81,226,48*7B

$GLGSV,2,1,08,74,23,225,38,71,04,191,23,83,09,083,17,70,49,146,48*62

$GLGSV,2,2,08,85,29,330,43,75,26,284,38,69,44,059,46,84,38,034,38*65

# PCB Layout Recommend

## Recommended Layout PAD




**Unit: mm**

**Tolerance: 0.1mm**

**PCB Layout Recommendations**

Do not routing the other signal or power trace under the engine board.

**RF:**

This pin receives signal of GPS analog via external active antenna .It has to be a controlled impedance trace at 50ohm.

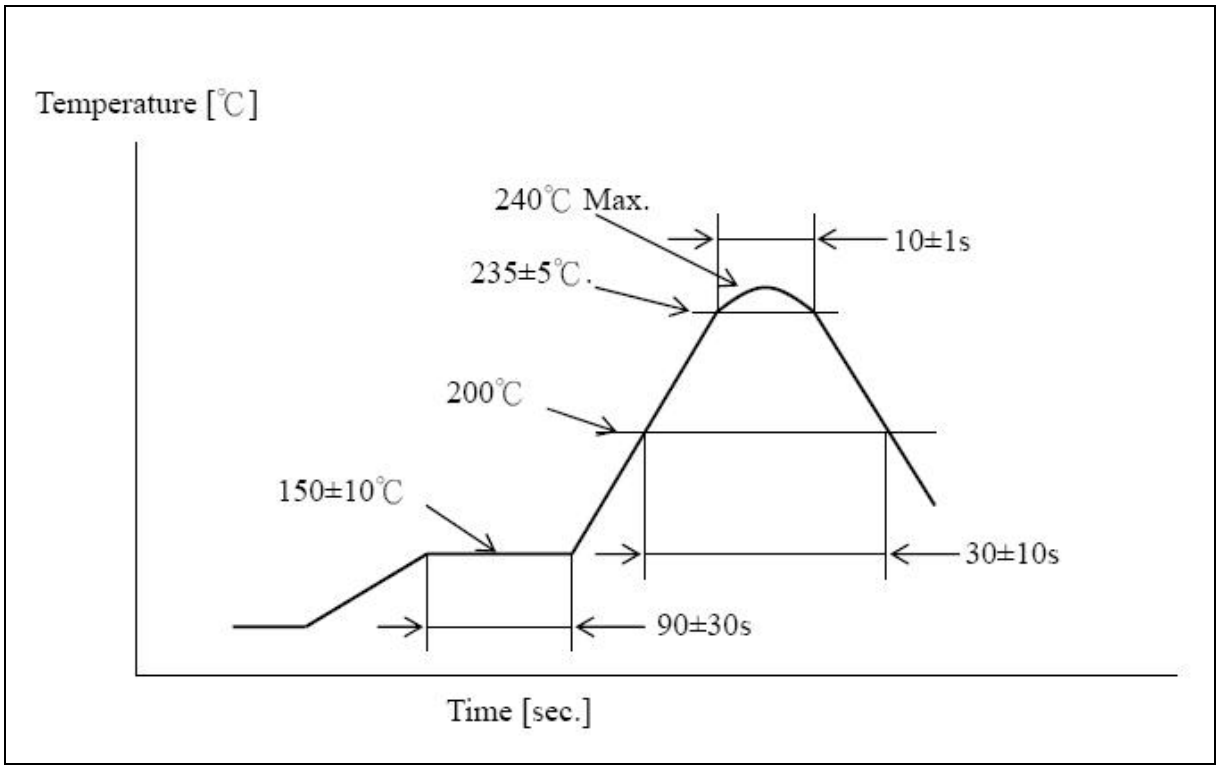
Do not place the RF traces close to the other signal path and not routing it on the top layer.

Keep the RF traces as short as possible.

**Antenna:**

Keep the active antenna on the top of your system and confirm the antenna radiation pattern、axial ratio、power gain、noise figure、VSWR are correct when you Setup the antenna in your case.

## Recommended Reflow Profile:




| | | | |
|---|---|---|---|
| Pre heating temperature: | 150±10[℃] | Pre heating time: | 90±30[sec.] |
| Heating temperature: | 235±5[℃] | Heating time: | 10±1[sec.] |

Peak temperature must not exceed 240℃ and the duration of over 200℃ should be 30±10 Seconds.