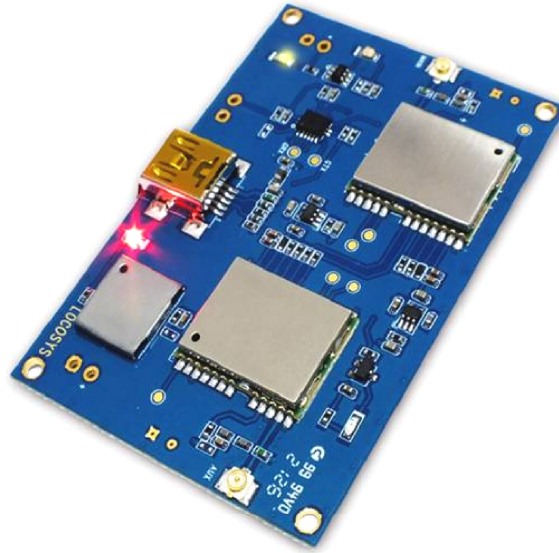


| Product name  | Description  | Version |
|---------------|--|---------|
| RTK-4057-MHPD | L1+L5 Dual-Frequency (Position& Orientation) RTK Board | 0.1     |



## 1. Introduction

LOCOSYS RTK-4057-MHPD is a L1+L5 Dual-Frequency Position with Heading RTK Board, which targeting for precision autonomous guided vehicle, smart agriculture, unmanned aerial vehicle, and any other unmanned system to integrate in.

This receiver board provides fast precise heading and RTK position. It supports global multiple constellations, including GPS, GLONASS, BeiDou, GALILEO, QZSS and SBAS to improve the continuity and reliability of precise heading and RTK position even in the harsh environment.

Besides, it features powerful compatibility with other GNSS receivers in the market by flexible USB interfaces, smart hardware design and output standard NMEA formats. Versatile, compact size, complete driver support, low power and high update rate.

LOCOSYS RTK-4057-MHPD meets *Windows, Linux, Raspberry Pi* and *Nvidia* developer requirements or system integrator need, and helps you quickly realize unmanned application positioning function.

## 2. Features

- L1 + L5 Dual-frequency and multi-constellation heading and RTK positioning solution.
- Support GPS, GLONASS, BeiDou, GALILEO, QZSS satellite.
- Capable of SBAS (WAAS, EGNOS, MSAS, GAGAN).
- Dual 135 channels GNSS with dual-antenna input.
- Built in independent short-circuit protection for each antenna input.
- RTK Position Accuracy 1cm CEP.
- Heading accuracy < 0.2° RMS.
- Support proprietary heading and elevation.
- Support 1/5Hz Default, Up to 10Hz update rate.
- Industrial operating temperature range -40 to +85°C.
- Low-power consumption and compact size.
- USB complete driver.
- LOCOSYS IATF 16949 Taiwan certified production sites.

## 3. Application

- Autonomous Vehicle Guidance
- Unmanned Aerial Vehicles
- Precision Agriculture
- AGV Robotics
- Structural / Land Monitoring
- IPC equipment

#### 4. Product feature

| GNSS feature                     | Description                             |  |
|----------------------------------|---|--|
| Frequency                        | GPS/QZSS: L1 C/A, L5C                   | GALILEO: E1, E5a   |
|                                  | GLONASS: L1OF                           | BEIDOU: B1I, B2a   |
| Channels                         | Support 135 channels                    |  |
| Update rate                      | 1/5Hz (default) /10Hz (option)          |  |
| Sensitivity                      | Tracking                                | -165dBm (with external LNA)  |
|                                  | Cold start                              | -148dBm (with external LNA)  |
| Acquisition Time                 | Cold start                              | 28s (typical)  |
|                                  | RTK Convergence time                    | < 10s (typical; after 3D fix)  |
| Position Accuracy <sup>(1)</sup> | Autonomous                              | < 1.5m CEP   |
|                                  | RTK <sup>(2)</sup>                      | 0.01m + 1ppm (Horizontal)  |
| Heading Accuracy                 | < 0.2 deg @ 1m antenna separation (RMS) |  |
| Max. Altitude                    | < 18,000 m                              |  |
| Max. Velocity                    | < 500 m/s                               |  |
| Protocol Support                 | NMEA 0183 ver. 4.1                      | 115200 bps <sup>(3)</sup> , 8 data bits, no parity, 1 stop bits (default)<br>5Hz: GGA, GLL, GSA, RMC, VTG, HDT<br>1Hz: GSV |
|                                  | Raw data                                | 115200 bps, RTCM V3.3, message type 1005, 1074, 1084, 1094, 1114, 1124   |

Note 1: Open sky, dual band, demonstrated with a good external LNA.

Note 2: CEP, 24hr static.

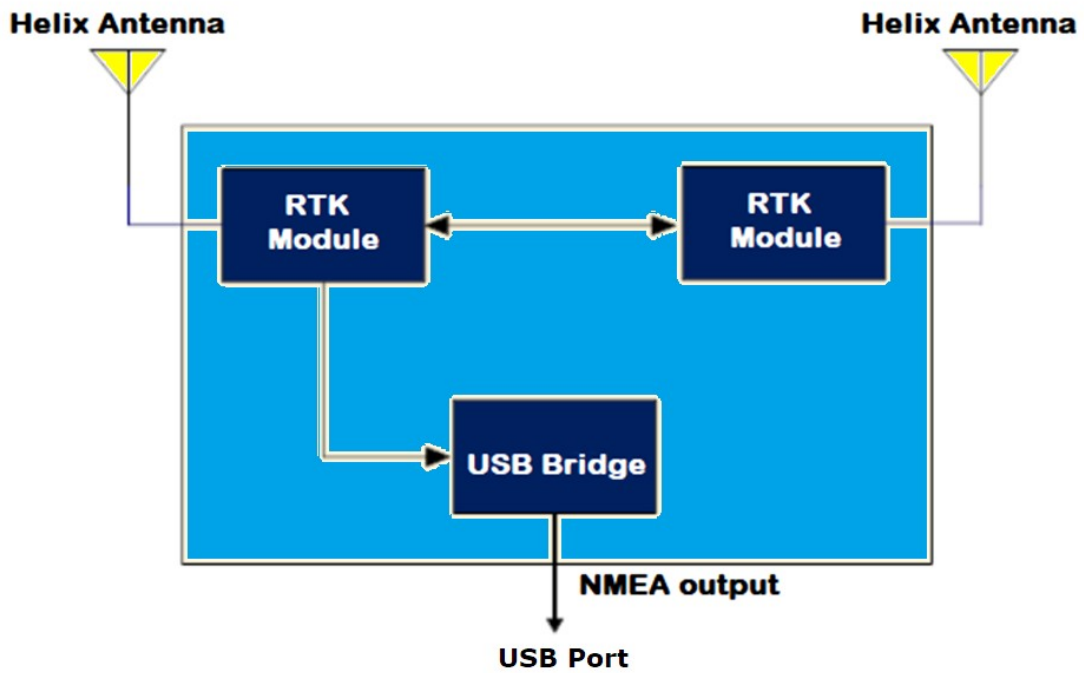
Note 3: Both baud rate output message rate are configurable to be factory default.

**CAUTION:** For the first test, it is recommended to use an EVK Box; If you use an RTK board, Please use it in a closed environment system, do not use a "bare board" for testing, otherwise it will affect the performance. (Please refer to Chapter 13).

5. Operation Specifications

| Parameter                   | Description | Note   |
|-----------------------------|-------------|--|
| Power Consumption           | 800mW@5Vdc  | Include 2 external helix antennas (LH-105A2-B) |
| Baud Rate                   | 115200 bps  |  |
| Operating Temperature Range | -40~85°C    |  |
| Storage Temperature         | -40~85°C    |  |

6. Block Diagram



## 7. Software interface

### 7.1. NMEA output message

Table 7.1-1 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      |
| HDT         | Heading, True                            |

#### ● GGA--- Global Positioning System Fixed Data

Table 7.1-2 contains the values for the following example:

```
$GNGGA,091250.000,2503.71250,N,12138.74514,E,1,32,0.55,119.0,M,17.2,M,,*7E
```

Table 7.1- 2 GGA Data Format

| Name                   | Example     | Units  | Description  |
|------------------------|-------------|--------|--|
| Message ID             | \$GNGGA     |        | GGA protocol header  |
| UTC Time               | 091250.000  |        | hhmmss.sss   |
| Latitude               | 2503.71250  |        | ddmm.mmmmm   |
| N/S indicator          | N           |        | N=north or S=south   |
| Longitude              | 12138.74514 |        | dddmm.mmmmm  |
| E/W Indicator          | E           |        | E=east or W=west   |
| Position Fix Indicator | 1           |        | See Table 7.1-3  |
| Satellites Used        | 32          |        | Number of satellites in view                                       |
| HDOP                   | 0.55        |        | Horizontal Dilution of Precision (meters)                          |
| MSL Altitude           | 119.0       | meters | Antenna Altitude above/below mean-sea-level (geoid)<br>(in meters) |
| Units                  | M           | meters | Units of antenna altitude, meters                                  |
| Geoidal Separation     | 17.2        | meters |  |
| Units                  | M           | meters | Units of geoidal separation, meters                                |
| Age of diff. GNSS data |             | second | Null fields when DGPS is not used                                  |
| Diff. Ref. Station ID  |             |        | Differential reference station ID, 0000-1023                       |
| Checksum               | *7E         |        | Checksum   |
| <CR> <LF>              |             |        | End of message termination   |

Table 7.1-3 Position Fix Indicators

| Value | Description                  |
|-------|------------------------------|
| 0     | No position fix              |
| 1     | Autonomous GNSS fix          |
| 2     | Differential GNSS fix        |
| 4     | RTK fixed                    |
| 5     | RTK float                    |
| 6     | Estimated/Dead reckoning fix |

● **GLL--- Geographic Position – Latitude/Longitude**

Table 7.1-4 contains the values for the following example:

\$GNGLL,2503.71193,N,12138.74582,E,094450.000,A,A\*47

Table 7.1-4 GLL Data Format

| Name          | Example     | Units | Description   |
|---------------|-------------|-------|---|
| Message ID    | \$GNGLL     |       | GLL protocol header   |
| Latitude      | 2503.71193  |       | ddmm.mmmmm  |
| N/S indicator | N           |       | N=north or S=south  |
| Longitude     | 12138.74582 |       | dddmm.mmmmm   |
| E/W indicator | E           |       | E=east or W=west  |
| UTC Time      | 094450.000  |       | hhmmss.sss  |
| Status        | A           |       | A=data valid or V=data not valid  |
| Mode          | A           |       | N = No position fix<br>A = Autonomous GNSS fix<br>D = Differential GNSS fix<br>R = RTK fixed<br>F = RTK float<br>E = Estimated/Dead reckoning fix |
| Checksum      | *47         |       |   |
| <CR> <LF>     |             |       | End of message termination  |

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

Table 7.1-5 contains the values for the following example:

\$GNGSA,A,3,11,195,194,199,08,07,01,27,16,09,23,,1.19,0.64,1.00,1\*3F

\$GNGSA,A,3,87,81,76,,,,,,,,,1.19,0.64,1.00,2\*0F

\$GNGSA,A,3,,,,,,,,,1.19,0.64,1.00,3\*09

\$GNGSA,A,3,34,24,12,07,11,10,08,38,25,09,13,16,1.19,0.64,1.00,4\*02

Table 7.1-5 GSA Data Format

| Name                 | Example | Units | Description                      |
|----------------------|---------|-------|----------------------------------|
| Message ID           | \$GNGSA |       | GSA protocol header              |
| Mode 1               | A       |       | See Table 7.1-6                  |
| Mode 2               | 3       |       | See Table 7.1-7                  |
| ID of satellite used | 11      |       | SV on Channel 1                  |
| ID of satellite used | 195     |       | SV on Channel 2                  |
| ....                 |         |       | ....                             |
| ID of satellite used |         |       | SV on Channel 12                 |
| PDOP                 | 1.19    |       | Position Dilution of Precision   |
| HDOP                 | 0.64    |       | Horizontal Dilution of Precision |
| VDOP                 | 1.00    |       | Vertical Dilution of Precision   |
| GNSS system ID       | 4       |       | See Table 7.1-8                  |
| Checksum             | *3F     |       |                                  |
| <CR> <LF>            |         |       | End of message termination       |

Table 7.1-6 Mode 1

| Value | Description                                   |
|-------|---|
| M     | Manually set to operate in 2D or 3D mode      |
| A     | Automatically switching between 2D or 3D mode |

Table 7.1-7 Mode 2

| Value | Description     |
|-------|-----------------|
| 1     | No position fix |
| 2     | 2D fix          |
| 3     | 3D fix          |

Table 7.1-8 GNSS system ID

| Value | Description |
|-------|-------------|
| 1     | GPS         |
| 2     | GLONASS     |
| 3     | GALILEO     |
| 4     | BEIDOU      |
| 6     | IRNSS       |

● **GSV---GNSS Satellites in View**

Table 7.1-9 contains the values for the following example:

```
$GPGSV,3,1,09,8,71,268,47,27,63,18,49,11,44,191,46,4,41,237,46,1*54
$GPGSV,3,2,09,16,38,42,42,9,32,279,39,26,22,70,38,31,15,131,36,1*56
$GPGSV,3,3,09,7,15,320,40,1*6B
$GPGSV,1,1,04,8,71,268,50,27,63,18,49,9,32,279,43,26,22,70,42,8*6C
$GLGSV,2,1,05,82,63,47,47,83,56,182,36,80,47,9,42,79,33,85,45,1*71
$GLGSV,2,2,05,81,15,27,37,1*71
$GAGSV,1,1,04,08,48,300,43,03,47,025,45,13,36,309,42,05,06,061,34,7*79
$GAGSV,1,1,04,08,48,300,43,03,47,025,47,13,36,309,43,05,06,061,33,1*7B
$GBGSV,5,1,17,12,80,182,47,24,64,5,51,7,58,355,44,3,57,205,45,1*7C
$GBGSV,5,2,17,1,54,141,44,34,52,211,49,9,48,230,45,10,47,316,42,1*79
$GBGSV,5,3,17,26,44,100,47,16,39,207,43,4,38,117,41,2,37,240,41,1*77
$GBGSV,5,4,17,39,37,210,43,6,36,198,41,38,27,173,41,25,18,317,42,1*4E
$GBGSV,5,5,17,35,16,39,40,1*7F
$GBGSV,1,1,02,24,64,5,50,26,44,100,43,4*77
```

Table 7.1-9 GSV Data Format

| Name                     | Example | Units   | Description   |
|--------------------------|---------|---------|---|
| Message ID               | \$GPGSV |         | GSV protocol header<br>GP=GPS/QZSS, GL=GLONSS, GA=GALILEO,<br>GB=BEIDOU, GI=IRNSS.            |
| Total number of messages | 3       |         | Range 1 to 9  |
| Message number           | 1       |         | Range 1 to 9  |
| Satellites in view       | 09      |         |   |
| Satellite ID             | 8       |         | Channel 1   |
| Elevation                | 71      | degrees | Channel 1 (Range 00 to 90)  |
| Azimuth                  | 268     | degrees | Channel 1 (Range 000 to 359)  |
| SNR (C/No)               | 47      | dB-Hz   | Channel 1 (Range 00 to 99, null when not tracking)  |
| ....                     |         |         | ....  |
| Satellite ID             | 4       |         | Channel 4 (Range 01 to 196)   |
| Elevation                | 41      | degrees | Channel 4 (Range 00 to 90)  |
| Azimuth                  | 237     | degrees | Channel 4 (Range 000 to 359)  |
| SNR (C/No)               | 46      | dB-Hz   | Channel 4 (Range 00 to 99, null when not tracking)  |
| Signal ID                | 1       |         | GPS/QZSS: L1 C/A=1, L5Q=8<br>GLONASS: L1 C/A=1<br>GALILEO: E1=7, E5a=1<br>BEIDOU: B1=1, B2a=4 |



|           |     |  |                            |
|-----------|-----|--|----------------------------|
|           |     |  | IRNSS: L6=1                |
| Checksum  | *54 |  |                            |
| <CR> <LF> |     |  | End of message termination |

## ● RMC---Recommended Minimum Specific GNSS Data

Table 7.1-10 contains the values for the following example:

\$GNRMC,070143.000,A,2503.71317,N,12138.74533,E,0.002,70.50,130220,,,A,V\*01

Table 7.1-10 RMC Data Format

| Name                          | Example     | Units   | Description   |
|-------------------------------|-------------|---------|---|
| Message ID                    | \$GNRMC     |         | RMC protocol header   |
| UTC Time                      | 070143.000  |         | hhmmss.sss  |
| Status                        | A           |         | A=data valid or V=data not valid  |
| Latitude                      | 2503.7117   |         | ddmm.mmmm   |
| N/S Indicator                 | N           |         | N=north or S=south  |
| Longitude                     | 12138.74533 |         | dddmm.mmmmm   |
| E/W Indicator                 | E           |         | E=east or W=west  |
| Speed over ground             | 0.002       | knots   | True  |
| Course over ground            | 70.50       | degrees |   |
| Date                          | 130220      |         | ddmmyy  |
| Magnetic variation            |             | degrees |   |
| Variation sense               |             |         | E=east or W=west  |
| Mode                          | A           |         | N = No position fix<br>A = Autonomous GNSS fix<br>D = Differential GNSS fix<br>R = RTK fixed<br>F = RTK float<br>E = Estimated/Dead reckoning fix |
| Navigational status indicator | V           |         | S = Safe<br>C = Caution<br>U = Unsafe<br>V = Void   |
| Checksum                      | *01         |         |   |
| <CR> <LF>                     |             |         | End of message termination  |

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

Table 7.1-11 contains the values for the following example:

\$GNVTG,0.00,T,,M,0.003,N,0.006,K,A\*26

Table 7.1-11 VTG Data Format

| Name               | Example | Units   | Description   |
|--------------------|---------|---------|---|
| Message ID         | \$GPVTG |         | VTG protocol header   |
| Course over ground | 0.00    | degrees | Measured heading  |
| Reference          | T       |         | True  |
| Course over ground |         | degrees | Measured heading  |
| Reference          | M       |         | Magnetic  |
| Speed over ground  | 0.003   | knots   | Measured speed  |
| Units              | N       |         | Knots   |
| Speed over ground  | 0.006   | km/hr   | Measured speed  |
| Units              | K       |         | Kilometer per hour  |
| Mode               | A       |         | N = No position fix<br>A = Autonomous GNSS fix<br>D = Differential GNSS fix<br>R = RTK fixed<br>F = RTK float<br>E = Estimated/Dead reckoning fix |
| Checksum           | *26     |         |   |
| <CR> <LF>          |         |         | End of message termination  |

● **HDT---Heading from true north message fields**

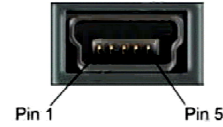
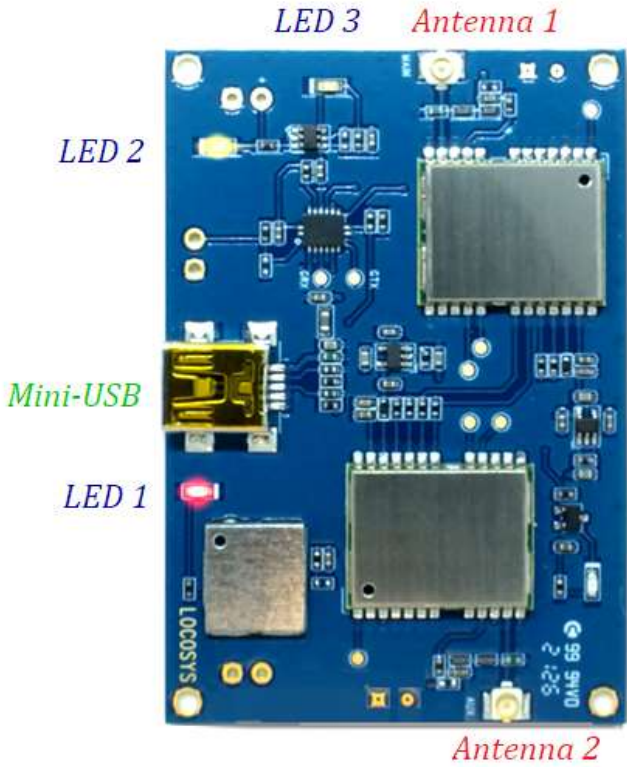
Table 7.1-12 contains the values for the following example:

\$GPHDT,94.005,T\*0D

Table 7.1-12 GPHDT Data Format

| Name                   | Example | Units   | Description                              |
|------------------------|---------|---------|--|
| Message ID             | \$GPHDT |         | HDT protocol header                      |
| Heading                | 94.005  | degrees | Heading in degrees                       |
| Relative to True North | T       |         | Indicates heading relative to True North |
| Checksum               | *0D     |         |  |
| <CR> <LF>              |         |         | End of message termination               |

8. Hardware LED State and USB interface



| USB Pin | Name   | Type | Description     |
|---------|--------|------|-----------------|
| 1       | VBUS   | P    | USB power input |
| 2       | D-     |      | D- line         |
| 3       | D+     |      | D+ line         |
| 4       | GND    | P    | Ground          |
| 5       | Shield | P    | Ground          |

| LED   | Function       |
|-------|----------------|
| LED 1 | Power states   |
| LED 2 | GNSS TX states |
| LED 3 | 1pps states    |

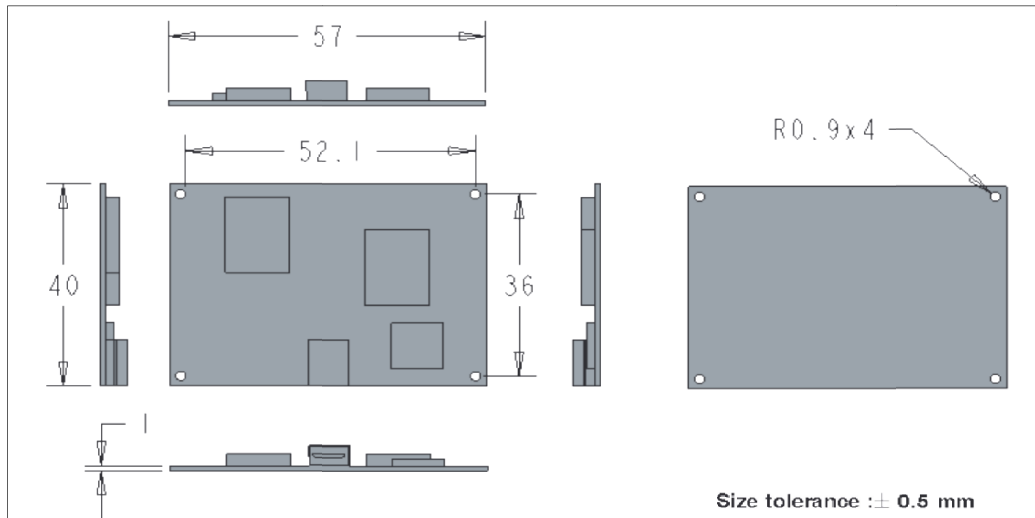
**RTK-4057-MHPD**



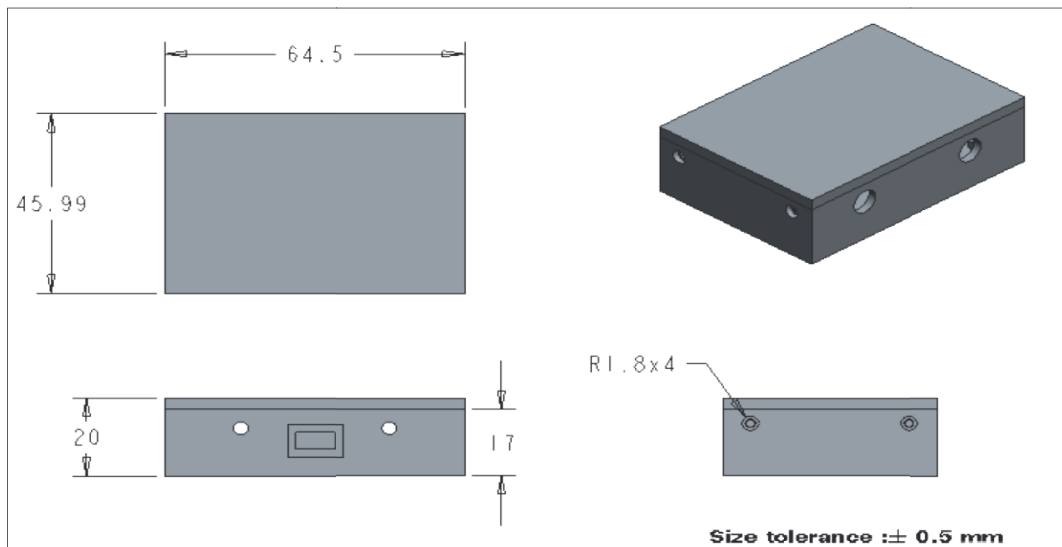
| LED   | Function       |
|-------|----------------|
| LED 1 | Power states   |
| LED 2 | GNSS TX states |

**RTK-4057-MHPD EVK Box**

## 9. Dimension Information



**RTK-4057-MHPD**



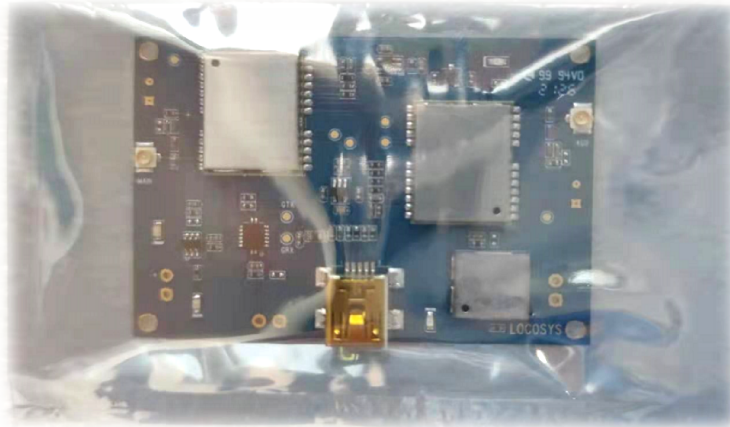
**RTK-4057-MHPD EVK Box**

## 10. USB Driver and Test Software Download

Please link to LOCOSYS company website and click RTK-4057-MHPD product icon  
<https://www.locosystech.com/en/page/Evaluation-Kit-Testing-Software-Manual/support-evk.html>

## 11. Packing Material Information

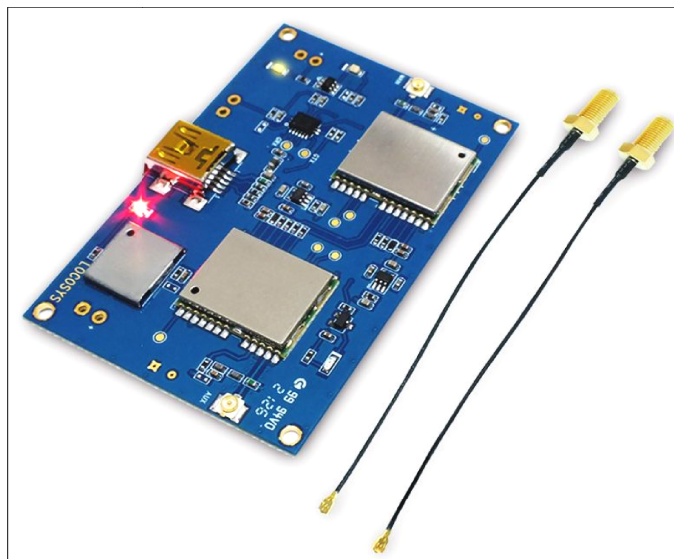
The RTK board are sealed in a moisture barrier ESD bag.



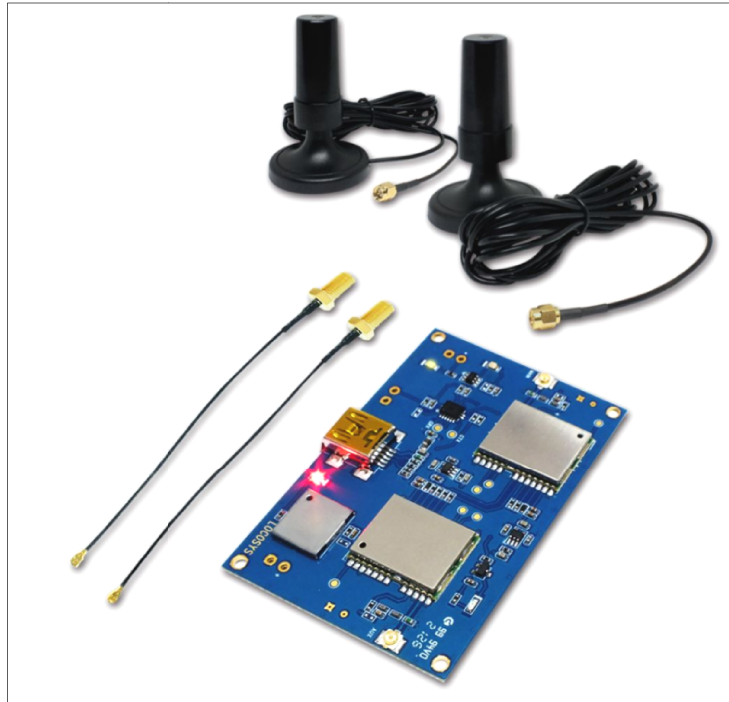
*Anti-static bag and waterproof packaging.*

## 12. Recommended to Accessories

**CAUTION:** For the first test, it is recommended to use an EVK Box **Package (C)** ; If you use an RTK board, Please use it in a closed environment system, do not use a "bare board" for testing, otherwise it will affect the performance.



*Package (A) : RTK-4057-MHPD Board + IPEX Cable*



*Package (B) : RTK-4057-MHPD Board + IPEX Cable + Helix Antenna (LH-105A2-B)*



*Package (C) : RTK-4057-MHPD EVK Box + Helix Antenna (LH-105A2-B)*

## Document change list

### Revision 0.1

- Draft release on July 21, 2021.