
# HI-203E
# Mini-DIN
# GPS Receiver

## User Manual

# HI-203E

# GPS Receiver

# General description of what GPS is and how it works.

GPS (Global Positioning System) is the only system today able to show you your exact position on the Earth anytime, in any weather, anywhere. GPS satellites, 24 in all, orbit at 11,000 nautical miles above the Earth. They are continuously monitored by ground stations located worldwide. The satellites transmit signals that can be detected by anyone with a GPS receiver. Using the receiver, you can determine your location with great precision.

The satellites are positioned so that we can receive signals from six of them nearly 100 percent of the time at any point on Earth. You need that many signals to get the best position information. Satellites are equipped with very precise clocks that keep accurate time to within three nanoseconds- that's 0.000000003, or three billionths of a second. This precision timing is important because the receiver must determine exactly how long it take s for signals to travel from each GPS satellite. The receiver uses this information to calculate its position.

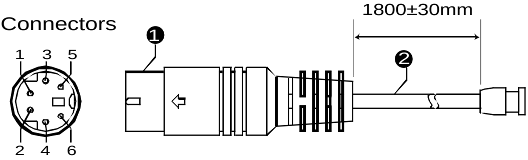
Although GPS was designed for military use, many thousands of civi lians make use of it. The satellites actually broadcast two signals, one is only formilitary use, and the ther can be used by both military and civilians. Since GPS is passive (you only need to receive the signal), there are no restrictions on who can use the signal available to civilians.

GPS technology can be used in a variety of fields besides providing navigation for vehicles on the sea, in the air and on the ground. GPS applications also include keeping track of where a fleet of trucks, trains, ships or planes are and how fast they are moving; directin gemergency vehicles to the scene of an accident; mapping where a city's assets are located ; and providing precise timing for endeavors that require large-scale coordination.

## GLOBAL POSITIONING SYSTEM
# HI-203E GPS RECEIVER

### Pin Assignment

Connectors




**PS/2 Connector**

| Color | Function | CN1 |
|---|---|---|
| Green | TX | 5 |
| White | RX | 4 |
| Red | VCC | 2 |
| Black | GND | 1 |

❶ Mini Din: 6 pin male connector

❷ Wire: 3.6 ± 0.1mm

**Pocket PC**

HI-203E PS/II GPS receiver Can Connecting to a female PS/II Connector. One end from the female Connector is +12V car charger (charging PDA and GPS receiver simultaneously) the other end form the female PS/II connector is the PDA connector for connecting your PDA.

**For notebook PC use:**

HI-203E PS/II can also connect with a PS/II to DB9 PS-232 serial cable or USB connector.

# 1. HI-203E Series Introductions

HI-203E is a GPS receiver with PS/II mini-DIN interfaces and built-in active antenna for high sensitivity to tracking signal. HI-203E is well suited to system integration and users who use any kinds of mobile devices, such as, PDA, notebook PC, Tablet PC, etc. It satisfies a wide variety of applications for car navigation, personal navigation or touring devices, tracking and marine navigation purpose. Users can simply plug it into a PDA or other type of handheld PC running with suitable mapping and routing software for navigation.

## 1.1 Standard Package

Before you start up, make sure that your package includes the following items. If any items are missing or damaged, contact your dealer immediately.

- HI-203E GPS Receiver unit
- Suction CUP
- User Manual CD (including User Manual, HaiTest Testing Program, Driver for PCMCIA card slot of Notebook PC)

**Optional Accessories:**

- PS/II to PDA connector and car charger
- PS/II to DB9 adapting cable
- PS/II to USB adapting cable

**SECTION 1**

INTRODUCTION

## 1.1 OVERVIEW

12 Channel GPS Sensor Module

The HI-203E is an all-in-one GPS receiver module specifically designed for handheld device market. It features small size, low power consumption, and ease of use.

The HI-203E is optimized for good performance and low cost. Its 12 parallel channels and 4000 time/frequency search bins provide very fast signal lock-on and rapid time to first fix. Having much faster satellite signal acquisition and re-acquisition speed than the conventional 48 correlator design, the HI-203E offers good navigation performance even in difficult environments.

Both LVTTL-level and RS232-level serial interface are provided on the interface connector.

## 1.2 Features

- 12 parallel channel GPS receiver
- 4000 simultaneous time-frequency search bins
- Better than -135dBm sensitivity
- < 10 second hot start
- < 45 second cold start
- 5m CEP accuracy

**SECTION 2**

RECEIVER OPERATION

Upon power up, after initial self-test has completed, the HI-203E will begin satellite acquisition and tracking process. Under normal open-sky condition, position-fix can be achieved within approximately 35 seconds (within 10 seconds if valid ephemeris data is already collected from recent use). After receiver position has been calculated, valid position, velocity and time information are transmitted through the on board serial interface.

The receiver uses the latest stored position, satellite data, and current RTC time to achieve rapid GPS signal acquisition and fast TTFF. If the receiver is transported over a large distance across the globe, cold-start automatic-locate sequence is invoked. The first position fix may take up to 50 sec searching the sky for the GPS signal. The acquisition performance can be improved significantly if the host initializes the receiver with a rough estimate of time and user position.

As soon as GPS signal is acquired and tracked, the HI-203E will transmit valid navigation information through its serial interface. The navigation data contains following information:

- Receiver position in latitude, longitude, and altitude
- Receiver velocity
- Time
- DOP error-magnification factor
- GPS signal tracking status

The HI-203E will perform 3D navigation when four or more satellites are tracked. When three or fewer satellites are tracked, altitude-hold is enabled using the last computed altitude and 2D navigation mode is entered.

With signal blockage or rising and setting of the satellites, where a change in satellite constellation used for position fix occurred, large position error may result. The HI-203E incorporates a proprietary algorithm to compensate the effect of satellite constellation change, and maintains an accurate smooth estimate of the receiver position, velocity, and heading.

## 2.1 TECHNICAL SPECIFICATIONS

| FEATURES | DESCRIPTIONS |
|---|---|
| Receiver Type | 12 parallel channel, L1 C/A code |
| Accuracy | Position: 5m CEP Velocity: 0.1m/sec |
| Startup Time | < 10sec hot start < 35sec warm start<br>< 45sec cold start |
| Reacquisition | 1s |
| Acquisition Sensitivity | Better than -135dBm |
| Update Rate | 1Hz |
| Dynamics | 4G (39.2m/sec2) |
| Operational Limits | Altitude < 18,000m or velocity < 515m/s (COCOM limit, either may be exceeded but not both) |
| Serial Interface | LVTTL level and RS-232 level |
| Protocol | NMEA-0183 V3.01<br>GPGGA, GPGLL, GPGSA, GPGSV, GPRMC, GPVTG, GPZDA<br>4800 baud, 8, N, 1 |
| Datum | Default WGS-84<br>User definable |
| Interface Connector | One 1.0mm pitch WTB S/R wafer<br>87213 SMT R/A type connector |
| Input Voltage | 3.8V ~ 12.0V |
| Current Consumption | 90 ~ 110mA |
| Dimension | 46mm L x 31mm W x 14.5mm H |
| Weight: | 14g |
| Operating | -40°C ~ +85°C |
| Humidity | 5% ~ 95% |

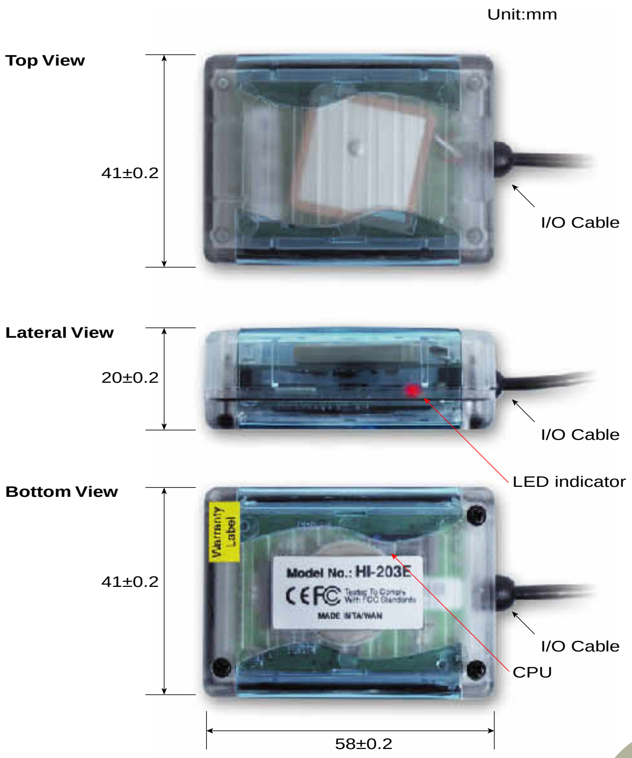
## 2.2 LED INDICATOR

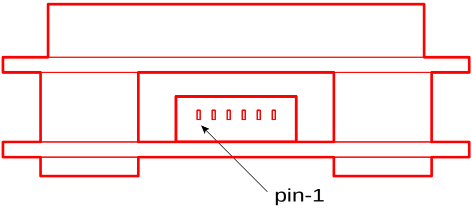
| | |
|---|---|
| LED flashing 0.25Hz | Signal Searching |
| LED flashing 1Hz | Position Fixed |

**SECTION 3**

HARDWARE INTERFACE

## 3.1 MECHANICAL DIMENSIONS






HI-203E Lateral View

## 3.2 PINOUT DESCRIPTION

| Pin Number | Signal Name | Description |
|---|---|---|
| 1 | Serial Data Out 1 | Asynchronous serial output at LVTTL level, to output NMEA message |
| 2 | Serial Data In 1 | Asynchronous serial input at LVTTL level, to input command message |
| 3 | Serial Data Out 2 | Asynchronous serial output at RS-232 level, to output NMEA message |
| 4 | Serial Data In 2 | Asynchronous serial input at RS-232 level, to input command message |
| 5 | Power | 3.8V ~ 12.0V DC input |
| 6 | Ground | Power and signal ground |

## 3.3 ONE-PULSE-PER-SECOND (1PPS) OUTPUT

The one-pulse-per-second output is provided for applications requiring precise timing measurements. The output pulse is 1usec in duration. Rising edge of the output pulse is accurate to +/-1usec with respect to the start of each GPS second. Accuracy of the one-pulse-per-second output is maintained only when the GPS receiver has valid position fix.

The 1PPS output is always generated when the GPS receiver is powered-on. Proper adjustment of the 1PPS output to align with the GPS second requires calculation of the receiver clock offset and clock drift-rate as part of the position-velocity-time (PVT) solution. When enough satellite signals are received to generate valid position fixes, the 1PPS output is adjusted to align with the GPS second in several seconds. When the 1PPS output is brought in sync with the GPS second, the 1PPS Valid Signal on the I/O pin becomes active (HIGH); when the 1PPS output is not yet in sync with the GPS second, the 1PPS Valid Signal remains inactive (LOW).

As long as enough satellite signals are received to generate valid position fixes, the 1PPS output remains synchronized to the GPS second, and the 1PPS Valid Signal remains active. If signal blockage prevents the receiver from generating valid position fix, the 1PPS output will drift away from the GPS second and the 1PPS Valid Signal will become inactive. Upon re-acquiring enough satellites to generate consecutive valid position fixes, the 1PPS Valid Signal will become active again, signaling that the 1PPS output is again synchronized with the GPS second.

For best stable operation of the 1PPS signal, it is to be operated in static environment having clear view of the sky.

**SECTION 4**

# SOFTWARE INTERFACE

This section describes the details of the serial port commands through which the HI-203E is controlled and monitored. The serial port commands allow users to set the receiver parameters, configure output message type, and retrieve status information. The baud rate and protocol of the host COM port must match the baud rate and protocol of the GPS receiver serial port for commands and data to be successfully transmitted and received. The default receiver protocol is 4800baud, 8 data bits, 1 stop bit, and none parity.

## 4.1 NMEA OUTPUT MESSAGE SPECIFICATION

The HI-203E supports NMEA-0183 output format as defined by the National Marine Electronics Association (http://www.nmea.org). The currently supported NMEA messages for GPS applications are:

**GGA** Global Positioning System Fix 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

### 4.1.1 NMEA Messages

The serial interface protocol is based on the National Marine Electronics Association's NMEA 0183 ASCII interface specification. This standard is fully define in "NMEA 0183, Version 3.01" The standard may be obtained from NMEA, www.nmea.org

### 4.1.2 GGA - GPS FIX DATA

Time, position and position-fix related data (number of satellites in use, HDOP, etc.).

**Format:**

$GPGGA,<1>,<2>,<3>,<4>,<5>,<6>,<7>,<8>,<9>,
M,<10>,M,<11>,<12>,*<13><CR><LF>

**Example:**

$GPGGA,104549.04,2447.2038,N,12100.4990,E,1,06,
01.7,00078.8,M,0016.3,M,,*5C<CR><LF>

| Field | Example | Description |
|---|---|---|
| 1 | 104549.04 | UTC time in hhmmss.ss format, 000000.00 ~ 235959.99 |
| 2 | 2447.2038 | Latitude in ddmm.mmmm format Leading zeros transmitted |
| 3 | N | Latitude hemisphere indicator, 'N' = North, 'S' = South |
| 4 | 12100.4990 | Longitude in dddmm.mmmm format Leading zeros transmitted |
| 5 | E | Longitude hemisphere indicator, 'E' = East, 'W' = West |
| 6 | 1 | Position fix quality indicator<br>0: position fix unavailable<br>1: valid position fix, SPS mode<br>2: valid position fix, differential GPS mode |
| 7 | 06 | Number of satellites in use, 00 ~ 12 |
| 8 | 01.7 | Horizontal dilution of precision, 00.0 ~ 99.9 |
| 9 | 00078.8 | Antenna height above/below mean sea level, -9999.9 ~ 17999.9 |
| 10 | 0016.3 | Geoidal height, -999.9 ~ 9999.9 |
| 11 | | Age of DGPS data since last valid RTCM transmission in xxx format (seconds)<br>NULL when DGPS not used |
| 12 | | Differential reference station ID, 0000 ~ 1023<br>NULL when DGPS not used |
| 13 | 5C | Checksum |

**Note:** The checksum field starts with a '*' and consists of 2 characters representing a hex number. The checksum is the exclusive OR of all characters between '$' and '*'.

## 4.1.3 GLL - LATITUDE AND LONGITUDE, WITH TIME OF POSITION FIX AND STATUS

Latitude and longitude of current position, time, and status.

**Format:**

$GPGLL,<1>,<2>,<3>,<4>,<5>,<6>,<7>*<8><CR><LF>

**Example:**

$GPGLL,2447.2073,N,12100.5022,E,104548.04,A,
A*65<CR><LF>

| Field | Example | Description |
|---|---|---|
| 1 | 2447.2073 | Latitude in ddmm.mmmm format<br>Leading zeros transmitted |
| 2 | N | Latitude hemisphere indicator,<br>'N' = North, 'S' = South |
| 3 | 12100.5022 | Longitude in dddmm.mmmm format<br>Leading zeros transmitted |
| 4 | E | Longitude hemisphere indicator,<br>'E' = East, 'W' = West |
| 5 | 104548.04 | UTC time in hhmmss.ss format,<br>000000.00 ~ 235959.99 |
| 6 | A | Status, 'A' = valid position,<br>'V' = navigation receiver warning |
| 7 | A | Mode indicator<br>'N' = Data invalid 'D' = Differential<br>'A' = Autonomous 'E' = Estimated |
| 8 | 65 | Checksum |

## 4.1.4 GSA - GPS DOP AND ACTIVE SATELLITES

GPS receiver operating mode, satellites used for navigation, and DOP values.

**Format:**

$GPGSA,<1>,<2>,<3>,<3>,<3>,<3>,<3>,<3>,<3>,<3>,
<3>,<3>,<3>,<3>,<4>,<5>,<6>*<7><CR><LF>

**Example:**

$GPGSA,A,3,26,21,,,09,17,,,,,,,10.8,02.1,10.6*07<CR><LF>

| Field | Example | Description |
|---|---|---|
| 1 | A | Mode, 'M' = Manual, 'A' = Automatic |
| 2 | 3 | Fix type, 1 = not available, 2 = 2D fix, 3 = 3D fix |
| 3 | 26,21,,,09, 17,,,,,, | PRN number, 01 to 32, of satellite used in solution, up to 12 transmitted |
| 4 | 10.8 | Position dilution of precision, 00.0 to 99.9 |
| 5 | 02.1 | Horizontal dilution of precision, 00.0 to 99.9 |
| 6 | 10.6 | Vertical dilution of precision, 00.0 to 99.9 |
| 7 | 07 | Checksum |

### 4.1.5 GSV - GPS SATELLITE IN VIEW

Number of satellites in view, PRN number, elevation angle, azimuth angle, and C/No. Only up to four satellite details are transmitted per message. Additional satellite in view information is sent in subsequent GSV messages.

**Format:**

$GPGSV,<1>,<2>,<3>,<4>,<5>,<6>,<7>, … ,
<4>,<5>,<6>,<7> *<8><CR><LF>

Example:

$GPGSV,2,1,08,26,50,016,40,09,50,173,39,21,43,316,
38,17,41,144,42*7C<CR><LF>
$GPGSV,2,2,08,29,38,029,37,10,27,082,32,18,22,309,
24,24,09,145,*7B<CR><LF>

| Field | Example | Description |
|---|---|---|
| 1 | 2 | Total number of GSV messages to be transmitted |
| 2 | 1 | Number of current GSV message |
| 3 | 08 | Total number of satellites in view, 00 ~ 12 |
| 4 | 26 | Satellite PRN number, GPS: 01 ~ 32, SBAS: 33 ~ 64 (33 = PRN120) |
| 5 | 50 | Satellite elevation number, 00 ~ 90 degrees |
| 6 | 016 | Satellite azimuth angle, 000 ~ 359 degrees |
| 7 | 40 | C/No, 00 ~ 99 dBNull when not tracking |
| 8 | 7C | Checksum |

### 4.1.6 RMC - RECOMMANDED MINIMUM SPECIFIC GPS/TRANSIT DATA

Time, date, position, course and speed data.

**Format:**

$GPRMC,<1>,<2>,<3>,<4>,<5>,<6>,<7>,<8>,<9>,<10>,
<11>,<12>*<13><CR><LF>

**Example:**

$GPRMC,104549.04,A,2447.2038,N,12100.4990,E,
016.0,221.0,250304,003.3,W,A*22<CR><LF>

| Field | Example | Description |
|---|---|---|
| 1 | 104549.04 | UTC time in hhmmss.ss format,<br>000000.00 ~ 235959.99 |
| 2 | A | Status, 'V' = navigation receiver warning,<br>'A' = valid position |
| 3 | 2447.2038 | Latitude in dddmm.mmmm format<br>Leading zeros transmitted |
| 4 | N | Latitude hemisphere indicator,<br>'N' = North, 'S' = South |
| 5 | 12100.4990 | Longitude in dddmm.mmmm format<br>Leading zeros transmitted |
| 6 | E | Longitude hemisphere indicator,<br>'E' = East, 'W' = West |
| 7 | 016.0 | Speed over ground, 000.0 ~ 999.9 knots |
| 8 | 221.0 | Course over ground, 000.0 ~ 359.9 degrees |
| 9 | 250304 | UTC date of position fix, ddmmyy format |
| 10 | 003.3 | Magnetic variation, 000.0 ~ 180.0 degrees |
| 11 | W | Magnetic variation direction, 'E' = East, 'W' = West |
| 12 | A | Mode indicator<br>'N' = Data invalid 'D' = Differential<br>'A' = Autonomous 'E' = Estimated |
| 13 | 22 | Checksum |

## 4.1.7 VTG - COURSE OVER GROUND AND GROUND SPEED

Velocity is given as course over ground (COG) and speed over ground (SOG).

**Format:**

GPVTG,<1>,T,<2>,M,<3>,N,<4>,K,<5>*<6><CR><LF>

**Example:**

$GPVTG,221.0,T,224.3,M,016.0,N,0029.6,K,A*1F<CR><LF>

| Field | Example | Description |
|---|---|---|
| 1 | 221.0 | True course over ground,<br>000.0 ~ 359.9 degrees |
| 2 | 224.3 | Magnetic course over ground,<br>000.0 ~ 359.9 degrees |
| 3 | 016.0 | Speed over ground,<br>000.0 ~ 999.9 knots |
| 4 | 0029.6 | Speed over ground,<br>0000.0 ~ 1800.0 kilometers per hour |
| 5 | A | Mode indicator<br>'N' = Data invalid<br>'A' = Autonomous<br>'D' = Differentia<br>l'E' = Estimated |
| 6 | 1F | Checksum |

### 4.1.8 ZDA TIME AND DATE

**Format:**

$GPZDA,<1>,<2>,<3>,<4>,<5>,<6>*<7><CR><LF>

**Example:**

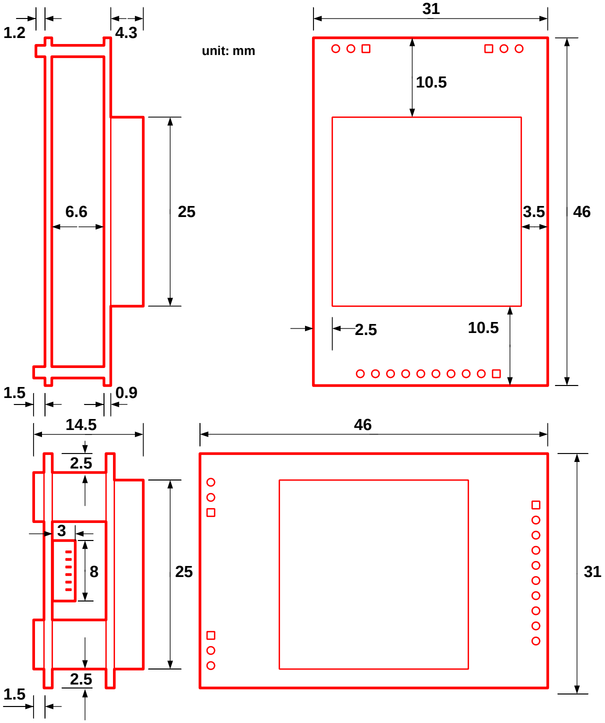
$GPZDA,104548.04,25,03,2004,,*6C<CR><LF>

| Field | Example | Description |
|---|---|---|
| 1 | 104548.04 | UTC time in hhmmss.ss format, 000000.00 ~ 235959.99 |
| 2 | 25 | UTC time: day (01 ... 31) |
| 3 | 03 | UTC time: month (01 ... 12) |
| 4 | 2004 | UTC time: year (4 digit year) |
| 5 | | Local zone hour<br>Not being output by the receiver (NULL) |
| 6 | | Local zone minutes<br>Not being output by the receiver (NULL) |
| 7 | 6C | Checksum |

**Binary Messages**

See Binary Message Protocol User's Guide for detailed descriptions.

# MECHANICAL CHARACTERISTICS



## APPENDIX B
DEFAULT VALUES

The product has the following factory preset default values:

| | |
|---|---|
| Datum: | 000 (WGS-84) |
| NMEA Enable Switch: | GGA ON<br>GLL ON<br>GSA ON<br>GSV ON<br>RMC ON<br>VTG ON<br>Checksum ON |
| Baud Rate: | 4800 Bps |
| Elevation Mask: | 5 degrees |
| DOP Mask: | DOP Select: Auto<br>GDOP: 20<br>PDOP: 15<br>HDOP: 8 |
| Receiver Operating Mode: | Normal Mode (without 1PPS) |

Commands can be issued to the HI-203E to change the settings of the receiver. The new settings will remain effective on next power-on as long as the on-board rechargeable backup battery is not discharged. After the backup battery is discharged, factory preset default settings will be used.

## TROUBLESHOOTING

| Problem | Reasons | Solutions |
|---|---|---|
| No Position output but timer is counting | Weak or no GPS signal can be received at the place of HI-203E unit | Place the HI-203E under an open space, then, press 'Reset' |
| | At outdoor space but GPS signal is blocked by building or car roof | To try again, go to outdoor and press 'Reset' or connect external antenna on the side of HI-203E to improve the poor GPS signal |
| Execute Fail | Wrong CPU type | PocketPC support multiple typs of CPU. Make sure you download the correct testing (or mapping software). You can use the PDA smart menu's 'setting' function to see wether the CPU type is correct or not. |
| Can's open COM port | The PS/II connector did not insert correctly or some other application is the COM port | Plug HI-203E connector firmly or close all other application that occupied the COM port |
| Can not find HI-203E | Poor connection | Check HI-203E if Plug firmly |
| No signal | No action for few minites may causes PocketPC into the power saving mode. It could close the COM port at the same time. | Close all applications and exacute it again to re-open the COM port |
| | Weak or no GPS signal when using HI-203E indoor or inside the car. | Put HI-203E to an open space or car roof, then, press the Reset button |

# GPS Receiver

4 710635 517182