# PowerGPS User Manual V2.2



MediaTek

# List of Contents

## Version Control:

| Version | Date | Description |
|---|---|---|
| 2.2 | 2015/09/02 | Add Clock information feature ( chapter 3.4) |

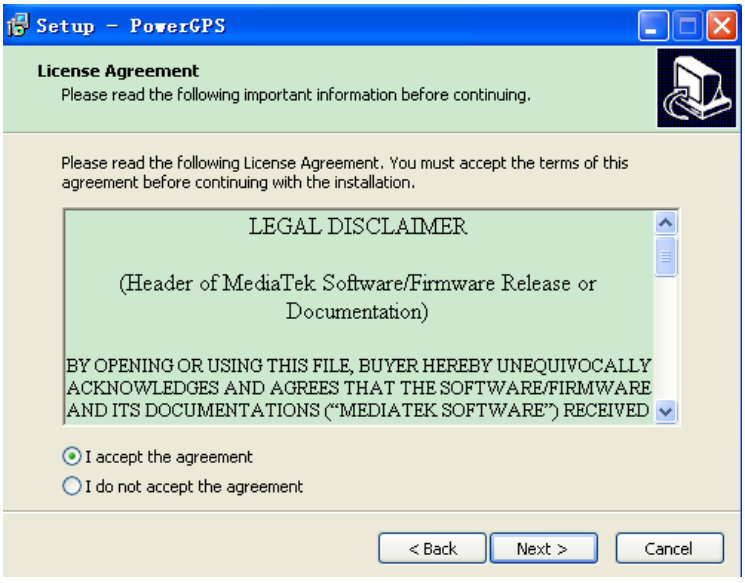
# 1. Installation

This chapter describes how to install the program on your computer.

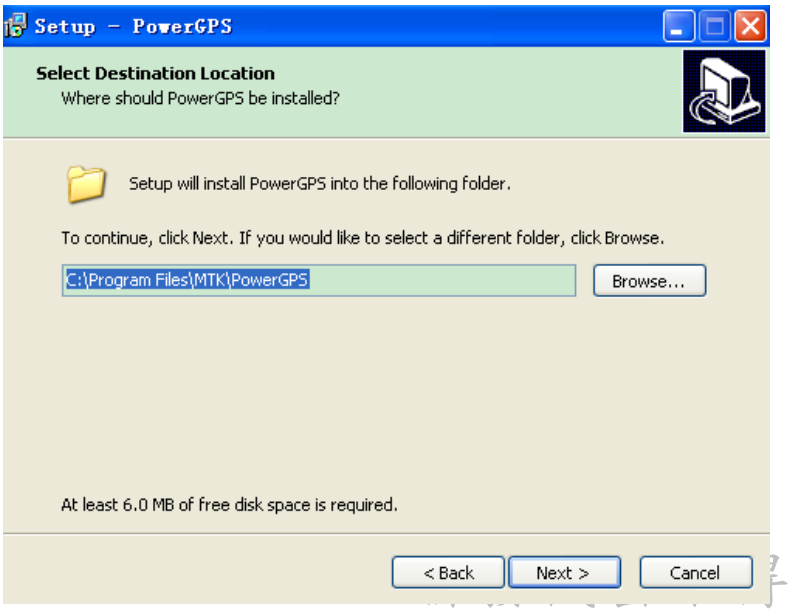
1. Double-click on the setup.exe icon.


2. Click on the Next button.


3. Choose the accept radio button and then click on the Next button.

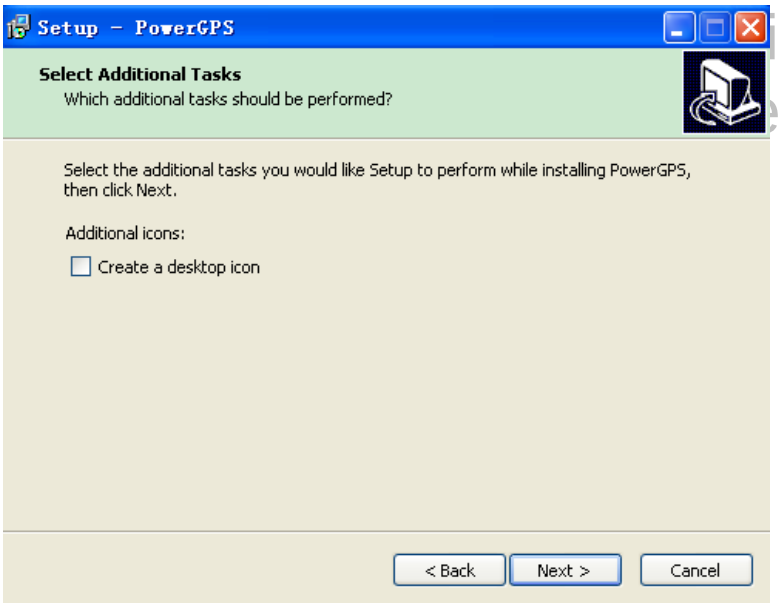


4. You can change the directory where this software is going to be installed in. Click on the Next button when you are done.

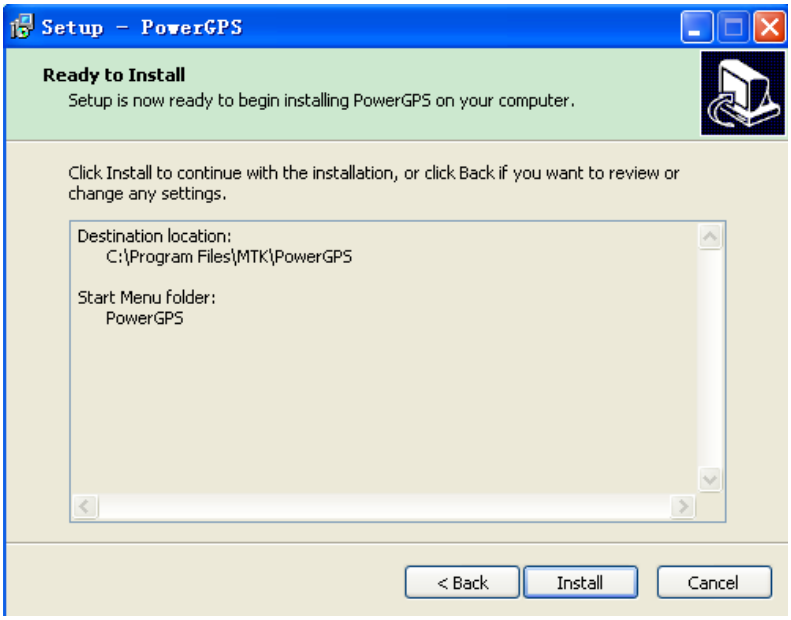





5. Click on the next button.




6. Click on the Install button.



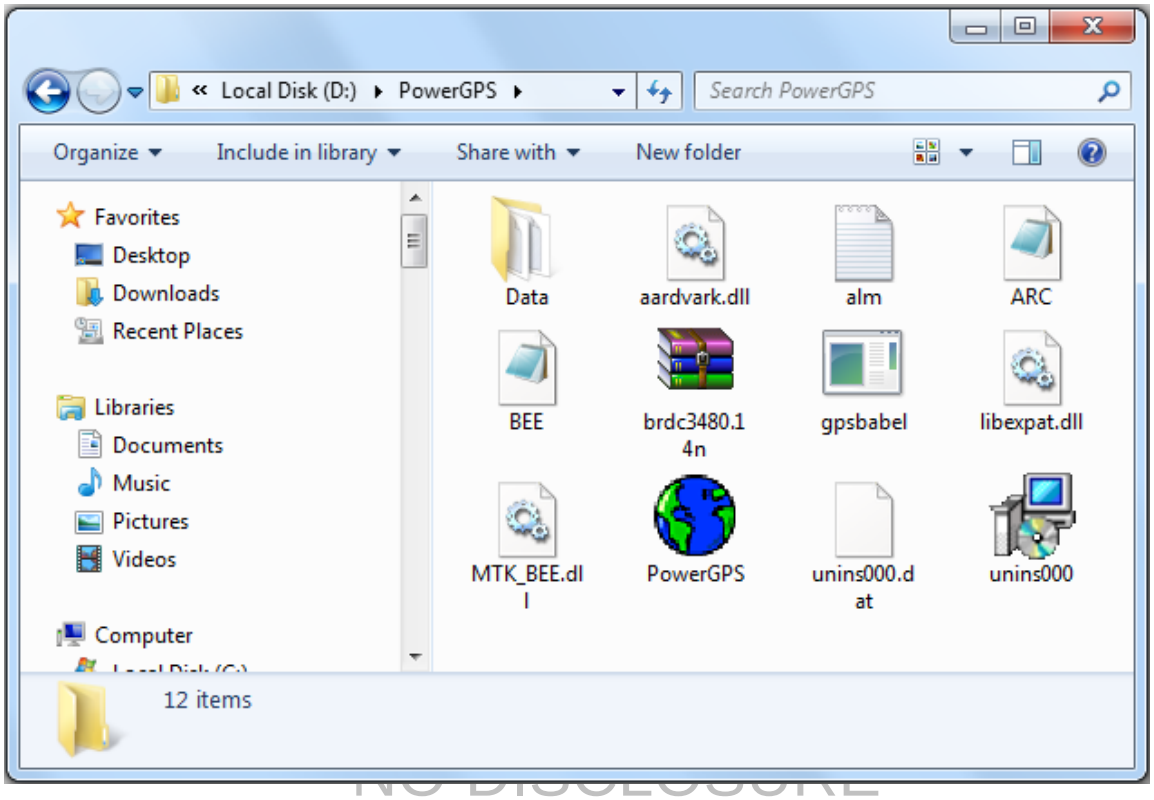



7. Click on the Finish button. The software is successfully installed at this stage.


8. You shall see a shortcut to PowerGPS.exe on the desktop.


There should be an user manual, an almanac file (alm.txt) and some auxiliary files in the

directory that you chose earlier to have this software installed in.



# 2. Getting Started

After the program is successfully installed, we are now ready to run it. This chapter talks about how to start the program.

## 2.1. Button Introduction

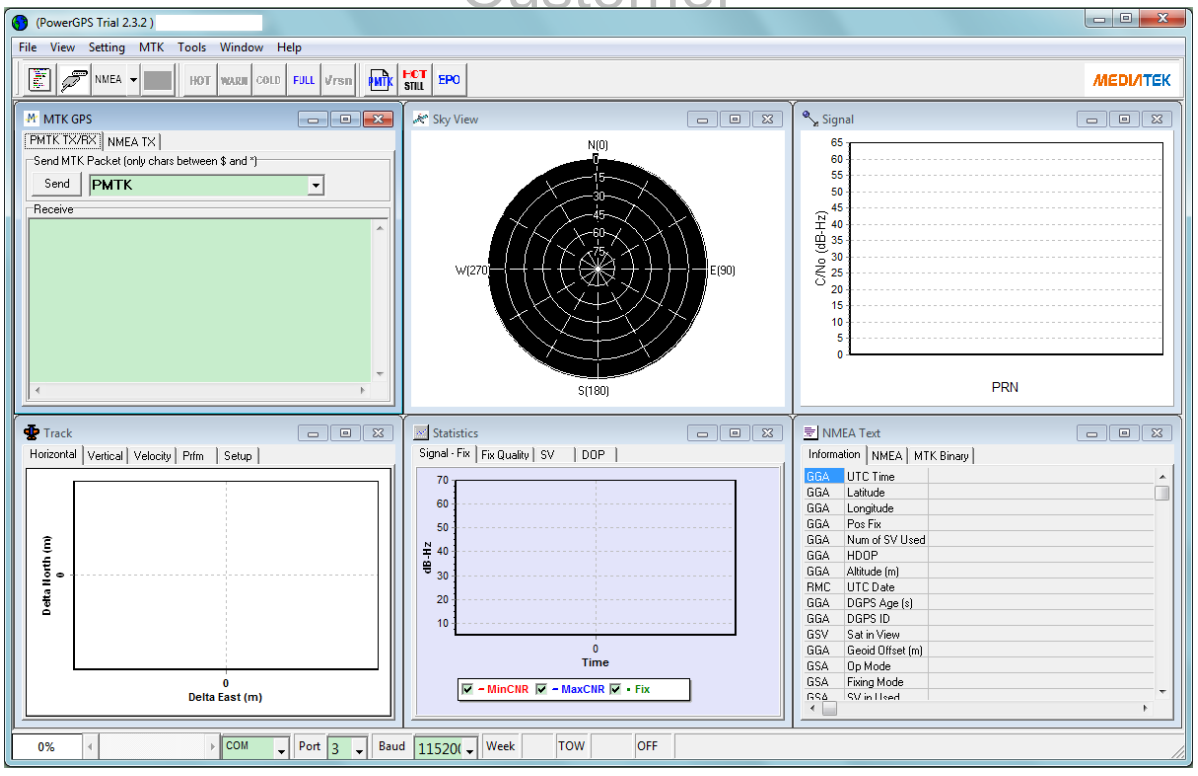
The buttons in the tool bar from left to right are: NMEA File and NMEA Port Connection.

## 2.2. Run the Program

Double-click on the PowerGPS shortcut on your desktop.




A screen like below will show up.

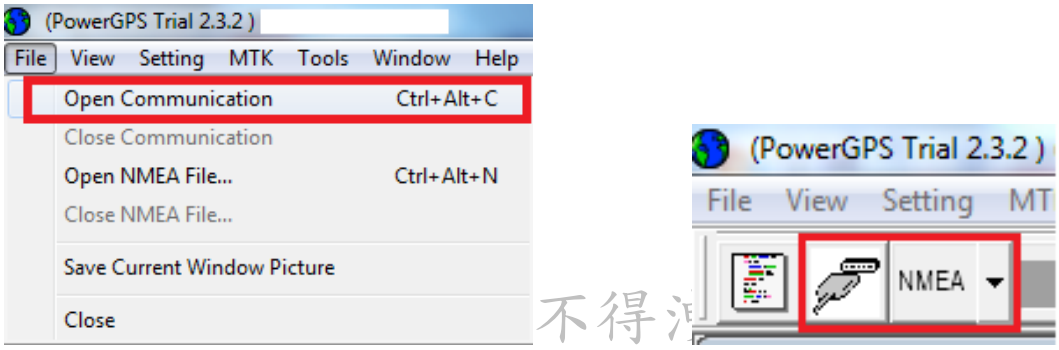


Input data can be read from either COM port or NMEA log file. These two ways are described in the sequel. By default, the program will try to read from COM port when starting to run.

### 2.2.1. Read from COM Port

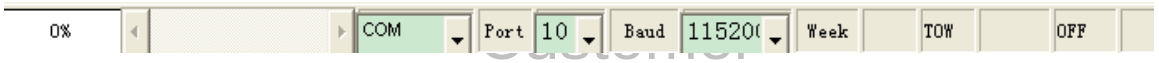
#### 2.2.1.1. Open COM Connection

To set up a connection again, click on the Open Communication in the File menu or click on the port Connect/Disconnect button.

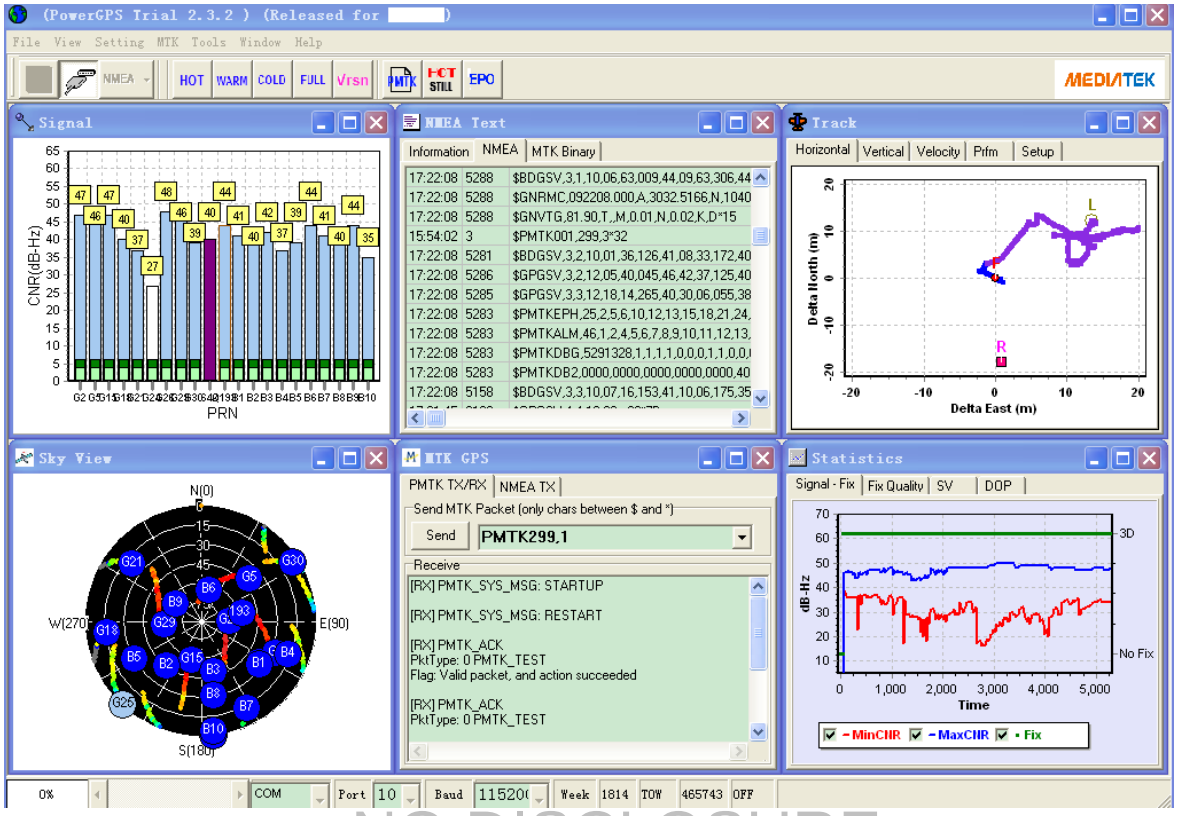





The program will read from the specified COM port using the given baud rate. The COM port and baud rate in use can be seen from the panel on the bottom of main window. (To change the COM port and the baud rate, see 4.2)




If NMEA data are received successfully, windows should look like below.

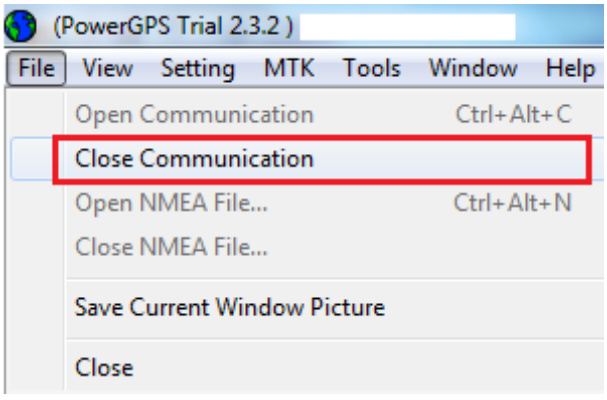


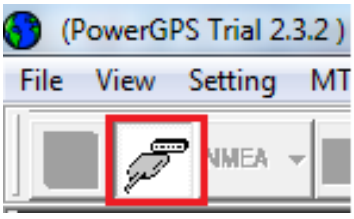



If you do not see anything showing up, you should make sure that the COM port is opened and the port number and the baud rate are correctly set.

### 2.2.1.2. Close COM Port Connection

The connection can be closed by either clicking on the Close Communication in the File menu or clicking on the Connect/Disconnect button.



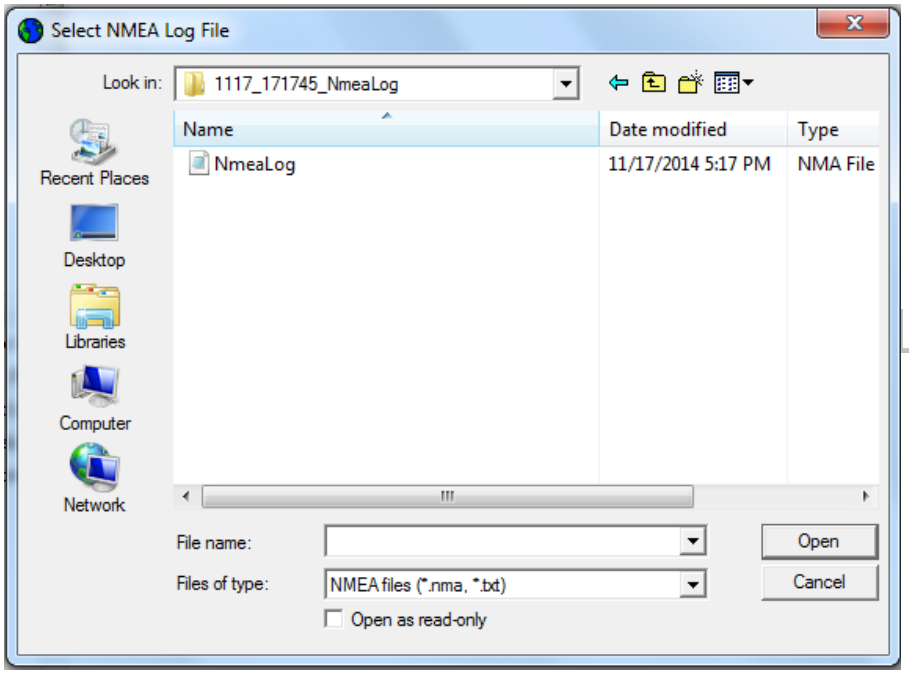

### 2.2.2. Read from NMEA Log File

Launch the program by either clicking on the PowerGPS shortcut on the desktop or clicking on

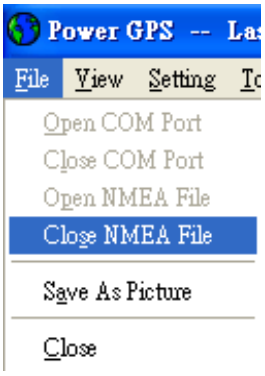
any .nma file. The data will be automatically loaded if the program is executed by clicking on .nma files.

If program is executed by clicking on the shortcut and a connection has been set up, you will need to disconnect the current connection first. See 2.2.1.2 to know how to close the connection.

Click on the Open NMEA File in the File menu or press the Read Log File button in the top left corner. Then a file selection dialog will appear.




1. Select the file you would like to read from and then press Open.
2. To stop the connection, click on the Close NMEA File in the File menu or click on the NMEA file button.



# 3. Features

This chapter introduces some hidden functions that the program provides and something that you might need to know about the program.

The program will create a directory under the directory where PowerGPS.exe is in every time a new connection is set up. The name of the directory is in the format of MMDD_hhmmss_COMx if the program reads from a COM port. If the program reads from a log file, the name will be in the format of MMDD_hhmmss_filename. x is the COM port being used, MM, DD, hh, mm and ss are the month, day, hour, minute and second of the local time when the connection is set up and filename is the name of the file that is opened. Files that will be put in this directory include: all the auto-saved pictures, error report, invalid packet report and NMEA log file.

## 3.1. Update Frequency for Chart Figures



In order to speed-up the processing speed, we adopt a mechanism: the frequency of plotting charts is changed according to the amount of data at hand. This change is shown in Table 1.

Table 1. Update frequency for figures V.S. the number of data points

| Number of data points | Update Frequency |
|---|---|
| 0~3600 | Every point |
| 3601~7200 | Every 2 points |
| 7201~14400 | Every 4 points |
| 14401~28800 | Every 8 points |
| 28800~43200 | Every 16 points |
| 43201~86400 | Every 32 points |
| > 86400 | N/A |

This mechanism applies to:

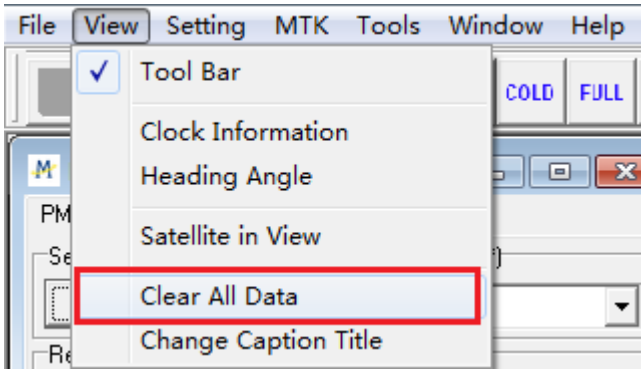
1. Statistic window: State points in SV, DOP, Signal-Fix, Fix Quality panel.
2. Track window: Track points in Horizontal, Vertical, Velocity panel.

## 3.2. Amount of Data

The maximum amount of data points this program can process for these figures is 86400. This number is chosen based on the assumption that the input data rate is 1 per second and there are 86400 seconds a day. If the amount of data exceeds this number, those extra points will not be added to the Track and Statistic windows but will still be shown in other windows.

### 3.3. Data Clearance

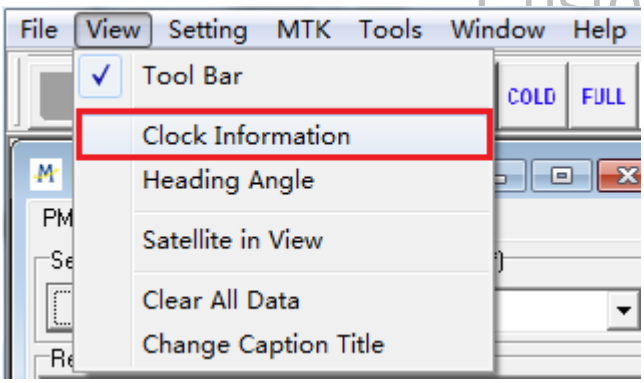
When a new connection is made, all the previous data will be cleared. You can also clear data of all windows by clicking on the items in the View menu at any time.

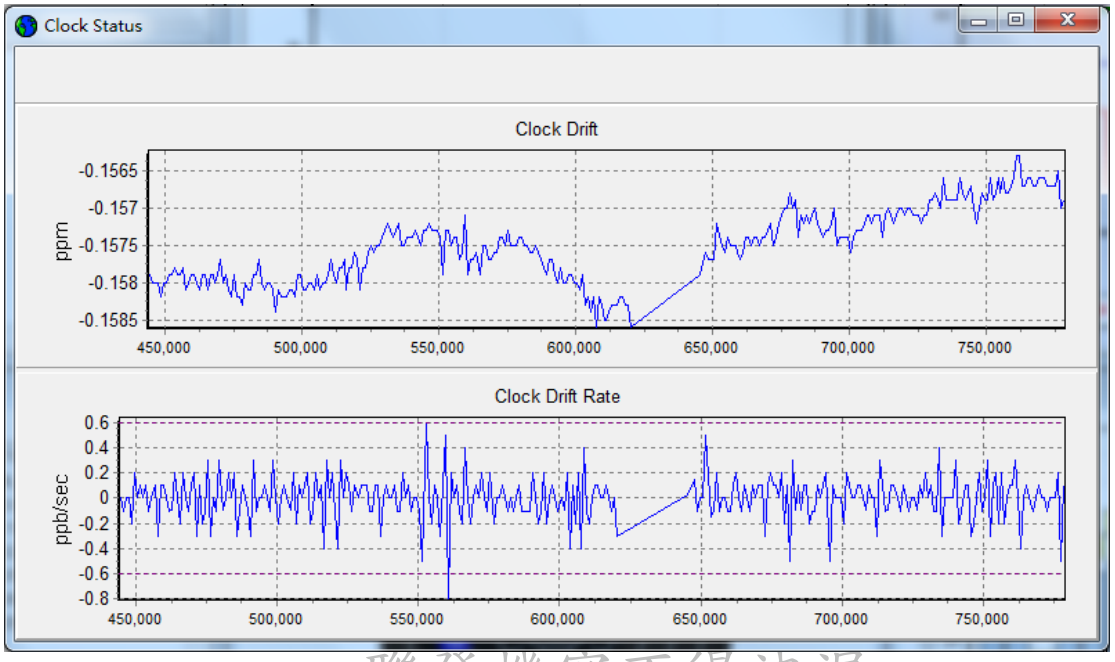



### 3.4. Clock Information Tool

This tool can display the real-time clock drift and clock drift rate, with which the clock (TCXO) performance can be easily to check. Please enable debug log output before using this tool. There are two ways to enable debug log. One is sending “$PMTK299,1*2D” command by UART, and the other is using Corebuilder tool to set it. The setting flow is : “Corebuilder” -> “Core Options” -> “NMEA” -> “Output debug information”.

The threshold of clock drift and clock drift rate are based on the scenario. The clock drift should less than 2.0ppm, and the clock drift rate should less than 2.5ppb/sec.



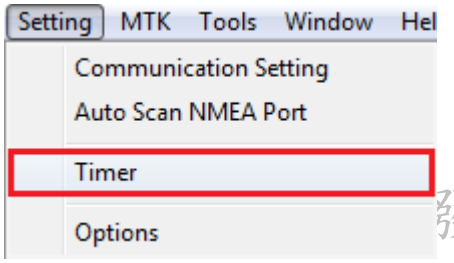


# 4. Settings

## 4.1. Connection Timer

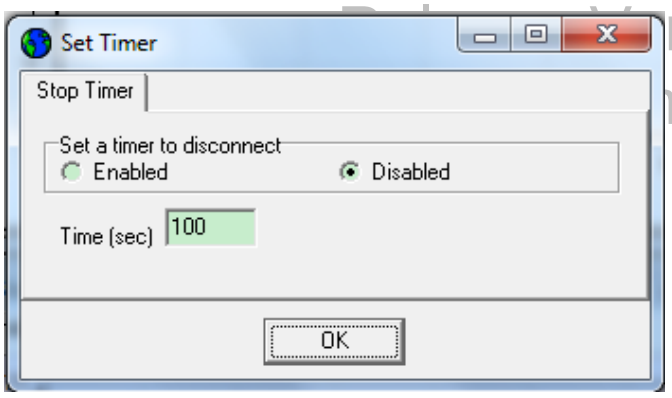
When reading from a COM port, you can set how long you would like the program to run. The timer function is disabled when the data are loaded from a file. The timer setting is in the Setting menu.

1. Click on the Timer in the Setting menu.






2. If you do not want to use the timer, select the Disabled radio button and then press OK.




3. If you want to use the timer, select the Enabled radio button, key in the time you would like the program to run and then press OK. The current timer setting can be seen from the panel on the bottom of the screen.


4. You can change the settings of the timer at any time you want. The new settings will override the old settings and become effective immediately. For example, if the timer is

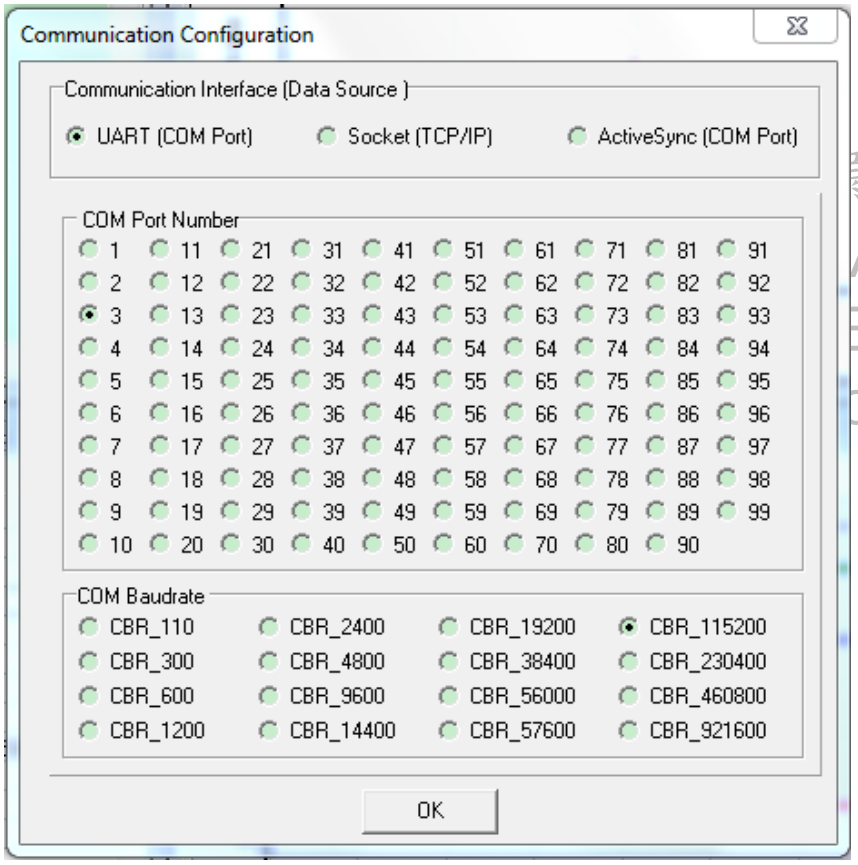
working and you change the expiry time of the timer, the remaining time will be set to the new value that you just input. If you disable the timer when the timer is running, the timer will be disabled right away.

## 4.2. COM Port & Baud Rate

### 4.2.1. Communication Setting

1. To change the COM port and the baud rate, first stop the existing connection if applicable.

2. Click on the Communication Setting in the Setting menu. A form will be displayed.



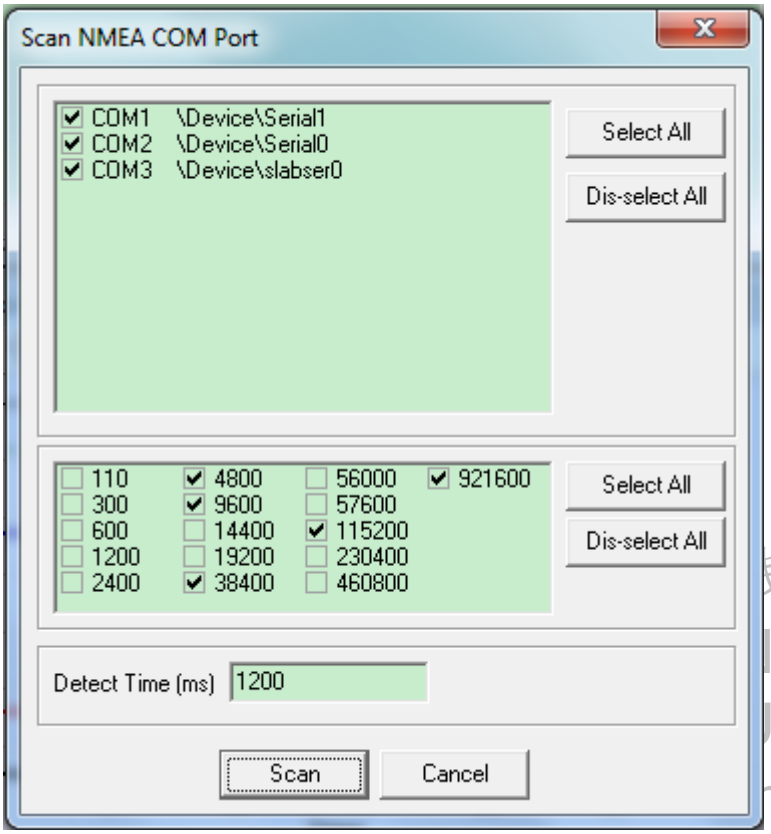

3. Choose UART as the data source. Select the correct COM port and baud rate and then press OK.

### 4.2.2. Auto Scan NMEA Port

If you are not sure which port and baud rate should be chosen, this function will help to auto find right port and baud rate.

1. To change the COM port and the baud rate, first stop the existing connection if applicable.

2. Click on the Auto Scan NMEA Port in the Setting menu. A form will be displayed.

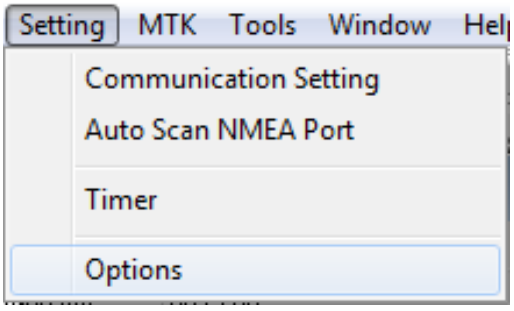





3. Select possible ports and baud rates to be scanned and click scan button. After that program will scan all the possible combinations of ports and baud rates having been selected until right result is found. Besides, program will auto connect while the right port is found.

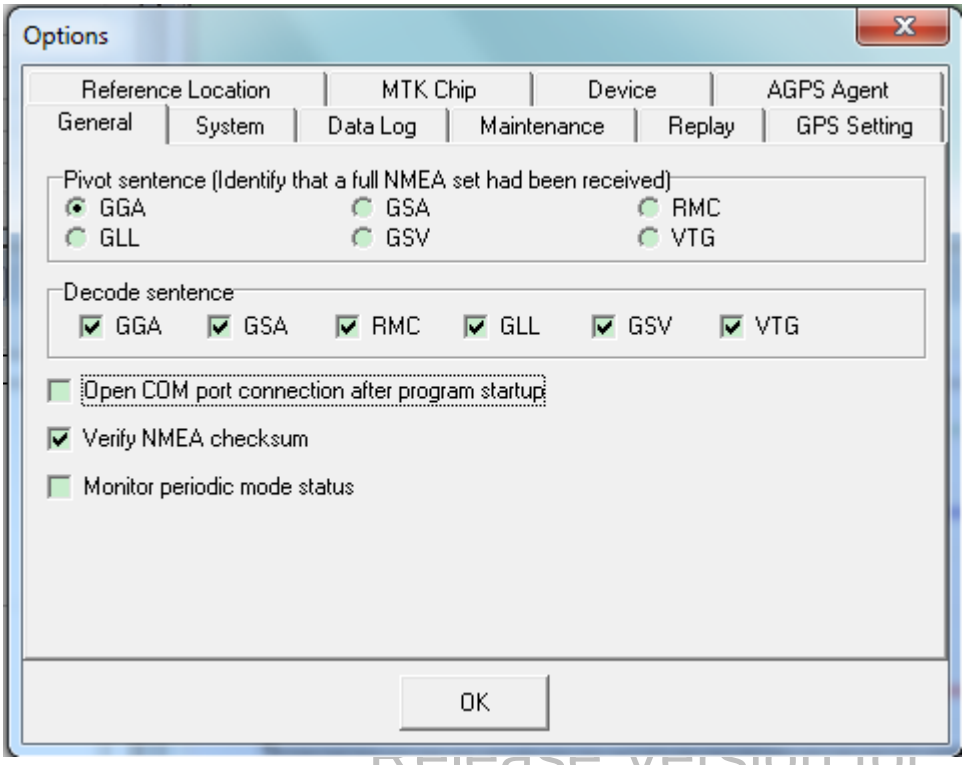
### 4.3. Options

In this part, all the options provided for developers will be description in detail. After clicking on the Options in the Setting menu, ten pages of configuration will be shown.



### 4.3.1. General Configuration

Main menu -> Setting -> Options -> General






1. Select a type of NMEA sentence as pivot sentence so as to identify that a full NMEA set had been received.

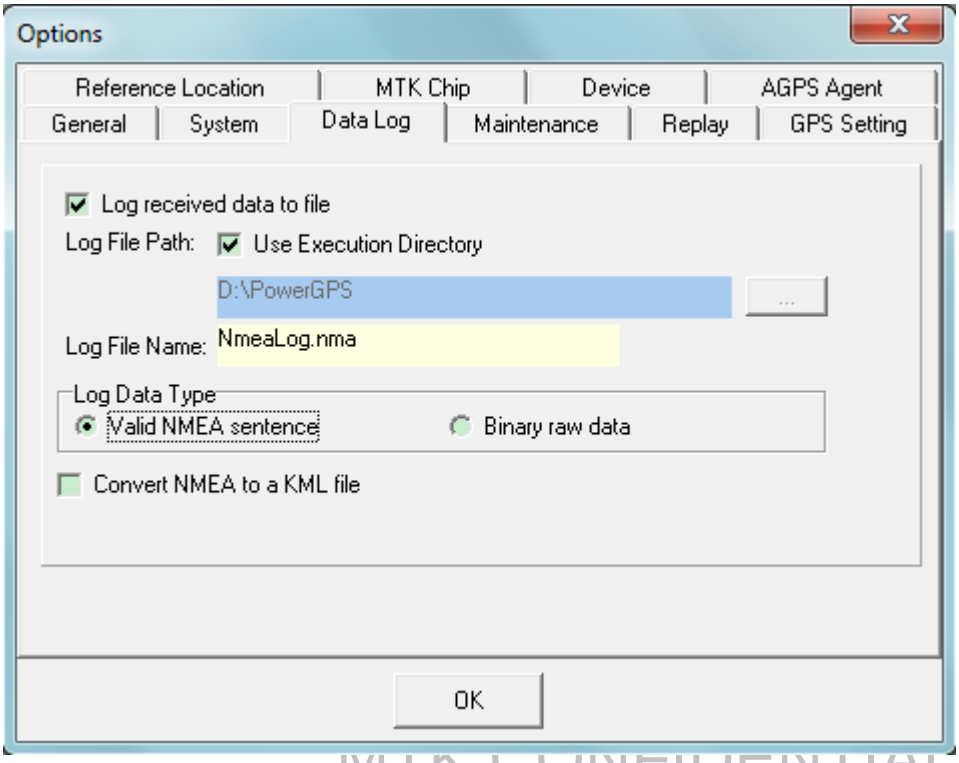
2. Check which NMEA sentences you want to decode. The decoded contents will show in Information panel of NMEA Text.

3. Determine whether auto set up connection after program startup or not.

4. Determine whether verify NMEA checksum or not.

### 4.3.2. Save Data Log

Main menu -> Setting -> Options -> Data Log






When the program reads packets from a COM port, you can choose to save those valid packets in a file. By default, they will be saved. This setting is available only when no connection is set up.

1. Check the “Log received data to file” if you want to save those input data in a file.

2. Select a directory to save the log file or you can check “Use Execution Directory” to save it in default directory easily.

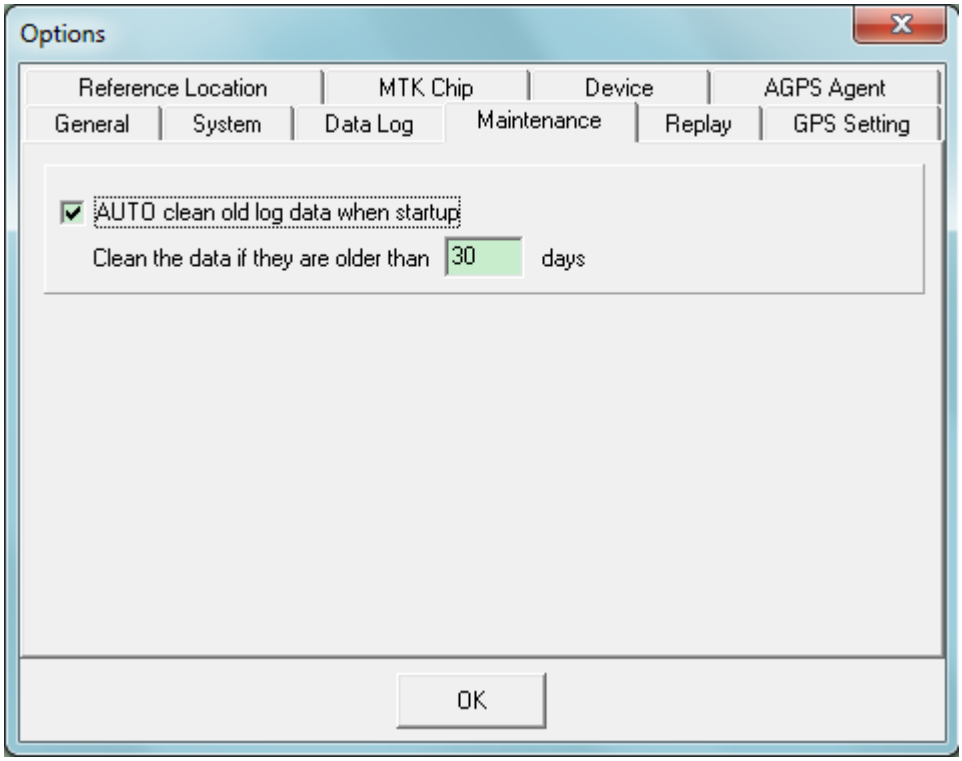
3. Enter the name of the log file.

4. Select Log File Type
   Valid NMEA sentence: Only valid NMEA sentences will be logged in the file.
   Binary raw data: All the data received will be logged in the file.

5. If you want to transfer the NMEA format file into a KML format file (Be used in Google Earth), check “Convert NMEA to KML”. There will be a KML file produced in the specified directory.

### 4.3.3. Auto Clean Log

Main menu -> Setting -> Options -> Maintenance

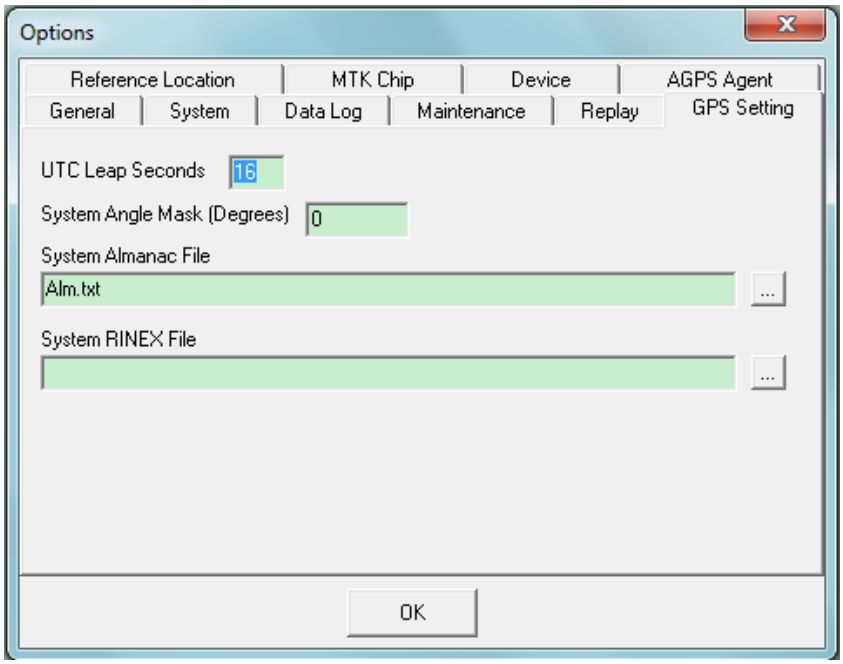



The settings in this page can help to auto delete the log folders which are older than the specified threshold.



### 4.3.4. GPS Setting

Main menu -> Setting -> Options -> GPS Setting



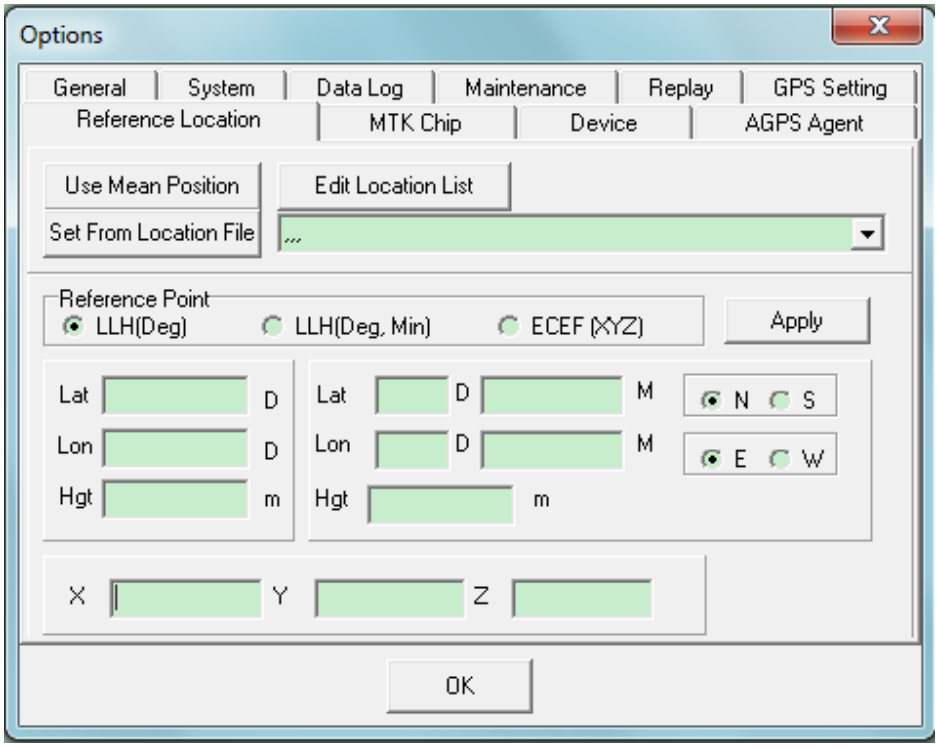
1. Change to the GPS System page, set the current UTC leap time and then click OK. This value is used to convert UTC time to GPS time when you click on the track points in the horizontal panel of the Track window.

2. Set angle mask of system. By doing this, program can filter the satellites with elevation lower than the specified mask.

3. Select the directory to load the almanac information if needed.

### 4.3.5. Reference Location

Main menu -> Setting -> Options -> Reference Location page




This page allows you setting reference location. The reference location information will be used in TTFF testing tool, position accuracy statistics and so on.

There are four ways provided for you to set reference location:

1. “Use Mean Position”:

First of all, you have to wait for GPS receiver fixing for a period of time (several minutes at least). Then click the button to use the average position as reference location.

2. “Set From Location File”:

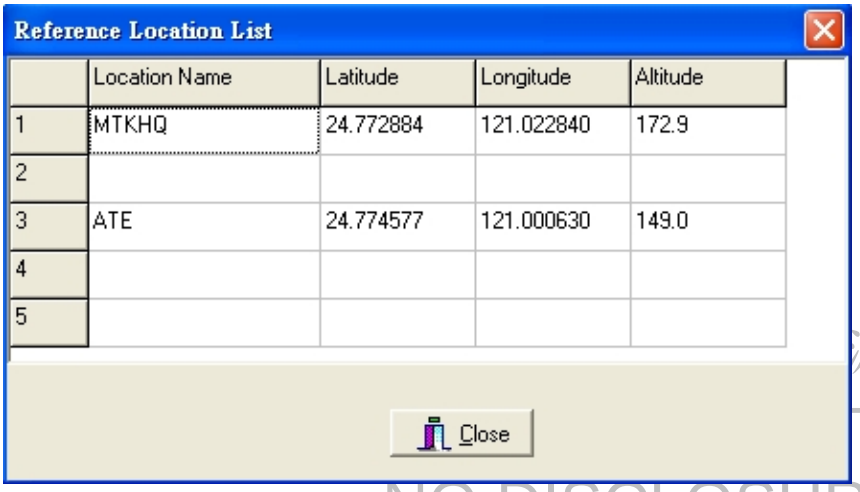
Load reference location from a file which contains position information as the format below:

Latitude(degree) Longitude(degree) Height(meter)

For example: 24.772884 121.022840 172.9

3. Select from Location List:

You can edit some frequently used reference location points by “Edit Location List”




Then choose one from the location list.

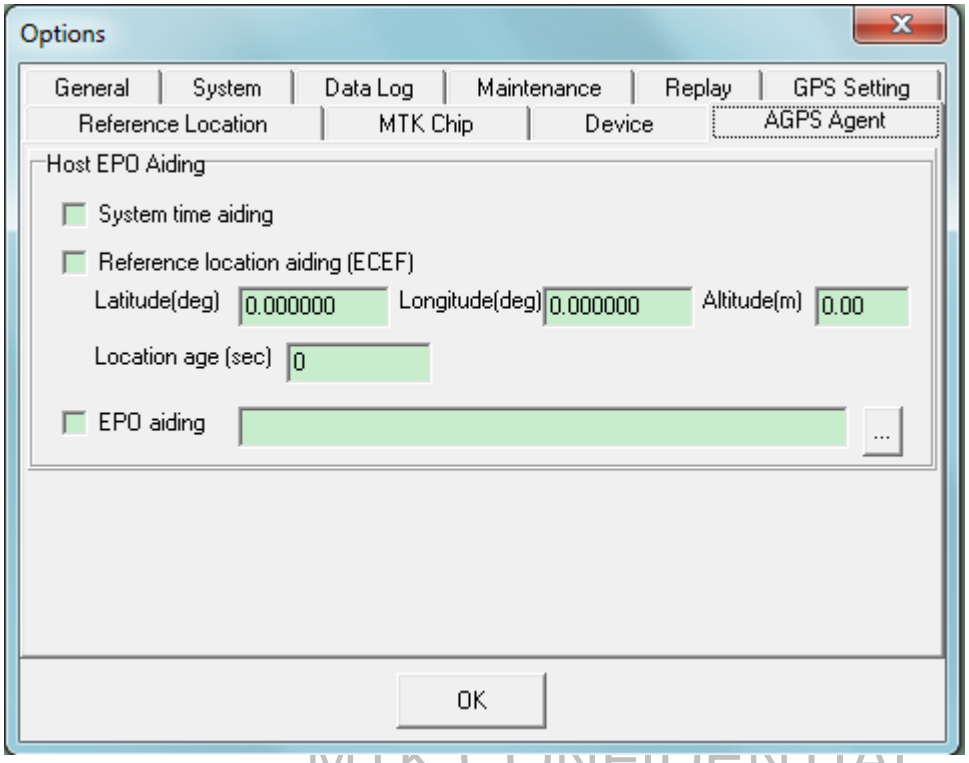


4. Set reference location directly:

Firstly select the location format: LLH(Deg) or LLH(Deg, Min) or ECEF(XYZ). Then enter the location information in the corresponding fields. Finally click the button “Apply” to finish setting.

### 4.3.6. AGPS Agent

Main menu -> Setting -> Options -> AGPS Agent






The options of Host EPO Aiding are set in this page. These settings could help to have faster TTFF.

1. System time aiding

By selecting this option, program can use system time as the EPO reference time, with which GPS chip can determine a rough satellite position to be used for positioning.

2. Reference location aiding(ECEF)

By selecting this option, information in the blank will be used as the EPO reference position to improve TTFF performance. The accuracy requirement for the reference location is within 30km.

3. EPO aiding

Load EPO file to get EPO aiding data.

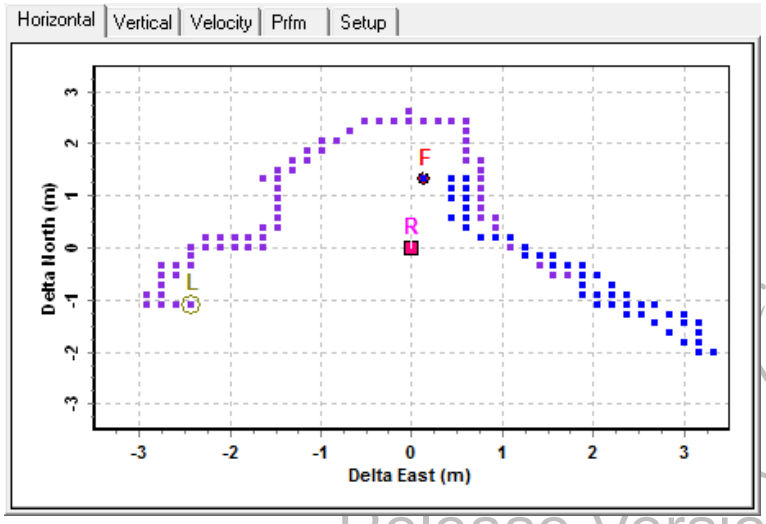
Note: Detail information please refers to MTK EPO Host aiding document.

# 5. Windows

This chapter describes the meaning of each window.

## 5.1. Track Window

### 5.1.1. Horizontal Tracking






This chart keeps track of the position fix. The horizontal axis is delta east and the vertical axis is delta north. They are calculated from the latitude and longitude field of the GPGGA sentence. The unit is meter. The origin is the first position fix if the “Show reference point” in the Setup panel is not checked and is the reference point on the other hand. F is the first position fix and L is the latest one. R is the reference point and is shown only when the “Show reference point” in the Setup panel is checked. The origin is always put at the center of this chart.

The color of each track point is set depending on the value of HDOP.

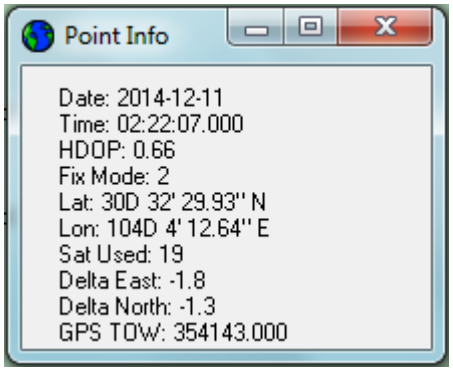
When HDOP is less than or equal to 1, the color is blue.

When 1 < HDOP ≦ 1.5, the color is sky blue.

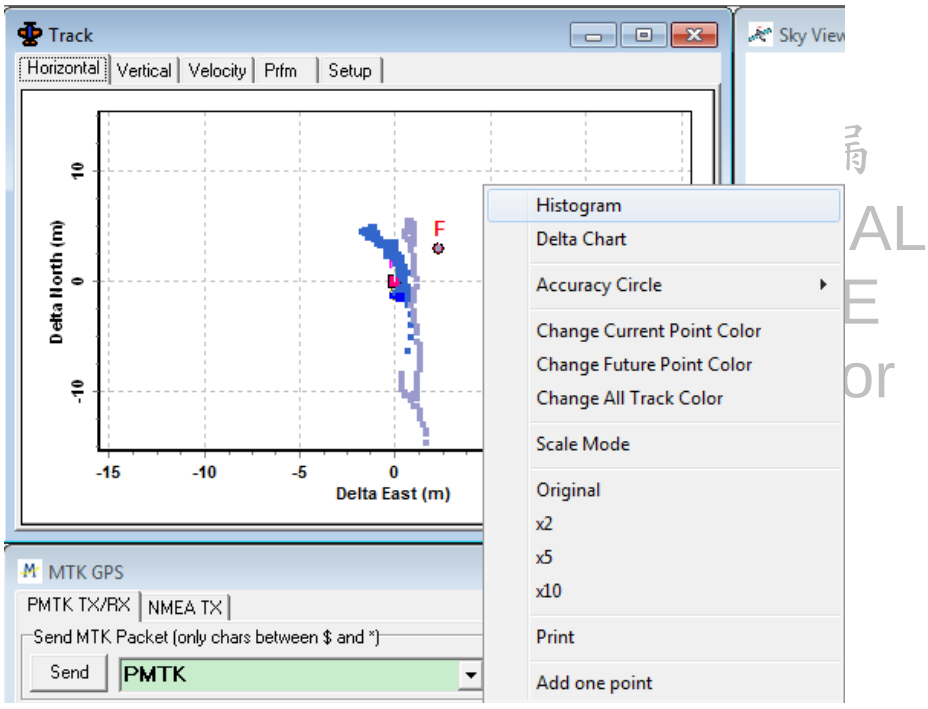
When fix mode is DGPS, the color is purple.

The color is gray in all other cases.

The information about each track point is shown when you click on that point. The information includes UTC Data / Time, HDOP, position fix mode, latitude and longitude in (degree, minute, seconds) format, the number of satellites being used, delta east, delta north and the GPS week time.

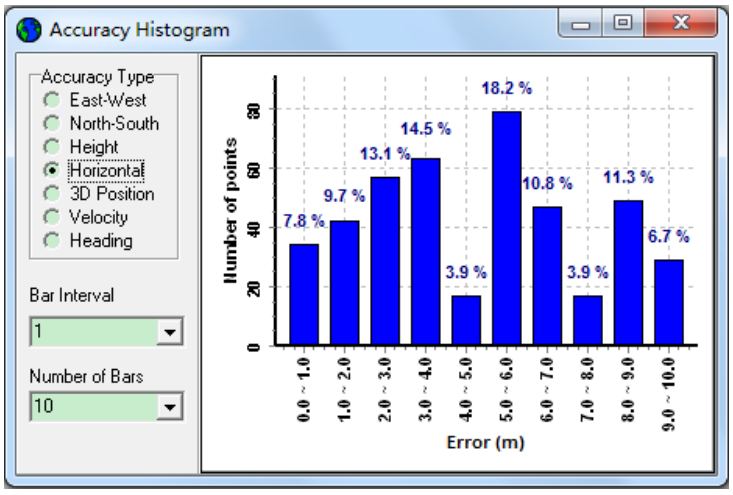



Besides, there are also some hidden functions in this panel and they can be found by right clicking on the chart. The descriptions of each function list below.

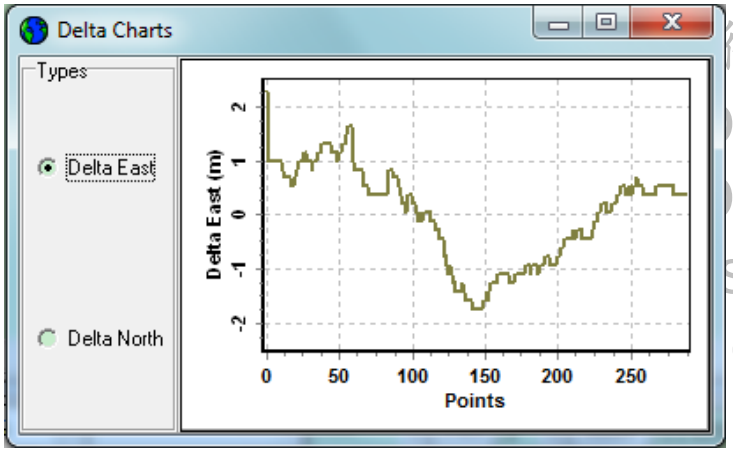



(1) Histogram

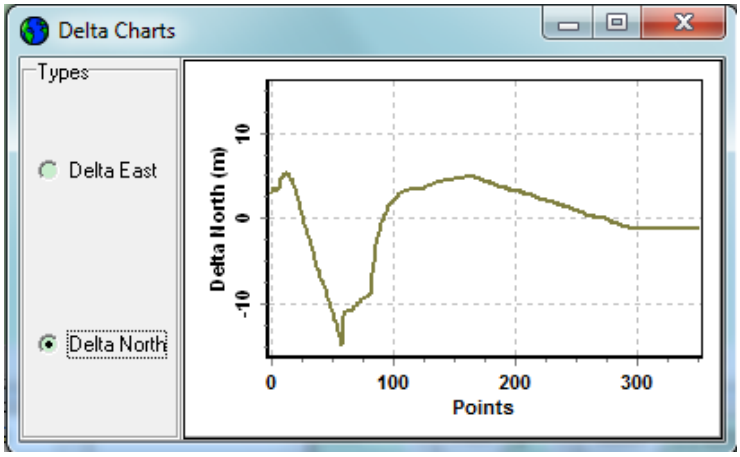
This function shows you a histogram about the fix accuracy. It will be helpful if you want to visually know the statistic of different accuracy levels. You can choose which type of fix accuracy to be shown by selecting the radio button in the left setting panel.




(2) Delta Chart

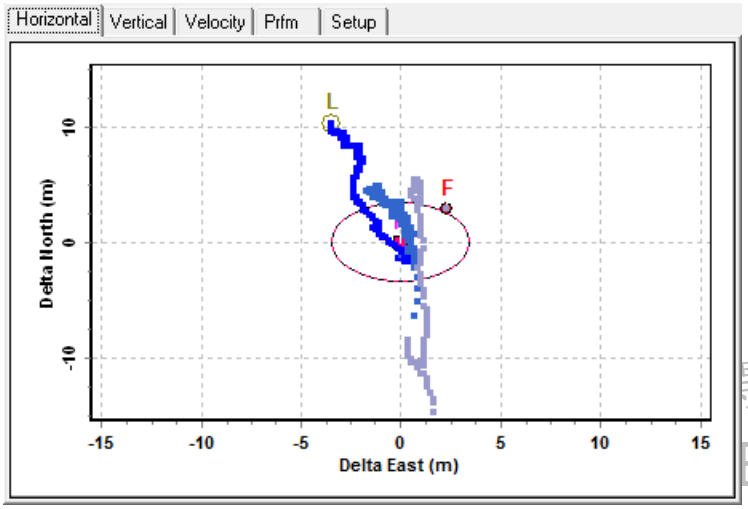



This chart shows the delta east got from the latitude and longitude field of the GPGGA sentence. If the “Show reference point” in the Setup panel is checked, these values are calculated with respect to the reference point; otherwise, they are calculated with respect to the first position estimate. This chart can be printed by right clicking on it and then selecting Print.



This chart shows the delta north got from the latitude and longitude field of the GPGGA sentence. If the “Show reference point” in the Setup panel is checked, these values are calculated with respect to the reference point; otherwise, they are calculated with respect to the first position estimate. This chart can be printed by right clicking on it and then selecting Print.

(3) Accuracy Circle






This option will draw a circle in the horizontal Tracking chart which depends on one of the statistic information below:

2D deviation, 2D RMS, CEP(50%), Horizontal error(95%).

(3) Change Point Color

This option allows you to change the color of current points, future points and all track points as your needed.

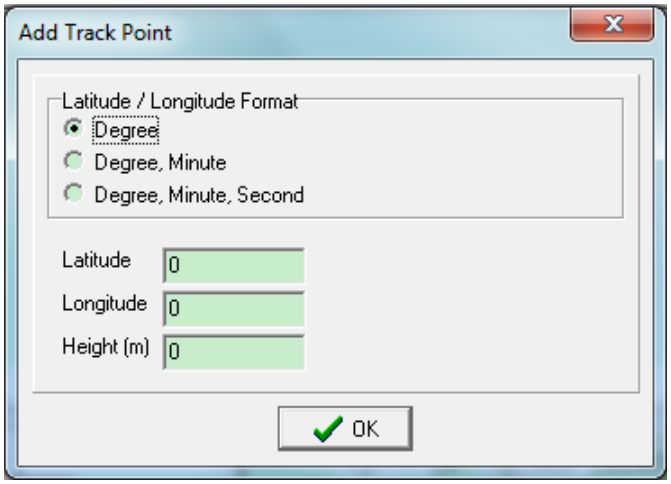
(5) Zoom In

This chart can be zoomed in by right clicking on it and selecting x2, x5 or x10. The multiple is cumulative. This chart can be returned to the original size by selecting Original when you right click on the chart.

(6) Print

The chart will be print after clicking ‘Print’ button.

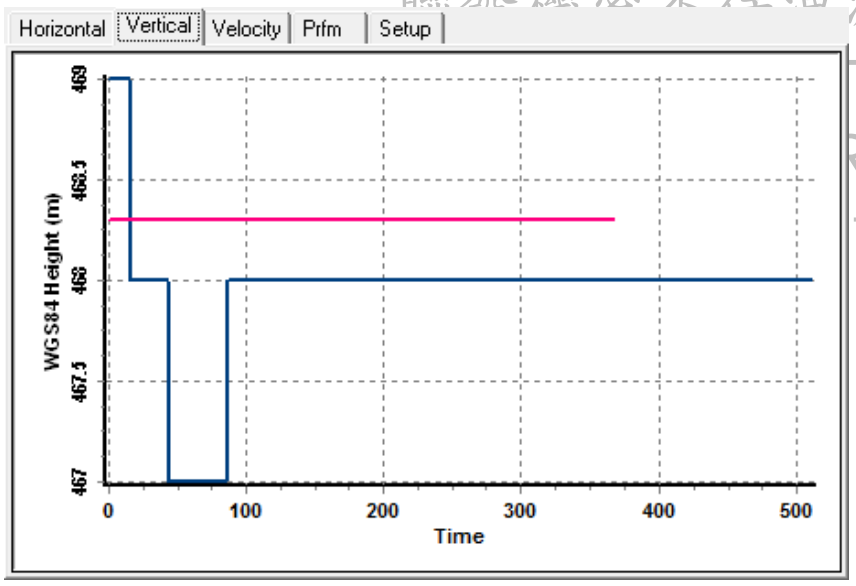
(7) Add one point




Developer can add one point into the chart by setting the latitude, longitude and height corresponding to specified format.

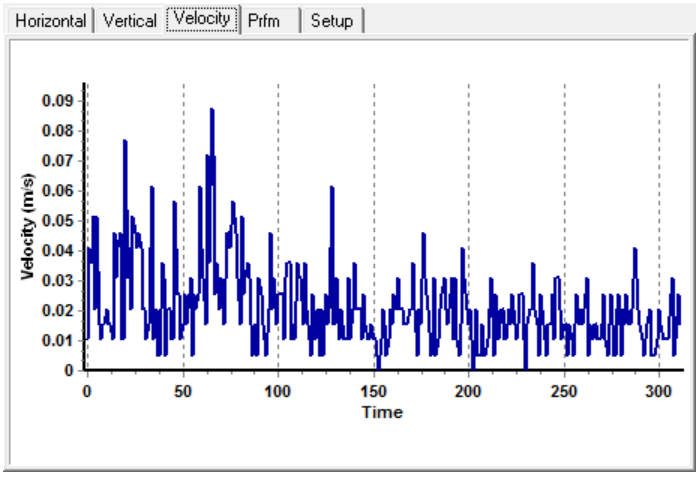
### 5.1.2. Vertical Tracking






This chart keeps track of the altitude of the position fix. The horizontal axis is time series and the vertical axis is WGS84 height in meters. The WGS84 height is the summation of the altitude and the geoid separation in the GPGGA sentence. The mean height is shown on the top of this chart. The pink line represents the height of the reference point and is shown only when the “Show reference point” in the Setup panel is checked. You can print this chart by right clicking on it and then selecting Print.

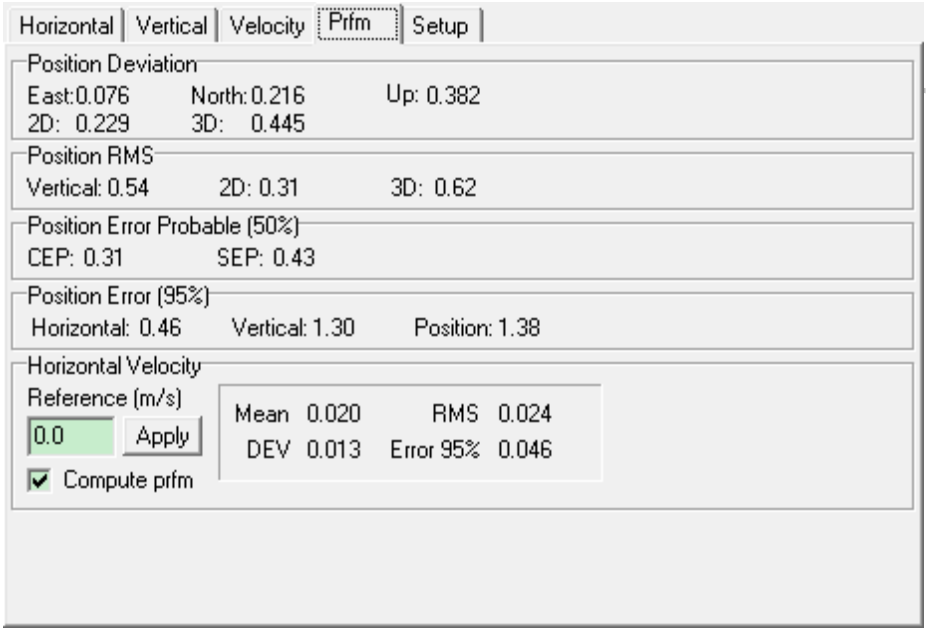
### 5.1.3. Velocity




The velocity of the receiver is shown in this chart. This parameter is got from the GPRMC sentence. The unit is converted from knots to m/s.



### 5.1.4. Performance




This panel shows some statistical values of the fix results. The details of the panel are described as below.

#### 5.1.4.1. Deviation

This shows the standard deviation of delta east, delta north and delta up. The origin used here is the first fix position.

#### 5.1.4.2. RMS

This is the root mean square error of the errors in the east, north and vertical components of the position estimate samples. The origin is the reference point.

RMS vertical error = $\sqrt{\frac{1}{n}\sum \Delta z^2}$

2-D rms error = $\sqrt{\frac{1}{n}\sum (\Delta x^2 + \Delta y^2)}$

3-D rms error = $\sqrt{\frac{1}{n}\sum (\Delta x^2 + \Delta y^2 + \Delta z^2)}$

These values are shown only when both “Show reference point” and “Show performance” are checked.



#### 5.1.4.3. Error Probable (50%)

CEP (Circular Error Probable) is the 50th percentile of the horizontal error and defines the radius of a circle centered at the true position which contains the position estimate with probability of 0.5.

SEP (Spherical error probable) defines the radius of a sphere centered at the true position which contains the position estimate with probability of 0.5.

These two values are shown only when both “Show reference point” and “Show performance” are checked.

#### 5.1.4.4. Error (95%)

Horizontal Error (95%) defines the radius of a circle centered at the true position which contains the position estimate with probability of 0.95.

Position Error (95%) defines the radius of a sphere centered at the true position which contains the position estimate with probability of 0.95.

Vertical Error (95%) is the 95th percentile of the vertical error.

These three values are shown only when both “Show reference point” and “Show performance” are

checked.

### 5.1.5. Setup


#### 5.1.5.1. Show Reference Point

If the Show reference point is checked,

(1) The reference point will be shown at the center of the chart in the horizontal tracking panel and will be treated as origin.

(2) The reference height will be shown in the chart of the Vertical tracking panel.

(3) RMS, CEP, SEP and 95% of position errors in the Performance panel will be calculated if the “Show performance” is also checked.

(4) The delta east, north and up in the Histogram panel and in the Delta East and Delta North panels are calculated using the reference point as the origin.

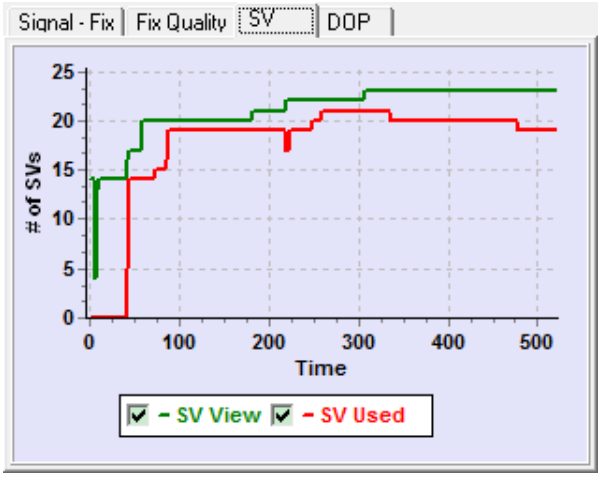


#### 5.1.5.2. Show Performance

If the “Show performance” is checked, those metrics in the Performance panel will be calculated.

### 5.2. Statistic Window

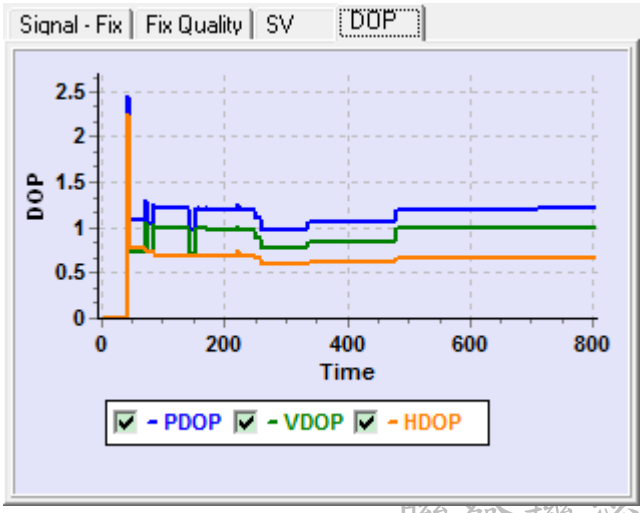
### 5.2.1. Number of Satellites




Two curves are shown in this chart: SV View and SV Used. SV View is the number of satellites in view. This value is got from the GPGSV sentence. SV Used is the number of satellites that is used for fixing and is got from the GPGGA sentence. Developer can set curves’ visibility of the SV

Used and SV View at the bottom of this panel.

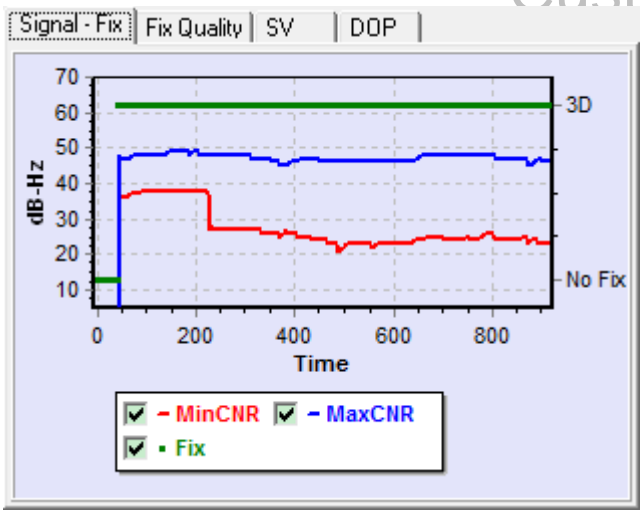
### 5.2.2. DOP





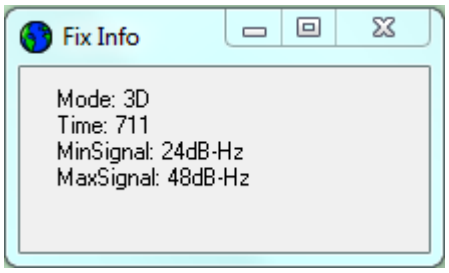

This chart shows PDOP, VDOP and HDOP. HDOP is from the GPGGA sentence and PDOP and VDOP are from the GPGSA sentence. The DOPs provide a characterization of the user-satellite geometry. Developer can set curves' visibility at the bottom of this panel.

### 5.2.3. Signal – Fix

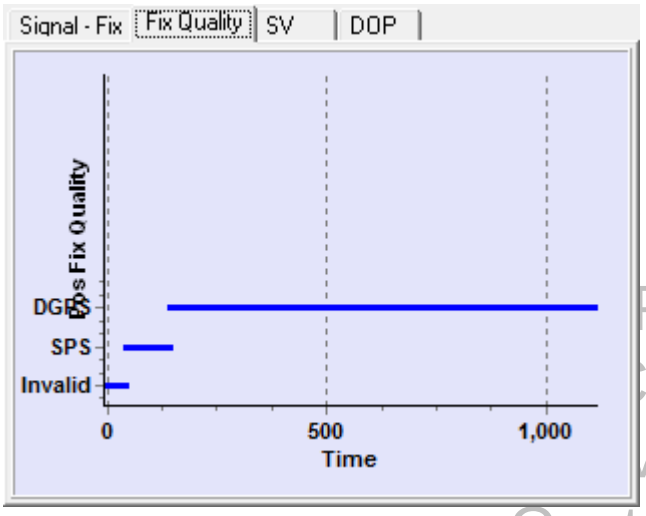



MinCNR shows the minimum SNR in dB-Hz that those satellites in the Signal window have. MaxCNR shows the maximum SNR in dB-Hz that those satellites in the Signal window have. They are got from the GPGSV sentence. Fix Mode is from the GPGSA sentence. It has three possibilities: No fix, 2D and 3D. Clicking on the Fix Mode curve shows the time index, fix mode, minimum SNR

and maximum SNR at that time like the figure in the below.




### 5.2.4. Position Fix Quality



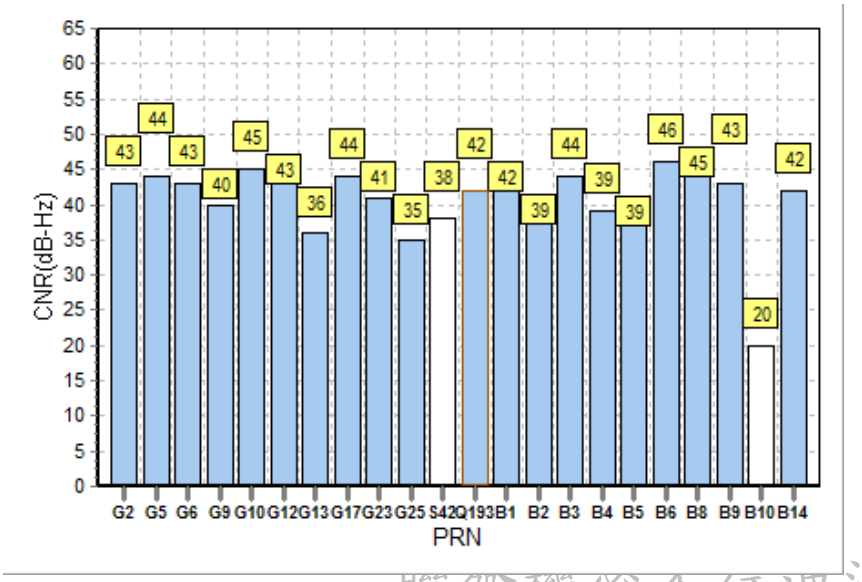



This shows the position fix mode in the GPGGA sentence. Possible modes include:

Invalid,
SPS (valid SPS),
DGPS (valid DGPS),
PPS (valid PPS),
RTK (Real Time Kinematic),
FRTK (Float RTK),
Estimat (Estimated mode),
Manual (Manual input mode),
and Simulat (Simulator mode).

All of the charts in the Statistic window can be printed by right clicking on the page and then selecting Print Chart.

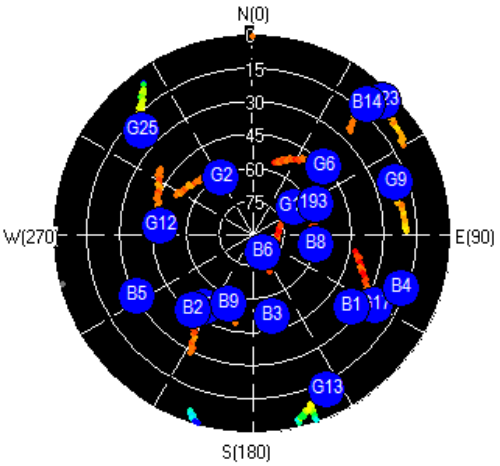
## 5.3. Signal Window





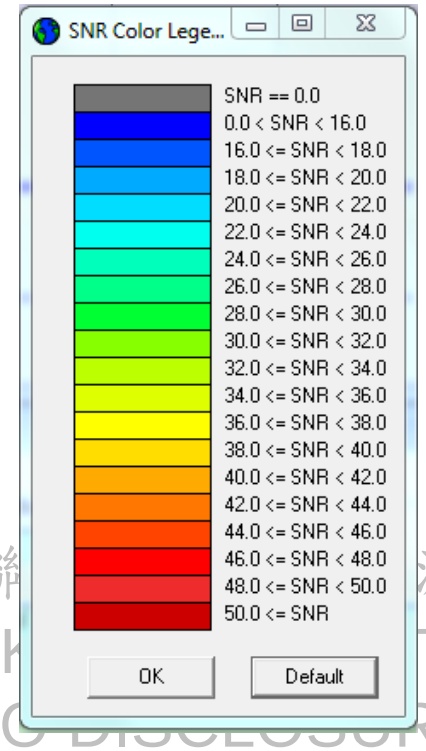

In this window, the SNR of each satellite in view is shown (if the SNR is greater than 0). These values are from the GPGSV sentence. The hidden settings will be shown by right clicking on the chart. There are 3 units to choose from: dB-Hz, dBm and dBW. The noise figure can be set from 0 to 5 in step of 1. If the satellite whose navigation data have been received is in use, the SNR bar for that satellite is blue. If the satellite is not in use, its SNR bar is white. The horizontal axis is the satellite PRN number.

## 5.4. Sky View Window




The elevation angles and the azimuth angles of those satellites in view are shown in this plot.

The colored lines represent the tracks and SNR. We use multiple colors to differentiate the levels of SNR. The corresponding colors of SNR are shown in the picture below.

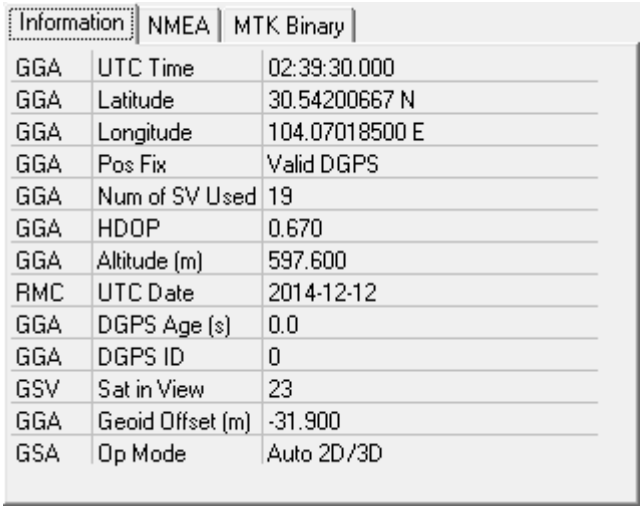





Some hidden function can be shown by right clicking on the window.

## 5.5. NMEA Text Window

### 5.5.1. Information

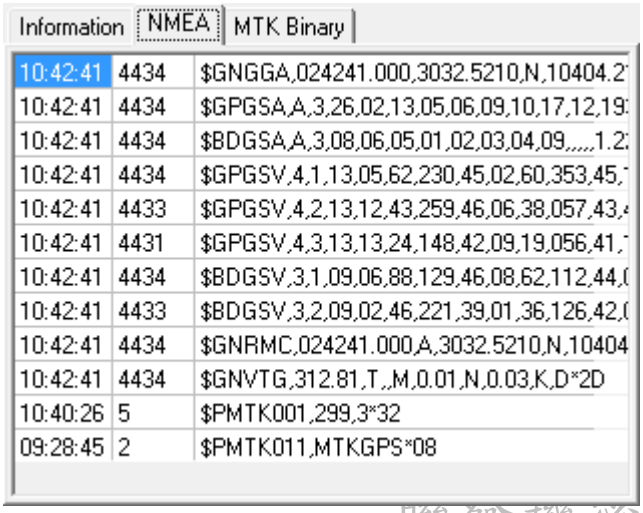



| | | |
|---|---|---|
| GGA | UTC Time | 02:39:30.000 |
| GGA | Latitude | 30.54200667 N |
| GGA | Longitude | 104.07018500 E |
| GGA | Pos Fix | Valid DGPS |
| GGA | Num of SV Used | 19 |
| GGA | HDOP | 0.670 |
| GGA | Altitude (m) | 597.600 |
| RMC | UTC Date | 2014-12-12 |
| GGA | DGPS Age (s) | 0.0 |
| GGA | DGPS ID | 0 |
| GSV | Sat in View | 23 |
| GGA | Geoid Offset (m) | -31.900 |
| GSA | Op Mode | Auto 2D/3D |

This window summarizes those fields contained in the GPGGA, GPRMC, GPGSV, GPGSA, GPVTG and GPGLL sentences. The information in this panel can be saved as a picture to

auto-save folder by right clicking on the panel and clicking “Save Information”.

### 5.5.2. NMEA Window





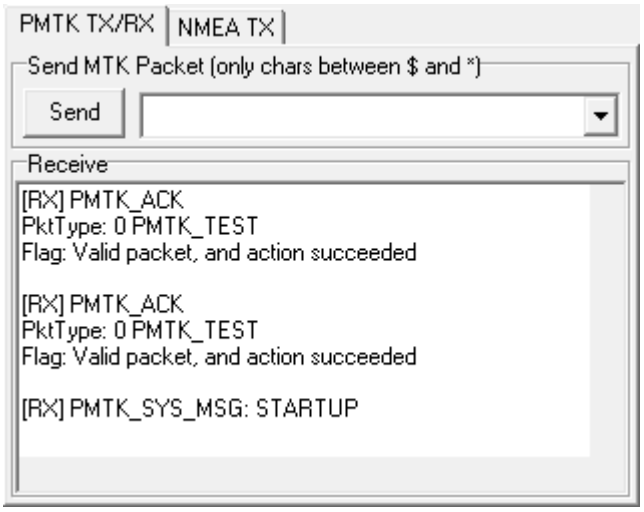

Each row represents one type of sentence. The third column records the most recent sentence of this type and the second column counts the total number of sentences of this type. The first column shows the local time on your computer when this most recent sentence is received or processed. Each field can be easily copy by right clicking on the panel and clicking “copy”.

### 5.5.3. MTK Binary

Binary information will be shown in this panel if “MTK Binary” is selected in Packet Format.

## 5.6. MTK GPS Window

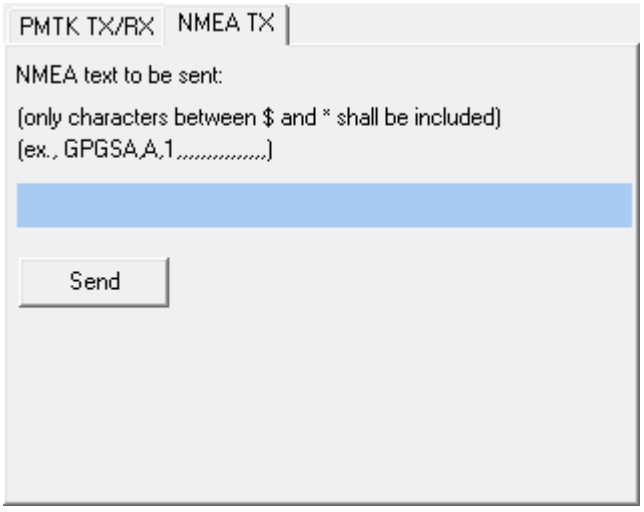
### 5.6.1. Send/Recv Commands




This page allows you to send commands to the GPS receiver. Commands here mean those commands staring with PMTK. We call them MTK commands in order to differentiate them from regular NMEA commands. MTK commands are sent when the Send button is clicked or when the Enter key is pressed. MTK commands are sent through the NMEA COM port and thus this function is enabled only when the NMEA COM port is opened. The Receive window on the lower part of this page shows those MTK commands sent from the GPS receiver and received by PowerGPS. See MTK NMEA Packet Format to get a basic understanding of the meaning of each MTK command.



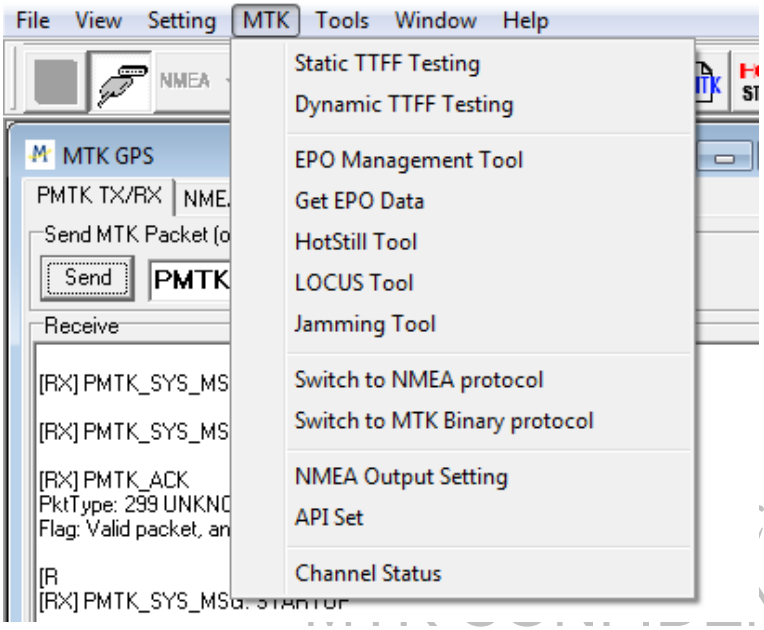
### 5.6.2. NMEA TX




This function allows you to send a NMEA sentence to the COM port. The sentence you send shall exclude the $ sign and the checksum field. Click on the Send button to have the sentence sent

when it is ready.

# 6. MTK Menu

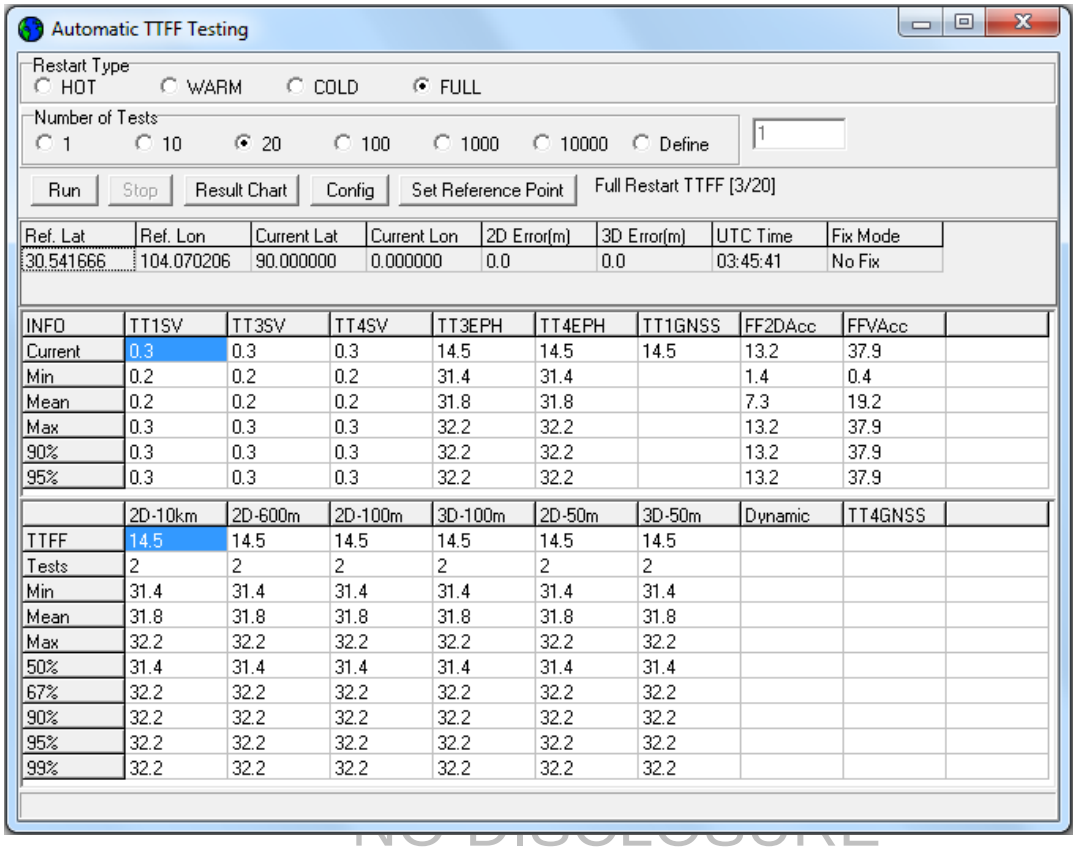





The MTK menu provides some tools helping you

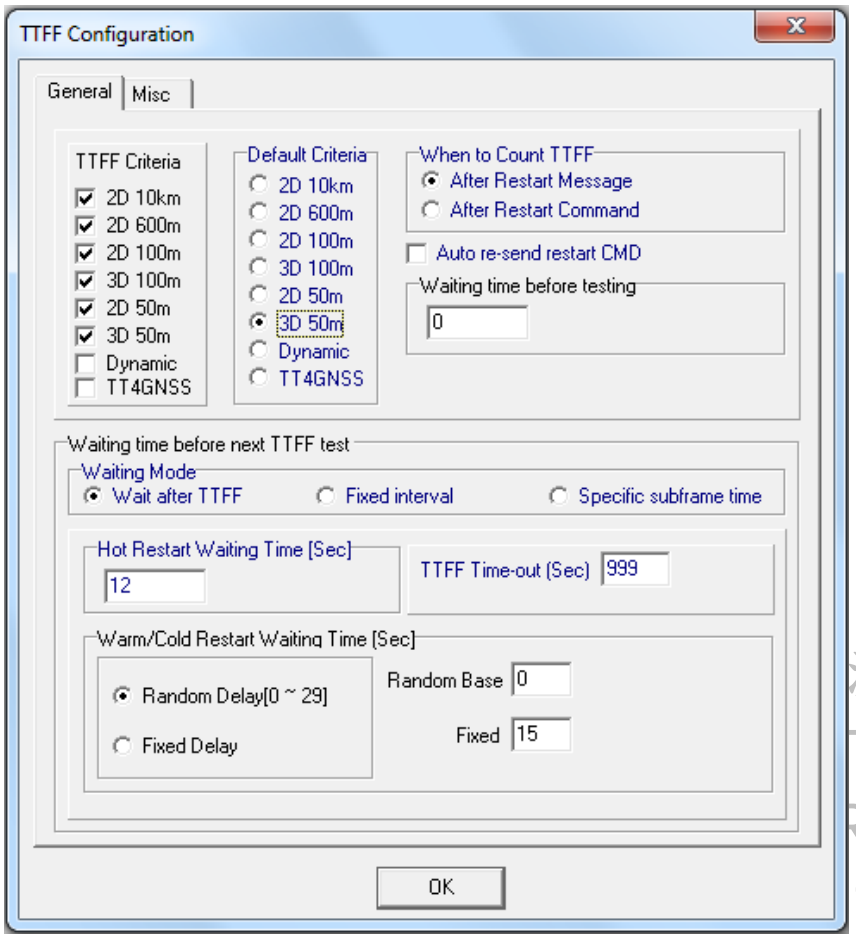
(1) Perform some automatic testing with MTK receiver
(2) EPO process tool
(3) HotStill tool
(4) Dump and parse LOCUS information
(5) Jamming tool
(6) NMEA/MTK Binary switch
(7) Issue PMTK commands to MTK receiver
(8) View channel status of MTK receiver

## 6.1. Automatic TTFF Testing






This tool allows you to measure the TTFF (Time to First Fix) under different testing conditions. You can choose to test the TTFF from full start, cold start, warm start and hot start and the number of tests can be chosen from 1, 10, 20, 100, 1000, 10000 or the number defined in the right blank. Besides, before starting test, some configurations should be set in the “Config” as below.






1. In “TTFF Criteria” panel, developer can choose which type of TTFF should be calculated and shown in the test table.

TTFF for “2D 50m” means the time it takes for the receiver to reach the 2D fix mode and the 2D offset is less than 50m.

Similarly, the TTFF for “3D 100m” means the time it takes for the receiver to reach the 3D fix mode and the 3D offset is less than 100 m.

“Dynamic” means the time it takes for the receiver to get fix regardless of fix mode and offset.

2. In “Default Criteria” panel, developer could set which type’s test result will be default shown in “Result Chart”.

3. If “Auto re-send restart CMD” is checked, restart command will automatically re-sent when the command lost.

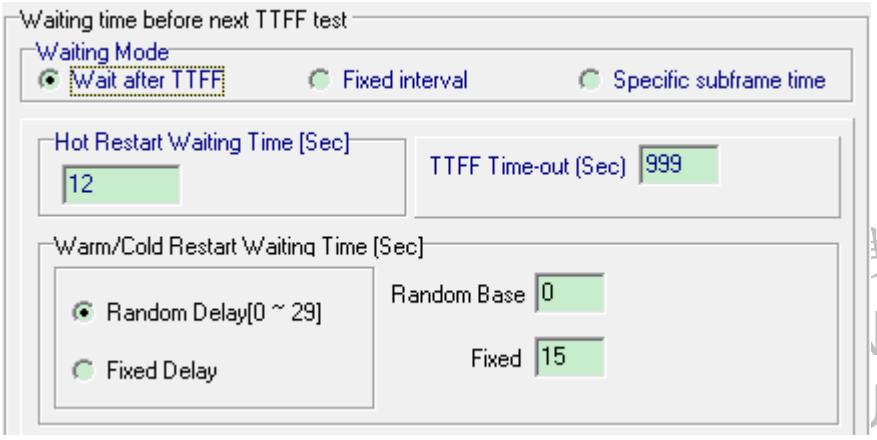
4. “Waiting time before testing” means the waiting time before the first test.

5. “The waiting time before next TTFF test” means the waiting time between each test, which can be set at the lower part of the window. Developer will choose the waiting mode first and then set the expected values in the corresponding blanks. Three supported waiting modes are described

below.

(1) Wait after TTFF

In this mode, the waiting time will start to count after the last TTFF ended. There are three waiting time can be set in this panel. “Hot Restart Waiting Time” means the waiting time of hot restart. “TTFF Time-out” means the maximum time of each test, after which the program will do the restart and go to the next TTFF test. “Warm/Cold Restart Waiting Time” means the waiting time of warm/cold restart. Developer can set it in two ways. If the Random Delay is selected, the waiting time will be a random number in 0 ~ 29. Otherwise the fix value filled in the “Fixed” blank will be used as the waiting time. The unit of waiting time is seconds.

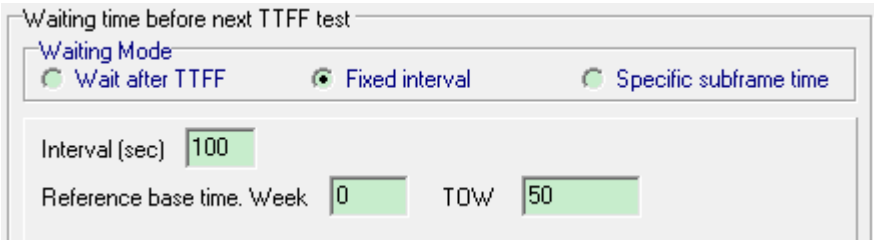




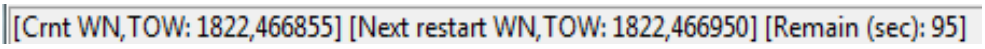

(2) Fixed Interval

In this mode, next TTFF test will not start until the TOW (seconds in week) counts to the specified time. The specified time is composed of Interval and Reference base time. The Interval means the time between two adjacent tests, and Reference base time means the base time in each Interval. For example, if you set parameters like case1 and current TOW is 466855, the program will do restart when TOW is 466950, 467050, 467150, … If you set parameters like case2 and current TOW is 467331, the program will do restart when TOW is 467400, 467500, 467600, …

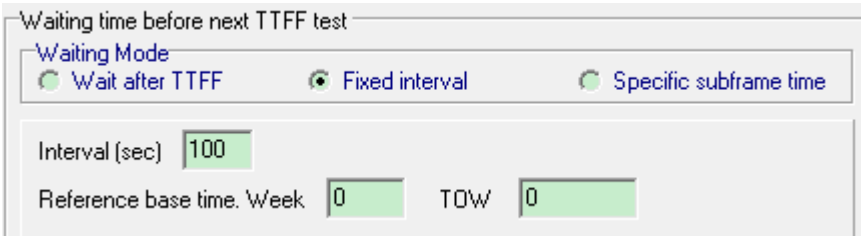
Setting1:




Result1:



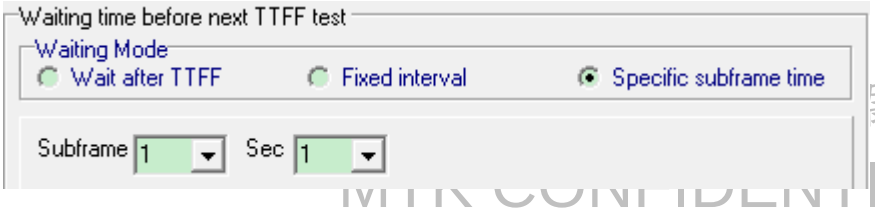

Setting2:




Result2:


(3) Specified subframe time

In this mode, there are two parameters to be set. Subframe means choose which subframe as a restart flag. Sec means the waiting time(1-6s) after the specified subframe was founded. The system will do next restart when the specified subframe is founded and the waiting time is met.






Click on the Run button to start the test and it can be stopped by clicking on the Stop button.

After the test starts, the window below the buttons shows reference latitude, reference longitude, current latitude, current longitude, 2D error, 3D error, UTC time and fix mode. These values are updated continuously as long as the test is still going on.

The table in the middle of the window shows the TTFF for tracking satellites and receiving ephemeris.

TT1SV, TT3SV, TT4SV show the time it takes for the receiver to have one satellite, three satellites and four satellites in tracking channels respectively.

TT3EPH and TT4EPH show the time it takes for the receiver to have three satellites and four satellites with ephemeris received respectively.

FF2DAcc and FFVAcc show the horizontal and vertical accuracy of the first fix.

Current, Mean, Max and Min show the current, mean, maximum and minimum of those TTFFs that have been obtained respectively. 90% calculates the time that 90% of those TTFFs obtained are less than.

The table in the bottom of the window shows the statistic information of different TTFF type.

The TTFF field shows the TTFF for the latest test that is done and the Tests field indicates the number of tests that has been made. Mean, Max and Min show the mean, maximum and minimum of those TTFFs that have been obtained respectively. 50% calculates the time that 50% of those

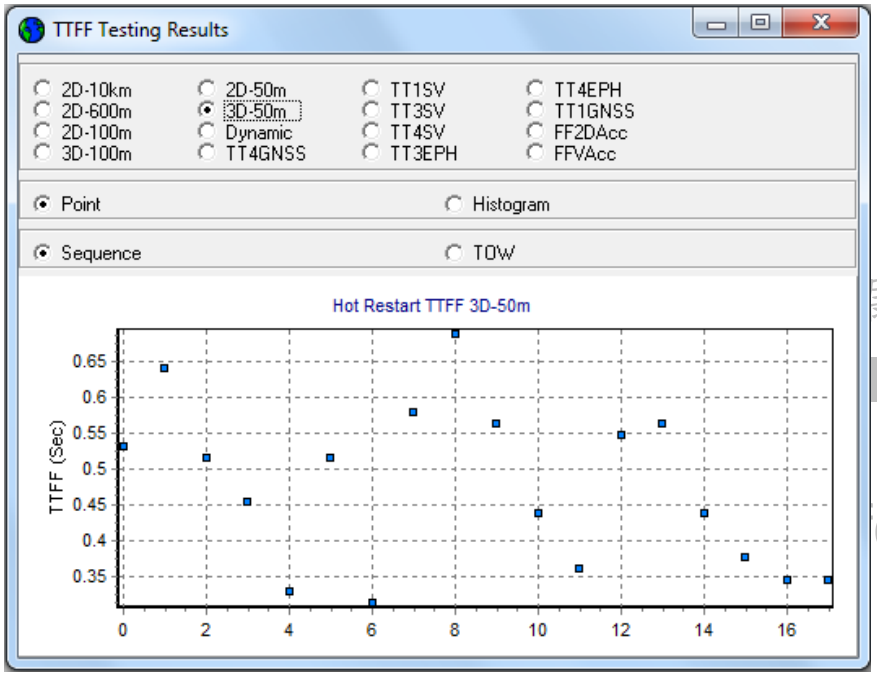
TTFFs obtained are less than.

After finishing the testing, you can click the “Result Chart” button to see the testing result charts. There are three types of charts for your reference:

(1) TTFF v.s. Sequence

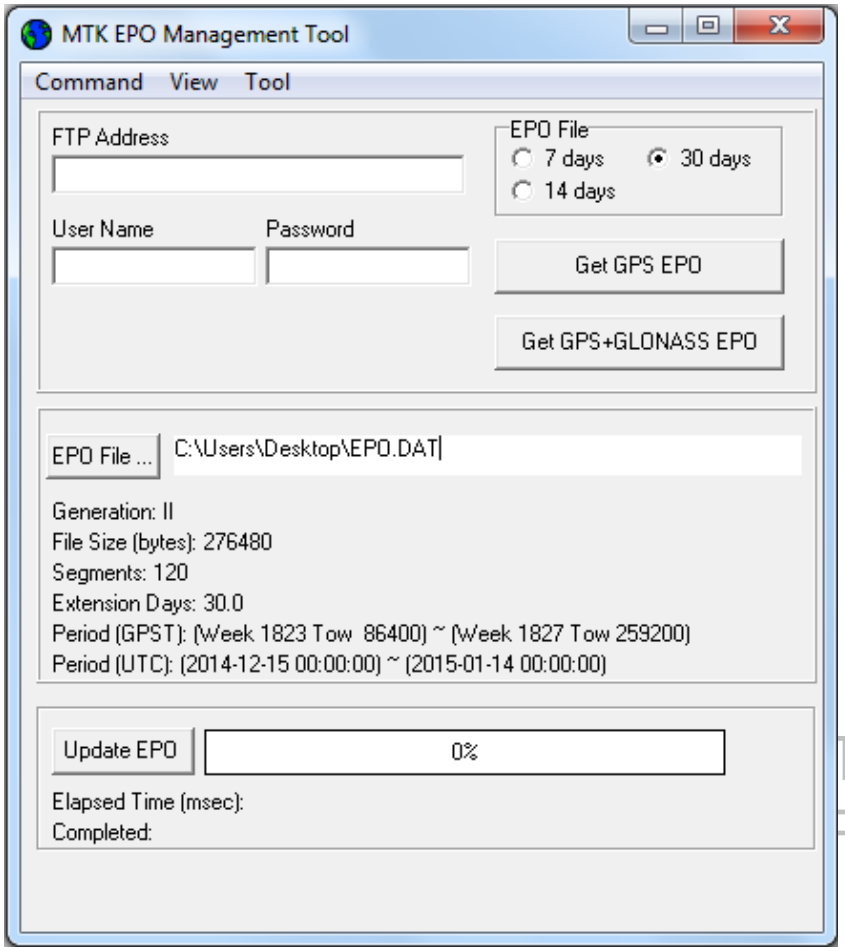
(2) TTFF v.s. TOW

(3) TTFF result in histogram view




## 6.2. MTK EPO Management Tool

This tool is used to download and update EPO information.






### 6.2.1. Upload EPO to MTK GPS receiver

(1) Enter the download address and user account information in the blank.

(2) Select the extension days of EPO data that wants to get.

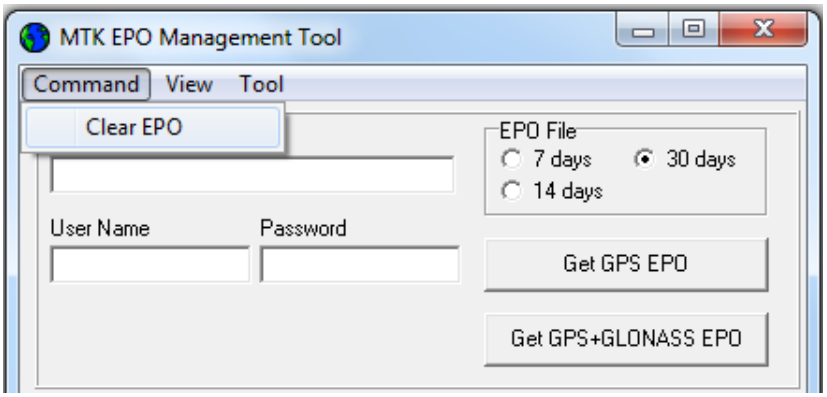
(3) Click the button Get GPS EPO to download GPS EPO or click the button Get GPS+GLONASS EPO to download GPS+GLONASS EPO. After that, the program will download corresponding EPO data to your local disk.

(4) Click the EPO File button and select the EPO file just downloaded. If the selected file is a valid EPO, the information of EPO will be shown in the panel.

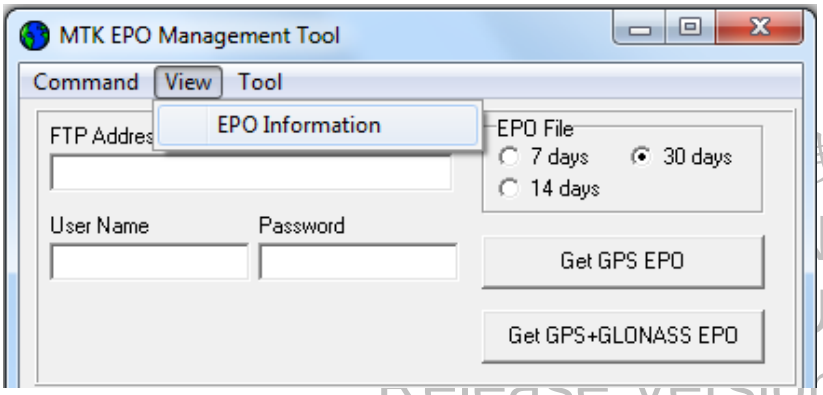
(5) Click the button Upload EPO to send EPO data to MTK GPS receiver. The progress bar shows you the current status.

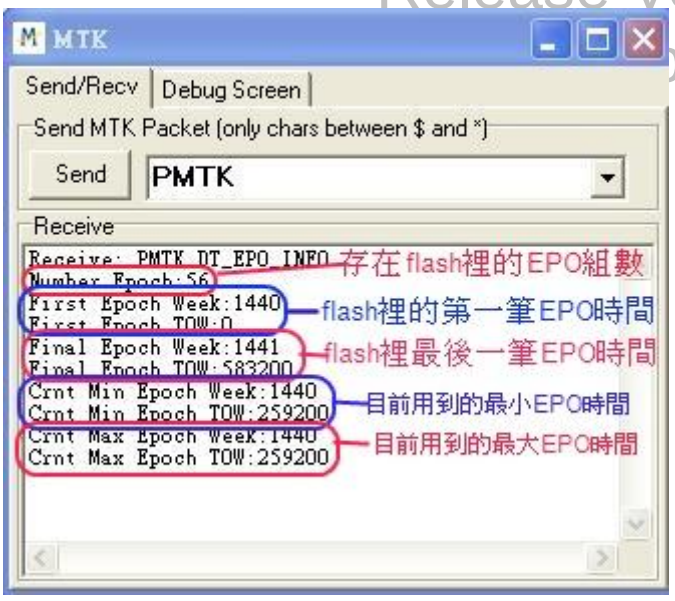
### 6.2.2. EPO management

(1) Clear EPO data in flash

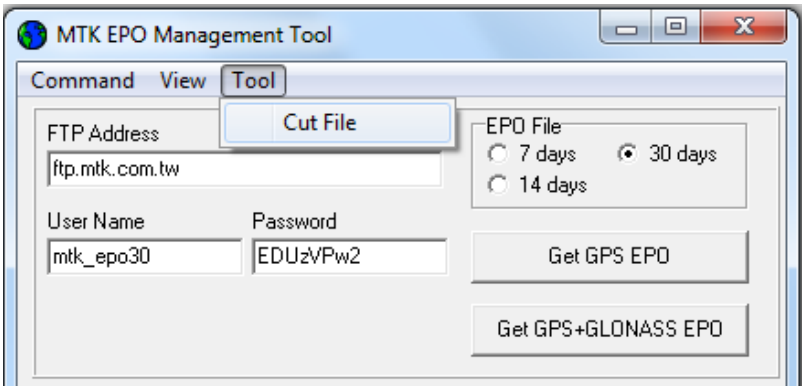


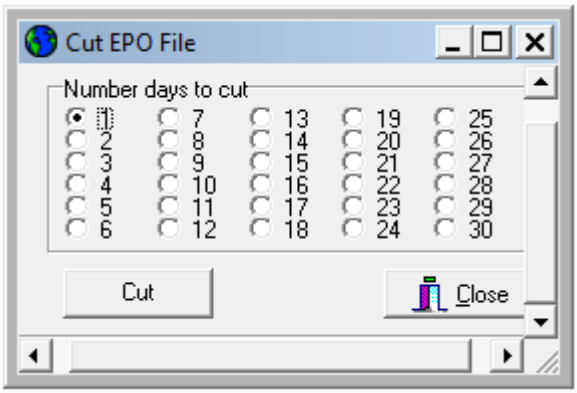

(2) View EPO information




(3) Cut EPO file

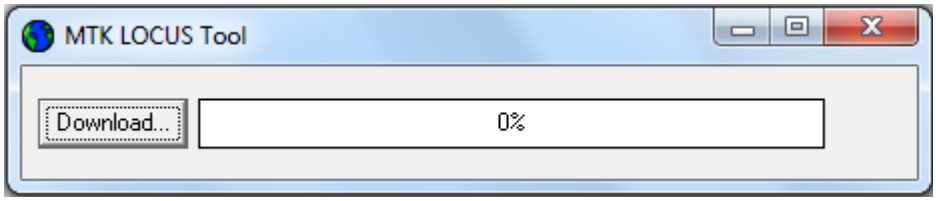





Cut the original EPO file to pieces with you wanted length. The unit of length is days.

## 6.3. MTK LOCUS Tool



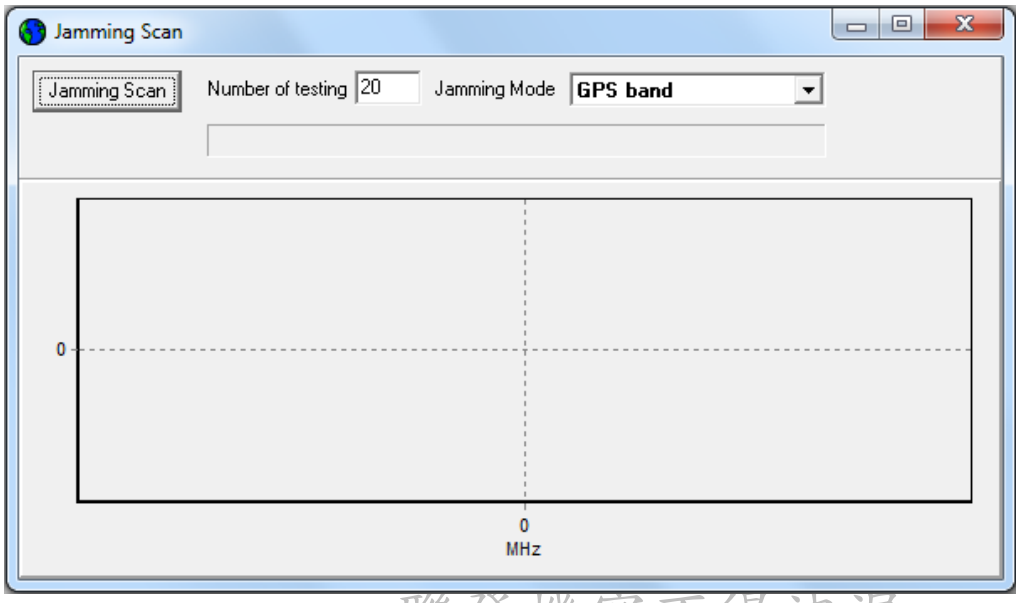

LOCUS is a MTK developed feature that can auto log data to internal flash of MTK chip. This tool can help developers easily download and parse the LOCUS data. After download finish, three types of LOCUS files will exist in the data file.

Locus.bin: log data with binary protocol.

Locus.loc: log data with a simple format about UTC time and position.

Locus.nma: log data with NMEA format, including GGA and RMC sentences.

## 6.4. Jamming Tool




Jamming Tool will show jamming signal in the window.

Number of testing: the number of test jamming signal. PowerGPS will show average result in the window.

Jamming Mode:

GPS band: test GPS signal jamming signal.

GLONASS band: test GLONASS signal jamming signal.

BEIDOU band: test BEIDOU signal jamming signal.



## 6.5. NMEA Output Setting

In the Output page, you can enable/disable and change output rate for individual NMEA sentences. The output rate can be 0 to 5:

‘0’: disable output

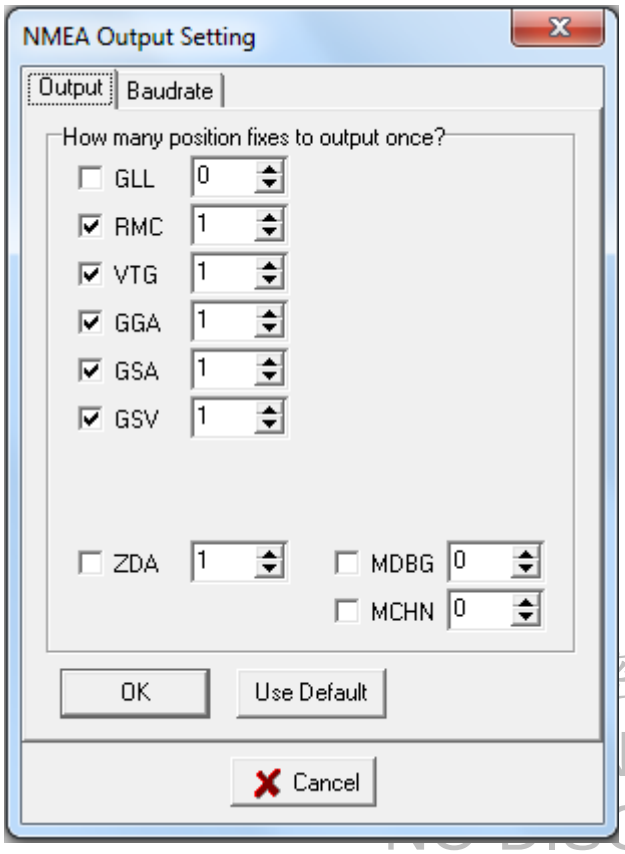
‘1’: output once per one fix

‘2’: output once per two fixes

‘3’: output once per three fixes

‘4’: output once per four fixes

‘5’: output once per five fixes

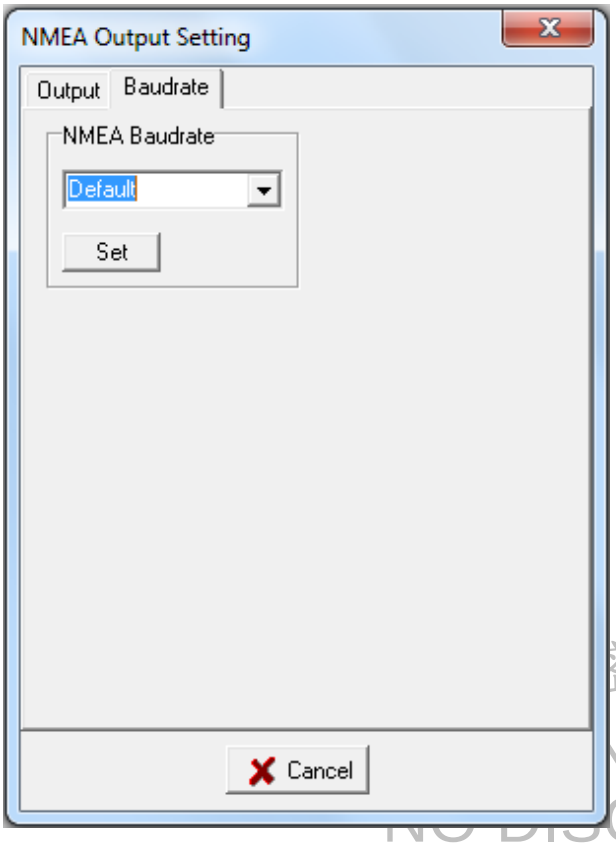





In the Baudrate page, you can specify the baudrate for NMEA port. The possible values are:

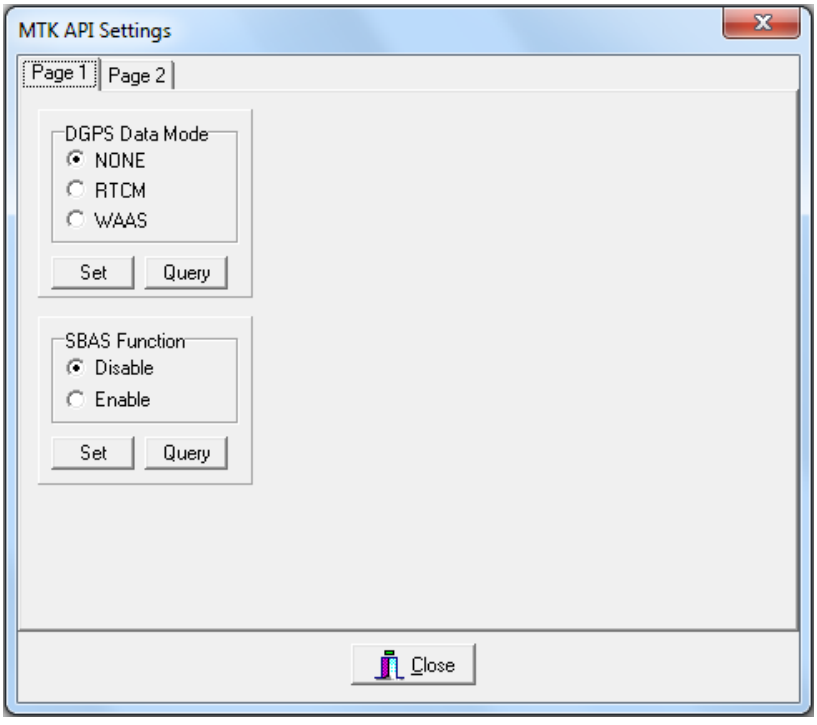
'Default': Restore the default baudrate setting
'4800', '9600', '14400', '19200', '38400', '57600', '115200'

After the new value was set, PowerGPS will automatically switch to the new baudrate value (except the Default setting).

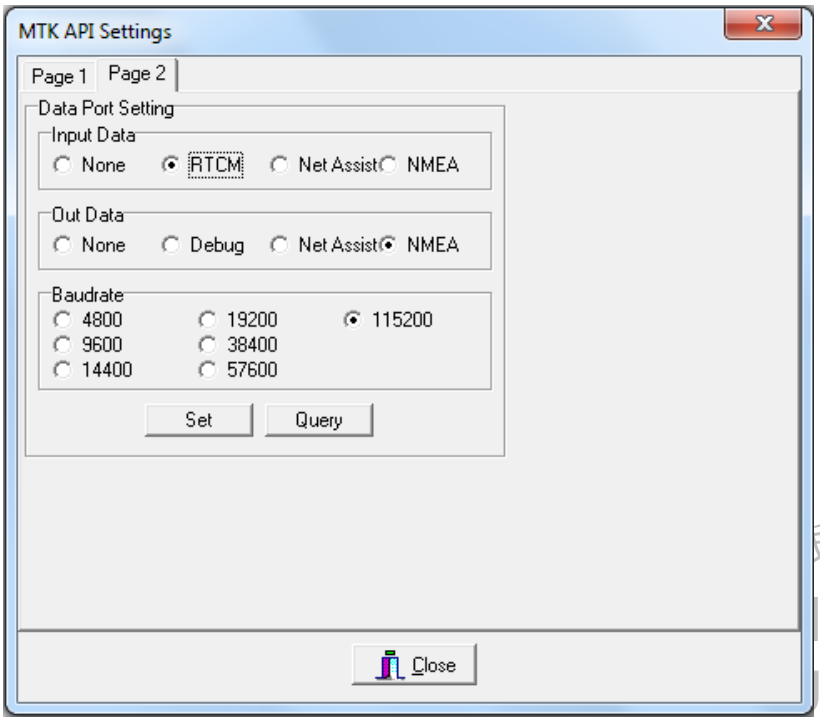





## 6.6. API Set



In page 1, DGPS Data Mode and status of SBAS Function can be set and query. The query information will be shown in the MTK GPS window.

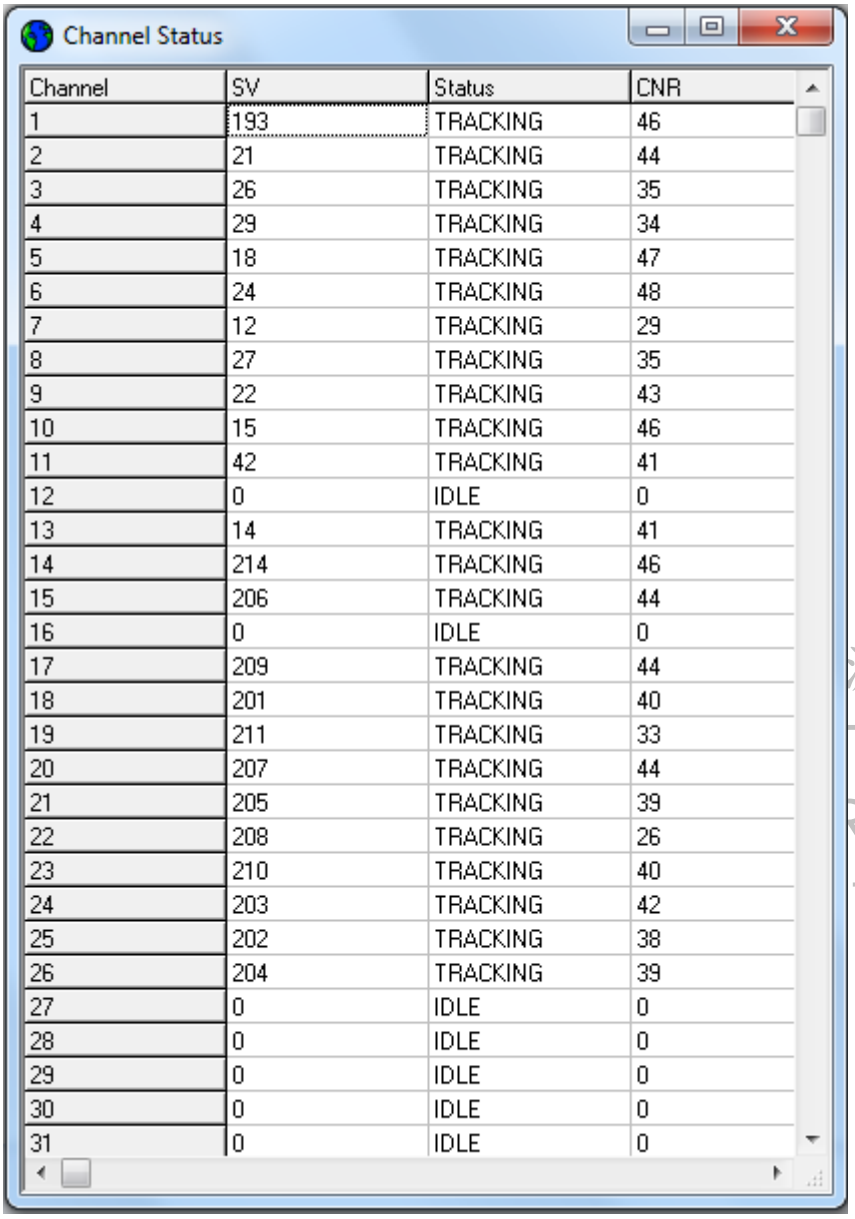



In page 2, the type of Input/output data and baudrate can be set and query. The query information will be shown in the MTK GPS window.



## 6.7. Channel Status

The channel status window shows you the channel information of MTK receiver. The information includes which satellite is allocated to the channel, the current channel status and the signal strength of the tracking satellite. You must firstly enable the PMTKCHN NMEA sentence before showing the channel status (Please see the section NMEA Output Setting).




| Channel | SV | Status | CNR |
|---|---|---|---|
| 1 | 193 | TRACKING | 46 |
| 2 | 21 | TRACKING | 44 |
| 3 | 26 | TRACKING | 35 |
| 4 | 29 | TRACKING | 34 |
| 5 | 18 | TRACKING | 47 |
| 6 | 24 | TRACKING | 48 |
| 7 | 12 | TRACKING | 29 |
| 8 | 27 | TRACKING | 35 |
| 9 | 22 | TRACKING | 43 |
| 10 | 15 | TRACKING | 46 |
| 11 | 42 | TRACKING | 41 |
| 12 | 0 | IDLE | 0 |
| 13 | 14 | TRACKING | 41 |
| 14 | 214 | TRACKING | 46 |
| 15 | 206 | TRACKING | 44 |
| 16 | 0 | IDLE | 0 |
| 17 | 209 | TRACKING | 44 |
| 18 | 201 | TRACKING | 40 |
| 19 | 211 | TRACKING | 33 |
| 20 | 207 | TRACKING | 44 |
| 21 | 205 | TRACKING | 39 |
| 22 | 208 | TRACKING | 26 |
| 23 | 210 | TRACKING | 40 |
| 24 | 203 | TRACKING | 42 |
| 25 | 202 | TRACKING | 38 |
| 26 | 204 | TRACKING | 39 |
| 27 | 0 | IDLE | 0 |
| 28 | 0 | IDLE | 0 |
| 29 | 0 | IDLE | 0 |
| 30 | 0 | IDLE | 0 |
| 31 | 0 | IDLE | 0 |

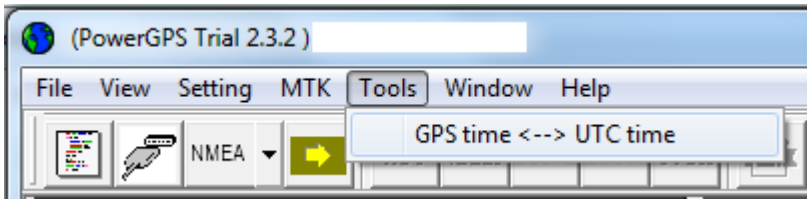
# 7. Tools

This chapter introduces the tools that are provided in the Tools menu.

## 7.1. GPS / UTC Time Conversion

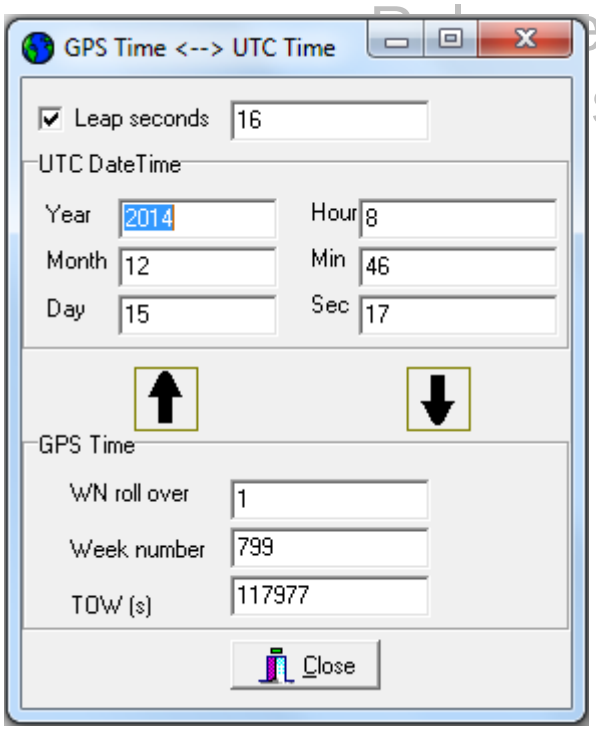
This is a two-way converter of the GPS and UTC time.

1. Click on the GPS time <--> UTC time in the Tools menu.




2. To convert from UTC time to GPS time, enter the UTC time in the fields of UTC time and then click on the down-arrow image. To use the leap time, check the leap seconds box and enter the leap second in that field.

3. To convert from GPS time to UTC time, enter the GPS time in the fields of GPS time and then click on the up-arrow image. To use the leap time, check the leap seconds box and enter the leap second in that field.



# 8. Appendix

## 8.1. NMEA Messages

NMEA 0183 defines the transmission protocol that is used to support one-way serial data transmission from a single TALKER to one or more LISTENERS. A TALKER is any device that sends data to other devices within this standard. A LISTENER is any device that receives data from another device within this standard.

### 8.1.1. TALKER Sentence Format

A TALKER sentence looks like the following:

$ttsss,d1,d2,…*hh<CR><LF>

The maximum number of characters in a sentence shall be 82, consisting of a maximum of 79 characters between the starting “$” and the terminating <CR><LF>.



#### 8.1.1.1. Address Field

(1) Approved Address Field: $ttsss. tt is the TALKER ID. For example, GP is used to stand for the Global Positioning System (GPS). sss is the sentence ID.

(2) Query Address Field: $ttddQ. tt is the TALKER ID of the device requesting data and dd is the TALKER ID of the device being addressed.

(3) Proprietary Address Field: $Pmmm. mmm is the manufacturer’s mnemonic code.

#### 8.1.1.2. Data Fields

Data fields in approved sentence follow a “,” delimiter and follow the format defined. Data fields in proprietary sentences are not defined by the standard.

#### 8.1.1.3. Checksum Field

The checksum is the 8-bit exclusive OR of all characters between the “$” and the “*” delimiters.

### 8.1.2. Common Sentences for GPS

| Sentence |
|---|
| $GPGGA |
| $GPGLL |
| $GPGSA |
| $GPGSV |

| $GPRMC |
|---|
| $GPVTG |

### 8.1.2.1. GPGGA – Global Positioning System Fix Data.

Time, position and fix related data for a GPS receiver.

Example: $GPGGA,082651.10,2446.4768,N,12100.0344,E,1,07,0.75,140.00,M,15.03,M,,*5A

| Field | Example | Comments |
|---|---|---|
| Sentence ID | $GPGGA | |
| UTC Time | 082651.10 | hhmmss.ss |
| Latitude | 2446.4768 | ddmm.mmmm |
| N/S Indicator | N | N = North, S = South |
| Longitude | 12100.0344 | ddmm.mmmm |
| E/W Indicator | E | E = East, W = West |
| GPS Quality Indicator | 1 | 0 = Fix not available or invalid<br>1 = GPS SPS Mode, fix valid<br>2 = DGPS, SPS Mode, fix valid<br>3 = GPS PPS Mode, fix valid<br>4 = Real Time Kinematic<br>5 = Float RTK<br>6 = Estimated (dead reckoning) Mode<br>7 = Manual Input Mode<br>8 = Simulator Mode |
| Satellites Used | 07 | Number of satellites in use (00-12) |
| HDOP | 0.75 | Horizontal Dilution of Precision |
| Altitude | 140.00 | Mean-sea-level (geoid) altitude |
| Altitude Units | M | M = meters |
| Geoid Seperation | 15.03 | The difference between the WGS-84 earth ellipsoid surface and mean-sea-level (geoid) surface. “-“ = mean-sea-level surface below WGS-84 ellipsoid surface. |
| Seperation Units | M | M = meters |
| DGPS Age | | Age of DGPS data in seconds |
| DGPS station ID | | 0000-1023 |
| Checksum | *5A | |
| Terminator | <CR><LF> | |



### 8.1.2.2. GPGLL – Geographical Position – Latitude/Longitude

Latitude and Longitude of vessel position, time of position fix and status

Example: $GPGLL,2446.4768,N,12100.0344,E,082652.10,A,A*6B

| Field | Example | Comments |
|---|---|---|
| Sentence ID | $GPGLL | |
| Latitude | 2446.4768 | ddmm.mmmm |
| N/S Indicator | N | N = North, S = South |
| Longitude | 12100.0344 | ddmm.mmmm |
| E/W Indicator | E | E = East, W = West |
| UTC Time | 082651.10 | hhmmss.ss |
| Status | A | A = Data Valid (only when the mode indicator is A or D), V = Data not valid |
| Mode Indicator | A | A = Autonomous mode<br>D = Differential mode<br>E = Estimated (deck reckoning) mode<br>M = Manual input mode<br>S = Simulator mode<br>N = Data not valid |
| Checksum | *6B | |
| Terminator | <CR><LF> | |



### 8.1.2.3. GPGSA – GNSS DOP and Active Satellites

GNSS receiver operating mode, satellites used in the navigation solution reported by the GGA or GNS sentence and DOP values

Example: $GPGSA,A,3,30,03,25,20,06,16,14,,,,,,2.25,1.00,2.00*05

| Field | Example | Comments |
|---|---|---|
| Sentence ID | $GPGSA | |
| Mode | A | M = Manual, forced to operate in 2D or 3D mode<br>A = Automatic, allowed to automatically switch 2D/3D |
| Mode | 3 | 1 = No Fix, 2 = 2D, 3 = 3D |
| ID of Satellite in use | 30 | Satellite used on channel 1 |
| ID of Satellite in use | 03 | Satellite used on channel 2 |
| ID of Satellite in use | 25 | Satellite used on channel 3 |
| ID of Satellite in use | 20 | Satellite used on channel 4 |
| ID of Satellite in use | 06 | Satellite used on channel 5 |
| ID of Satellite in use | 16 | Satellite used on channel 6 |
| ID of Satellite in use | 14 | Satellite used on channel 7 |
| ID of Satellite in use | | Satellite used on channel 8 |
| ID of Satellite in use | | Satellite used on channel 9 |
| ID of Satellite in use | | Satellite used on channel 10 |
| ID of Satellite in use | | Satellite used on channel 11 |
| ID of Satellite in use | | Satellite used on channel 12 |

| | | |
|---|---|---|
| PDOP | 2.25 | Position dilution of precision |
| HDOP | 1.00 | Horizontal dilution of precision |
| VDOP | 2.00 | Vertical dilution of precision |
| Checksum | *05 | |
| Terminator | <CR><LF> | |

### 8.1.2.4. GPGSV – GNSS Satellites in View

Number of satellites (SV) in view, satellite ID numbers, elevation, azimuth and SNR value. Four satellites maximum per transmission.

Example: $GPGSV,2,1,08,30,09,045,31,03,11,196,40,25,52,007,45,20,17,300,39*79

| Field | Example | Comments |
|---|---|---|
| Sentence ID | $GPGSV | |
| Number of sentences | 2 | Total number of sentences (1-9) |
| Sentence Number | 1 | Sequence number of this entry (1-9) |
| Satellites in View | 08 | Total number of satellites in view |
| Satellite ID 1 | 30 | Range: 1 – 32 |
| Elevation 1 | 09 | Elevation angle in degrees, 0-90 |
| Azimuth 1 | 045 | Azimuth angle in degrees, True, 000 - 359 |
| SNR 1 | 31 | SNR (C/No), 00-99 dB-Hz, null while not tracking |
| Satellite ID 2 | 03 | Range: 1 – 32 |
| Elevation 2 | 11 | Elevation angle in degrees, 0-90 |
| Azimuth 2 | 196 | Azimuth angle in degrees, True, 000 - 359 |
| SNR 2 | 40 | SNR (C/No), 00-99 dB-Hz, null while not tracking |
| Satellite ID 3 | 25 | Range: 1 – 32 |
| Elevation 3 | 52 | Elevation angle in degrees, 0-90 |
| Azimuth 3 | 007 | Azimuth angle in degrees, True, 000 - 359 |
| SNR 3 | 45 | SNR (C/No), 00-99 dB-Hz, null while not tracking |
| Satellite ID 4 | 20 | Range: 1 – 32 |
| Elevation 4 | 17 | Elevation angle in degrees, 0-90 |
| Azimuth 4 | 300 | Azimuth angle in degrees, True, 000 - 359 |
| SNR 4 | 39 | SNR (C/No), 00-99 dB-Hz, null while not tracking |
| Checksum | *79 | |
| Terminator | <CR><LF> | |



### 8.1.2.5. GPRMC – Recommended Minimum Specific GNSS Date

Time, date, position, course and speed data provided by a GNSS navigation receiver.

Example: $GPRMC,082653.10,A,2446.4768,N,12100.0344,E,0.00,128.42,270705,,,A*57

| Field | Example | Comments |
|---|---|---|
| Sentence ID | $GPRMC | |
| UTC Time | 082653.10 | hhmmss.ss |
| Status | A | A = Data valid, V = Navigation receiver warning |
| Latitude | 2446.4768 | ddmm.mmmm |
| N/S Indicator | N | N = North, S = South |
| Longitude | 12100.0344 | ddmm.mmmm |
| E/W Indicator | E | E = East, W = West |
| Speed over ground | 0.00 | Knots |
| Course over ground | 128.42 | True, degrees |
| UTC Date | 270705 | ddmmyy |
| Magnetic variation | | Degrees |
| Magnetic variation | | E = East, W = West |
| Mode Indicator | A | A = Autonomous mode<br>D = Differential mode<br>E = Estimated (deck reckoning) mode<br>M = Manual input mode<br>S = Simulator mode<br>N = Data not valid |
| Checksum | *57 | |
| Terminator | <CR><LF> | |



### 8.1.2.6. GPVTG – Course over Ground and Ground Speed

The actual course and speed relative to the ground.

Example: $GPVTG,128.42,T,,,0.00,N,0.00,K,A*7D

| Field | Example | Comments |
|---|---|---|
| Sentence ID | $GPVTG | |
| Course over ground | 128.42 | Degrees |
| Reference | T | T = True heading |
| Course over ground | | Degrees |
| Reference | | M = Magnetic heading |
| Speed over ground | 0.00 | Horizontal speed |
| Units | N | N = Knots |
| Speed over ground | 0.00 | Horizontal speed |
| Units | K | K = Km/h |
| Mode Indicator | A | A = Autonomous mode<br>D = Differential mode<br>E = Estimated (deck reckoning) mode<br>M = Manual input mode<br>S = Simulator mode<br>N = Data not valid |

| | | |
|---|---|---|
| Checksum | *7D | |
| Terminator | <CR><LF> | |

### 8.2. How to perform EPO TTFF testing?

Please refer to the following steps to perform EPO TTFF testing.

(一) Before the testing, please remember to set reference position (The TTFF testing tool needs a correct reference position):
(1) Make sure PowerGPS has connected to MTK GPS receiver,
(2) Wait for some seconds until the receiver has reached TTFF and outputs valid position information.
(3) Go to PowerGPS -> Track Window -> Setup Page, and then click the button "Set from mean position". The button automatically set reference position for you.



(二) Using static TTFF testing tool
(1) Please go to PowerGPS -> MTK -> Static TTFF Testing.
In the testing window, there are 7 TTFF criteria defined by MTK.

| | Definitions |
|---|---|
| **2D-10km** | 2D TTFF, Position Error < 10km |
| **2D-600m** | 2D TTFF, Position Error < 600m |
| **2D-100m** | 2D TTFF, Position Error < 100m |
| **3D-100m** | 3D TTFF, Position Error < 100m |
| **2D-50m** | 2D TTFF, Position Error < 50m |
| **3D-50m** | 3D TTFF, Position Error < 50m |
| **Dynamic** | TTFF |

(2) Since the position accuracy of using EPO is claimed to be less than 100m in CEP (50% in horizontal).
You are suggested to do some setting:
a. In the Static TTFF testing window, click "Config", you will see a TTFF configuration dialog.
b. In the "TTFF Criteria" page of the dialog, only check 2D-10km and 2D-600m. The others are not suitable for EPO TTFF testing.
c "Default Criteria": please select 2D-600m as the default criterion to show TTFF chart.

(3) After the configuration, select the restart type (WARM or COLD) and “number of tests” you want to test, then click the button "Run" to start EPO TTFF testing.