

Onyx

RFG-2000 GPS Receiver

User Manual



RFG-2000 Ver1.0c,
April/2/04'

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What is Onyx, RFG-2000

Congratulation on your purchase of Onyx, offering diverse GPS (Global Positioning System) applications. Onyx GPS receiver, RFG-2000, is a GPS mouse targeted on clients using in automotive, fleet vehicle, and electronics applications where a small and highly accurate GPS receiver is required. It provides a GPS measurement platform that performs the processor-intensive GPS tracking and processing tasks. Its 12-channel integrated receiver and one-second navigation update rate allows for continuous tracking of all visible satellites, and it can provide your exact location information soon after the power is on. With the waterproof, industrial level design and the different interfaces for laptops and PDAs, RFG-2000 can guide you in the air, land and water as a highly reliable, long-lasting Navigator. It is the most cost effective GPS-Mouse in the world.

What Is Inside

Before you start up, make sure that your package includes the following items. If any items are missing or damaged, contact RoyalTek immediately. Please refer to the contact information on the last page of this manual.

- ◆GPS Receiver ◆ Cable(RS-232 , USB, or PDA adaptor)
- ◆CD Disc(optional)

What Is GPS

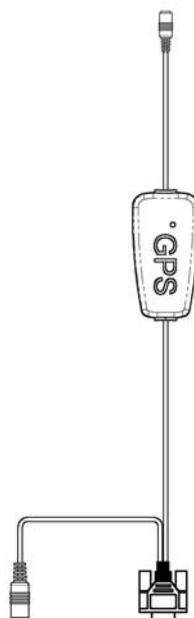
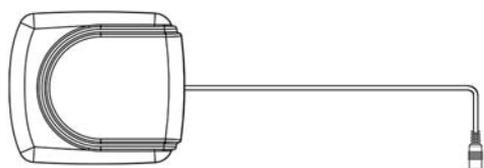
In 1974 the USA Department of Defense set about developing a Global Positioning System (GPS), a constellation of 24 satellites that Orbits 12,000 miles above the Earth. Using triangulation of signals from four of the satellites, a receiving unit on earth can pinpoint its current location to within a few meters. A GPS device receives the data, converts the longitude, latitude, and altitude (LLA) data into a location point. Position and navigation information is vital to a wide range of professional and recreational activities covering surveying, search and rescue, tracking, hiking, navigating, and so forth.

What's Inside the Package

Before you start up, make sure your package includes the following items. If any item is missing or damaged, contact your dealer immediately. Please refer to the contact information on the last page of this manual.

- ◆ GPS Receiver
- ◆ Application CD
- ◆ Cable for RS232 , USB , or PDA adaptor(depending on what you buy)

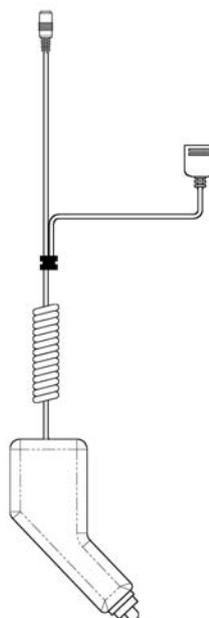
RFG-2000



RS-232/PS2



USB



Car cigarette
adaptor 12V

PDA Cable Selection

- 1.iPAQ 36xx/37xx/38xx/
39xx/19xx series
- 2.iPAQ B5450/2210
- 3.HP Jornada 54x/56x series
- 4.Fujitsu-Siemens LOOX series
- 5.Casio e125/e500
- 6.Dell Axim X5
- 7.ETEN P300/P700
- 8.O2 XPDA series
- 9.Yakumo Delta
- 10.NEC 200E/300E
- 11.Mitac MIO338/399/528/558
- 12.ViewSonic V35
- 13.Asus A-600/A-620
- 14.Palm 5xx series/Tungsten T/
Tungsten C/Zire71
- 15.Toshiba e740/e330/e335/
e350/e400/e750

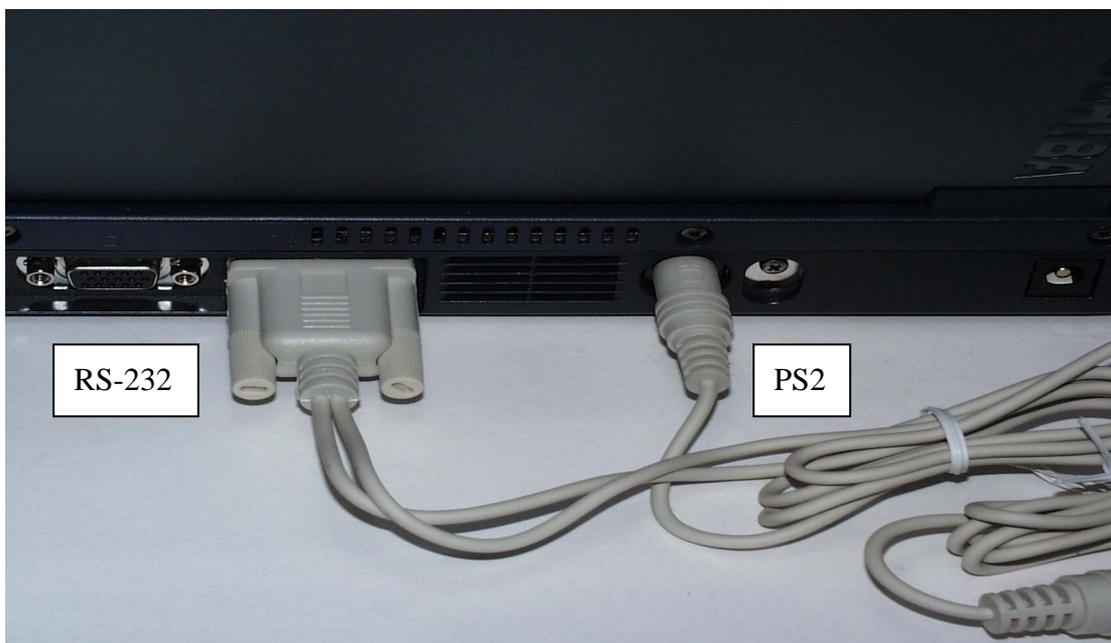
*For other various PDA cables,
please refer to our web site.*

Start-Up for RFG-2000 (RS-232 & USB)

Getting Started

Step 1: Plug-in RS-232 or USB cable to your laptop or desktop PC.

Step 2: Install USB driver if you use USB cable to connect RFG-2000 to your PC. (for detail, please go to [USB driver installation for Windows Operation System](#))



Step 3: Choose the correct COM port and baud rate (4800bps) for map or navigation software.

Step 4: Place your Onyx on the outside roof of your vehicle with magnetic base if you encounter any problem to receive GPS signal.

Notice:

- (1) For safety reason, please do not install RFG-2000 while driving.
- (2) The formats of NMEA messages are illustrated on *Software Data* section.

- (3) It is strongly recommend that user doesn't plug and unplug this connector frequently.

Start-Up for RFG-2000 (PDA)

Getting Started

Step 1: Plug-in PDA connector to your PDA.

Step 2: Connect the car cigarette adaptor to your car.

Step 3: Choose the correct COM port and baud rate (4800bps) for map or navigation software.

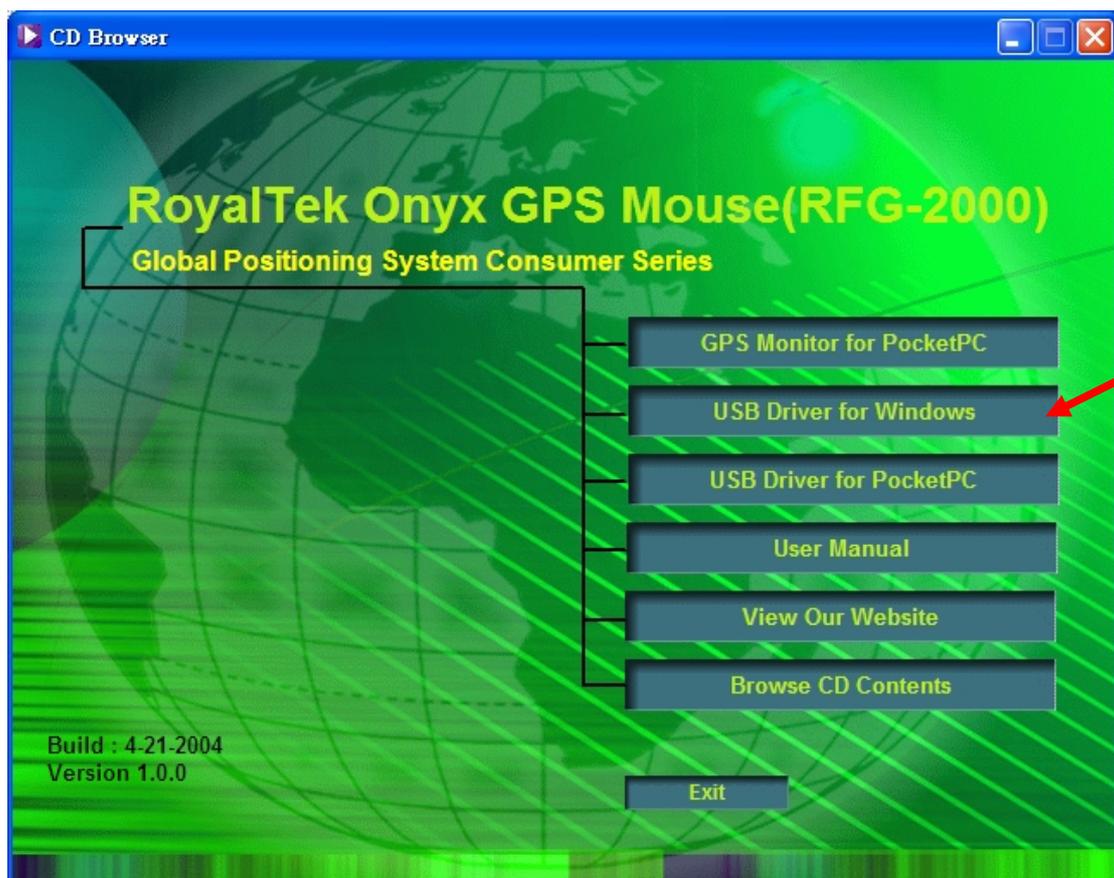
Step 4: Place your Onyx on the outside roof of your vehicle with magnetic base if you encounter any problem to receive GPS signal.

USB Driver Installation for Windows Operation System

Getting Started

Step 1: Plug USB connector to USB port of your laptop or desktop PC.

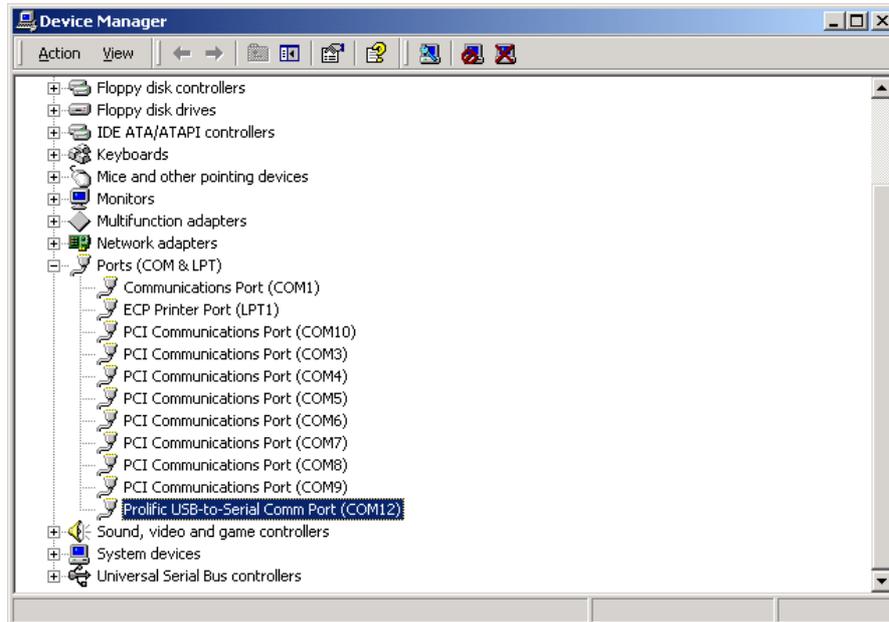
Step 2: Insert RFG-2000 CD-Disc, choose “USB Driver for Windows” item to install USB driver for Windows Operation System.



Step 3: There is alternative way to install USB driver by selecting
”/USB Driver/PL-2302 Driver installer.exe” file and double click to run.

Caution: During USB driver installation, a message box “Driver is not certificated by Microsoft” may pop-up. Please crick “Continue” to continue the USB driver installation.

Step 4. You can check COM port number of RFG-2000 from System properties now. The COM port is COM3 in this example.



Step 5: Place your Onyx on the outside roof of your vehicle with magnetic base if you encounter any problem to receive GPS signal (optional).

Step 6: Choose the correct COM port and baud rate (4800bps) for map or navigation software.

Caution: Sometimes, USB driver can't work properly after recovering from power-saving mode. To solve this problem, please restart your PC and disable power-saving function.

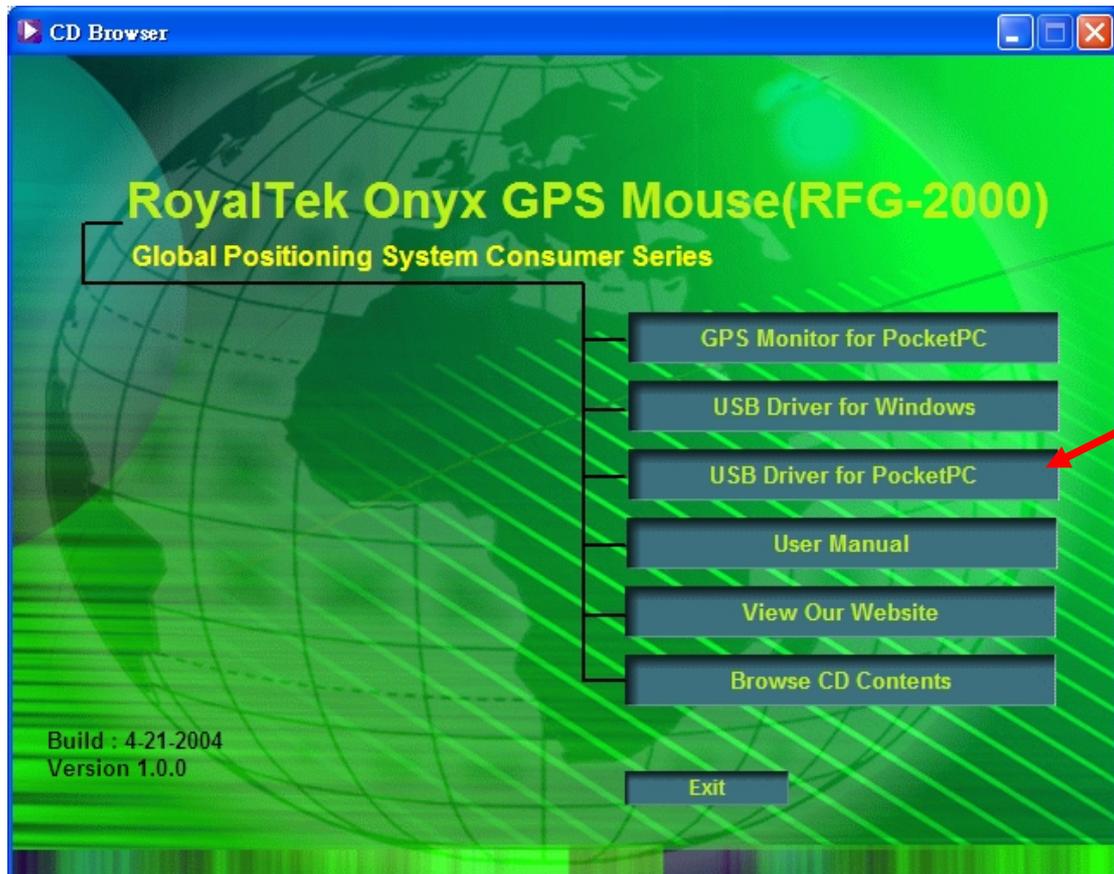
USB Driver Un-Installation for Windows Operation System

To completely remove the USB-driver, please run "*USB Driver/PL-2302 Driver installer.exe*" in RFG-2000 CD.

USB Driver Installation for Pocket PC

The RFG-2000 Installation CD provides the Pocket PC USB driver installation.

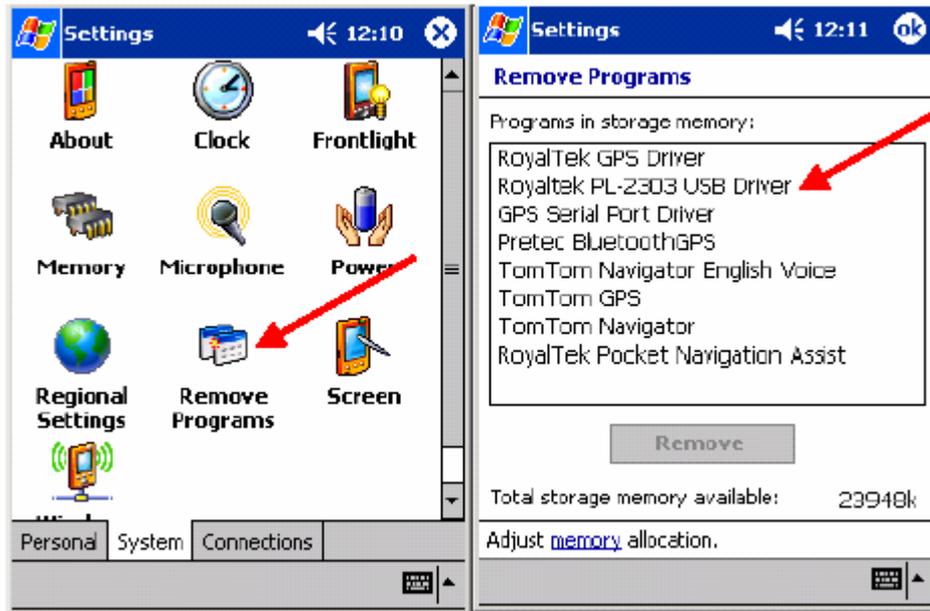
If your Pocket PC need to install USB Driver for RFG-2000, you should choose the “USB Driver for PocketPC” item to install.



USB Driver Un-Installation for Pocket PC

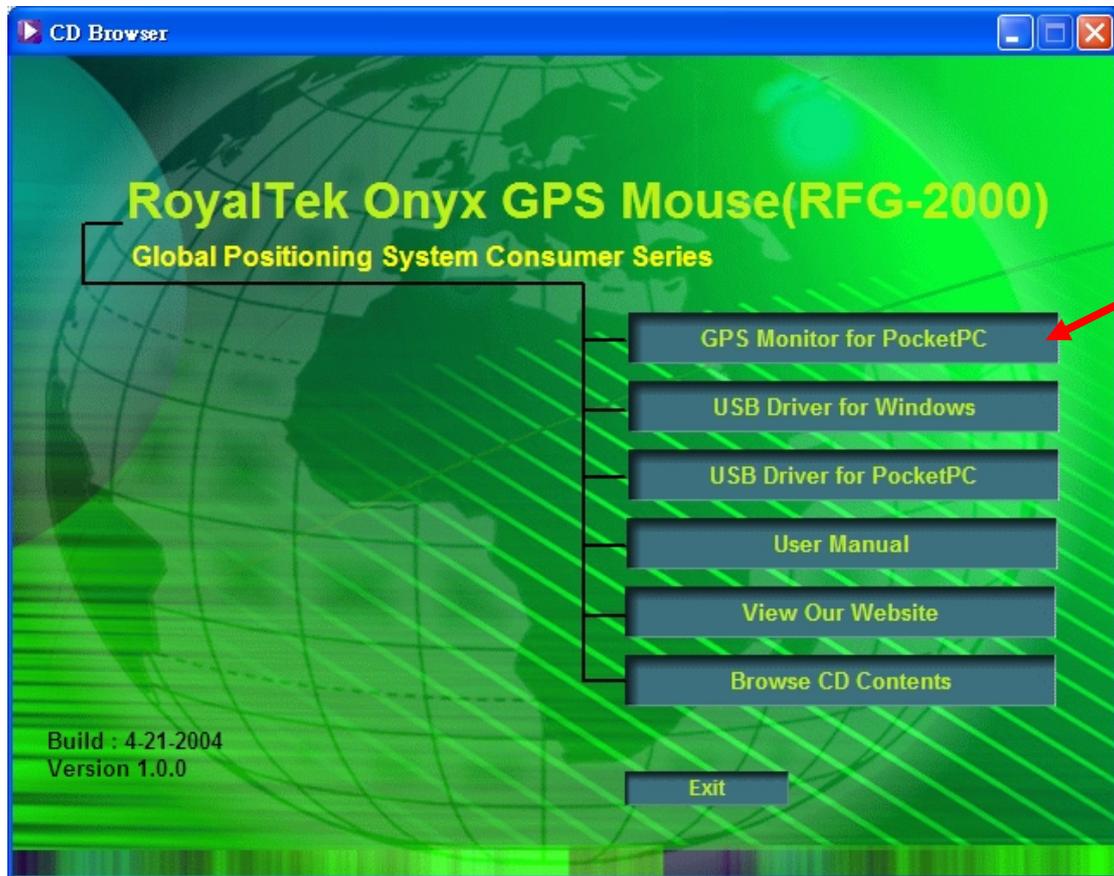
Step 1: Go to Start->Setting->System->Remove Program

Step 2: Select “RoyalTek PL-2303 USB Driver” for un-installation.

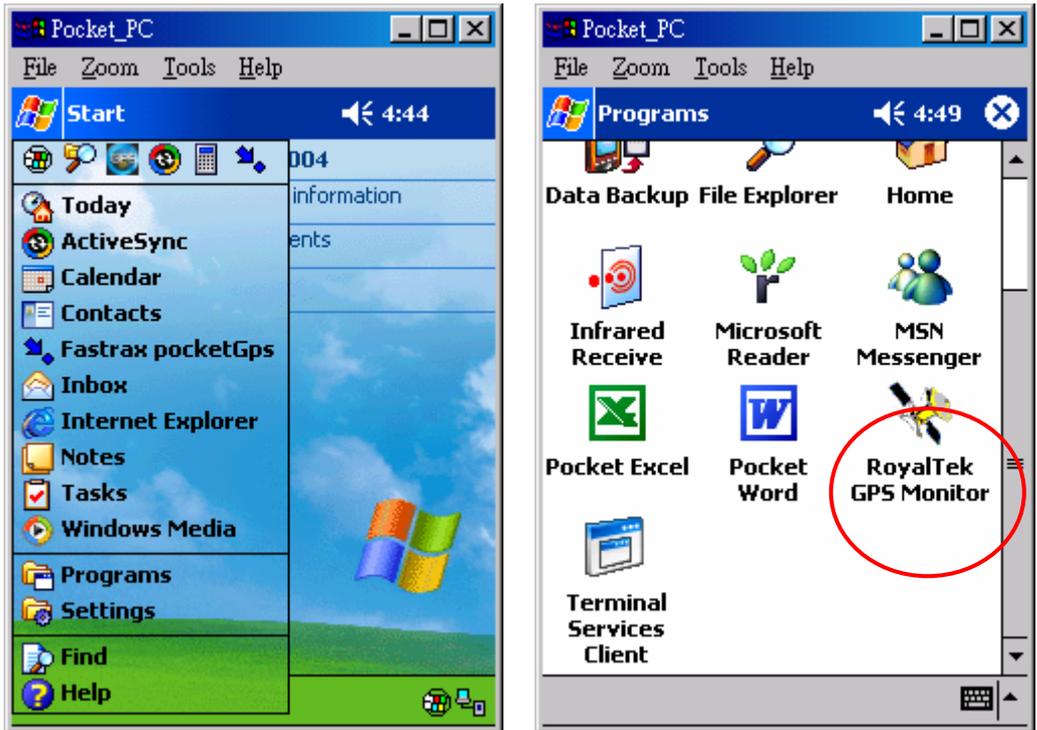


How to test RFG-2000 (PDA version only)

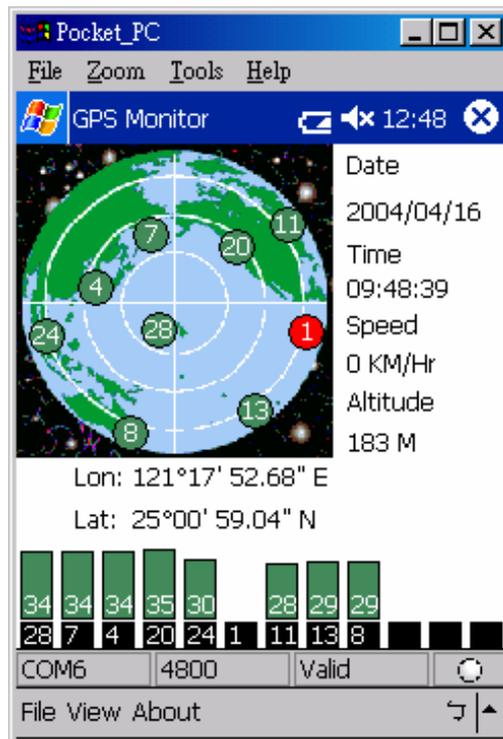
1. Insert RFG-2000 CD-Disc, choose “GPS Monitor for PocketPC” item to install the PocketPC version of *RoyalTek GPS Monitor* test application.



2. Execute the Pocket PC version of RFG-2000 GPS test application by double clicking the “*RoyalTek GPS Monitor*” icon as shown.



3. The *RoyalTek GPS Monitor* main screen as shown.



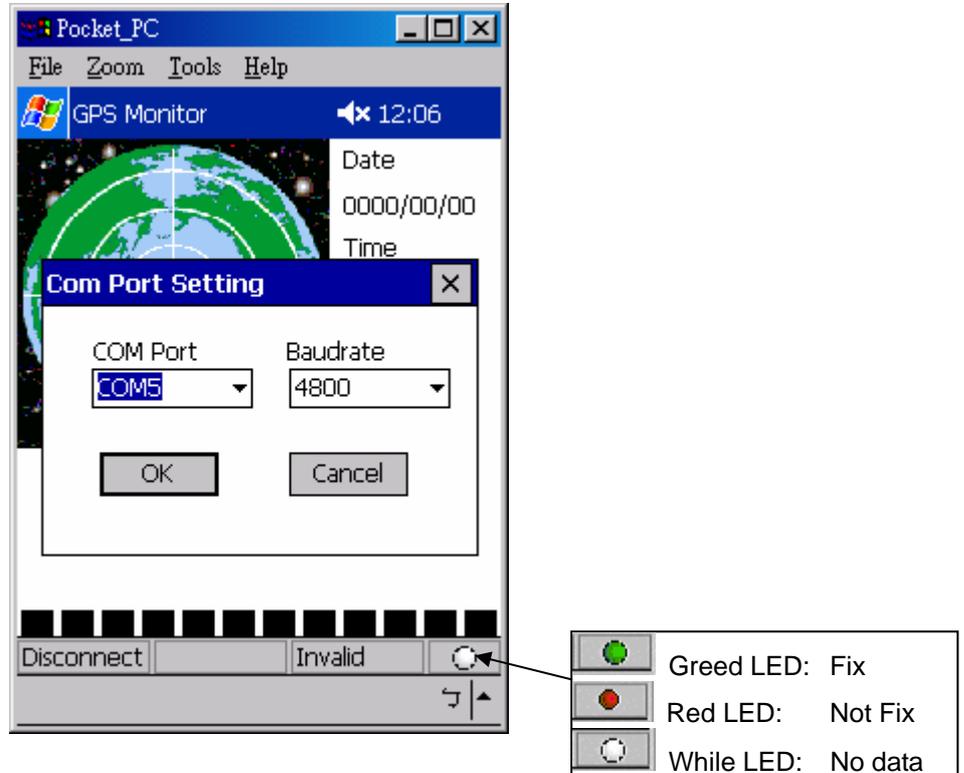
12-Channel Signal Level Color Coding

Red Color: The satellite is known from almanac information; however, the satellite is not currently being tracked.

Blue Color: The satellite is being tracked; however, it is not being used in the current position solution.

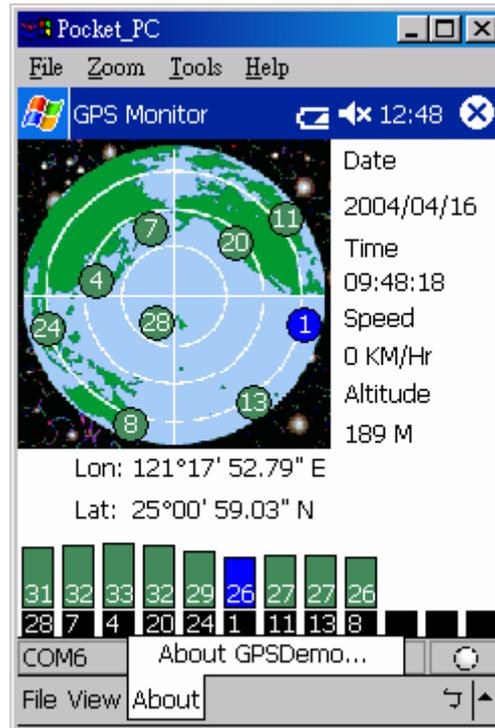
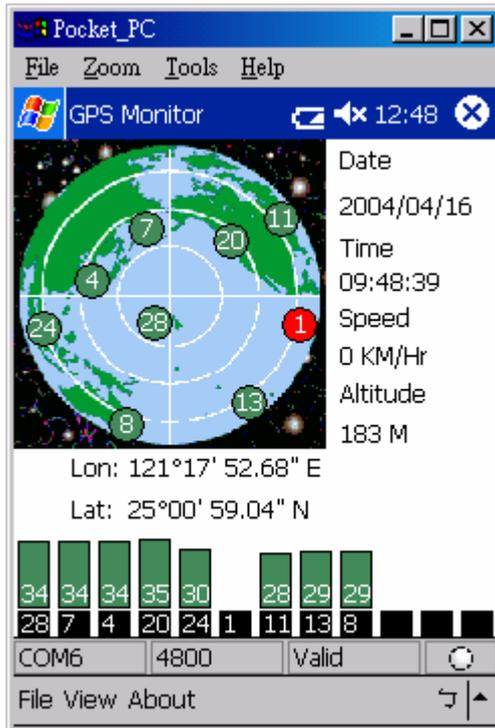
Green Color: The satellite is being tracked and is being used in the current position solution.

4. Select [File]->[Connect/Disconnect] menu item to prompt Com Port Setting window. Please choose the correct COM port.

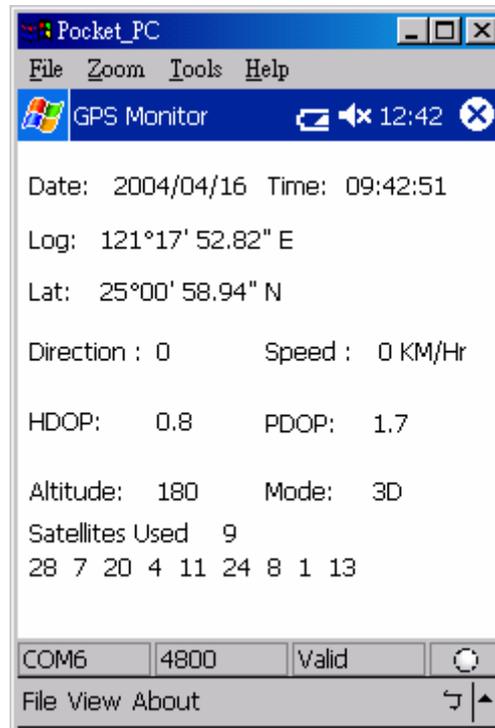
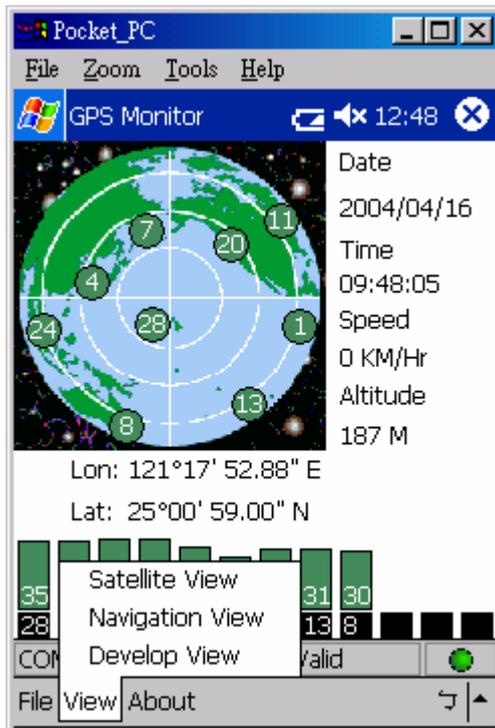


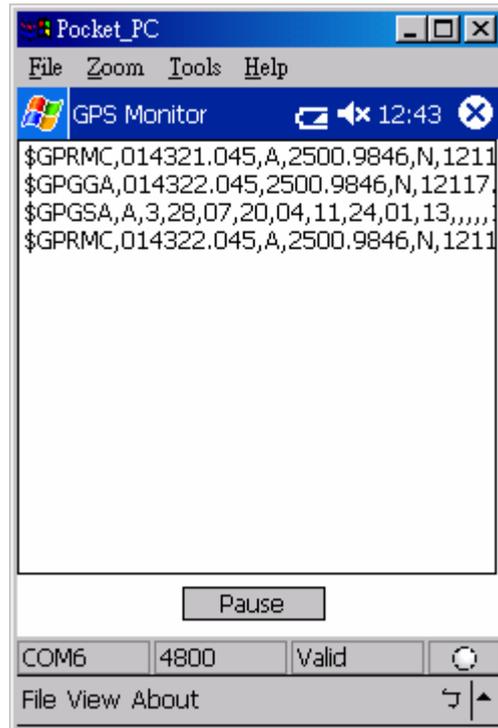
The baud rate of the RFG-2000 was defaulted as 4800 bps.

5. If everything is OK, it will show the position information and satellite's constellation.

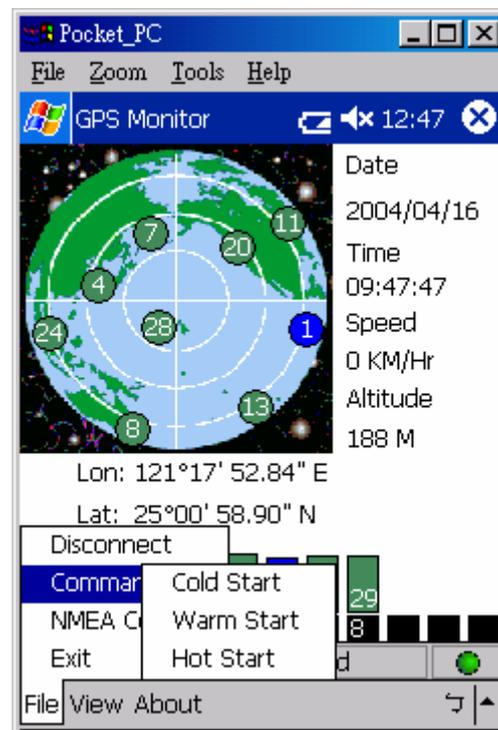
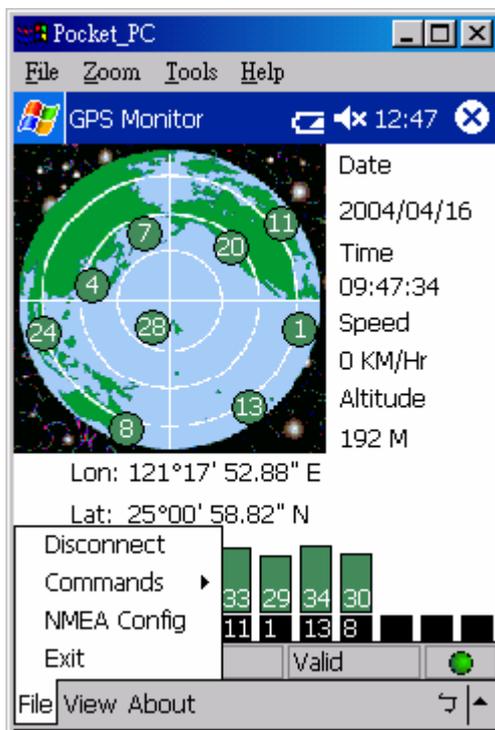


- Select [View] menu and select different view modes including Satellites View, Navigation View and Development View as below.

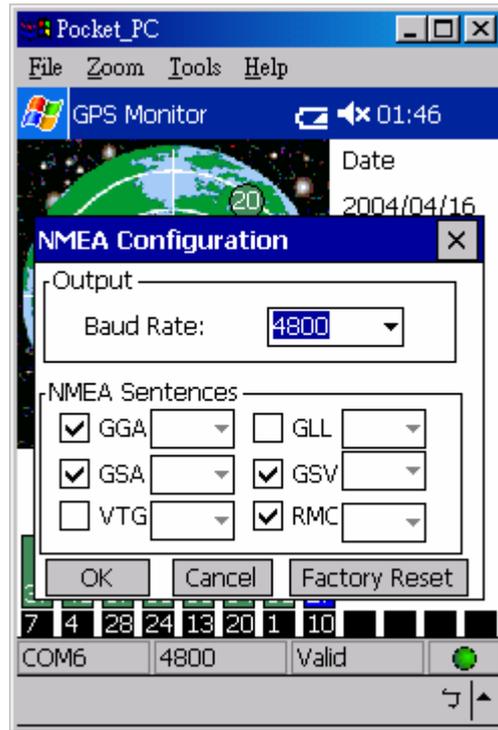




- If you want to cold start the GPS receiver, select “Cold Start” from the “Function” menu and click “Action” icon, the system will clear the RFG-2000 module data and initialize a cold start on GPS receiver.



- Select [File]->[NMEA Config] menu item to prompt NMEA Configuration window. Please select output NMEA sentences.



Specifications

Physical characteristics

Dimension: 57±0.3(Length) X 50 ±0.3(Width) X 15.5 ±0.3(Height)

Weight: 70 +/- 5 grams

Temperature characteristics

Storage temperature: -40°C ~ +85°C

Operating temperature: -40°C ~ +85°C

General

Channels: 12 channels

L1: 1575.42 MHz

C/A code: 1.023MHz chip rate

Accuracy

Position accuracy: 15 meters (49 feet) RMS

Velocity accuracy: 0.1 knot RMS steady state

Datum

WGS-84

Position update rate

1Hz, once per second

Dynamic conditions

Altitude : 18000 meters (60000 feet) max

Velocity : 515 meters / second max

Jerk : 20 meters / second, max

Acceleration : 4 G, max

Power

PS2/USB input power: DC 5V ± 5 %, 55mA typical

Car cigarette power adaptor: +9V ~ +16V.

Certification

FCC/CE compliant

Waterproof standard

IEC 68-2-18 test Ra1

Software Data

NMEA 0183 V3.0 Protocol

It is the RS-232 interface : 4800 bps, 8 bit data, 1 stop bit and no parity.

NMEA Output Messages

The RFG-2000 outputs the following messages as shown in Table 1 :

TABLE 1 NMEA OUTPUT MESSAGES

NMEA Record	Description
GGA	Global positioning system fixed data
GLL	Geographic position – Latitude/Longitude
GSA	GNSS DOP and active satellites
GSV	GNSS satellites in view
RMC	Recommended minimum specific GNSS data
VTG	Course over ground and ground speed

GGA – Global Positioning System Fixed Data

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

\$GPGGA, hhmmss.dd, xmm.dddd, <N|S>, yyymm.dddd, <E|W>, v, ss, d.d, h.h , M, g.g, M, a.a, xxxx
hh<CR><LF>*

Example:

*\$GPGGA, 111200.02, 6016.3092, N, 02458.3841, E, 1, 09, 0.8, 30.6, M, 18.1, M,, *5D*

Name	Example	Units	Description
Message ID	\$GPGGA		GGA protocol header
UTC Time	111200.02		hhmmss.dd hh = hours mm = minutes ss = seconds dd = decimal parts of seconds
Latitude	6016.3092		xmm.dddd xx = degrees mm = minutes dd = decimal parts of minutes
<N S> Indicator	N		N=north or S=south
Longitude	02458.3841		yyymm.dddd yyy = degrees mm = minutes

			dddd = decimal parts of minutes
<E W> Indicator	E		E=east or W=west
Fix Valid Indicator	1		v 0 = Fix not valid 1 = Fix valid
Satellites Used	09		ss Number of satellites used in position fix, 00-12. Fixed length
HDOP	1.0		d.d Horizontal Dilution of Precision
MSL Altitude	9.0	meters	h.h Altitude(mean-sea-level, geoid)
Units	M	meters	Letter M
Geoid Separation		meters	g.g Difference between the WGS-84 reference ellipsoid surface and the mean-sea-level altitude.
Units	M	meters	Letter M
NULL			a.a NULL (missing)
NULL			xxxx NULL (missing)
Checksum	*5D		*hh
<CR><LF>			End of message termination

GLL – Geographic Position – Latitude/Longitude

Latitude and Longitude, UTC time of fix and status.

*\$GPGLL,xxmm.dddd,<N|S>,yyymm.dddd,<E|W>,hhmmss.dd,S,M*hh<CR><LF>*

Example:

*\$GPGLL,6016.3073,N,02458.3791,E,134157.48,A,A*26*

Name	Example	Units	Description
Message ID	\$GPGLL		GLL protocol header
Latitude	6016.3073		xxmm.dddd xx = degrees mm = minutes dd = decimal parts of minutes
<N S> Indicator	N		N=north or S=south
Longitude	02458.3791		yyymm.dddd yyy = degrees mm = minutes dddd = decimal parts of minutes
<E W> Indicator	E		E = East, W = West
UTC Time	134157.48		hhmmss.dd hh = hours

			mm = minutes ss = seconds dd = decimal parts of seconds
Status Indicator	A		A = valid V = invalid
Mode Indicator	A		A=autonomous N=data not valid
Checksum	*26		*hh
<CR> <LF>			End of message termination

GSA – GNSS DOP and Active Satellites

GPS receiver operating mode, satellites used in the navigation solution reported by the GGA sentence, and DOP values.

`$GPGSA,a,b,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,p,p,h,h,v,v*hh<CR><LF>`

Example:

`$GPGSA,A,3,03,15,17,18,22, 23,,,,,,4.7,3.7,2.9*37`

Name	Example	Units	Description
Message ID	\$GPGSA		GSA protocol header
Mode 1	A		a Mode: M = Manual, forced to operate in 2D or 3D mode. A = Automatic, allowed to automatically switch 2D/3D.
Mode 2	3		b Mode: 1 = Fix not available, 2 = 2D, 3 = 3D
Satellite Used	03		xx ID (PRN) numbers of GPS satellites used in solution
PDOP	4.7		p.p Position Dilution of Precision
HDOP	3.7		h.h Horizontal Dilution of Precision
VDOP	2.9		v.v Vertical Dilution of Precision
Checksum	*37		*hh
<CR> <LF>			End of message termination

GSV – GNSS Satellites in View

Number of satellites in view, satellite ID (PRN) numbers, elevation, azimuth,

and SNR value. The information for four satellites maximum per one message, additional messages up to maximum of eight sent as needed. The satellites are in PRN number order.

Before a position fix is acquired the information contains only the SNR (signal to noise ratio) value. After a fix is acquired, also the elevation and azimuth angles are added. Note that there can be also “theoretical” satellites in the GSV message. These are satellites of which the angles (elevation, azimuth) are known but for some reason, e.g. due to an obstruction, have not been found by Onyx. The SNR value for these satellites is set to zero.

Please notice that as all the satellites that in the view are reported, the amount of satellites may occasionally be more than the number of receiver tracking channels, 12.

`$GPGSV,n,m,ss,xx,ee,aaa,cn,.....,xx,ee,aaa,cn*hh<CR><LF>`

Example:

`$GPGSV 4,1,14,03,66,207,50,08,09,322,44,11,01,266,42,14,00,155,00*79`

`$GPGSV,4,2,14,15,41,088,48,17,21,083,44,18,57,087,51,21,57,173,50*78`

`$GPGSV,4,3,14,22,05,203,00,23,52,074,49,26,17,028,44,27,00,300,00*79`

`$GPGSV,4,4,14,28,32,243,00,31,48,286,00*70`

Name	Example	Units	Description
Message ID	<code>\$GPGSV</code>		GSV protocol header
Number of Messages	4		n Total number of messages, 1 to 9
Messages Number	1		m Message number, 1 to 9
Satellites in View	14		ss Total number of satellites in view
Satellite ID	03		xx Satellite ID (PRN) number
Elevation	66	degrees	ee Satellite elevation, degrees 90 max
Azimuth	207	degrees	aaa Satellite azimuth, degrees True, 000 to 359
SNR (C/No)	50	dBHz	cn SNR (C/No) 00-99 dB-Hz. zero when not tracking
....
Checksum	<code>*79</code>		*hh

<CR> <LF>			End of message termination
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RMC – Recommended Minimum Specific GNSS Data

Time, date, position, course and speed data.

```
$GPRMC,hhmmss.dd,S,xxmm.dddd,<N|S>,yyymm.dddd,<E|W>,s.s,h.h,ddmmyy,d.d,
<E|W>,M*hh<CR><LF>
```

Example:

```
$GPRMC,134829.486,A,1126.6639,S,11133.3299,W,58.31,309.62,110200,,A*14
```

Name	Example	Units	Description
Message ID	\$GPRMC		RMC protocol header
UTC Time	134829.486		hhmmss.dd hh = hours mm = minutes ss = seconds dd = decimal parts of seconds
Status Indicator	A		S A=data valid or V=data not valid
Latitude	1126.6639		xxmm.dddd xx = degrees mm = minutes dd = decimal parts of minutes
N/S Indicator	S		N=north or S=south
Longitude	11133.3299		yyymm.dddd yyy = degrees mm = minutes dddd = decimal parts of minutes
E/W Indicator	W		E=east or W=west
Speed, Knots	58.31	knots	s.s Speed, knots.
Heading	309.62	degrees	
Date	110200		ddmmyy dd – date mm = month yy = year
Magnetic Variation		degrees	d.d This value is available if magnetic model data has been stored to the flash memory.
Declination			E = East, W = West
Mode Indicator	A		A=autonomous N=data not valid

Checksum	*14		*hh
<CR> <LF>			End of message termination

VTG – Course over ground and ground speed

Course and speed.

*\$GPVTG,h.h,T,m.m,M,s.s,N,s.s,K,M*hh<CR><LF>*

Example:

*\$GPVTG,202.60,T,,,0.38,N,0.7,K,A*0D*

Name	Example	Units	Description
Message ID	\$GPVTG		VTG protocol header
Heading	202.60	Degrees	h.h
Heading Units	T		Letter T
Magnetic Heading		Degrees	m.m This value is available if magnetic model data has been stored to the flash memory
Magnetic Heading Units			Letter M
Speed, Knots	0.38	Knots	s.s Speed, knots.
Speed Unit	N		Letter N
Speed	0.7	km/h	s.s
	K		Letter of K
Mode Indicator	A		A=autonomous N=data not valid
Checksum	*0D		*hh
<CR> <LF>			End of message termination

Troubleshooting

Problem	Reason	Solution
Test Fail	Poor connection or can't find GPS module	Check the RS232 and PS2 connector or USB connector to make sure they are well connected. Check the RFG-2000 is inserted correctly.
	Wrong BIOS setting for PS2	Check the BIOS setting to make sure the PS2 port is enable. If you still get the testing fail message, contact your local distributor
No position output but timer is counting	At outdoor space but GPS signal is blocked by buildings	Go outdoors where you can see clear sky and retest Onyx again,
Can't Open COM port	Some other application is using the COM port.	Reset the Pocket PC.
	PDA Low Battery	Using AC/DC charge for recharge
If operated Onyx over 5 minutes with nothing showing on the tracking diagram	Maybe Onyx received not enough data to sure tracking	Utilize the Pocket PC test program – RoyalTek GPS Monitor program to reset Onyx.

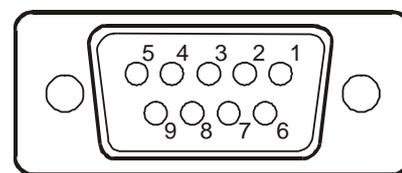
Note

- Please don't expose the unit under the sun for long period of time.
- Please don't leave the unit in the vehicle while not using.
- Please perform Cold start if last fixed position is more than 500km away from the present position.
- Please adjust your PDA system time to correct local time to achieve better GPS performance. Incorrect PDA system time may cause poor TTFF(Time To First Fix).

Appendix: Connector Interface

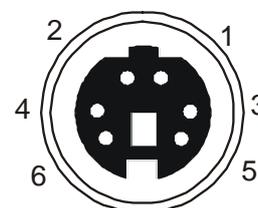
9 pin D-SUB

Pin NO	Signal Name	I/O	Description	Characteristics
1	No connect			
2	TX	O	Serial Data Output	High: -3V ~ -15V Low: +3V ~ +15V
3	RX	I	Serial Data Input	High: -3V ~ -15V Low: +3V ~ +15V
4	No connect			
5	GND	G	Ground	
6	No connect			
7	No connect			
8	No connect			
9	No connect			



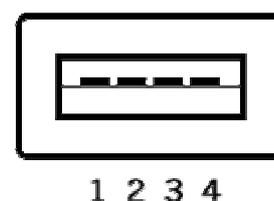
6 pin mini din

Pin NO	Signal Name	I/O	Description	Characteristics
1	No connect			
2	No connect			
3	GND	G	Ground	
4	VCC	I	+5V DC Power Input	DC +5V \pm 10%.
5	No connect			
6	No connect			



USB A Type Connector

Pin NO	Signal Name	I/O	Description	Characteristics
1	GND	-	Ground	Ground
2	D+	I/O	Data plus	Data plus
3	D-	I/O	Data Minus	Data Minus
4	VCC	+	+5V DC Power Input	+5V DC Power Input



Limited Warranty

Distributor for RFG-2000 grants a warranty for this product for one year starting from the date of purchasing of the product. Please retain the sales receipt as proof of purchase. During the warranty period, the product is eligible for replacement in case of defects in material and workmanship. In such case, the defective unit will be repaired or replaced according to an assessment by Manufacturer. However this warranty does not cover damages caused by improper use or from unauthorized modifications by third parties. In addition, this warranty does not cover expendable materials and defects, which constitute as normal wear or tear. Please contact us as following: