find your way

StarUtil

User Guide

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NAVCOM

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StarUtil User Guide
96-310008-3001
Revision G
April 2009

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The StarFire™ signal requires a subscription that must be purchased in order to access the service. Licenses are non-transferable, and are subject to the terms of the StarFire™ Signal License agreement. For further details on the StarFire™ Signal Network, its capabilities, terms and conditions visit *www.navcomtech.com* or send an email inquiry to *sales@navcomtech.com*.

USG FAR

Technical Data Declaration (Jan 1997)

The Contractor, NavCom Technology, Inc., hereby declares that, to the best of its knowledge and belief, the technical data delivered herewith under Government contract (and subcontracts, if appropriate) are complete, accurate, and comply with the requirements of the contract concerning such technical data

Global Positioning System

Selective availability (S/A code) was disabled on 02 May 2000 at 04:05 UTC. The United States government has stated that present GPS users use the available signals at their own risk. The US Government may at any time end or change operation of these satellites without warning.

The U.S. Department of Commerce Limits Requirements state that all exportable GPS products contain performance limitations so that they cannot be used to threaten the security of the United States.

Access to satellite measurements and navigation results will be limited from display and recordable output when predetermined values of velocity and altitude are exceeded. These threshold values are far in excess of the normal and expected operational parameters of the NCT-2000D and NCT-2100D family of products.

Revision History

Rev G (Apr 2009)	Added a Note regarding message B0. (B0 at the default rate of On Change is 1Hz regardless of the nav rate setting. To set the output of B0 at a higher rate to match the output of B1, use the *NCT Binary Messages* window.) Updated Figures 18 and 42 to show B0 set at 5Hz instead of On Change in the *NCT Binary Messages* window, as an example of scheduling B0 to a higher rate to match B1. Added an updated StarFire Satellite table for Software v5.1.6 and later. Indentified the original StarFire Satellite table as pertaining to Software v4.2.26 and earlier. Corrected the valid range for a Base site ID. The corrected range is "1 to 1023". The incorrect range was "0 to 1023". Added "Failed Search" section describing receiver functionality after a 5 minute failed search for a StarFire satellite.
Rev F (May 2008)	Updated guide to describe StarUtil-2000 & StarUtil-2100 Format change Added Revision History

Use of this Document

This User Guide is intended to be used by someone familiar with the concepts of GPS and satellite surveying equipment.

Note indicates additional information to make better use of the product.

This symbol means Reader Be Careful. Indicates a caution, care, and/or safety situation. The user might do something that could result in equipment damage or loss of data.

This symbol means Danger. You are in a situation that could cause bodily injury. Before you work on any equipment, be aware of the hazards involved with electrical and RF circuitry and be familiar with standard practices for preventing accidents.

Revisions to this User Guide can be obtained in a digital format from *http://www.navcomtech.com/Support/DownloadCenter.cfm?category=manuals*

Related Documents

Technical Reference Manual
P/N 96-3120001-3001

Describes the control and output data message formats utilized by this instrument (for customer programming purposes; included on CD).

RINEXUtil User Guide
P/N 96-310021-2101

Describes the conversion program used on NavCom proprietary output data message formats to RINEX ver 2.10 observation and navigation files (for customer programming purposes; included on CD).

Integrators Toolkit
P/N 97-310020-3001

Provides additional instruction and tools for developing control programs for this instrument (not included in the packaging material; contact *http://www.navcomtech.com/Support/* for a copy).

NavCom Release Notes

Describes software updates for NavCom products. Current and archived Release Notes are available on the NavCom web site: http://www.navcomtech.com/Support/DownloadCenter.cfm?category=releasenotes.

NavCom Customer Support provides software updates described in the Release Notes. Submit a request for software updates via the Request Support web page.

Install Utility User Guide
P/N 96-310012-3001

Provides instruction for the upload of software updates, software options, and the StarFire™ license (included with software ensemble files).

Related Standards

ICD-GPS-200

NAVSTAR GPS Space Segment / Navigation User Interfaces Standard. ARINC Research Corporation; 2250 E. Imperial Highway; El Segundo, California 90245

RTCM-SC-104

Recommended Standards For Differential GNSS Service. Radio Technical Commission For Maritime Services; 1800 N. Kent St, Suite 1060; Arlington, Virginia 22209

CMR, CMR+

Compact Measurement Record; Trimble Navigation Limited; 935 Stewart Drive; Sunnyvale, CA 94085

NMEA-0183

National Marine Electronics Association Standard For Interfacing Marine Electronic Devices. NMEA National Office; 7 Riggs Avenue; Severna Park, Maryland 21146

Publicly-Operated SBAS Signals

RTCA/DO-229D

The Radio Technical Commission for Aeronautics (RTCA) develops consensus-based recommendations regarding communications, navigation, surveillance, and air traffic management (CNS/ATM) system issues.

RTCA. 1828 L Street, NW, Suite 805, Washington, DC 20036.

These organizations implement the RTCA/DO-229D standard set by RTCA:

WAAS (Wide Area Augmentation System)

U.S. Department of Transportation. Federal Aviation Administration. 800 Independence Ave, SW, Washington, DC 20591

EGNOS (European Geostationary Navigation Overlay Service)

European Space Agency. 8, 10 rue Mario-Nikis, F-75738 Paris Cedex 15, France.

MSAS (MTSAT Satellite-based Augmentation System)

Japan Civil Aviation Bureau. Ministry of Transport. Kasumigaseki 2-1-3, Chiyoda-ku, Tokyo 100, Japan.

GAGAN (GPS Aided Geo Augmented Navigation)

Indian Space Research Organization. Antariksh Bhavan, New Bel Road, Bangalore - 560 094, India.

Chapter 1 ..... Introduction

StarUtil Overview

StarUtil is a NavCom developed utility designed to configure and view many (but not all) of the GPS receiver functions. In addition to its setup capabilities, StarUtil can capture and log data, upload new software and licenses to the internal processors, and query and display various receiver performance functions. Though it is primarily an Engineering tool, it has its own place in the commercial market as well.

This user guide provides information for two versions of StarUtil. Any differences between the versions is noted.

- ✓ StarUtil-2100 (NCT-2100D family of products)
- ✓ StarUtil-2000 (NCT-2000D family of products)

StarUtil is provided on a CD-ROM (P/N 96-310006-3001) included with the GPS receiver. It runs on PCs only. No special drivers are required.

UltraRTK™ is only available for and compatible with the NCT-2100D family of products.

Determine StarUtil Version & Run StarUtil

The GPS unit serial number or the GPS digital card serial number is used to determine the StarUtil version to install.

- ✓ Refer to Figure 1 to locate:
  - The GPS unit serial number on the rear of the receiver

    Or
  - The digital card serial number if an old version of StarUtil is installed on the computer. Open StarUtil and select *View > AE - Version Information*. A tab opens that includes the digital card serial number.

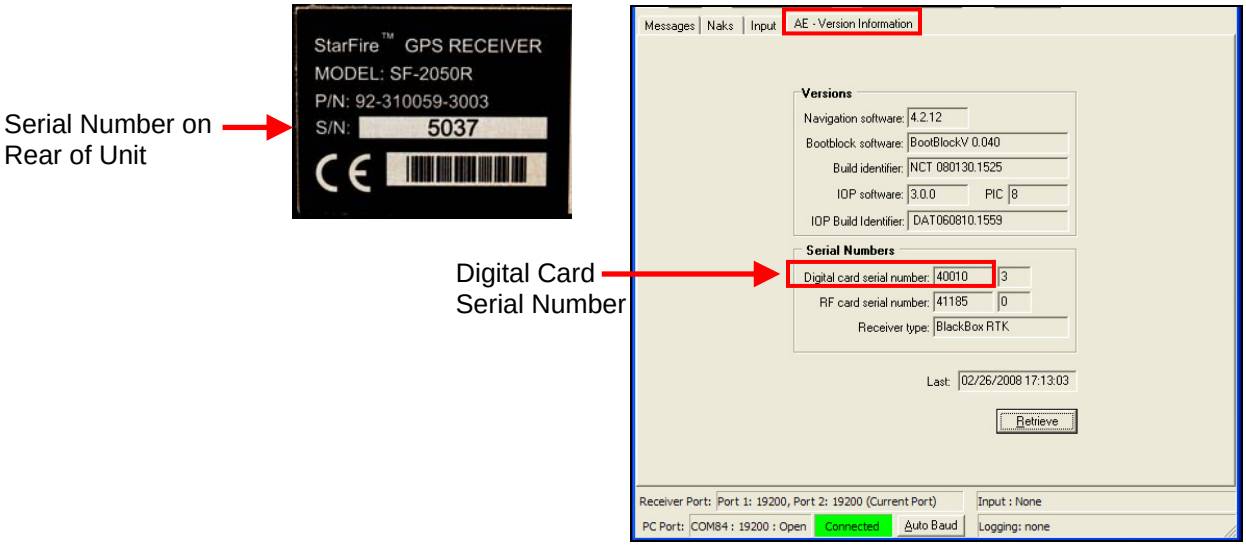


Figure 1: Unit & Digital Card Serial Numbers

✓ Refer to Table 1 to determine the correct StarUtil executable file for the GPS unit.

Table 1: Serial Numbers To Determine StarUtil Version

StarUtil Version	Digital Card Serial Number	Unit Serial Number	Software Options Type
StarUtil-2000.exe	< 40,000	< 5000	Version 1
StarUtil-2100.exe	> 40,000	> 5000	Version 2

✓ Insert the supplied CD-ROM into the CD-ROM drive. Locate the executable file, StarUtil-2100.exe or StarUtil-2000.exe, and save it to a folder on the PC. Double-click the appropriate executable file to run StarUtil.

⚠ Both versions of StarUtil share most of the same features, but are not interchangeable. StarUtil will not function properly if the incorrect version is installed.

✓ Uninstall any old version of StarUtil if resident on the computer.

To load GPS software options, such as faster navigation rates (10Hz >), the user must know the *Software Options Type* shown in Table 1. Refer to the section, *Load Purchased Software Options*, in *Chapter 9* for details.

StarUtil GUI

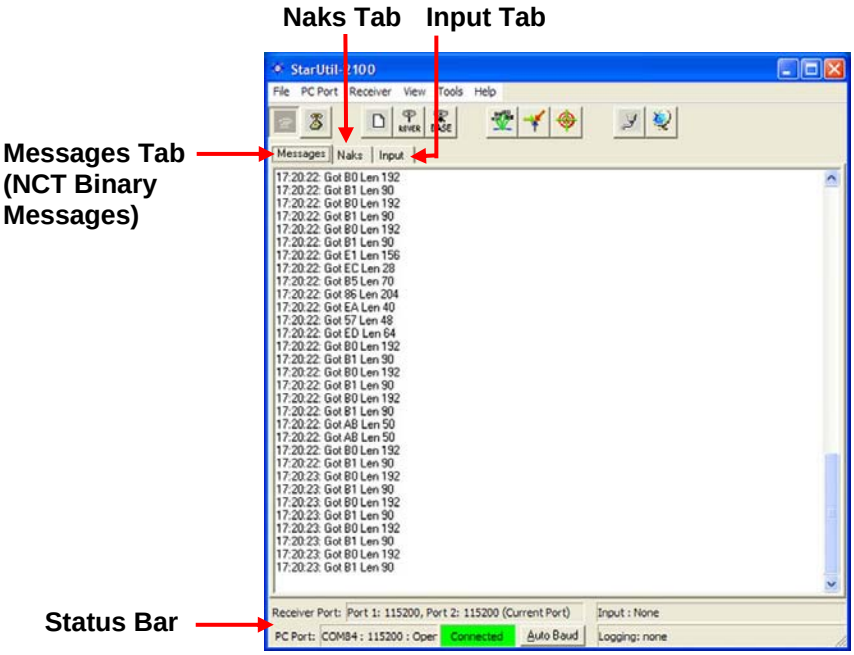


Figure 2: StarUtil Window


Configure PC COM Port (see Figure 5)


Close PC COM Port


Configure Data Logging (see Figure 104)

Configure Receiver Rover / Navigation & Tracking Settings (see Figure 16)

Configure Receiver Base Settings (see Figure 9)


View Satellite Status - Message 0x86 (see Figure 93)


View B1 Solution (see Figure 95)


View B1 Solution Plot (see Figure 96)


Configure Receiver Ports (see Figure 7)


Configure Vertical Antenna Bias (see Figure 21)

StarUtil Main Functions

Configure Base Station And Rover

This user guide provides information in two ways to configure the base station and rover:

✓ Reference Chapters:

- *Chapter 3:* A reference of all the options on the *Base Configuration* window. The window contains most (but not all) of the controls that enable the receiver to operate as a base station.
- *Chapter 4*: A reference of all the options on the *Rover / Navigation & Tracking Setup* window. The window contains most (but not all) of the controls that enable the receiver to operate as a rover.

✓ Step-by-Step RTK Configuration:

- *Chapter 5:* Step-by-step procedures to set up RTK communications between the base station and the rover via internal or external radios, plus steps to verify the successful communication of corrections. RTK Configuration involves the use of multiple windows: *Base Configuration*, *Rover / Navigation & Tracking Setup*, *Unit Port Configuration*, etc. This chapter highlights NCT RTK configuration, but also includes setup information for RTCM, CMR and CMR+ corrections. Basic hardware setup is described.

Setup Message Output Lists

StarUtil provides the user with two windows to schedule and configure messages for output according to application requirements:

✓ *NCT Binary Messages Window* (see Figure 86)

✓ *NMEA Messages Window* (see Figure 100)

The factory default for the GPS receiver is to output 7 NCT binary messages via the Control Port 2, and 2 NMEA messages via the Data Port 1. The user has full control over the utilized message types and their associated rates. Refer to *Chapter 7 Setup Message Output Lists* for details.

The *Technical Reference Manual (TRM)* details all NCT binary messages that can be output from the receiver (see *Related Documents* in the fore-matter).

View Message Output

✓ *View Menu*: Provides access to output of common NCT Binary Messages (see Figure 91)

✓ *NMEA Viewer*: View output of scheduled NMEA Messages (see Figure 115)

Log Message Output

✓ *External Data Logging*: Log the data from scheduled NCT Binary Messages continuously in a single file or in 24-hour data file splits (see Figure 104)

✓ *MMC Internal Data Logging*: Refer to the section, *Log NCT Binary Data Internally Via Memory Module Card (MMC)*, in *Chapter 8*.

✓ *NMEA Viewer*: Log the data from scheduled NMEA Messages (see Figure 116)

- StarFire™ Operation

Load or cancel the license for the StarFire™ subscription service. StarUtil also provides functions and data pertinent only to StarFire™ enabled receivers. Refer to *Chapter 6 StarFire™ Operation*.

- Load Software

Load purchased software options and/or free software updates to the GPS receiver. Refer to *Chapter 9 Load Software*.

Configuration Reset

Select *Receiver* > *Commands* > *Configuration Reset* from the menu bar to reset the GPS receiver to factory default settings. This command does not reset the position, time, almanac, and ephemeris, but resets all other user settings to the factory default.

How Changes to Settings are Applied & Output Data Is Polled

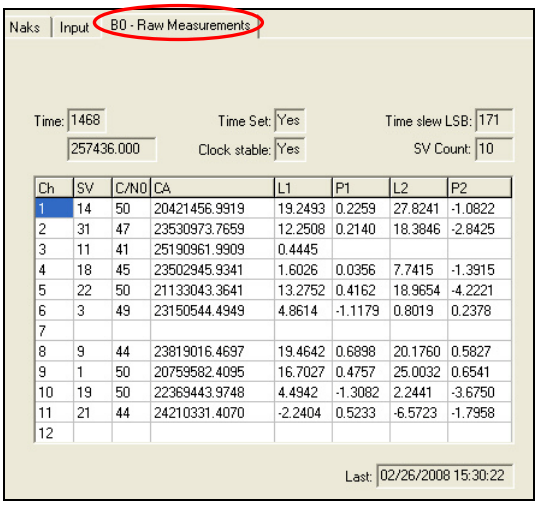
The *Apply* and *Retrieve* buttons are at the bottom of most windows in StarUtil (see Figure 3). StarUtil resides on the PC and allows the user to make changes which are not activated on the receiver until after the *Apply* button is clicked.

The user clicks the *Apply* button to apply one or more new settings, and then clicks the *Retrieve* button to confirm that the receiver accepts the setting(s).

Figure 3: Apply and Retrieve Buttons

StarUtil displays output data in two ways (see Figure 4):

- ✓ Data is continuously updated for some scheduled messages, for example, *B0-Raw Measurements*. StarUtil does not automatically poll the receiver for content. The user must schedule the proper message(s) for output to view the data.
- ✓ Some screens allow the user to poll for data to populate the screen. The user clicks the *Retrieve* button, as on the *30-Software Options* screen.



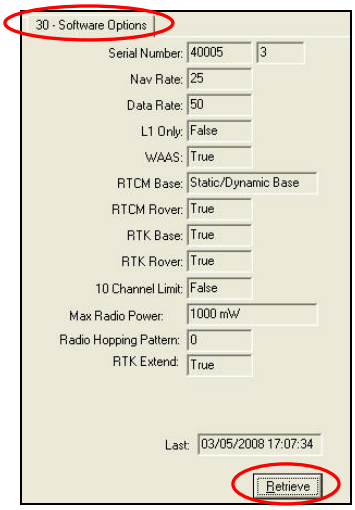


Figure 4: Examples of Output Data

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Chapter 2 .....Establish Communications

This chapter provides instructions to:

- ✓ Establish communications between a PC running StarUtil and the GPS receiver
- ✓ Configure unit ports

Establish Communications

1. Connect the PC and the GPS receiver. Use the supplied data cable.

Refer to the *Product User Guide* for the appropriate model purchased for a list of the equipment supplied with the GPS receiver.

2. Run the appropriate version of StarUtil on the PC. Refer to the section, *Determine StarUtil Version & Run StarUtil* in *Chapter 1*.

3. Click the  icon on the toolbar to establish communications between the PC and the GPS receiver. The *PC Port Configuration* window opens (see Figure 5).

To open the window from the menu bar, select *PC Port > Configure PC COM Port*.

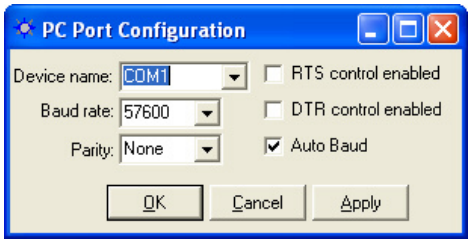

Figure 5: PC Port Configuration Window

4. In the *Device name* drop-down list, select the PC COM port connected to the GPS receiver.
5. Accept the default option, *Auto Baud*, or uncheck the *Auto Baud* box and select a baud rate from the drop-down list if the current receiver settings are known.

Auto Baud automatically detects the baud rate. If the user manually selects a baud rate that does not match the current receiver settings, the connection will fail. To change the receiver baud rate, refer to the section below, *Configure Unit Ports*.

6. Check both options together, *RTS control enabled* (Request To Send) and *DTR control enabled* (Data Terminal Ready), as necessary, to configure the receiver and the computer to acknowledge readiness before connection is established. This is optional and not required by the GPS receiver.

7. Click the *OK* button. If the connection is successful:

✓ NCT Messages scroll down the Messages tab of the *StarUtil* window.

Refer to Figure 6 for a screen capture of the status bar.

✓ The status bar at the bottom of the StarUtil window displays *Connected* in a green box. It also provides connection information for both the receiver and PC ports.

✓ The *Auto Baud* button in the status bar becomes active. If StarUtil becomes disconnected, click the *Auto Baud* button to re-establish communications.

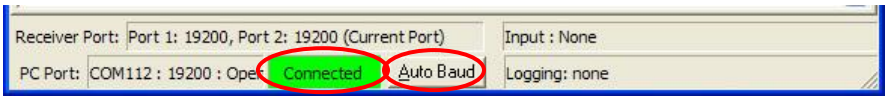

Figure 6: Status Bar

Configure Unit Ports

✓ Click the  icon on the toolbar to configure the physical and logical unit ports for specific application requirements. The *Unit Port Configuration* window opens (see Figure 7).

To open the window from the menu bar, select *Receiver* > *Setup* > *Ports*.

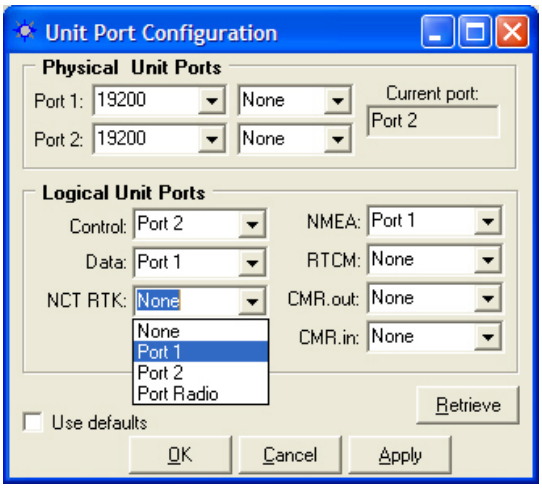

Figure 7: Unit Port Configuration Window

Physical Unit Ports

✓ Click the *Port 1* and/or *Port 2* drop-down lists to select a baud rate, and if necessary, select the parity.

✓ Click the *Apply* button and then click the *Retrieve* button to confirm that the receiver accepts the new setting(s).

- If the receiver does not accept the new baud rate, the baud rate reverts to the previous value. Click the *Naks* tab in the *StarUtil* window to view the error code.
- If the receiver accepts the new baud rate, it is retained in the field.
- If the *Current Port* baud rate is changed, Auto Baud attempts to reconnect at the newly defined rate. Alternatively, the PC Port may require manual setting to the newly defined

baud rate, or press the *Auto Baud* button in the Status Bar of the main window to reconnect.

Logical Unit Ports

Refer to Figure 7 for the options below:

There are seven logical ports. The available port assignments are *Port 1*, *Port 2*, *Port Radio*, or *None*. *Port 1* is the equivalent of COM1. *Port 2* is the equivalent of COM2. *Port Radio* must be assigned to the internal radio models RT-3010 & RT-3020 only.

Logical Port Defaults:

- ✓ *Control:* The default is *Port 2*.
- ✓ *Data:* The default is *Port 1*.
- ✓ *NMEA:* The default is *Port 1*.

⚠ NMEA messages must be output from the *Data* port. They cannot be output on the same port that is used for *Control*. Refer to *Chapter 8 Log Output Data/View and Log NMEA Data* for details.

The default for the RTK logical ports is *None*. Depending on configuration, these logical ports are generally set to *Port 1*, except for models RT-3010 & RT-3020, which must be set to *Port Radio*:

- ✓ *NCT RTK*: Proprietary RTK and UltraRTK™
- ✓ *RTCM*
- ✓ *CMR.out:* Enables the output of CMR or CMR+ corrections
- ✓ *CMR.in*: Enables the input of CMR or CMR+ corrections

Corrections can be simultaneously sent from the base station to any of the logical ports, and also the internal MMC Memory Module for logging.

The factory default for the GPS receiver is to output 7 NCT binary messages via the Control Port 2, and 2 NMEA messages via the Data Port 1. The user has full control over the utilized message types and their associated rates. Refer to *Chapter 7 Setup Message Output Lists* for details.

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Chapter 3 ..... Base Configuration Window Options

This chapter is a reference of all the options on the *Base Configuration* window. This window contains most (but not all) of the controls that enable the receiver to operate as a base station.

Refer to Chapter 5 RTK Configuration for step-by-step procedures to set up a base station to transmit and a rover to receive RTK corrections via internal or external radios.

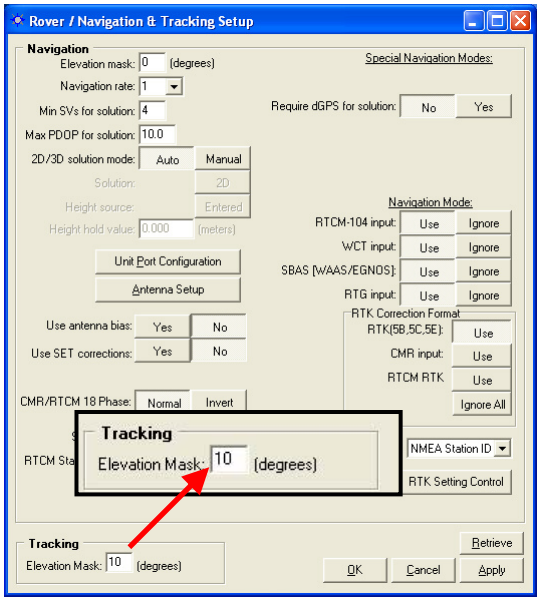
Refer to the *Technical Reference Manual* for details of the control and output messages that apply to RTK corrections (see *Related Documents* in the fore-matter).

Various Controls That Affect Base Station Operation

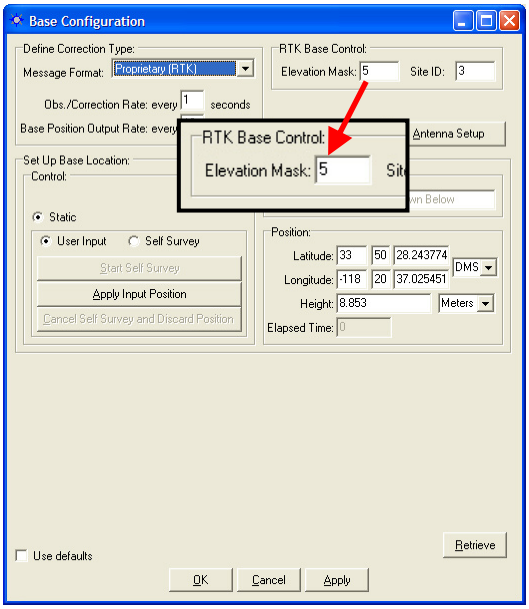
Depending on configuration, controls on these windows may affect base station operation:

✓ *Rover / Navigation & Tracking Setup Window*:

- *Min SV's For Solution*
- *Max PDOP For Solution*
- *Max RTK Age*
- *Tracking Elevation Mask:* if the rover Tracking Elevation Mask exceeds the RTK Base Control Elevation Mask, tracking will not begin until the Tracking Elevation Mask is reached. For example, if the Tracking Elevation Mask is 10 and the RTK Base Control Elevation Mask is 5, RTK corrections won't be computed until the satellite elevation reaches 10 (see Figure 8).



Rover Tracking Elevation Mask



RTK Base Control Elevation Mask

Figure 8: Elevation Mask Controls

- ✓ *53 – RTK Settings Window* (see Figure 27): This window is available in StarUtil-2100 only. If re-configuring a base station as a rover, check this window for settings that may need to be changed. On the *Rover / Navigation & Tracking Setup* window, click the *RTK Setting Control* button to access the *53 – RTK Settings* window.

Models RT-3010 & RT-3020 Only (with internal radio):

- ✓ *Radio Configurations Window* (see Figure 67): *Operation Mode* must be set to *1= Master, Point to Multipoint* to enable the receiver to operate as a base station.
- ✓ *Unit Port Configuration Window* (see Figure 66)*:* Depending on configuration, the *NCT RTK* logical port, *RTCM* logical port, or *CMR.out* logical port must be set to *Port Radio* to enable the base station to communicate with the rover via the internal radio.

Base Configuration Window

- ✓ Click the BASE icon on the toolbar to configure the base station. The *Base Configuration* window opens (see Figure 9).

To open the window from the menu bar, select *Receiver* > *Setup* > *Base.*

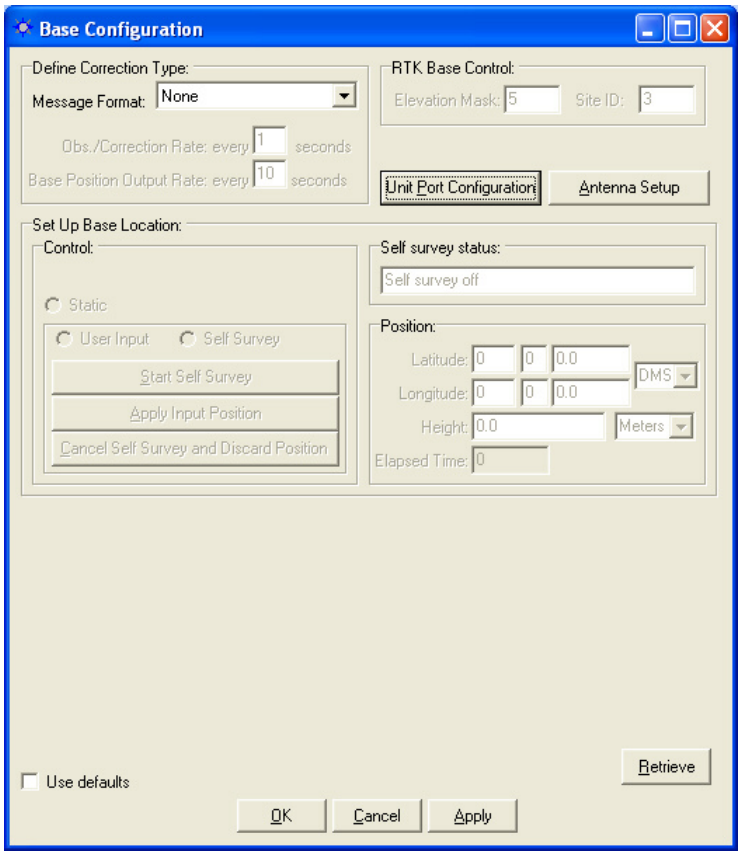


Figure 9: Base Configuration Window

After making settings in the sections below, click the *Apply* button and then click the *Retrieve* button to confirm that the receiver accepts the settings.

Define Correction Type

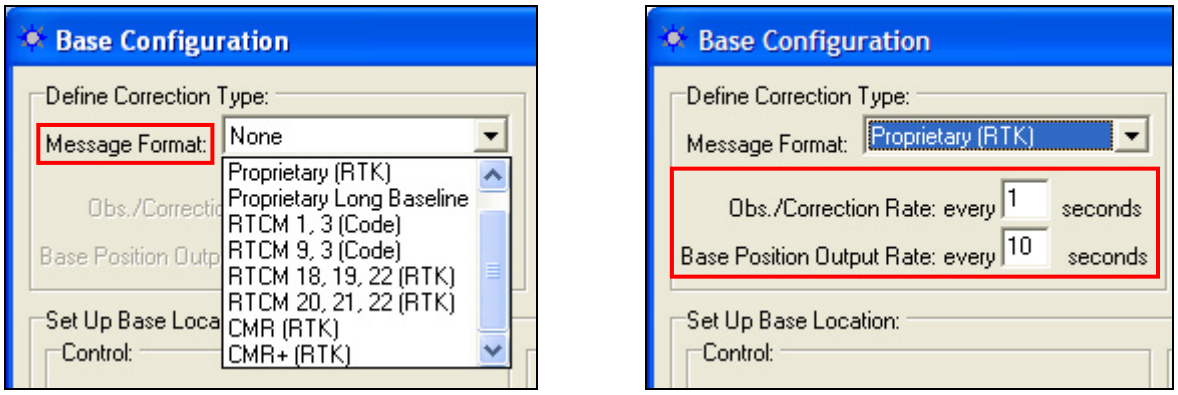


Figure 10: Base Configuration – Define Correction Type

Refer to Figure 10 for the options below:

✓ *Message Format:* The available RTK correction types.

Proprietary (RTK) is for surveys under 10 km. *Proprietary Long Baseline* (*UltraRTK*™), is for surveys from 10 km to 40 km.

✓ *Obs./Correction Rate:* Do *not* change the default, *every 1 second*. It is the optimum rate. *CMR+ (RTK)* is set at a pre-determined rate that can not be changed.

✓ *Base Position Output Rate:* Do *not* change the default, which is the optimum rate. The default for *Proprietary (RTK)* and *Proprietary Long Baseline (UltraRTK™)* is *every 10 seconds*. The default for all *RTCM* message formats and *CMR (RTK)* is *every 10 corrections*. *CMR+ (RTK)* is set at a pre-determined rate that can not be changed.

Proprietary (RTK) and *Proprietary Long Baseline (UltraRTK™)* only:

- The option, *Obs./Correction Rate,* applies to:
  - Message 0x5B for *Proprietary (RTK)*
  - Message 0x5E for *Proprietary Long Baseline (UltraRTK™)*
- In either configuration, the option, *Base Position Output Rate*, applies to message 0x5C.

When the base is configured for *Proprietary RTK*, messages 0x5B and 0x5C are automatically scheduled for output in the *NCT Binary Messages* window. When the base is configured for *Proprietary Long Baseline (UltraRTK™)*, messages 0x5E and 0x5C are automatically scheduled for output in the *NCT Binary Messages* window. In either configuration, message 0x5D is also scheduled for StarFire™ enabled receivers. For details, refer to *Chapter 5 RTK Configuration/Verify Base Configuration*.

Refer to the *Technical Reference Manual* for message details (see *Related Documents* in the fore-matter).

UltraRTK™ is only available for and compatible with the NCT-2100D family of products.

Additional Controls For CMR+

When the message format *CMR+ (RTK)* is selected, the *Base Configuration* window displays additional controls (see Figure 11). The same controls for *CMR (RTK)* are not active.

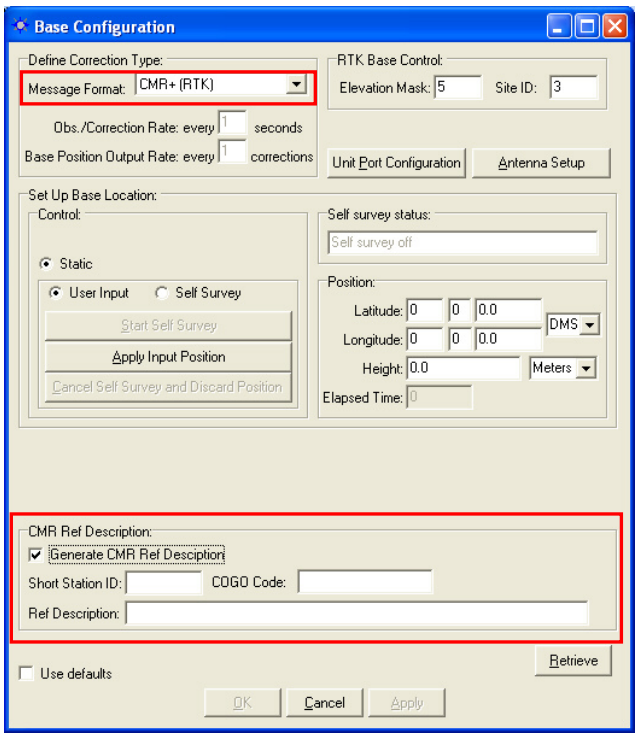


Figure 11: CMR Ref Description

Refer to Figure 11 for the options below:

- ✓ *Generate CMR Ref Description*: Click the check box to activate the fields.
- ✓ *Short Station ID:* Enter the Short Station ID / Name.
- ✓ *COGO Code:* Enter the reference station point feature code to be transmitted.
- ✓ Ref Description: The reference station description.

RTK Base Control, Unit Port Configuration, And Antenna Setup

- ✓ *Elevation Mask:* Enter the cutoff vertical angle above the horizon. For any satellites below this angle, no data will be transmitted to the rover for use in calculating positions.

The default recommended setting for the base receiver is 5 degrees; however, the height of on-site obstructions will dictate this setting. Collecting poor data (i.e. through trees) at the base will degrade the performance of the rover.

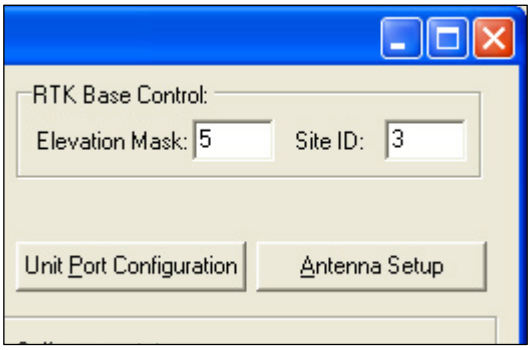


Figure 12: RTK Base Control

Refer to Figure 12 for the options below:

- ✓ *Site ID:* Accept the default base Site ID (3) or enter an ID to isolate the base and rover radios, if desired. The rover radio must be set to the identical ID. This avoids cross talk between the rover radio and any other base radio in the area that may be set to the same frequency. For multiple base stations, use a different site ID for each one. The valid range for a Base site ID is 1 to 1023. The valid range for a Rover site ID is 0 to 1023. If the rover Site ID is 0 (the default), the rover accepts RTK corrections from any base station (see Figure 23).

Models RT-3010 & RT-3020 only (with internal radio): StarUtil provides a Network ID option (see Figure 70).

- ✓ *Unit Port Configuration Button:* Click this button to configure the physical and logical unit ports. The *Unit Port Configuration* window opens. Refer to the section above, *Configure Unit Ports*, for more information.
- ✓ *Antenna Setup Button:* Click this button to set the appropriate bias adjustment values for the antenna model in use (optional). The *Vertical Antenna Bias* window opens (see Figure 13):
  - *Phase Center Adjustment (H1)*: The offset in millimeters from the physical center of the antenna (the element) to the Mechanical Reference Plane (MRP). The MRP is at the bottom of the BSW antenna mount. The range limits are -128 to 127mm.
  - *Radius of Antenna Body (R)*: The measurement in millimeters from the physical center of the antenna to the edge of the antenna. For a pole, enter 0. For a tripod, the range limits are -32768 to 32767mm.
  - *Slant Range of Antenna Body*: For a pole, the vertical measurement in millimeters from the Mechanical Reference Plane (MRP) to the control point. For a tripod, the measurement in millimeters from the edge of the antenna to the control point. The range limits are -32768 to 32767mm.

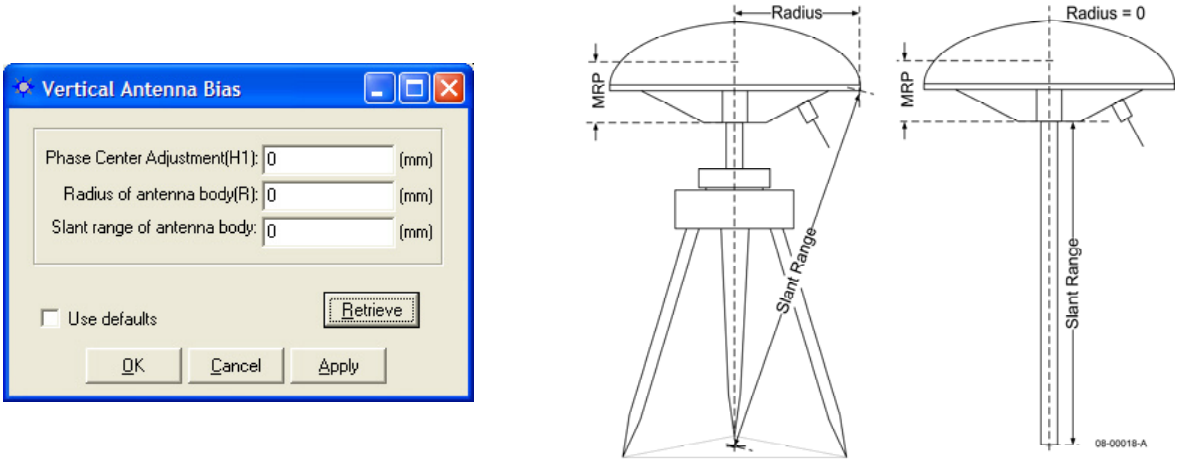


Figure 13: Vertical Antenna Bias

To access the *Vertical Antenna Bias* window from the main StarUtil window, click the icon or select *Receiver > Setup > Vertical Antenna Bias*.

Set Up Base Location

Enter the position of the base station, manually via *User Input* (the default) or automatically via *Self Survey*.

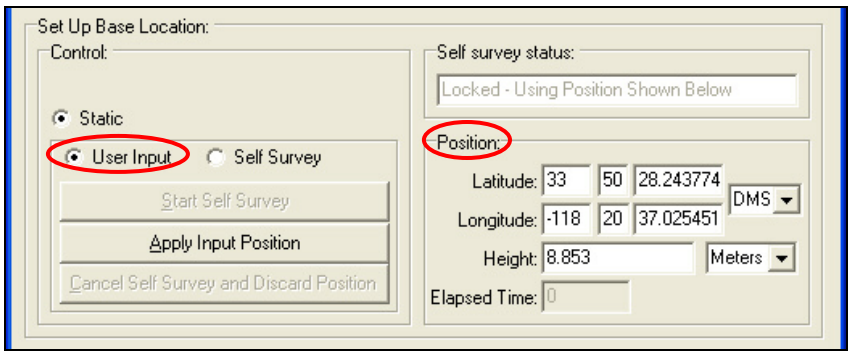


Figure 14: Base Location – User Input

✓ *User Input (the default):* Manually enter the known surveyed truth position in the *Position* section of the window (see Figure 14). Click the *Apply Input Position* button to save the position in NVRAM.

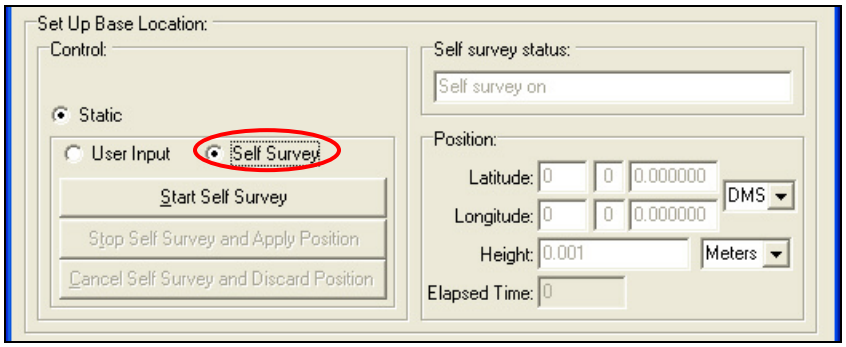


Figure 15: Base Location –Self Survey

Refer to Figure 15 for the option below:

✓ Self Survey:

- Click the radio button next to *Self Survey*.
- Click the *Start Self Survey* button to obtain a position from the received GPS signals.

The time of survey varies and average position is used. For best results, allow the receiver to run several hours (minimum of 10 minutes). Errors in the base position will apply an equal bias error in the rover position

- Click the *Stop Self Survey and Apply Position* button to save the position in NVRAM.

This sends the 0x51 message to the receiver, which contains only the averaged base antenna location parameters.

- Click the *Apply* button at the bottom of the window.

This sends the 0x50 message, and as appropriate, messages 0x56, 0x5A, and/or 0x5C. The base is configured to send RTK corrections to the rover.

Chapter 4 .....Rover / Navigation & Tracking Setup Window Options

This chapter is a reference of all the options on the *Rover / Navigation & Tracking Setup* window. This window contains the navigation mode and operational controls to configure the rover. The options apply to messages 0x47 (SV Tracking Control) and 0x49 (Solution Control).

Refer to Chapter 5 RTK Configuration for step-by-step procedures to set up a base station to transmit and a rover to receive RTK corrections via internal or external radios.

The available navigation modes on the *Rover / Navigation & Tracking Setup* window are:

- ✓ RTCM-104 (code)
- ✓ WCT: Not applicable as of January 2008
- ✓ SBAS (WAAS/EGNOS/MSAS/GAGAN): RTCA/DO-229D compliant. Refer to *Related Standards* in the fore-matter.
- ✓ RTG: Access to this mode is available only by purchase of a license for the StarFire™ subscription service. Refer to *Chapter 6 StarFire™ Operation*.
- ✓ RTK: RTK/UltraRTK™-NCT Proprietary, CMR, RTCM – Access to this mode is available only by purchase of a license.
- ✓ Non-differential mode: The default if all the navigation modes above are set to *Ignore*.

Rover / Navigation & Tracking Setup Window

- ✓ Click the ROVER icon on the toolbar to configure the rover. The *Rover / Navigation & Tracking Setup* window opens (see Figure 16).

To open the window from the menu bar, select *Receiver* > *Setup* > *Rover / Tracking and Navigation*.

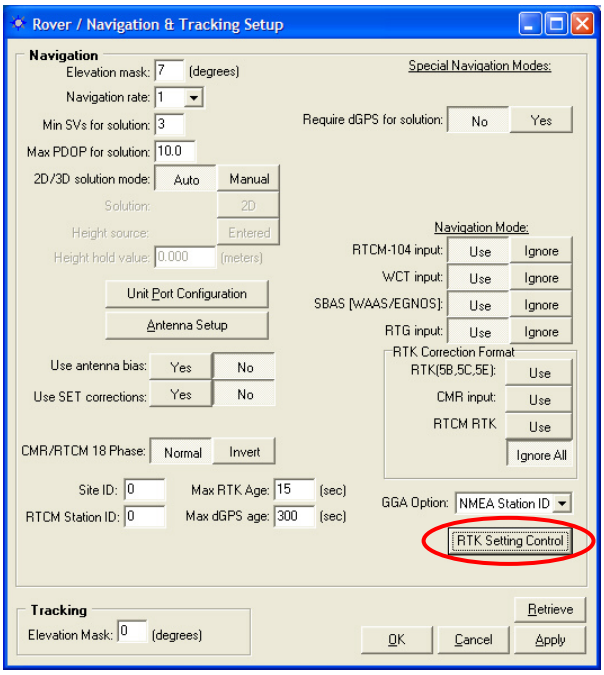


Figure 16: StarUtil-2100 -- Rover / Navigation & Tracking Setup Window

The options on the *Rover / Navigation & Tracking Setup* window are identical in StarUtil-2000 and StarUtil-2100, except for the *RTK Setting Control* button, which is included only in StarUtil-2100 (see Figure 16).

After making any settings in the sections below, click the *Apply* button and then click the *Retrieve* button to confirm that the receiver accepts the settings.

Navigation Rate and Other Options

✓ *Elevation Mask:* Enter a value between 0 and 90 degrees to set the elevation angle at which the receiver will start processing GPS data from satellites.

The default elevation mask is 7 degrees to prevent position jumps due to frequent satellite re-acquisitions at lower elevation mask angle limits.

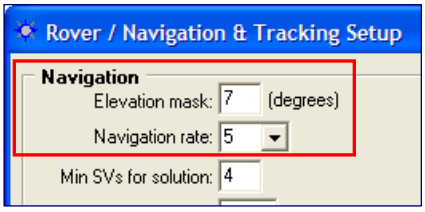


Figure 17: Elevation Mask & Nav Rate

✓ *Navigation Rate:* The number of navigation solutions per second. The standard rates are 1Hz (default), 2Hz, and 5Hz. Purchased software options are 10Hz and above, with the exception of the VueStar system for which all available rates are standard. The upload of a purchased navigation rate changes the setting in the *Navigation rate* field automatically to the purchased rate. Refer to *Chapter 9 Load Software* for information about the purchase and upload of software options.

The *Navigation Rate* setting in the *Rover / Navigation & Tracking Setup* window sets the output of the NCT Binary message B1 and the NMEA messages GGA, RMC and VTG, provided that those messages are set to *On Change* in the *NCT Binary Messages* window and the *NMEA Messages* window, respectively (see Figure 18).

For the NCT Binary message B0 only, the rate of *On Change* (the default) is 1Hz regardless of the navigation rate setting. To set the output of B0 at a higher rate to match the output of B1, use the *NCT Binary Messages* window. The rate must be a purchased navigation and raw data rate (refer to message 0x30 in the *Technical Reference Manual*).

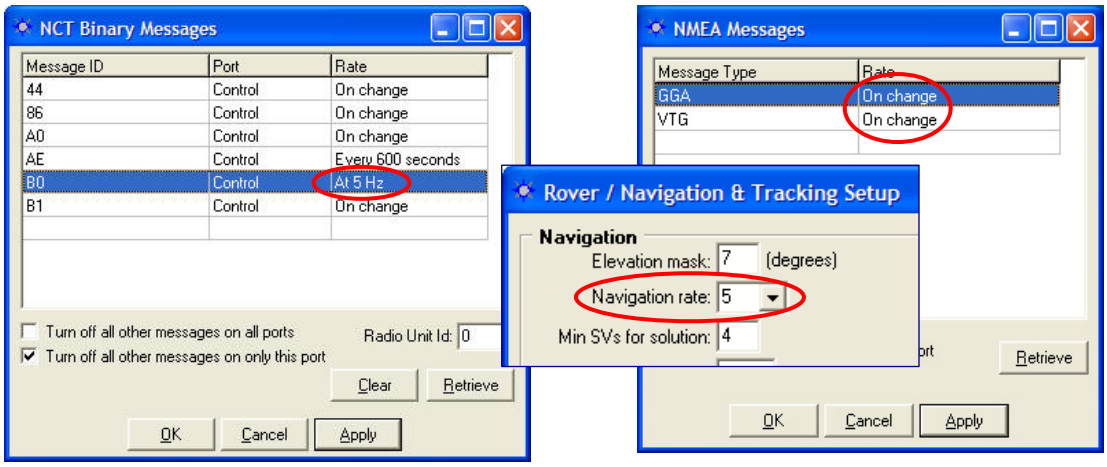
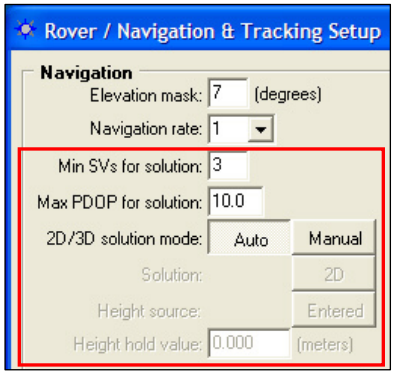


Figure 18: Navigation Rate

When a message is set to *On Change*, the data is output each time new data is available as determined by the *Navigation Rate* setting (see Figure 18). For example, if a position is steadfast at N 33°50'20.18592" W 118° 20'35.21218" for three seconds and the *Navigation Rate* is 5Hz, a 0xb1 solution is output 1 time because the position didn't change. If any element of the position changes continuously during the three second period then a 0xb1 solution is output 15 times.

The NMEA messages GGA, RMC, and VTG match the output of the navigation rate up to 10 Hz max when scheduled as *On Change*.



- ✓ *Min SVs for Solution:* The default setting is three satellites. Four satellites are the minimum SVs required for a 3D navigation solution, plus an acceptable PDOP.
- ✓ *Max PDOP for Solution:* The maximum PDOP value at which the receiver will compute positions is 25.5. Enter the highest PDOP value according to application requirements. An applied value above 25.5 reverts to the default of 10.0.

The default setting for Max PDOP is 10. The quality of GPS data is dependent on the geometry between the receiver and satellites; this includes the number of satellites that can be "seen" by the receiver and the angle between the receiver and satellites as a constellation seen by the receiver. A satellite near the horizon usually provides a lower quality signal because of greater atmospheric interference and the increased likelihood of the signal reflecting from surface features; this is known as "multipath" error. The effect of geometry on GPS quality is measured by PDOP (position dilution of precision). PDOP is the overall measure of the precision obtainable with a given satellite geometry. For example, a PDOP of 4 or less yields excellent precision, a PDOP between 5 and 7 is acceptable and a PDOP of 7 or more is considered poor.

- ✓ *2D/3D Solution Mode:* Click the *Auto* or *Manual* button to determine how height will be applied to a 2D navigation solution.
  - *Auto*: Sets the receiver to automatically transition between 3D (4 satellite) and 2D (3 satellite) navigation. This can also be determined by DOP values, even if 5 satellites are available. In 2D navigation, the last valid computed height measurement is used.
  - *Manual*: Enter the *Height hold value* to set the receiver to 2D (3 satellite) navigation with the *Height hold value* used for the height measurement. The receiver must compute an initial 3D navigation solution before it transitions to 2D navigation. After 2D navigation is established, the receiver will not transition back to 3D navigation.

Click the  icon in the toolbar to view the current navigation solution and other parameters of message 0xB1. The *3D nav* field indicates if 3D navigation is computed (see Figure 19).

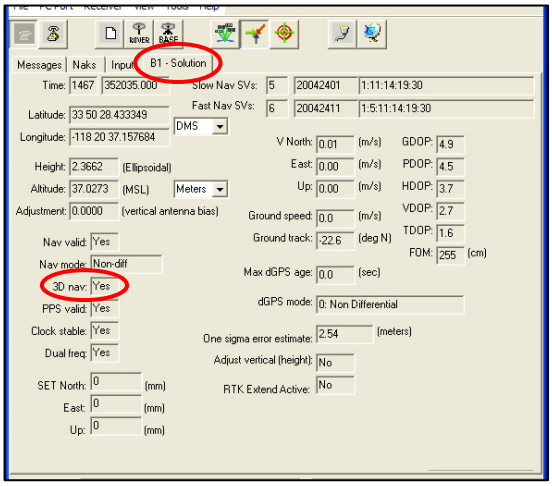


Figure 19: B1 – Solution, 3D nav Field

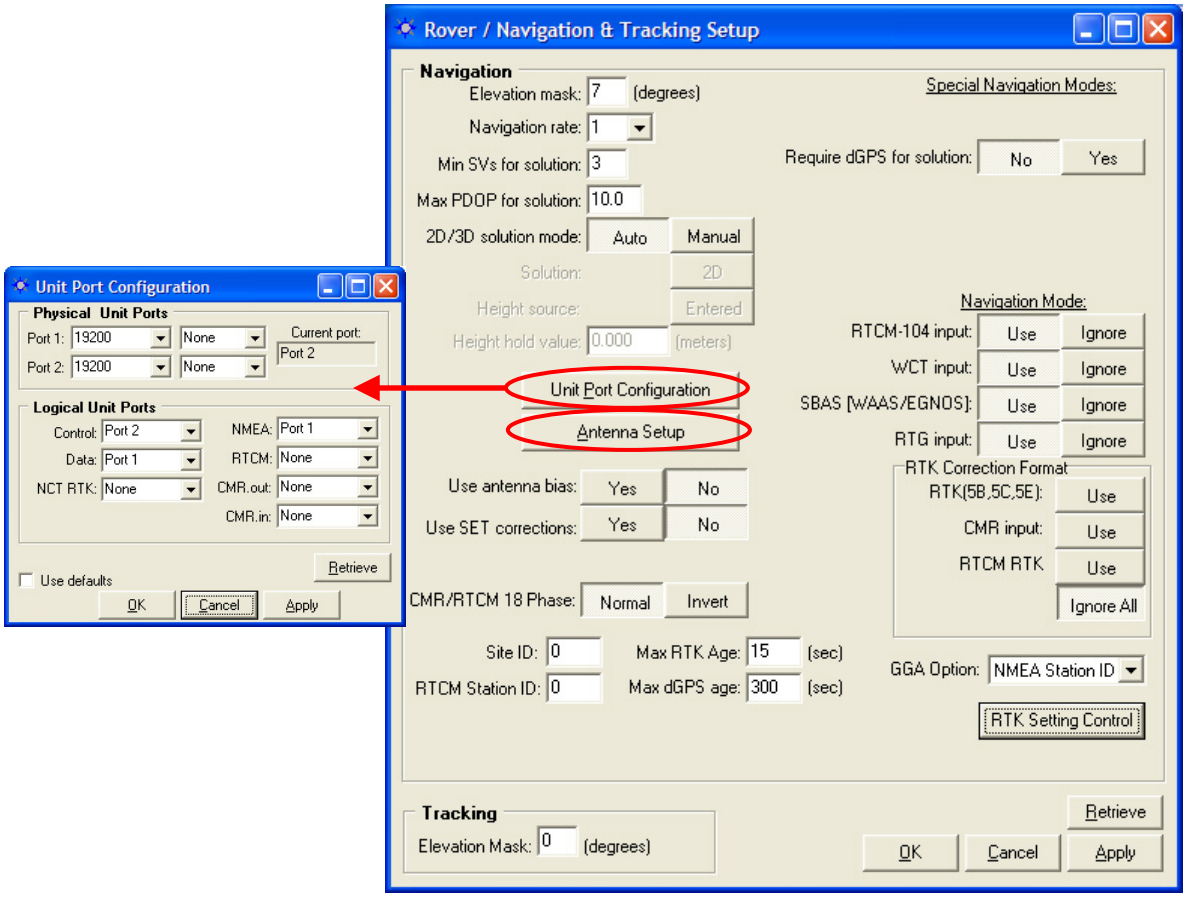


Figure 20: Rover / Navigation & Tracking Setup Window

✓ *Unit Port Configuration Button:* Click this button to configure the physical and logical unit ports. The *Unit Port Configuration* window opens (see Figure 20). Refer to the section above, *Configure Unit Ports*, for more information.

✓ *Antenna Setup Button:* Click this button to set the appropriate bias adjustment values for the antenna model in use (optional). The *Vertical Antenna Bias* window opens (see Figure 21):

- *Phase Center Adjustment (H1)*: The offset in millimeters from the physical center of the antenna (the element) to the Mechanical Reference Plane (MRP). The MRP is at the bottom of the BSW antenna mount. The range limits are -128 to 127mm.
- *Radius of Antenna Body (R)*: The measurement in millimeters from the physical center of the antenna to the edge of the antenna. For a pole, enter 0. For a tripod, the range limits are -32768 to 32767mm.
- *Slant Range of Antenna Body*: For a pole, the vertical measurement in millimeters from the Mechanical Reference Plane (MRP) to the control point. For a tripod, the measurement in millimeters from the edge of the antenna to the control point. The range limits are -32768 to 32767mm.

A label on the bottom of NavCom supplied antenna's provides the appropriate measurements for the antenna in use.

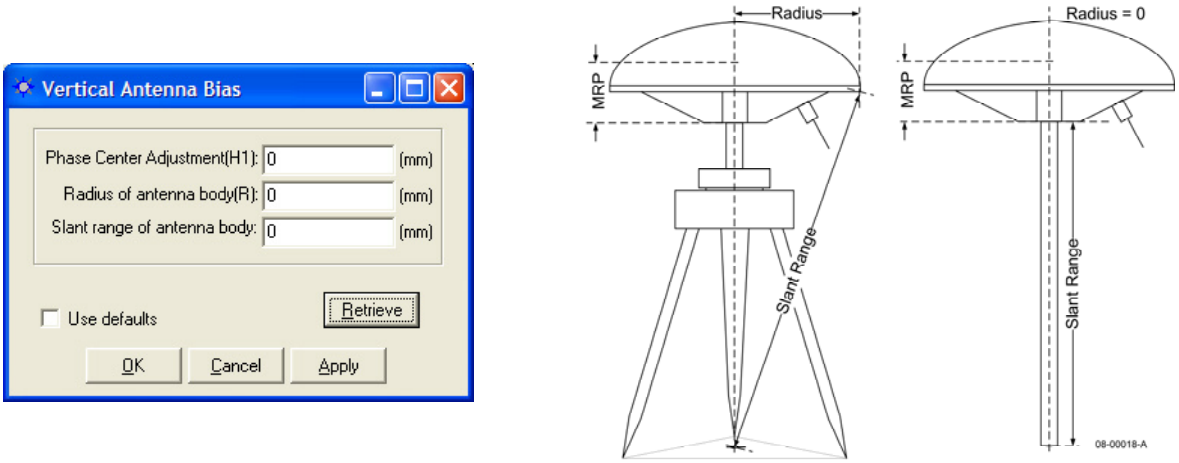


Figure 21: Vertical Antenna Bias

To access the *Vertical Antenna Bias* window from the main StarUtil window, click the icon or select *Receiver* > *Setup* > *Vertical Antenna Bias*.

✓ *Use Antenna Bias:* Click the *Yes* or *No* button to determine if the values set in the *Vertical Antenna Bias* window are applied to measurements.

✓ *Use SET Corrections*: Click the *Yes* or *No* button to determine if Solid Earth Tide (SET) corrections are applied to measurements.

Requirements for output of SET corrections:

- Message 0x49, W6 B6 set to *Apply Correction*
- *NCT SET* scheduled for output in the NMEA Messages window (see Figure 22)
- A license for the StarFire™ subscription service. The option, *RTG input,* must be set to *Use* on the *Rover / Tracking & Navigation Setup* window.
- Valid Navigation
- Valid SET correctors (A minimum of 1 run of the SET algorithm. These are an integral part of StarFire™ corrections.)

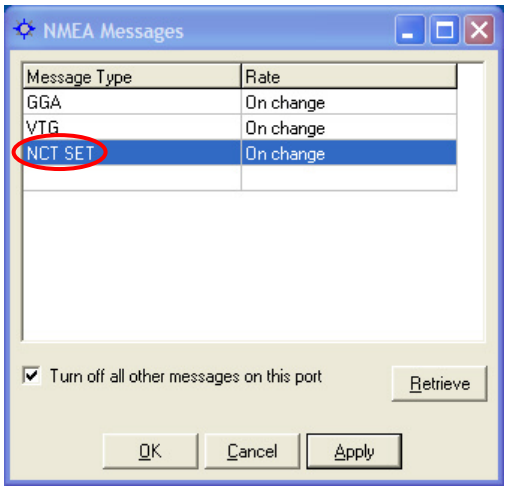


Figure 22: NCT SET

If the criteria above are met, the receiver applies the SET corrections to the position solution. The B1 Solution tab displays SET North, East, and Up corrections in millimeters (see Figure 19, lower left corner).

SET refers to Solid Earth Tides. Positions with SET provide better vertical (primarily) and horizontal positioning accuracy, to account for gravitational effects placed on terrain from celestial bodies (i.e. the Sun, Moon, etc.).

The SET message output via the NMEA port is a NavCom proprietary NMEA type message. It conforms to the header, checksum, and electrical characteristics of a standard NMEA string, but is not recognized by the NMEA governing body as an

officially sanctioned message. Refer to *Appendix A*, Table 12 for a detailed description of the NMEA Type message structure.

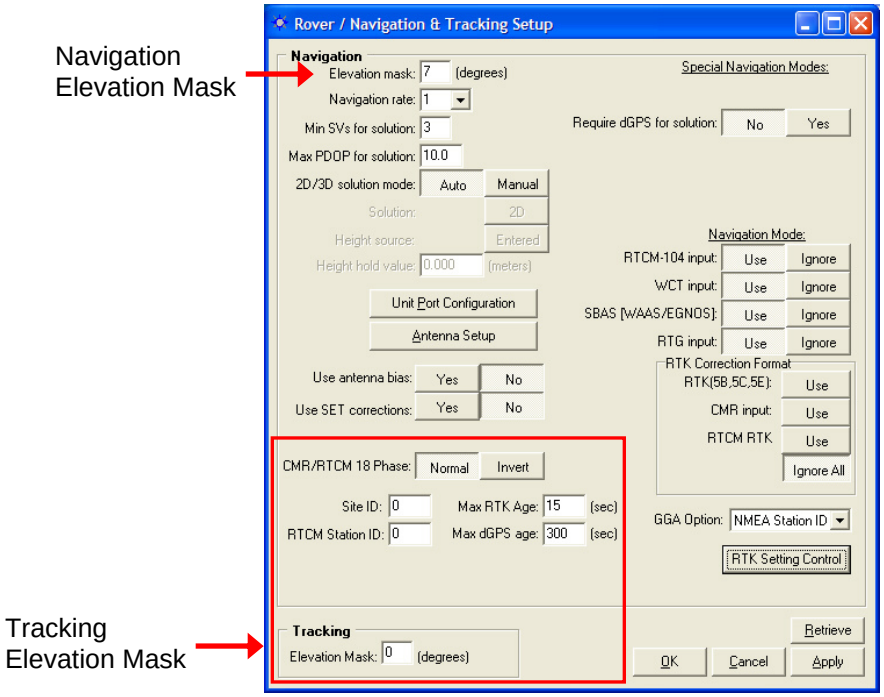


Figure 23: Rover / Navigation & Tracking Setup Window

Refer to Figure 23 for the options below:

- ✓ *CMR/RTCM 18 Phase:* The default is *Normal*. In a small number of instances, there is a requirement to receive the RTCM phase corrections in an "inverted" state. Click the *Invert* button. StarUtil will correct the sign of the corrections automatically so they may be applied without prejudice.
- ✓ *Site ID:* The default 0 configures the rover to accept RTK corrections from any base station. Enter a specific Site ID to accept RTK corrections only from the base station with the same Site ID. The default Site ID on the *Base Configuration* window is 3 (see Figure 12).
- ✓ *RTCM Station ID:* The default 0 configures the rover to accept corrections from any RTCM Station. Enter a specific RTCM Station ID to accept corrections only from that RTCM Station.
- ✓ *Max RTK Age:* Enter the maximum amount of time in seconds the received correction will be used in case of an outage or drop in the reception of corrections. The time must be within the max RTK age limit, which is 60 seconds. The default is 15 seconds. If the age is less than the rate of corrections received, the rover will not enter RTK mode.
- ✓ *Max dGPS Age:* Enter the maximum amount of time in seconds the received correction will be used in case of an outage or drop in the reception of corrections. The time must be within the max dGPS age limit, which is 1200 seconds. The default is 300 seconds.

Tracking

- ✓ *Elevation Mask:* Enter a value to set the elevation angle at which the receiver will start tracking satellites. The default is 0. The valid range is between 0 and 90 degrees, but a value higher than 10 is not recommended. The GPS data from the tracked satellites is *not* added to the navigation solution. In contrast, the Navigation/Elevation Mask setting sets the

elevation angle at which the receiver will start processing GPS data to be added to the navigation solution.

Special Navigation Modes

✓ *Require dGPS for Solution:* The default is *No* which indicates that all computed position solutions are output whether differentially corrected or not. Click the *Yes* button to require only dGPS for solution.

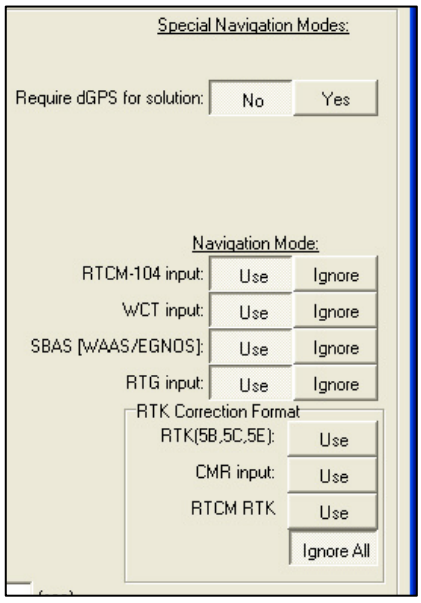


Figure 24: Navigation Modes

Navigation Mode

✓ *RTCM-104 Input, WCT Input, SBAS [WAAS/EGNOS/MSAS/GAGAN]*, and *RTG Input*: The default for all the navigation modes is *Use.*

- Access to *RTG input* is available only by purchase of a license for the StarFire™ subscription service. Refer to *Chapter 6 StarFire™ Operation*.
- *WCT input* is not applicable as of January 2008.
- Click the *Ignore* button to disable a navigation mode.
- Click the *Ignore* button for *all* the navigation modes to operate in non-differential mode.

StarUtil provides the option to manually enter two L1 SBAS satellite Prns from which to receive corrections. Refer to the section below, *WAAS Prn Selection*, for details.

RTK Correction Format:

✓ *RTK (5B, 5C, 5E)*, *CMR Input*, and *RTCM RTK:* The default is *Ignore All.*

- Click the *Use* button to apply a RTK correction format to the navigation solution.

RTK (5B, 5C, 5E) is the setting for the NavCom propriety RTK and UltraRTK™ formats. Refer to the *Technical Reference Manual* for details on messages 5B, 5C, and 5E (see *Related Documents* in the fore-matter).

CMR Input enables the input of CMR or CMR+ corrections.

GGA Option

✓ *GGA Option:* Determine how a GGA message is output:

- *NMEA Station ID:* Accept this default option to output a GGA message that strictly conforms to the NMEA Standard v3.01.
- *NCT Station ID:* Select this option to populate the *Differential Reference Station ID* field with values that indicate which StarFire™ satellite is being tracked (1st digit) and the navigation mode (2nd digit). See Appendix B for the NCT Station ID matrix.

The differential reference station is field 14 in the NMEA GGA message.

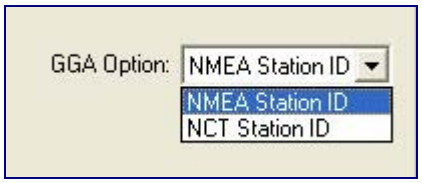


Figure 25: GGA Option

RTK Setting Control Button (StarUtil-2100 only)

✓ Click the *RTK Setting Control* button to apply a variety of RTK settings to message 0x53. The *53 – RTK Settings* window opens (see Figure 27). Message 0x53 is described in detail in the *Technical Reference Manual*.

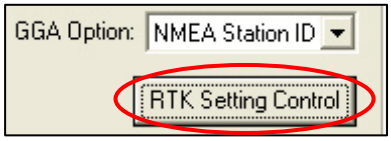


Figure 26: RTK Setting Control Button

To open the window from the menu bar, select *Receiver* > *Setup* > *RTK* > *RTK Settings*.

When re-configuring the receiver, check the *53 – RTK Settings* window for settings that may need to be changed.

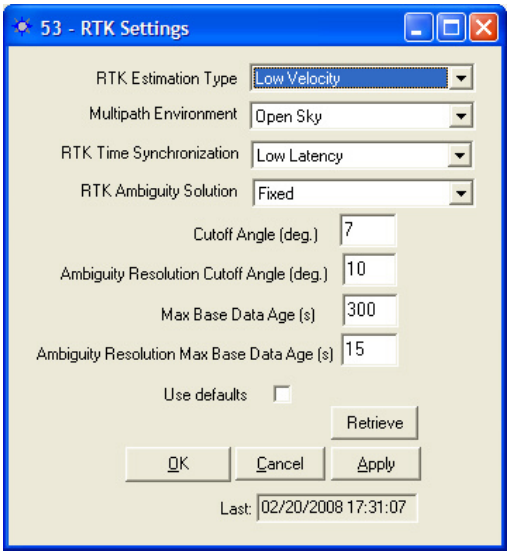


Figure 27: 53 – RTK Settings Window

After making one or more settings, click the *Apply* button and then click the *Retrieve* button to confirm that the receiver accepts the setting(s).

Refer to Figure 27 for the options below:

- ✓ *RTK Estimation Type:* Select the type of position smoothing for the required application:
  - *Static:* Not moving
  - *Stationary:* Very low velocity; e.g., walking speed
  - *Low Velocity:* Slow moving vehicle; e.g., agriculture or road construction vehicle
  - *High Velocity:* Faster moving vehicle; e.g., car or aircraft
- ✓ *Multipath Environment:* Select the tolerance for tracking and acquisition.
- ✓ *RTK Time Synchronization:*
  - *Low Latency:* Data is output as quickly as it is calculated.
  - *Time Synchronized:* Data is output at periodic intervals.
- ✓ *RTK Ambiguity Solution:*
  - Fixed: Phase and code RTK Ambiguity Solution
  - Float: Code RTK Ambiguity Solution only
- ✓ *Cutoff Angle (deg.*): The cutoff angle in degrees for measurements. The default 7 degrees is recommended. Never enter a cutoff angle higher than 15 degrees.
- ✓ *Ambiguity Resolution Cutoff Angle (deg.*): The cutoff angle in degrees for ambiguity search. The default 10 degrees is recommended.
- ✓ *Max Base Data Age (s):* The RTK maximum age to use base station correction. The valid range is 0 – 1200 seconds. The default is 300 seconds.
- ✓ *Ambiguity Resolution Max Base Data Age (s):* The maximum base station data age for ambiguity resolution search or for fixed ambiguities. The valid range is 0 – 120 seconds. The default is 15 seconds.
- ✓ *Use Defaults:* Click the check box to use the default settings.

Verify Reception of RTK Corrections

Refer to these sections in *Chapter 5 RTK Configuration* for instructions to verify that the rover is receiving RTK corrections from the base station:

- ✓ *Verify Reception of NCT RTK Corrections*
- ✓ *Verify Reception of RTCM RTK Corrections*
- ✓ *Verify Reception of CMR RTK Corrections*

WAAS Prn Selection

The *WAAS Prn Selection* window enables the user to manually configure the receiver to receive corrections from one or two L1 SBAS satellites.

The *WAAS Prn Selection* window is functional for all SBAS systems that comply with the RTCA/DO-229D standard: WAAS, EGNOS, MSAS, and GAGAN. Refer to *Related Standards* in the fore-matter.

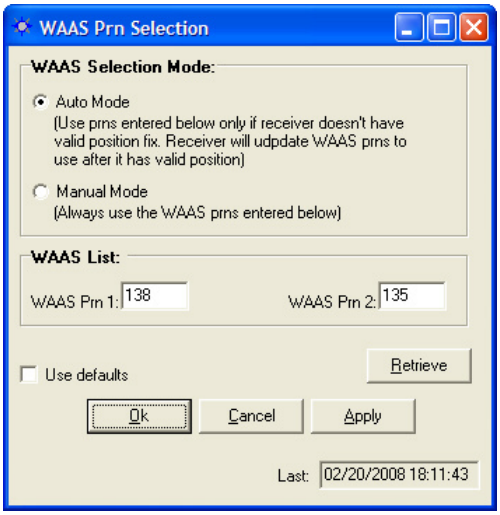


Figure 28: WAAS Prn Selection Window

- ✓ Select *Receiver > Setup > Select WAAS Prns*. The *WAAS Prn Selection* window opens (see Figure 28).
- ✓ Enter one or two L1 SBAS satellite Prns.
- ✓ Determine the use of the Prns:
  - *Manual Mode:* Always use the entered prns.
  - *Auto Mode:* Use the prns if the receiver doesn't have a valid position fix. The receiver will update the SBAS prns to use after it has a valid position.

Chapter 5 ..... RTK Configuration

This chapter provides step-by-step procedures to set up a base station to transmit and a rover to receive RTK corrections via internal or external radios:

- ✓ NCT RTK or UltraRTK™
- ✓ RTCM
- ✓ CMR / CMR+

Refer to *Chapter 3 Base Configuration Window Options* for a reference of base station controls. Refer to *Chapter 4 Rover / Navigation & Tracking Setup Window Options* for a reference of rover controls.

Ambiguity Resolution

Ambiguity resolution, or the ability to enter RTK navigation mode, requires:

- ✓ Four or more satellites, with good geometry, above the Navigation Elevation Mask
  - Good satellite geometry means the satellites should fall, one each, in each of four quadrants.
  - Satellite geometry is characterized by the PDOP value. The closer the value is to 0, the better the satellite geometry. The default maximum PDOP value is 10.

Hardware Setup

The hardware can be setup in any number of combinations. For receiver systems which do not incorporate an internal radio modem, the setup within the receiver is the same regardless of the DGPS correction physical interface (external radio modem, packet data cell phone/modem, Iridium satellite modem, Bluetooth, or null-modem cable). The internal radio option is available on the RT-3010 & RT-3020 models only.

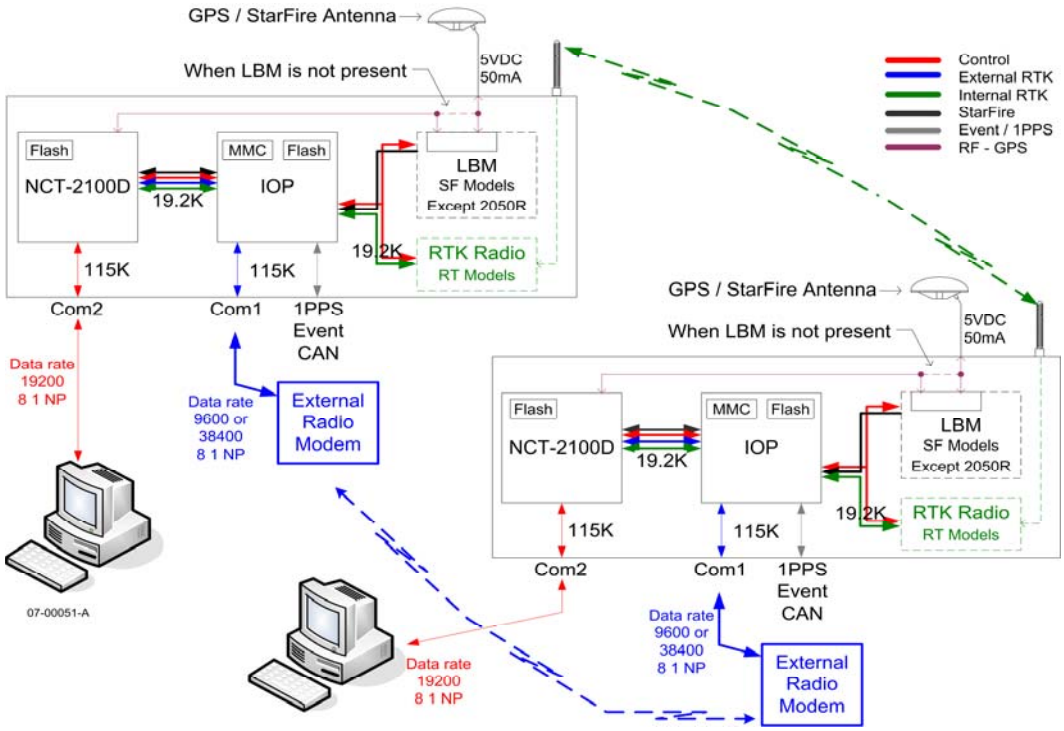


Figure 29: Traditional Radio Modem Hardware Interface

Table 2: Typical Radio Modem Interface

Manufacturer	Baud	Band (MHz)	Bits	Stop Bits	Parity
Satel	9600	450 / 900	8	1	None
Microhard	9600	2,400	8	1	None
Freewave	9600	900 / 2,400	8	1	None
Pacific Crest	38400	450 / 900	8	1	None

External Radio Setup

Connect and setup the radio modem or other DGPS correction medium per the manufacturer's instructions.

- ✓ Set the RTK correction data link at both ends to the same data rates (i.e. 9600 bps default, or 38400bps; 4800 bps minimum, slow data rates may increase correction latency), 8 bit, 1 stop bit, no parity.
- ✓ Set the radio modems to the same frequency or frequency pair (depending on type of radio modem)
- ✓ Verify addressing (if used) and error correction modes are properly set in the radio modem
- ✓ Verify Master / Slave settings (if used) are set correctly (the base station is set to Master)
- ✓ Verify frequency hopping plan (if used) is set correctly on both radios.
- ✓ Verify the transmit power (base), receive sensitivity (if adjustable), and antenna connection are correct
- ✓ Connect the radio modem to Com1 (Port 1 or Port A) on the GPS receiver

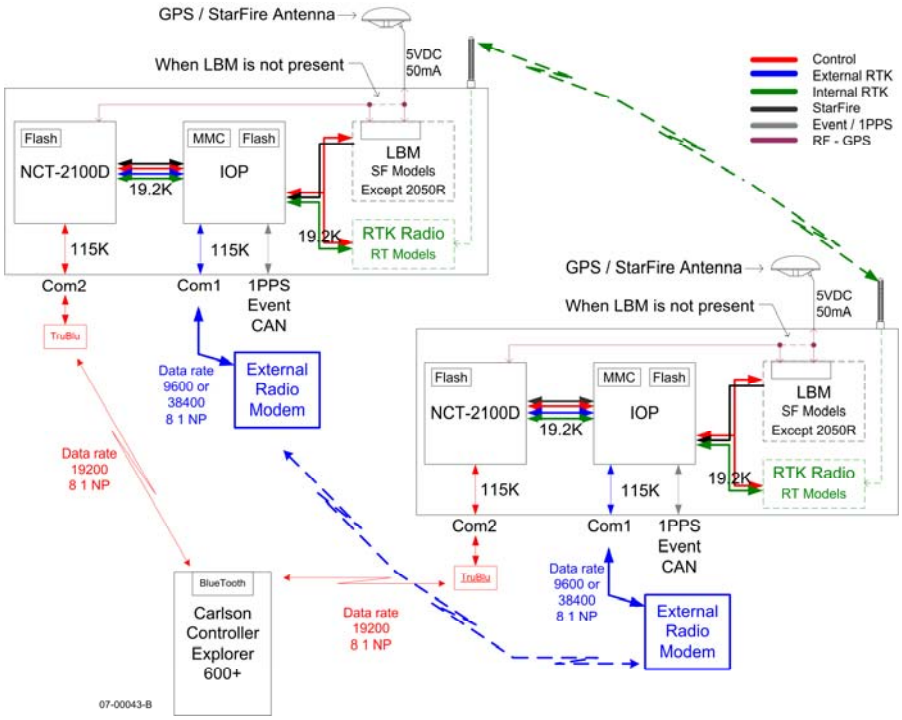


Figure 30: Example of a TruBlu & Bluetooth Controller Interface

NCT RTK Configuration

This section provides steps to configure a base station and rover to use NCT RTK or UltraRTK™ corrections:

- ✓ Establish communications between the radio modem and the base GPS receiver via the *Unit Port Configuration* window
- ✓ Set up Proprietary RTK or UltraRTK™, RTK Base Controls, and establish the base station position via the *Base Configuration* window.
- ✓ Establish communications between the radio modem and the rover GPS receiver via the *Unit Port Configuration* window
- ✓ Set up various navigation and RTK settings for the rover via the *Rover / Navigation & Tracking Setup* window.

If an internal radio is used, perform the procedures below and also in the section, *Configure Internal Radio*. The Internal radio option is available on the RT-3010 & RT-3020 models only.

Base Port Configuration

Refer to Figure 31 for the steps below:

1. Click the  icon on the toolbar to set the communications between the radio modem and the GPS receiver. The *Unit Port Configuration* window opens.

To open the window from the menu bar, select *Receiver* > *Setup* > *Ports*.

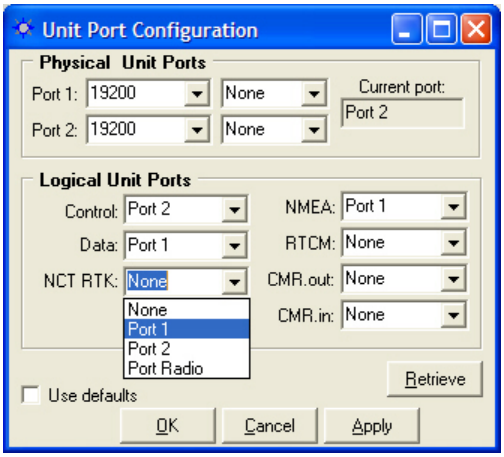


Figure 31: Base – NCT RTK Port Configuration

2. Set the baud rate, as appropriate, for Port 1 (19200 default). Do *not* change the default parity (*None*).
3. Set the *NCT RTK* logical port to *Port 1* (equivalent to Com1).

Models RT-3010 & RT-3020 only (with internal radio): Set the *NCT RTK* logical port to *Port Radio*.

4. Click the *Apply* button and then click the *Retrieve* button to confirm that the receiver accepts the settings.
5. Click the *OK* button to exit the window.

Base Configuration

6. Click the BASE icon on the toolbar to configure the base station. The *Base Configuration* window opens (see Figure 32).

To open the window from the menu bar, select *Receiver* > *Setup* > *Base.*

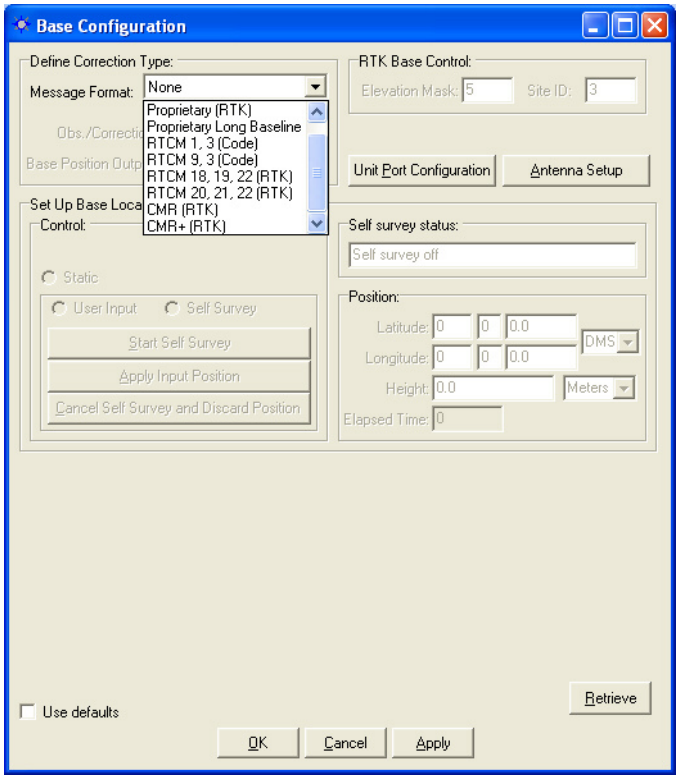


Figure 32: Base Configuration Window

Define Correction Type

Refer to Figure 32 for the steps below:

7. Depending on application requirements, select from the *Message Format* drop-down list:
   - *Proprietary (RTK):* for surveys under 10km

     or
   - *Proprietary Long Baseline* (UltraRTK™)*:* for surveys from 10km to 40km

UltraRTK™ is only available for and compatible with the NCT-2100D family of products.

8. Do *not* change the defaults for:
   - *Obs./Correction Rate:* every 1 second (the optimum rate)
   - *Base Position Output Rate:* every 10 seconds (the optimum rate)

The option, *Obs./Correction Rate*, applies to message 0x5B for *Proprietary (RTK)* or message 0x5E for *Proprietary Long Baseline (UltraRTK™).* In either configuration, the option, *Base Position Output Rate*, applies to message 0x5C. Refer to the *Technical Reference Manual* for message details (see *Related Documents* in the fore-matter).

RTK Base Control, Unit Port Configuration, And Antenna Setup

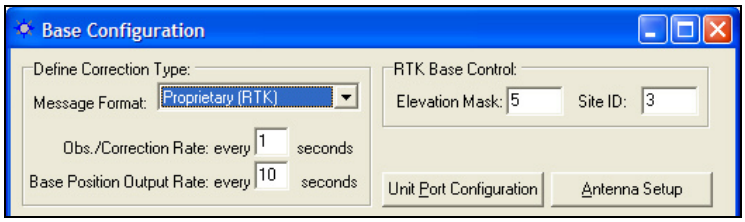


Figure 33: RTK Base Control

Refer to Figure 33 for the steps below:

9. Set the options if desired:

   - *Elevation Mask:* Enter the cutoff vertical angle above the horizon. For any satellites below this angle, no data will be transmitted to the rover for use in calculating positions.

   The default recommended setting for the base receiver is 5 degrees; however, the height of on-site obstructions will dictate this setting. Collecting poor data (i.e. through trees) at the base will degrade the performance of the rover.

   - *Site ID:* Accept the default base Site ID (3) or enter an ID to isolate the base and rover radios, if desired. The rover radio must be set to the identical ID. This avoids cross talk between the rover radio and any other base radio in the area that may be set to the same frequency. For multiple base stations, use a different site ID for each one. The valid range for a site ID is 0 to 1023. If the rover Site ID is 0 (the default), the rover accepts RTK corrections from any base station (see Figure 47).

   Models RT-3010 & RT-3020 only (with internal radio): StarUtil provides a Network ID option (see Figure 70). In addition to the RTK Site ID above, this provides a second method of differentiating multiple available networks.

   Depending on configuration, these options on the *Rover / Navigation & Tracking Setup* window may affect base station operation: *Min SV's For Solution*, *Max PDOP For Solution*, *Max RTK Age*, and *Tracking\Elevation Mask*. Refer to the section, *Various Controls That Affect Base Station Operation*, in *Chapter 3* for details.

10. Click the *Antenna Setup* button, if desired, to set the appropriate bias adjustment values for the antenna model in use (optional). The *Vertical Antenna Bias* window opens (see Figure 13)

Set Up Base Location

11. Enter the position of the base station, manually via *User Input* (the default) or automatically via *Self Survey*:

    - *User Input (the default):* Manually enter the known surveyed truth position in the *Position* section of the window (see Figure 34). Click the *Apply Input Position* button to save the position in NVRAM.

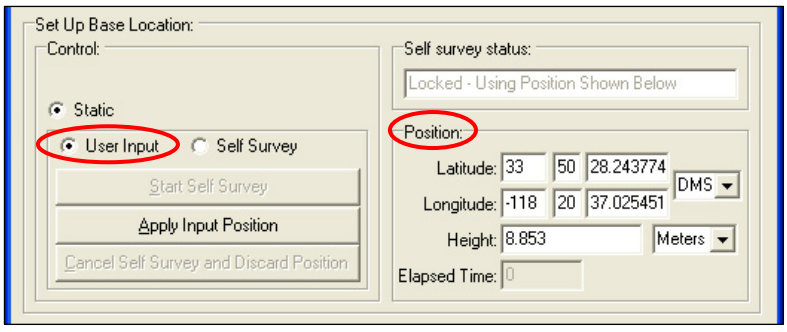


Figure 34: Base Location – User Input

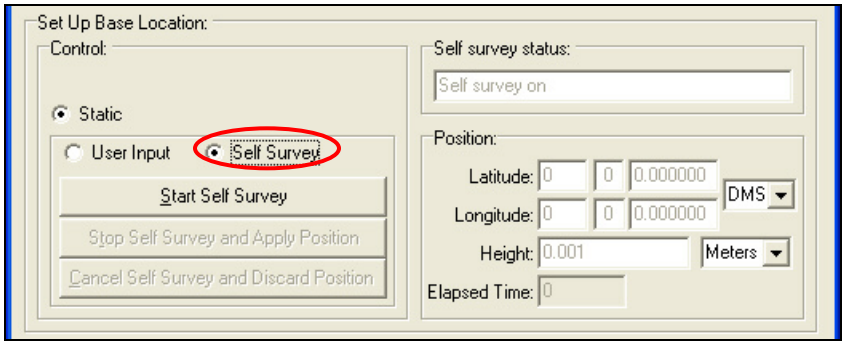


Figure 35: Base Location –Self Survey

Refer to Figure 35 for the options below:

- *Self Survey:*
  - Click the radio button next to *Self Survey*.
  - Click the *Start Self Survey* button to obtain a position from the received GPS signals.

The time of survey varies and average position is used. For best results, allow the receiver to run several hours (minimum of 10 minutes). Errors in the base position will apply an equal bias error in the rover position.

  - Click the *Stop Self Survey and Apply Position* button to save the position in NVRAM.

This sends the 0x51 message to the receiver, which contains only the averaged base antenna location parameters.

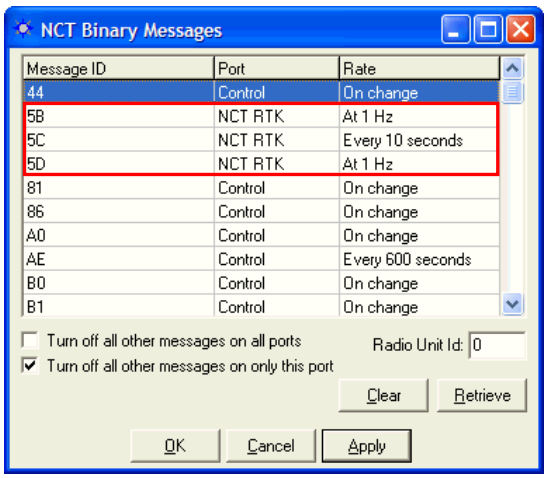
12. Click the *Apply* button at the bottom of the window. Then click the *OK* button to exit.

This sends the 0x50 message, and as appropriate, messages 0x56, 0x5A, and/or 0x5C to the base. The base is configured to send RTK corrections to the rover.

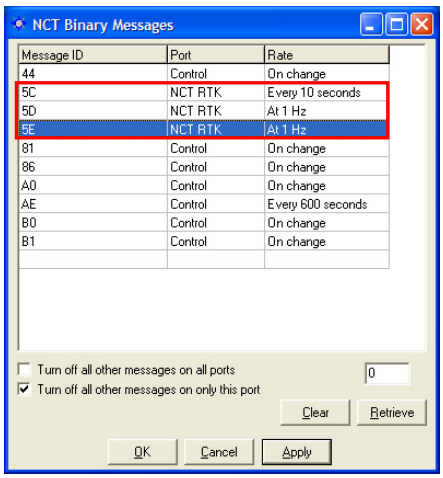
13. Go to the next section to verify that the base is correctly configured.

Verify Base Configuration

14. Select *Receiver > Messages > NCT output* from the menu bar. The *NCT Binary Messages* window opens (see Figure 36).



Proprietary RTK



Proprietary Long Baseline (UltraRTK™)

Figure 36: NCT RTK Scheduled Messages

Refer to Figure 36 for the steps below:

15. Verify that these messages are scheduled (the default configuration):
    - *Proprietary RTK:* 5B At 1 Hz, 5C Every 10 seconds, and for StarFire™ enabled receivers only, 5D At 1 Hz
    - *Proprietary Long Baseline (UltraRTK™):* 5C Every 10 seconds, 5E At 1 Hz, and for StarFire™ enabled receivers only, 5D At 1 Hz
16. Perform one of these steps:
    - If the appropriate RTK messages are scheduled in the *NCT Binary Messages* window, base configuration is successful. Go to the next step.
    - If the appropriate RTK messages are not scheduled in the *NCT Binary Messages* window, click the *Apply* button and then the *Retrieve* button. If the window still does not display the messages, base configuration is unsuccessful:
        - Check the Naks tab to see if the receiver rejected the configuration (see Figure 37).

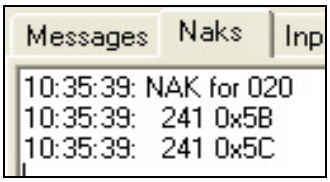


Figure 37: Naks Tab – Unsuccessful Base Configuration

        - Verify that the RTK license is active. Select *View > 30 – Software Options*. The message tab opens. Click the Retrieve button to view the current output data. The RTK license is active if the value for both RTK Base and RTK Rover is True (see Figure 38).

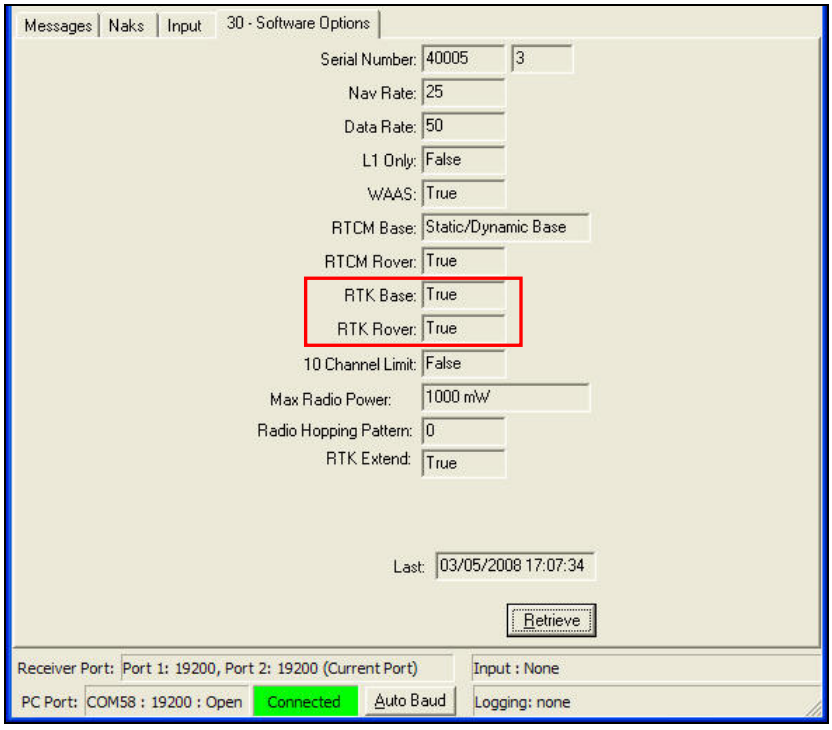


Figure 38: Message 30 – Software Options Tab: RTK License Active

17. To view the output data of messages 5B, 5C, and 5D to verify the reception of corrections, schedule a second instance of the messages output to the *Control* port (see Figure 39):

    - Click on an empty line in the *NCT Binary Messages* window.
    - Right click in the *Message ID* column on the empty line. A pop-up menu opens.
    - Select message 5B, 5C, or 5D from the menu. The message is scheduled by default to the *Control Port* at the rate of *On Change*.
    - Repeat the steps above to schedule a second instance of each message.
    - Click the *Apply* button and then the *Retrieve* button to confirm the settings.

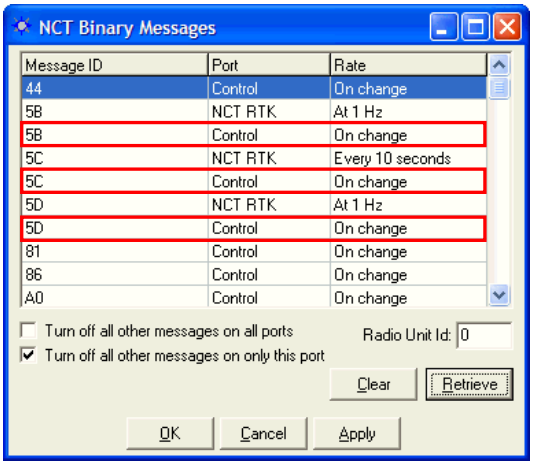


Figure 39: Second Instances of Messages

    - To view message output data, click *View* from the menu bar and select:
        - *5B – RTK Corrections* (see Figure 50)
        - *5C – Base Station* (see Figure 51)
        - *5D – RTG RTK Offset Vector* (Figure 53)

The *View* menu does not include message 5E. Schedule a second instance of 5E output to the *Control* port. To view output data for message 5E to verify the reception of corrections, use an external tool.

Refer to Chapter 8 Log Output Data for instructions to log the output data of 5E

to a file for use in a GPS data analysis program. Refer to the *Technical Reference Manual* for details on message 5E (see *Related Documents* in the fore-matter).

Rover Port Configuration

Refer to Figure 40 for the steps below:

18. Click the icon on the toolbar to set the communications between the radio modem and the GPS receiver. The *Unit Port Configuration* window opens.

To open the window from the menu bar, select *Receiver* > *Setup* > *Ports*.

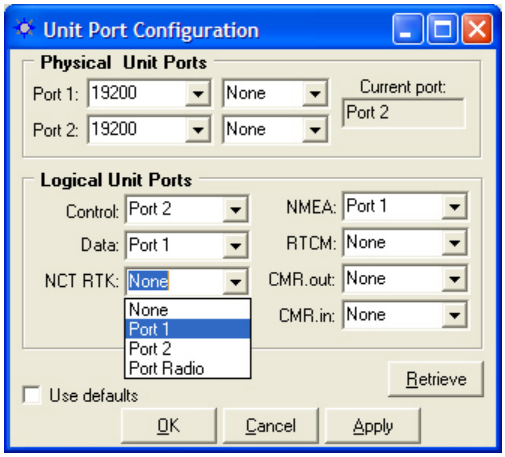


Figure 40: Rover – NCT RTK Port Configuration

19. Set the baud rate, as appropriate, for Port 1 (19200 default). Do *not* change the default parity (*None*).
20. Set the *NCT RTK* logical port to *Port 1* (equivalent to Com1).

Models RT-3010 & RT-3020 only (with internal radio): Set the *NCT RTK* logical port to *Port Radio*.

21. Click the *Apply* button and then click the *Retrieve* button to confirm that the receiver accepts the settings.
22. Click the *OK* button to exit the window.

Rover Configuration

23. Click the ROVER icon on the toolbar to configure the rover. The *Rover / Navigation & Tracking Setup* window opens (see Figure 41).

To open the window from the menu bar, select *Receiver* > *Setup* > *Rover / Tracking and Navigation*.

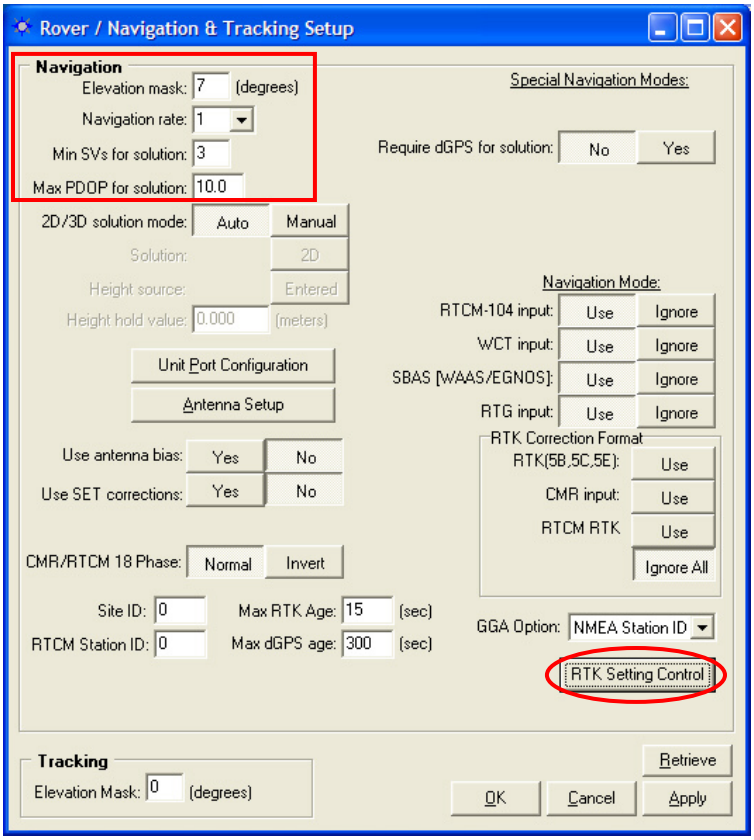


Figure 41: StarUtil-2100 -- Rover / Navigation & Tracking Setup Window

The options on the *Rover / Navigation & Tracking Setup* window are identical in StarUtil-2000 and StarUtil-2100, except for the *RTK Setting Control* button, which is included only in StarUtil-2100.

24. Set the options, as desired (see Figure 41):

- *Navigation/Elevation Mask:* Enter a value between 0 and 90 degrees to set the elevation angle at which the receiver will start processing GPS data from satellites.

The default elevation mask is 7 degrees to prevent position jumps due to frequent satellite re-acquisitions at lower elevation mask angle limits. If it is necessary for the rover to connect to more satellites, its elevation mask can be set as low as the base station. However, the lower setting may result in more noise and less accurate positioning. Be aware that solid obstructions will block a signal, and foliage will attenuate a signal resulting in degraded position quality.

- *Navigation Rate:* The number of navigation solutions per second. The standard rates are 1Hz (default), 2Hz, and 5Hz. Purchased software options are 10Hz and above, with the exception of the VueStar system for which all available rates are standard. The upload of a purchased navigation rate changes the setting in the *Navigation rate* field automatically to the purchased rate. Refer to *Chapter 9 Load Software* for information about the purchase and upload of software options.

The *Navigation Rate* setting in the *Rover / Navigation & Tracking Setup* window sets the output of the NCT Binary message B1 and the NMEA messages GGA, RMC and VTG, provided that those messages are set to *On Change* in the *NCT*

Binary Messages window and the *NMEA Messages* window, respectively (see Figure 42).

For the NCT Binary message B0 only, the rate of *On Change* (the default) is 1Hz regardless of the navigation rate setting. To set the output of B0 at a higher rate to match the output of B1, use the *NCT Binary Messages* window. The rate must be a purchased navigation and raw data rate (refer to message 0x30 in the *Technical Reference Manual*).

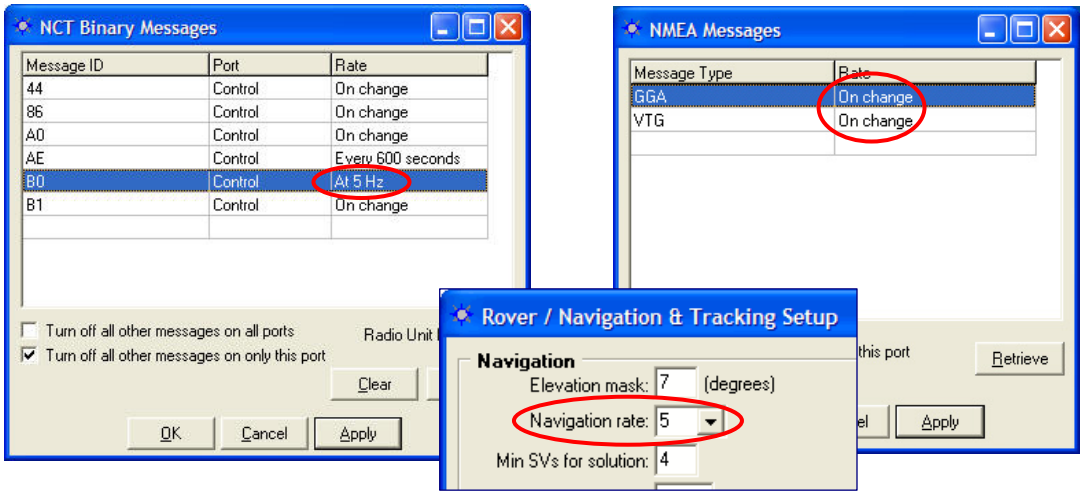


Figure 42: Navigation Rate

When a message is set to *On Change*, the data is output each time new data is available as determined by the *Navigation Rate* setting. For example, if a position is steadfast at N 33°50'20.18592" W 118° 20'35.21218" for three seconds and the *Navigation Rate* is 5Hz, a 0xb1 solution is output 1 time because the position didn't change. If any element of the position changes continuously during the three second period then a 0xb1 solution is output 15 times.

The NMEA messages GGA, RMC, and VTG match the output of the navigation rate up to 10 Hz max when scheduled as *On Change*.

Refer to Figure 41 for these two options:

- *Min SVs for Solution:* The default setting is three satellites. Four satellites are the minimum SVs required for a 3D navigation solution, plus an acceptable PDOP.
- *Max PDOP for solution:* Enter the highest PDOP value according to application requirements. The maximum PDOP value at which the receiver will compute positions is 25.5. An applied value above 25.5 reverts to the default of 10.0.

The quality of GPS data is dependent on the geometry between the receiver and satellites; this includes the number of satellites that can be "seen" by the receiver and the angle between the receiver and satellites as a constellation seen by the receiver. A satellite near the horizon usually provides a lower quality signal because of greater atmospheric interference and the increased likelihood of the signal reflecting from surface features; this is known as "multipath" error. The effect of geometry on GPS quality is measured by PDOP (position dilution of precision). PDOP is the overall measure of the precision obtainable with a given

satellite geometry. For example, a PDOP of 4 or less yields excellent precision, a PDOP between 5 and 7 is acceptable and a PDOP of 7 or more is considered poor.

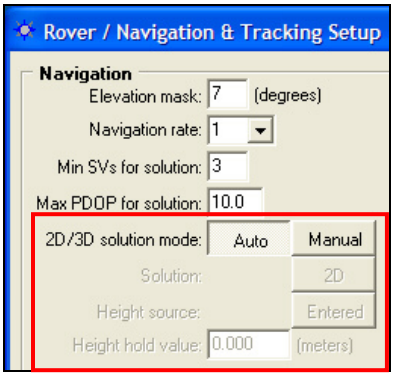


Figure 43: 2D/3D Solution Mode

- *2D/3D Solution Mode:* Click the *Auto* or *Manual* button to determine how height will be applied to a 2D navigation solution (see Figure 43).
  - *Auto*: Sets the receiver to automatically transition between 3D (4 satellite) and 2D (3 satellite) navigation. This can also be determined by DOP values, even if 5 satellites are available. In 2D navigation, the last valid computed height measurement is used.
  - *Manual*: Enter the *Height hold value* to set the receiver to 2D (3 satellite) navigation with the *Height hold value* used for the height measurement. The receiver must compute an initial 3D navigation solution before it transitions to 2D navigation. After 2D navigation is established, the receiver will not transition back to 3D navigation.

Click the  icon in the toolbar to view the current navigation solution and other parameters of message 0xB1. The *3D nav* field indicates if 3D navigation is computed (see Figure 44).

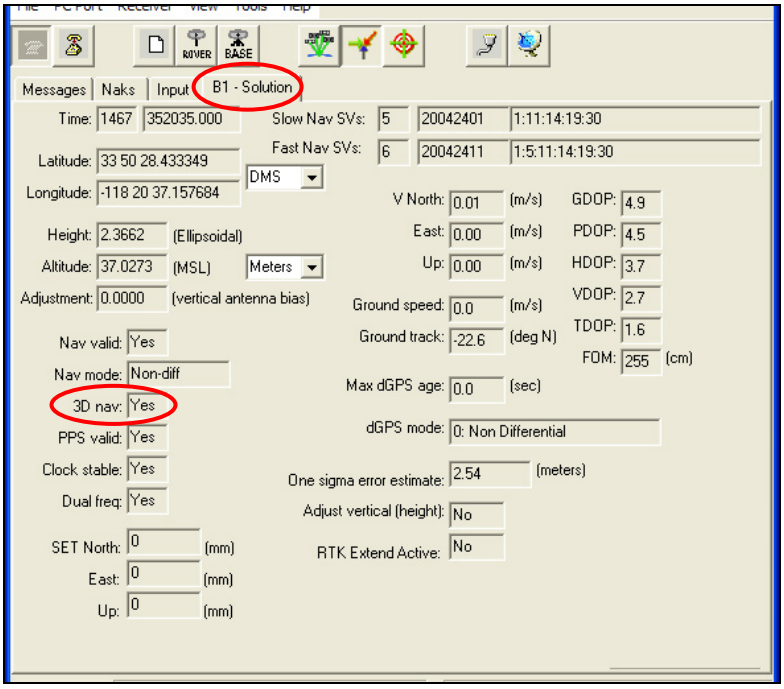


Figure 44: B1 – Solution, 3D nav Field

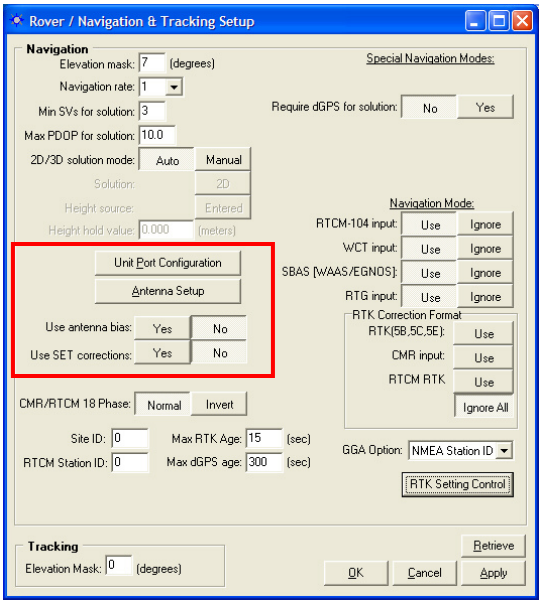


Figure 45: Rover / Navigation & Tracking Setup Window

Refer to Figure 45 for the options below:

- *Unit Port Configuration Button:* This button opens the *Unit Port Configuration* window (see Figure 40).
- *Antenna Setup Button:* Click this button to set the appropriate bias adjustment values for the antenna model in use (optional). The *Vertical Antenna Bias* window opens (see Figure 21):
- *Use Antenna Bias:* Click the *Yes* or *No* button to determine if the values set in the *Vertical Antenna Bias* window are applied to measurements.
- *Use SET Corrections*: Click the *Yes* or *No* button to determine if Solid Earth Tide (SET) corrections are applied to measurements.

Requirements for output of SET corrections:

- Message 0x49, W6 B6 set to *Apply Correction*
- *NCT SET* scheduled for output in the NMEA Messages window (see Figure 46)
- A license for the StarFire™ subscription service. The option, *RTG input,* must be set to *Use* on the *Rover / Tracking & Navigation Setup* window.
- Valid Navigation
- Valid SET correctors (A minimum of 1 run of the SET algorithm. These are an integral part of StarFire™ corrections.)

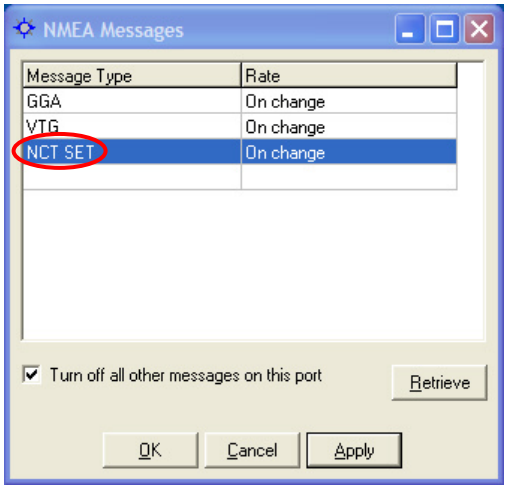


Figure 46: NCT SET

If the criteria above are met, the receiver applies the SET corrections to the position solution. The B1 Solution tab displays SET North, East, and Up corrections in millimeters (see Figure 44).

SET refers to Solid Earth Tides. Positions with SET provide better vertical (primarily) and horizontal positioning accuracy, to account for gravitational effects placed on terrain from celestial bodies (i.e. the Sun, Moon, etc.).

The SET message output via the NMEA port is a NavCom proprietary NMEA type message. It conforms to the header, checksum, and electrical characteristics of a standard NMEA string, but is not recognized by the NMEA governing body as an officially sanctioned message. Refer to *Appendix A*, Table 12 for a detailed description of the NMEA Type message structure.

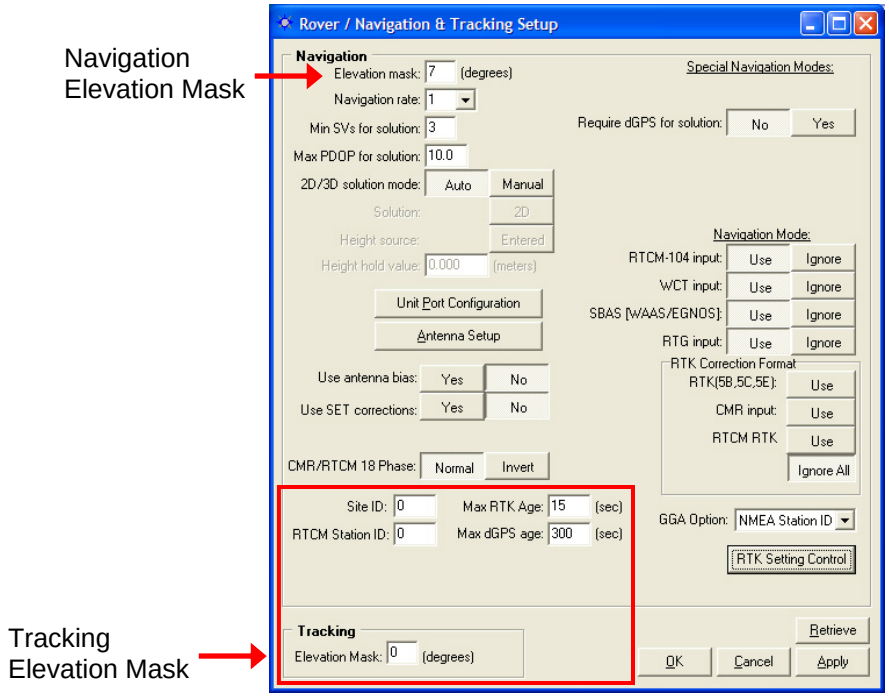


Figure 47: Rover / Navigation & Tracking Setup Window

Refer to Figure 47 for the options below:

- *Site ID:* The default 0 configures the rover to accept RTK corrections from any base station. Enter a specific Site ID to accept RTK corrections only from the base station with the same Site ID. The default Site ID on the *Base Configuration* window is 3 (see Figure 33).
- *Max RTK Age:* Enter the maximum amount of time in seconds the received correction will be used in case of an outage or drop in the reception of corrections. The time must be within the max RTK age limit, which is 60 seconds. The default is 15 seconds. If the age is less than the rate of corrections received, the rover will not enter RTK mode.
- *Max dGPS Age:* Enter the maximum amount of time in seconds the received correction will be used in case of an outage or drop in the reception of corrections. The time must be within the max dGPS age limit, which is 1200 seconds. The default is 300 seconds.
- *Tracking/Elevation Mask:* Enter a value to set the elevation angle at which the receiver will start tracking satellites. The default is 0. The valid range is between 0 and 90 degrees, but a value higher than 10 is not recommended. The GPS data from the tracked satellites is *not* added to the navigation solution. In contrast, the *Navigation/Elevation Mask* setting sets the elevation angle at which the receiver will start processing GPS data to be added to the navigation solution.

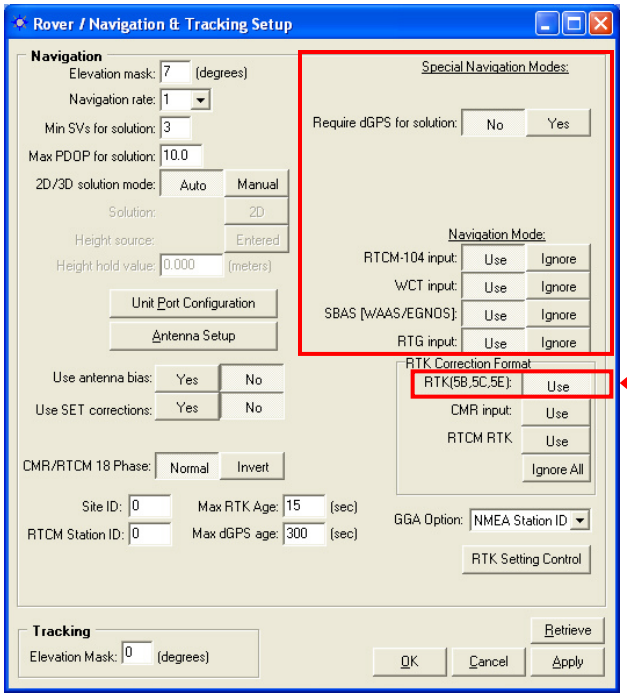


Figure 48: Rover Configuration Options

Refer to Figure 48 for the options below:

- *Require dGPS for Solution:* The default is *No* which indicates that all computed position solutions are output whether differentially corrected or not. Click the *Yes* button to require only dGPS for solution, if desired.
- *Navigation Mode:* Use or ignore *RTCM-104 Input* (code), *SBAS [WAAS/EGNOS]*, and *RTG Input*. The default for all these navigation modes is *Use*. The SBAS setting (RTCA/DO-229D compliant) also applies to MSAS and GAGAN. *WCT input* is not applicable as of January 2008.

Access to *RTG input* is available only by purchase of a license for the StarFire™ subscription service. Refer to *Chapter 6 StarFire™ Operation*.

25. Click the *Use* button to apply *RTK (5B, 5C, 5E)* to the navigation solution as the *RTK Correction Format*.

RTK (5B, 5C, 5E) is the setting for the NavCom propriety RTK and UltraRTK™ formats. Refer to the *Technical Reference Manual* for details on messages 5B, 5C, and 5E (see *Related Documents* in the fore-matter).

26. Click the *Apply* button and then click the *Retrieve* button to confirm that the receiver accepts the settings. If the radio modems are turned on and the link is functional, the rover enters into RTK mode in a few seconds. The rover needs to receive one 5C and a minimum of five 5B (RTK) or 5E (UltraRTK™) messages to enter RTK mode.
27. Go to the next section, *Verify Reception of NCT RTK* Corrections, to confirm that the rover is receiving RTK corrections.

Models RT-3010 & RT-3020 only (with internal radio): Go to the section below, *Configure Internal Radio*, for instructions to setup the communications between the internal radio modem and the GPS receiver. Then perform the steps in the next section, *Verify Reception of NCT RTK* Corrections.

Verify Reception of NCT RTK Corrections

To verify that the rover is receiving RTK corrections from the base station, this section provides steps to schedule copies of messages 5B, 5C, EC, 5E, and 5D from the base, and then view the output data.

Depending on Software version, these messages are scheduled for output on the *Control* port at *On Change* rate:

Software v3.2 and earlier:

- ✓ EC: displays the age of corrections
- ✓ FB: a copy of the 5B message from the base
- ✓ FC: a copy of the 5C message from the base
- ✓ FD: a copy of the 5D message; for RTK Extend™[1] users only
- ✓ FE: a copy of the 5E message from the base. For message 5E only, an external tool is necessary to view the output data.

Software v4.2 and later:

- ✓ EC: displays the age of corrections
- ✓ FE: copies of the 5B and 5C messages from the base. For Software v4.2 and later, copies of messages 5B and 5C cannot be individually scheduled.
- ✓ FD: a copy of the 5D message; for [1]RTK Extend™ users only

Refer to Figure 49 for the steps below:

28. Select *Receiver* > *Messages* > *NCT output*. The *NCT Binary Messages* window opens.
29. Schedule the appropriate messages. For Software v3.2 and earlier, schedule EC, FB (NCT RTK) or FE (UltraRTK™), FC, and FD (RTK Extend™[1]) if applicable. For Software v4.2 and later, schedule EC, FE, and FD if applicable.
    - Click on an empty line in the *NCT Binary Messages* window.
    - Right click in the *Message ID* column on the empty line. A pop-up menu opens.
    - Select *Other* from the menu. The cursor displays in the *Message ID* column.
    - Type in “EC”.
    - Press *Enter* on the keyboard. The message is scheduled by default to the *Control Port* at the rate of *On Change*.
    - Repeat the steps above to schedule the additional messages.
    - Click the *Apply* button and then click the *Retrieve* button to confirm that the receiver accepts the settings.

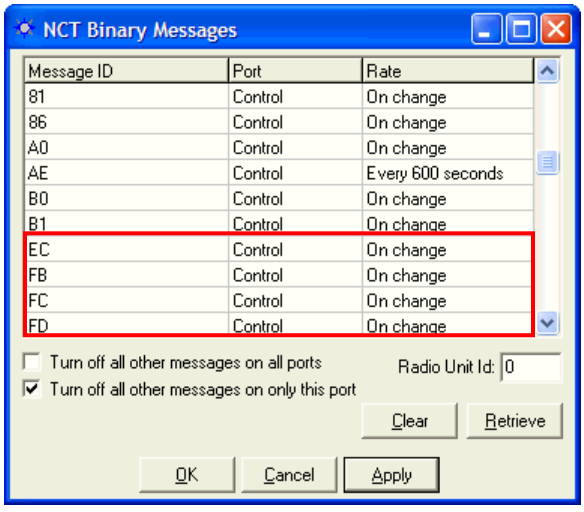


Figure 49: Scheduled Rover Messages

[1]Separate Software Option Required

30. Select *View* from the menu bar to open a menu of message outputs to view.
31. To verify that the rover is set up correctly and is receiving RTK corrections regularly, select from the *View* menu:
    - *5B – RTK Corrections* (see Figure 50)
    - *5C – Base Station* (see Figure 51)

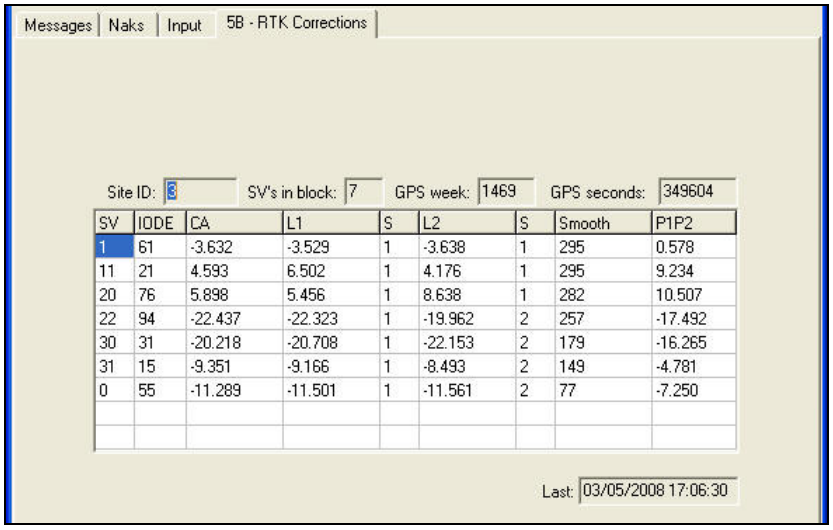


Figure 50: 5B – RTK Corrections

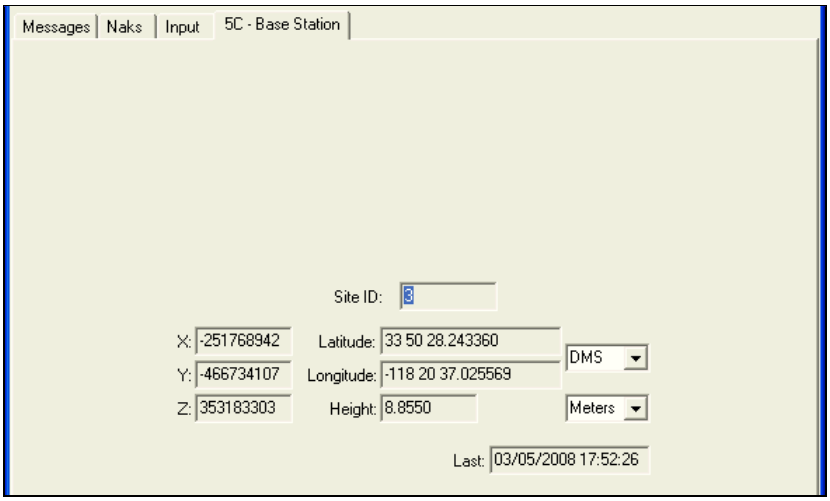
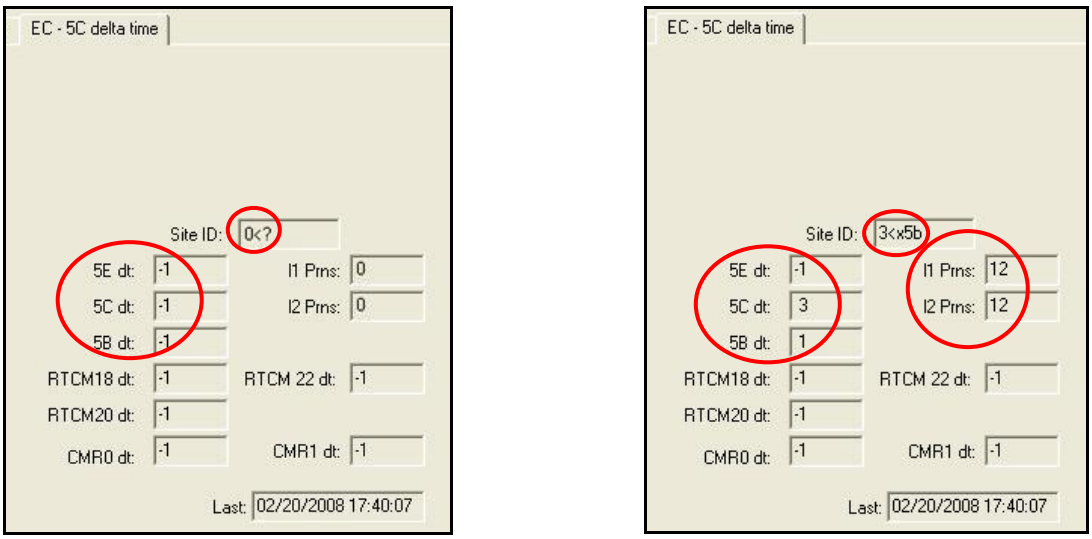


Figure 51: 5C – Base Station



Rover Is Not Receiving NCT RTK Corrections

Rover Is Receiving NCT RTK Corrections (Baseline < 10 km)

Figure 52: NCT RTK – EC – 5C Delta Time

Refer to Figure 52 for the steps below:

32. Select *View > EC – 5C Delta Time* to view the RTK age of corrections.
33. Verify whether or not the rover is receiving RTK corrections from the base station:
    - Indications of the rover not receiving RTK corrections:
        - *Site ID:* 0<
        - *5E dt, 5C dt, 5B dt:* -1
    - Indications of the rover receiving RTK corrections:
        - *Site ID:* the base station Site ID
        - *5C dt, 5B dt:* the counter increments based on the last received corrections (baseline < 10 km)
        - *5E dt:* the counter increments based on the last received corrections (baseline < 40 km)
        - *I1 Prns, I2 Prns:* the number of corrections from satellites L1 & L2

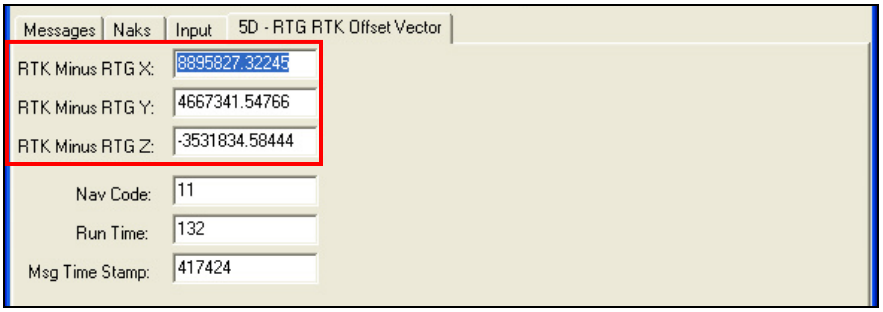


Figure 53: 5D – RTG RTK Offset Vector

Refer to Figure 53 for the steps below:

34. For [1]RTK Extend™ users only, select *View > 5D – RTG RTK Offset Vector*.

35. Verify that the RTG RTK offset vector is received from the base station.

RTCM Configuration

Except for the steps in this section, RTCM configuration is the same as NCT RTK configuration. Perform the steps below to configure a base station to transmit and a rover to receive RTCM corrections. Perform the additional steps in the section above, *NCT RTK Configuration*, to complete the configuration.

Base RTCM Port Configuration

Refer to Figure 54 for the steps below:

1. Click the  icon on the toolbar to set the communications between the radio modem and the GPS receiver. The *Unit Port Configuration* window opens.

To open the window from the menu bar, select *Receiver > Setup > Ports*.

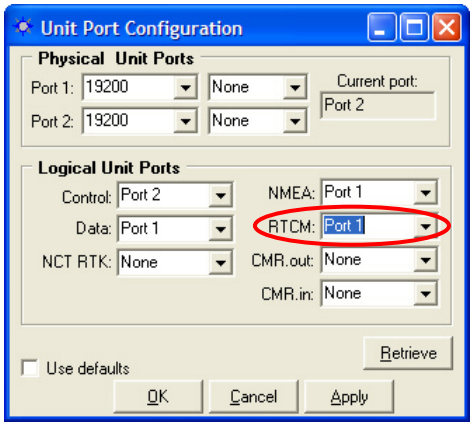


Figure 54: RTCM Port Configuration

2. Set the baud rate, as appropriate, for Port 1 (19200 default). Do *not* change the default parity (*None*).

3. Set the *RTCM* logical port to *Port 1* (equivalent to Com1).

Models RT-3010 & RT-3020 only (internal radio): Set *RTCM* logical port to *Port Radio*.

[1]Separate Software Option Required

4. Click the *Apply* button and then click the *Retrieve* button to confirm that the receiver accepts the settings.
5. Click the *OK* button to exit the window.

Base RTCM Configuration

Refer to Figure 55 for the steps below:

6. Click the BASE icon on the toolbar to configure the base station to transmit RTCM corrections. The *Base Configuration* window opens.

To open the window from the menu bar, select *Receiver* > *Setup* > *Base.*

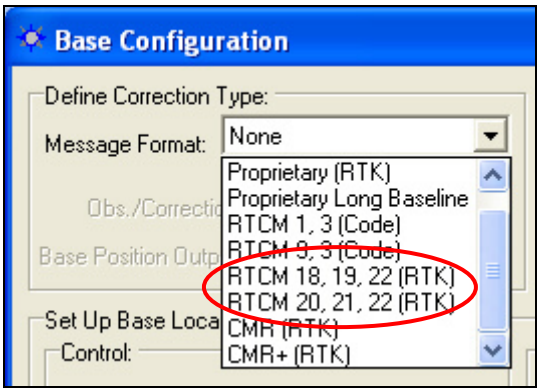


Figure 55: Base Configuration – RTCM Message Format

7. Depending on application requirements, select from the *Message Format* drop-down list:
   - *RTCM 18, 19, 22 (RTK)*

     or
   - *RTCM 20, 21, 22 (RTK)*
8. Do *not* change the defaults for:
   - *Obs./Correction Rate:* every 1 second (the optimum rate)
   - *Base Position Output Rate:* every 10 corrections (the optimum rate)
9. Go to the section above, *NCT RTK Configuration*, to perform the additional steps to complete the base configuration. Then go to the section below, *Rover RTCM Port Configuration*, to configure the rover.

Rover RTCM Port Configuration

Refer to Figure 56 for the steps below:

10. Click the  icon on the toolbar to set the communication between the radio modem and the GPS receiver. The *Unit Port Configuration* window opens.

    To open the window from the menu bar, select *Receiver* > *Setup* > *Ports*.

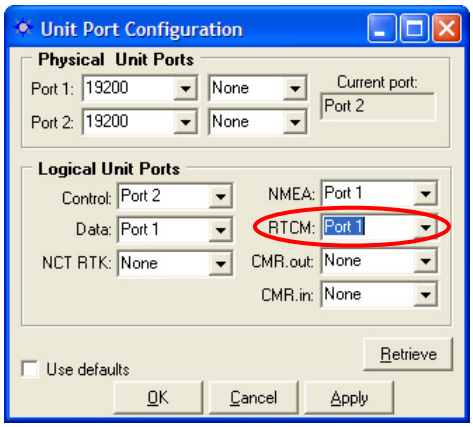


Figure 56: RTCM Port Configuration

11. Set the baud rate, as appropriate, for Port 1 (19200 default). Do *not* change the default parity (*None*).
12. Set the *RTCM* logical port to *Port 1* (equivalent to Com1).

    Models RT-3010 & RT-3020 only (with internal radio): Set the *RTCM* logical port to *Port Radio*.

13. Click the *Apply* button and then click the *Retrieve* button to confirm that the receiver accepts the settings.
14. Click the *OK* button to exit the window.

Rover RTCM Configuration

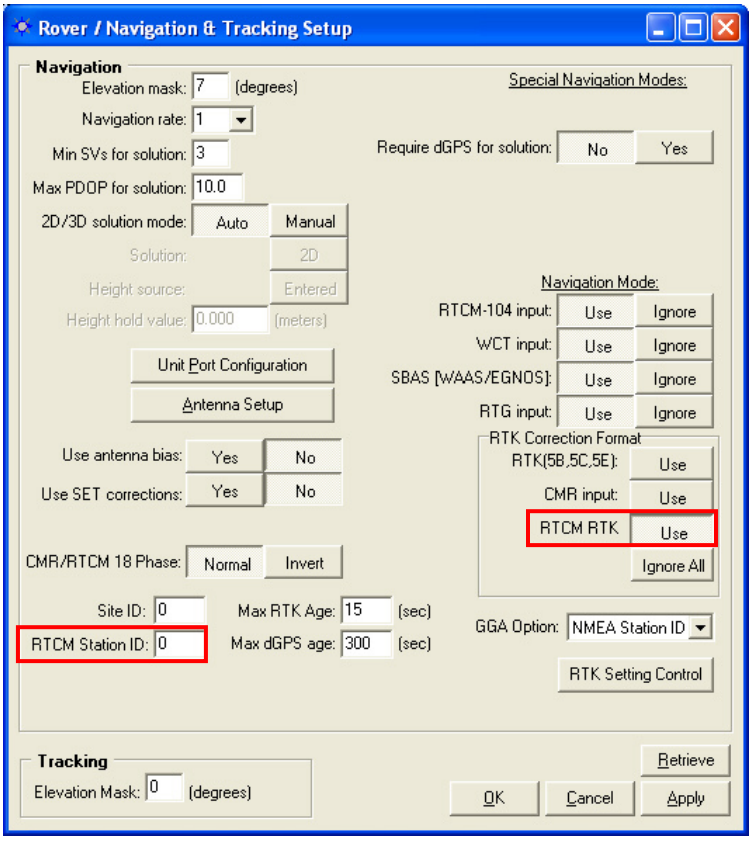


Figure 57: Rover RTCM Configuration

Refer to Figure 57 for the steps below:

15. Click the ROVER icon on the toolbar to configure the rover. The *Rover / Navigation & Tracking Setup* window opens.

    To open the window from the menu bar, select *Receiver* > *Setup* > *Rover / Tracking and Navigation*.

16. Click the *Use* button to apply *RTCM RTK* to the navigation solution.
17. Enter a specific *RTCM Station ID*, if desired, to accept corrections only from the RTCM Station with the same Site ID. The default 0 configures the receiver to accept corrections from any RTCM Station.
18. Go to the section above, *NCT RTK Configuration/Rover Configuration*, to perform the additional steps to complete the rover configuration. Then go to the section below, *Verify Reception of RTCM RTK Corrections*, to verify that the rover is receiving RTCM RTK corrections.

Verify Reception of RTCM RTK Corrections

To verify that the rover is receiving RTK corrections from the base station, this section provides steps to schedule and then view message EC. EC displays the RTK age of corrections. This message is scheduled for output on the *Control* port at *On Change* rate.

To view additional parameters to verify the reception of RTCM RTK corrections, use an external tool.

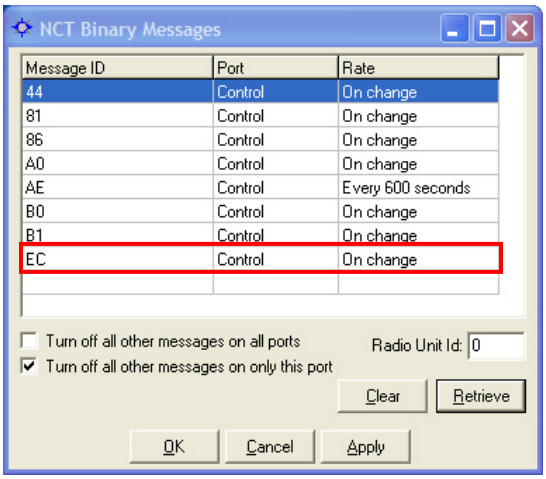
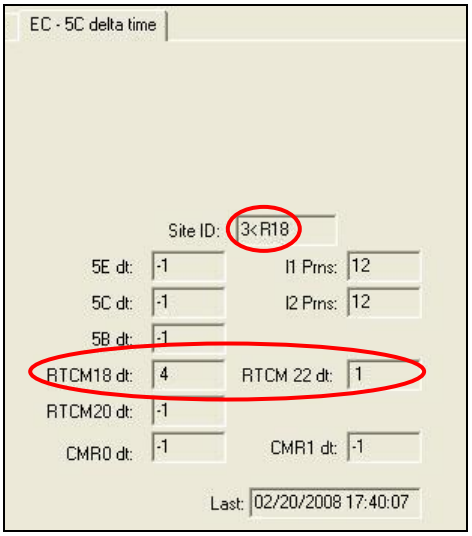


Figure 58: Message EC Scheduled

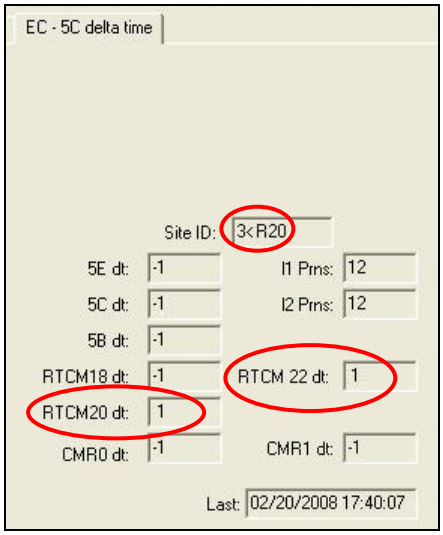
Refer to Figure 58 for the steps below:

19. Select *Receiver > Messages > NCT output* from the menu bar. The *NCT Binary Messages* window opens.
20. Schedule message EC, and for [1]RTK Extend™ users, FD:
    - Click on an empty line in the *NCT Binary Messages* window.
    - Right click in the Message ID column on the empty line. A pop-up menu opens.
    - Select *Other* from the menu. The cursor displays in the Message ID column.
    - Type in “EC”.
    - Press *Enter* on the keyboard. The message is scheduled by default to the *Control Port* at the rate of *On Change*.
    - Repeat the steps above to schedule message FD if necessary.
    - Click the *Apply* button and then click the *Retrieve* button to confirm that the receiver accepts the settings.

[1]Separate Software Option Required



Rover Is Receiving RTCM 18, 19, 22 Corrections



Rover Is Receiving RTCM 20, 21, 22 Corrections

Figure 59: RTCM – EC – 5C Delta Time

Refer to Figure 59 for the steps below:

21. Select *View > EC – 5C Delta Time* to view the RTK age of corrections.
22. Verify whether or not the rover is receiving RTK corrections from the base station:
    - Indications of the rover not receiving RTK corrections:
        - *Site ID:* 0<
        - *RTCM18 dt, RTCM20 dt,* and *RTCM22 dt:* -1
    - Indications of the rover receiving RTCM 18, 19, 22 corrections:
        - *Site ID:* the base station Site ID
        - *RTCM18 dt:* the counter increments based on the last received corrections
        - *RTCM22 dt:* the counter increments based on the last received corrections
        - *I1 Prns, I2 Prns:* the number of corrections from satellites L1 & L2
    - Indications of the rover receiving RTCM 20, 21, 22 corrections:
        - *Site ID:* the base station Site ID
        - *RTCM20 dt:* the counter increments based on the last received corrections
        - *RTCM22 dt:* the counter increments based on the last received corrections
        - *I1 Prns, I2 Prns:* the number of corrections from satellites L1 & L2

CMR Configuration

Except for the steps in this section, CMR configuration is the same as NCT RTK configuration. Perform the steps below to configure a base station to transmit and a rover to receive CMR or CMR+ corrections. Perform the additional steps in the section above, *NCT RTK Configuration*, to complete the configuration.

Base CMR.out Port Configuration

Refer to Figure 60 for the steps below:

1. Click the icon on the toolbar to set the communication between the radio modem and the GPS receiver. The *Unit Port Configuration* window opens.

   To open the window from the menu bar, select *Receiver* > *Setup* > *Ports*.

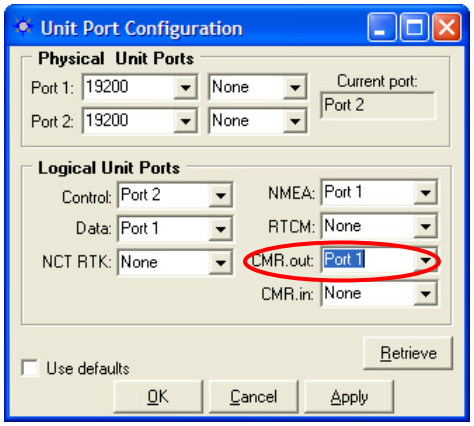


Figure 60: CMR.out Port Configuration

2. Set the baud rate, as appropriate, for Port 1 (19200 default). Do *not* change the default parity (*None*).
3. Set the *CMR.out* logical port to *Port 1* (equivalent to Com1). This setting is for CMR or CMR+ corrections.

   Models RT-3010 & RT-3020 only (with internal radio): Set the *CMR.out* logical port to *Port Radio*.

4. Click the *Apply* button and then click the *Retrieve* button to confirm that the receiver accepts the settings.
5. Click the *OK* button to exit the window.

Base CMR Configuration

Refer to Figure 61 for the steps below:

6. Click the BASE icon on the toolbar to configure the base station to transmit CMR corrections. The *Base Configuration* window opens.

   To open the window from the menu bar, select *Receiver* > *Setup* > *Base.*

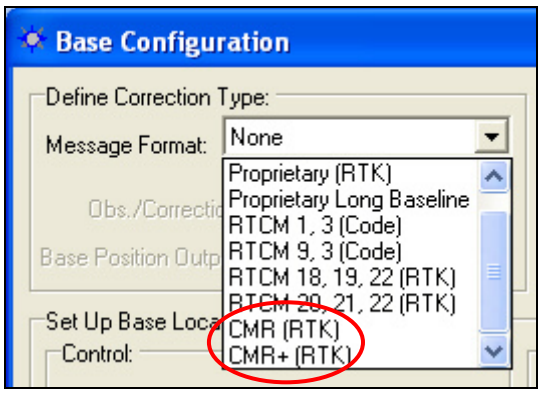


Figure 61: Base Configuration – CMR & CMR+ Message Format

7. Depending on application requirements, select from the *Message Format* drop-down list:
   - *CMR (RTK)*

     or
   - *CMR+ (RTK)*
8. Do *not* change the defaults for:
   - *Obs./Correction Rate:* every 1 second (the optimum rate)
   - *Base Position Output Rate:* every 10 corrections (the optimum rate)
9. Go to the section above, *NCT RTK Configuration*, to perform the additional steps to complete the base configuration. Then go to the section below, *Rover CMR.in Port Configuration*, to configure the rover.

Rover CMR.in Port Configuration

Refer to Figure 62 for the steps below:

10. Click the  icon on the toolbar to set the communication between the radio modem and the GPS receiver. The *Unit Port Configuration* window opens.

To open the window from the menu bar, select *Receiver* > *Setup* > *Ports*.

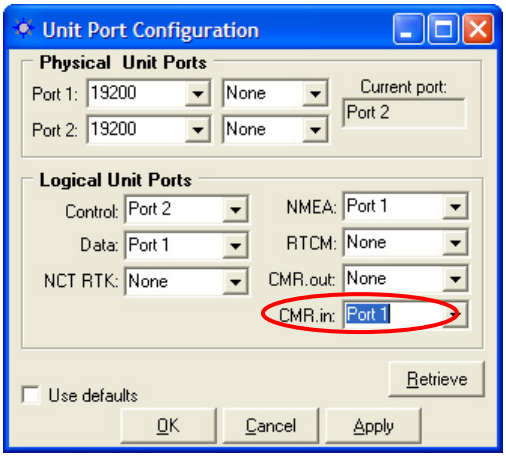


Figure 62: CRM.in Port Configuration

11. Set the baud rate, as appropriate, for Port 1 (19200 default). Do *not* change the default parity (*None*).
12. Set the *CMR.in* logical port to *Port 1* (equivalent to Com1).

Models RT-3010 & RT-3020 only (with internal radio): Set the *CMR.in* logical port to *Port Radio*.

13. Click the *Apply* button and then click the *Retrieve* button to confirm that the receiver accepts the settings.
14. Click the *OK* button to exit the window.

Rover CMR Configuration

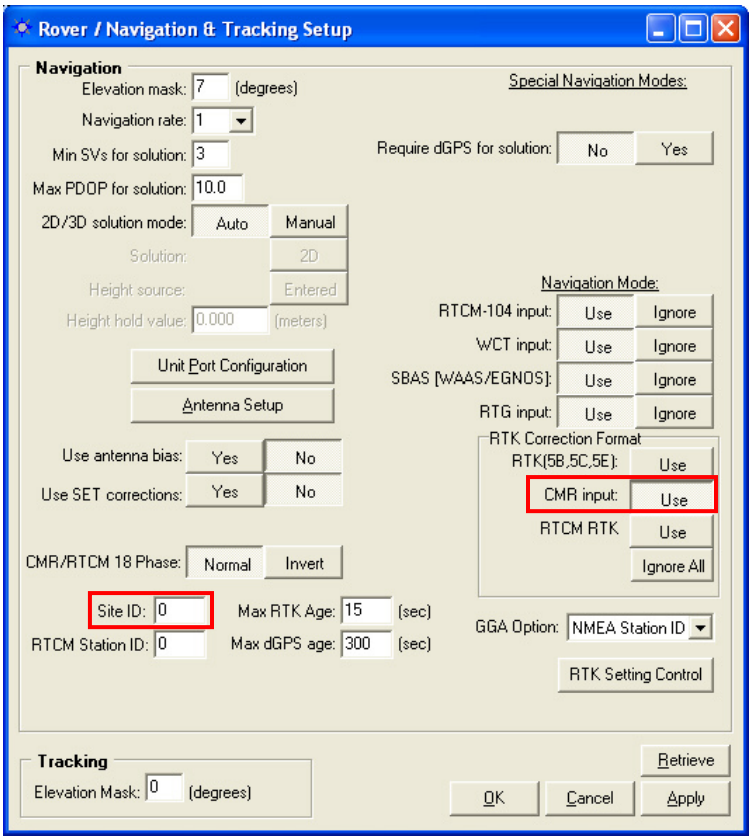


Figure 63: Rover CMR Configuration

Refer to Figure 57 for the steps below:

15. Click the ROVER icon on the toolbar to configure the rover. The *Rover / Navigation & Tracking Setup* window opens.

To open the window from the menu bar, select *Receiver* > *Setup* > *Rover / Tracking and Navigation*.

16. Click the *Use* button to apply *CMR input* to the navigation solution. This enables the input of CMR or CMR+ corrections.

To disable the input of CMR or CMR+ corrections, the user may click the *Ignore All* button or select *Receiver* > *Commands* > *CMR (In) Off*.

17. Enter a specific *Site ID*, if desired, to accept corrections only from the base station with the same Site ID. The default 0 configures the receiver to accept corrections from any base station.
18. Go to the section above, *NCT RTK Configuration/Rover Configuration*, to perform the additional steps to complete the rover configuration. Then go to the section below, *Verify Reception of CMR RTK Corrections*, to verify that the rover is receiving CMR or CMR+ RTK corrections.

Verify Reception of CMR RTK Corrections

To verify that the rover is receiving RTK corrections from the base station, this section provides steps to schedule and then view message EC. EC displays the RTK age of corrections. This message is scheduled for output on the Control port at On Change rate.

To view additional parameters to verify the reception of CRM or CRM+ RTK corrections, use an external tool.

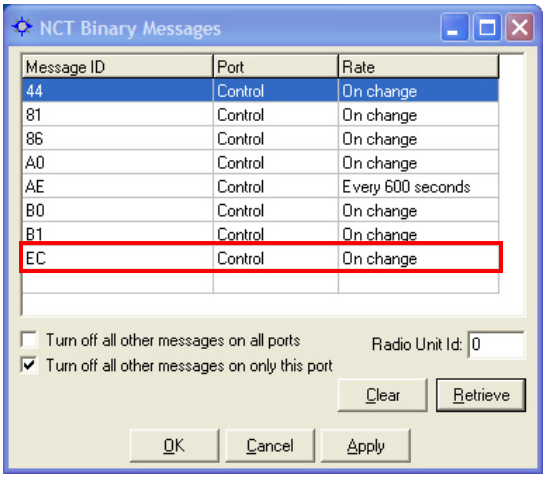


Figure 64: Message EC Scheduled

Refer to Figure 58 for the steps below:

19. Select *Receiver* > *Messages* > *NCT output* from the menu bar. The *NCT Binary Messages* window opens.
20. Schedule message EC, and for [1]RTK Extend™ users, FD:
    - Click on an empty line in the *NCT Binary Messages* window.
    - Right click in the Message ID column on the empty line. A pop-up menu opens.
    - Select *Other* from the menu. The cursor displays in the Message ID column.
    - Type in “EC”.
    - Press *Enter* on the keyboard. The message is scheduled by default to the *Control Port* at the rate of *On Change*.
    - Repeat the steps above to schedule message FD if necessary.
    - Click the *Apply* button and then click the *Retrieve* button to confirm that the receiver accepts the settings.

[1]Separate Software Option Required

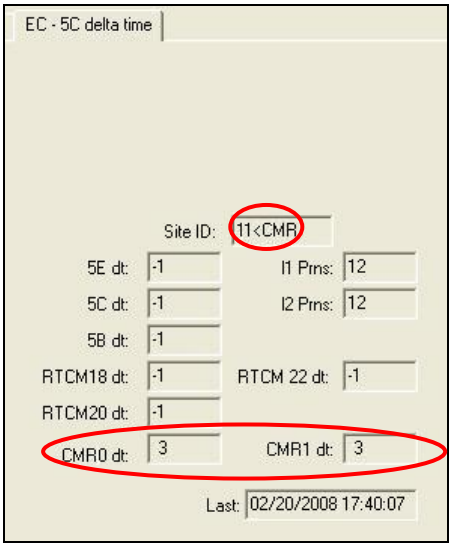


Figure 65: CMR – EC – 5C Delta Time

Refer to Figure 59 for the steps below:

21. Select *View > EC – 5C Delta Time* to view the RTK age of corrections.
22. Verify whether or not the rover is receiving RTK corrections from the base station:
    - Indications of the rover not receiving RTK corrections:
        - *Site ID:* 0<
        - *CMR0 dt* and *CMR1 dt:* -1
    - Indications of the rover receiving CMR or CMR+ corrections:
        - *Site ID:* the base station Site ID
        - *CMR0 dt:* the counter increments based on the last received corrections
        - *CMR1 dt:* the counter increments based on the last received corrections
        - *I1 Prns, I2 Prns:* the number of corrections from satellites L1 & L2

Configure Internal Radio

The internal radio option is available on the RT-3010 & RT-3020 models only. This section applies only to those models.

Refer to Figure 66 for the steps below:

1. Click the  icon on the toolbar to set the communication between the internal radio modem and the GPS receiver. The *Unit Port Configuration* window opens.

To open the window from the menu bar, select *Receiver > Setup > Ports*.

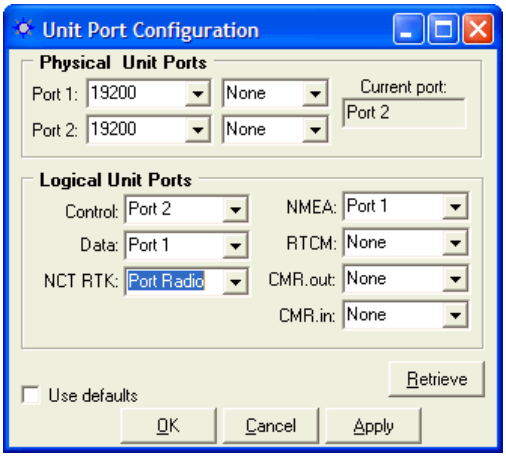


Figure 66: Port Radio Setting

2. Set the baud rate, as appropriate for data logging or NMEA output, for Port 1 (19200 default). Do *not* change the default parity (*None*).
3. Depending on configuration, set the logical port *NCT RTK, RTCM*, *CMR.out*, or *CMR.in* to *Port Radio* (equivalent to Com1).
4. Click the *Apply* button and then click the *Retrieve* button to confirm that the receiver accepts the settings.
5. Select *Receiver* > *Setup* > *Internal Radio* > *Settings*. The *Radio Configurations* window opens.
6. On the *Operation Mode* tab, select the mode (see Figure 67):
   - Base Station: 1 = Master, Point to Multipoint

     Or
   - Rover: 3 = Slave (default)

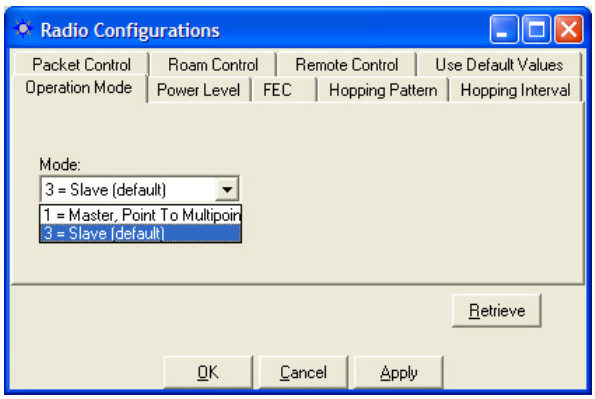


Figure 67: Radio Configuration – Operation Mode

7. Click the *Power Level* tab.
8. Select the *Radio Power Level*, typically 1000mW max (see Figure 68).

If the *Radio Power Level* is set to Off, the rover does not receive RTK corrections. Output power is limited by the license.

Some countries limit the output power to 100mW. NavCom typically limits the maximum power to the level permitted by the country the unit is sold to. Select the maximum licensed power level.

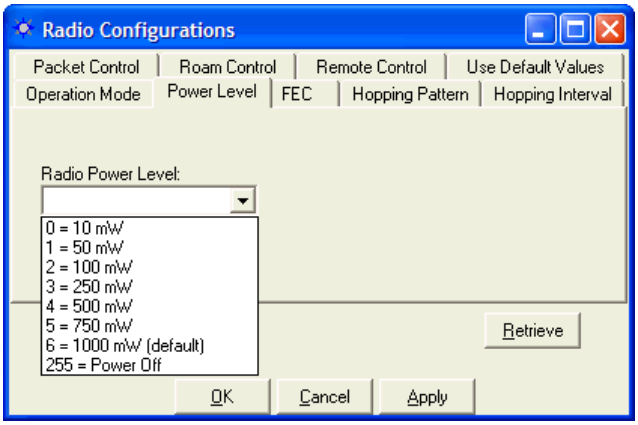


Figure 68: Radio Configuration – Power Level

9. Click the *Apply* button and then click the *Retrieve* button to confirm that the receiver accepts the settings. (The other settings in the *Radio Configuration* window typically remain at default.)
10. Click the *OK* button to close the *Radio Configurations* window.

Select *View > 30 – Software Options* to confirm the radio power setting (see Figure 69).

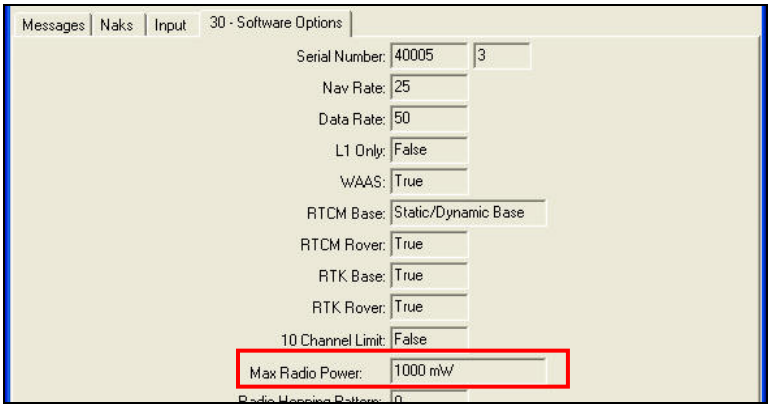


Figure 69: 30 – Software Options – Max Radio Power

Refer Figure 70 for the steps below:

11. Select *Receiver > Setup > Internal Radio > Network Configuration* to set the Network ID, if desired. The *Network Configuration* window opens.

StarUtil provides the Network ID option for models RT-3010 & RT-3020 only.

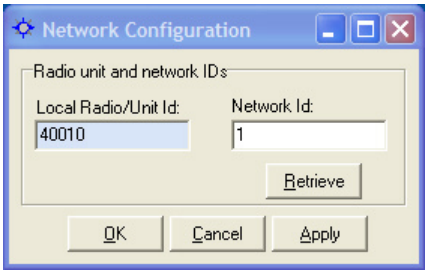


Figure 70: Network ID

12. Enter a Network ID. The valid range for a Network ID is 1 to 65535. The rover radio must be set to the identical ID. The *Local Radio/Unit ID* is the serial number of the NCT2100 or NCT-2000 Digital card serial number.

The user may create both a Network ID and a Site ID.

The Network ID may be assigned to one base station or several base stations. The rover radio set to the identical ID communicates only with the base station(s) with the network ID. The valid range for a Network ID is 1 to 65535.

The Site ID may be used when it is desirable to have multiple base stations on a single network ID, but with a separate site ID for each base receiver. The valid range for a site ID is 0 to 1023. The same Site ID must be set on the *Base Configuration* window (see Figure 33) and the *Rover / Navigation & Tracking Setup* window (see Figure 47).

13. Click the *Apply* button and then click the *Retrieve* button to confirm that the receiver accepts the setting.
14. Click the OK button to close the *Network Configuration* window.

Chapter 6 .....StarFire™ Operation

This chapter provides:

✓ Instructions to load and cancel the license for the StarFire™ subscription service.

Refer to *Chapter 9 Load Software* for information about the purchase of software options for the GPS receiver.

✓ Information about the menu options in StarUtil that are pertinent only to StarFire™ enabled receivers:

- *StarFire™ Menu* (see Figure 73):
  - o Provides options to augment StarFire™ functionality.
- *View Menu*:
  - o Provides access to the NavCom receiver serial number, StarFire™ license information, the StarFire™ software version in use, and StarFire™ satellite data.

LBM is the abbreviation for the StarFire™ *L-Band Module*.

Description of the StarFire™ Network

The StarFire™ Network is a global system for the distribution of SBAS corrections giving the user the ability to measure his position anywhere in the world with exceptional reliability and unprecedented accuracy of better than 10cm (3.9 inches). Because the SBAS corrections are broadcast via INMARSAT geo-stationary satellites, the user needs no local reference stations or post-processing to get this exceptional accuracy. Furthermore, the same accuracy is available virtually anywhere on the earth's surface on land or sea from 76°N to 76°S latitude, due to the worldwide coverage of these geo-stationary satellites.

RTK Extend™

[1]RTK Extend™ is a software option only available in NavCom Technology receivers that are StarFire™ capable and use the NCT-2100 GPS engine. It enables continuous real-RTK/RTK level positioning accuracy during radio communication outages by utilizing NavCom's global StarFire™ corrections.

Traditionally, when an RTK rover loses communication with the base station, it is unable to continue to provide centimeter position updates for more than a few seconds, resulting in user down-time and reduced productivity. With RTK Extend™, a NavCom StarFire™ receiver operating in RTK mode, can transition to RTK Extend™ mode and maintain centimeter level positioning during communication loss for up to 15 minutes. RTK Extend™ allows more efficient and uninterrupted work, enabling focused concentration on the work rather than the tools.

Load RTK Extend™

✓ To upload RTK Extend™, perform the instructions in the section, *Load Purchased Software Options*, in *Chapter 9*. The chapter also includes steps to verify that RTK Extend is enabled.

[1]Separate Software Option Required

How to Access the StarFire™ Service

StarFire™ is a subscription service. The user pays a subscription, which licenses the use of the service for a predetermined period of time.

Subscriptions are available via a NavCom authorized representative, or by contacting NavCom Sales Department (sales@navcomtech.com).

An authorized subscription provides an encrypted key, which is specific to the serial number of the NavCom receiver to be authorized. Typically the initial license is preinstalled at the factory, and the user installs subsequent licenses with StarUtil. The user receives the StarFire™ license file via email.

Provide the NavCom receiver serial number and the serial number on the GPS chassis when requesting a new StarFire™ license.

To view the NavCom receiver serial number, select *View > AE-Version Information* (see Figure 78) or *View > D1-LBM License Status* (see Figure 80).

Load StarFire™ License

The receiver must be navigating at the time of the license update for the receiver to accept the license.

- ✓ Save the StarFire™ license file received via email to the hard drive.
- ✓ Select *Tools > StarFire™ License Input* to upload the StarFire™ license. The *LBM License* window opens (see Figure 71).

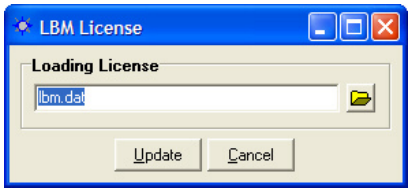


Figure 71: StarFire™ License Upload Window

- ✓ Click the button to browse to and select the StarFire™ license file. The path to the file appears in the *LBM License* window.
- ✓ Click the *Update* button. A window opens to indicate a successful upload.
- ✓ Click the ROVER icon on the toolbar to confirm that the rover is configured for StarFire™. The *Rover / Navigation & Tracking Setup* window opens. The navigation mode, *RTG input*, must be set to *Use* (the default) to enable StarFire™ navigation (see Figure 72).

[1]Separate Software Option Required

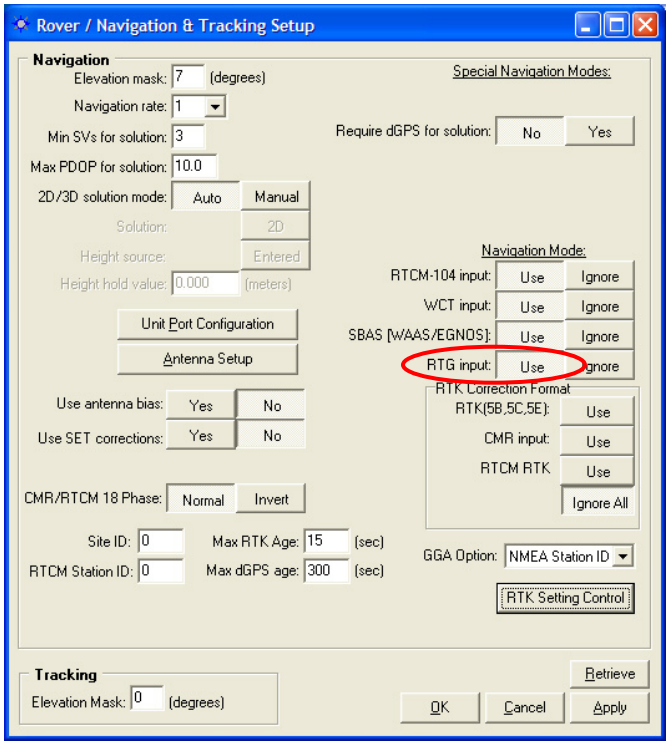


Figure 72: Rover Configured for StarFire™ Navigation

To verify an active StarFire™ license, select *View* > *D1 – LBM License Status*. Click the *Retrieve* button on the *D1* tab. If no license is displayed on the tab, the receiver will not decode the StarFire™ signal. If no license is displayed, select *View* > *D5 – LBM License Cancel History* to display cancelled licenses.

Cancel StarFire™ License

The receiver must be navigating at the time of this command for the receiver to accept the license cancellation.

✓ Select *Receiver* > *Commands* > *Cancel StarFire™ License*. A caution message opens.

✓ Click *OK* on the first caution message and *Yes* on the second message to cancel the StarFire™ license.

✓ Refer to the sections below:

- *D5 – LBM License Cancel History*: the history of the last two StarFire™ license cancellations
- *DD – LBM License Cancel Codes*: cancel codes to affirm the cancellation of the last two StarFire™ licenses before the expiration dates

StarFire™ Menu Options

The StarFire™ menu options (see Figure 73), which are described in more detail below, are:

- ✓ *QuickStart:* Select this option to initiate, reset, or turn off this startup mode that allows instant <decimeter accuracy with received StarFire™ signals, allowing the convergence period to be waived.
- ✓ *Alternate StarFire™ Satellite:* Select this option to *manually* force the receiver to use a licensed StarFire™ satellite or user-defined satellite in case of poor reception or during routine maintenance of the StarFire™ Network.
- ✓ *Configure Message Output:* With direction from NavCom, select this option to schedule messages for output that are pertinent to the StarFire™ L-Band Module (LBM).
- ✓ *Define Satellite:* With direction from NavCom, select this option to add (or delete) one licensed user-defined StarFire™ satellite to be available for automatic or manual selection. The user-defined satellite is a new satellite in the StarFire™ network or a backup StarFire™ satellite.

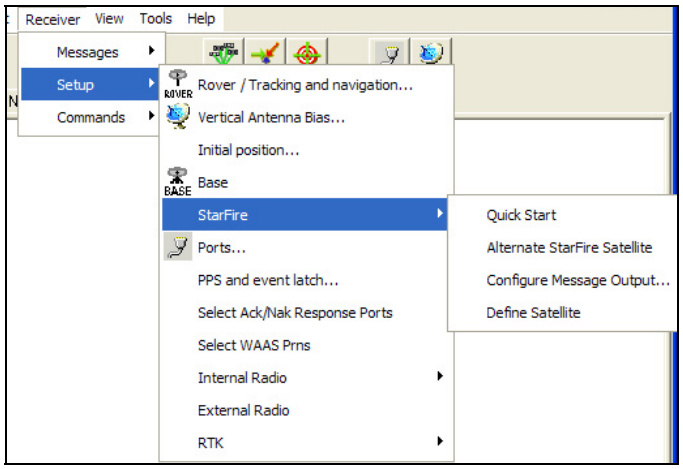


Figure 73: StarFire™ Menu

QuickStart

QuickStart is a feature that eliminates the convergence period for the StarFire™ Series NavCom GPS receivers. This function allows the StarFire™ RTG navigation solution to be initialized to an accurately known ITRF05 (Apr. 08) position, and therefore eliminate lengthy convergence times.

The QuickStart (user input) position must have a better than decimeter accuracy to achieve maximum results. Any error in the user input position will bias the StarFire™ position error accordingly, until convergence can correct the bias. In this case, convergence may take longer than the typical startup convergence period.

The receiver must be in a RTG dual mode before QuickStart can be initiated. This typically occurs in about three minutes after start up.

- ✓ Select *Receiver* > *Setup* > *StarFire™* > *QuickStart* to initiate, reset, or turn off this startup mode. The *RTG QuickStart* window opens (see Figure 74).

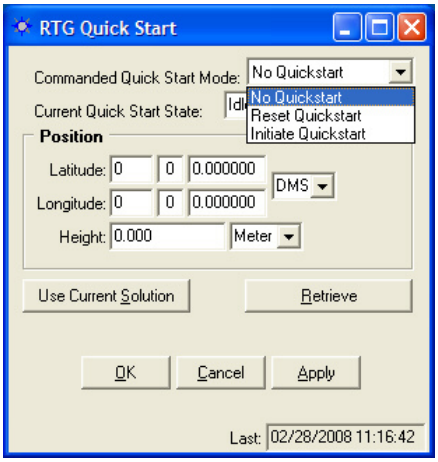


Figure 74: RTG Quick Start Window

Refer to Figure 74 for the options below:

- ✓ *Commanded QuickStart Mode:* These commands are activated when the *Apply* button is clicked.
  - *No QuickStart:* Do not initiate or turn off QuickStart. This command is often used to store a QuickStart position without initiating a QuickStart.
  - *Reset QuickStart:* Restart the entire RTG navigation mode with no a-priori position information, i.e. full pull-in duration.
  - *Initiate QuickStart:* Initiate the QuickStart operation.
- ✓ *Position:* Use only a fully converged solution at 10cm. If known, the coordinates may be entered manually. Or, populate the coordinate fields via one of these methods:
  - *Use Current Solution Button:* Click to retrieve the current navigation solution from the B1 message. Only use this option when the B1 solution is fully converged.
  - *Retrieve Button:* Click to retrieve the last saved QuickStart *Position* from NVRAM.

Apply Button: Set the *Commanded QuickStart Mode* to *No QuickStart*. Then click *Apply* to save the current coordinates in the *Position* section of the window to NVRAM. If the *Apply* button is not clicked, the coordinates are not saved. If the *Apply* button is clicked when there are no coordinates (zeroes), the *Retrieve* button will retrieve zeroes from NVRAM.

Example of QuickStart Use

The steps below present a typical use of QuickStart after extended use of a StarFire™ Series NavCom GPS receiver with a fully converged solution at 10cm.

- ✓ At the end of a work day, when the equipment is parked, use QuickStart to record the converged position.
- ✓ In StarUtil, open the *RTG QuickStart* window (*Receiver* > *Setup* > *StarFire™* > *QuickStart*).
- ✓ Select *No QuickStart* from the *Commanded QuickStart Mode* drop-down list, if not already selected.
- ✓ Click the *Use Current Solution* button to populate the *Position* section of the window with the current fully converged solution.
- ✓ Click the *Apply* button to save the position to NVRAM.

- ✓ Click the *Retrieve* button to confirm that the position is saved.
- ✓ Close the PC COM Port. Exit StarUtil.
- ✓ The next day, do not move the equipment from the parked position.
- ✓ Open StarUtil and connect to the GPS receiver. Wait for the receiver to enter RTG dual mode.
- ✓ Open the *RTG QuickStart* window.
- ✓ Click the *Retrieve* button to retrieve the position saved the day before from NVRAM.
- ✓ Select *Initiate QuickStart* from the *Commanded QuickStart Mode* drop-down list.
- ✓ Click the *OK* button to initiate QuickStart. When the QuickStart operation completes successfully, the StarFire™ RTG navigation solution is initialized to the accurately known position from the prior day, and therefore eliminates the lengthy convergence time.

QuickStart State

- ✓ *Current QuickStart State:* The QuickStart process goes through these modes:
  - *Idle*: QuickStart is not initiated or in progress. Once QuickStart is initiated, *Idle* is temporarily displayed if:
    - Power is cycled on the unit.
    - The command, *Reset QuickStart*, is applied. This causes a restart of the entire RTG navigation mode with no a-priori position information, i.e. full pull-in duration.
  - *Initiated*: QuickStart is initiated, but is not operating. QuickStart operation does not begin until the start of RTG navigation. This requires at least five satellites each with full dual frequency tracking and at least 10 seconds of code-carrier smoothing. If, for example, a QuickStart initiation request is given shortly after power-on, it may be a few minutes before these conditions are met. During this period, the reported QuickStart mode is *Initiated*.
  - *In Progress:* QuickStart is operating. QuickStart is *In Progress* until the operation completes or fails, or until a *No Quickstart* or *Reset Quickstart* command is received.
  - *Completed:* A QuickStart operation completed successfully.
  - *Failed Proximity Limit:* While a QuickStart operation is in progress, a check is performed at each 1Hz navigation epoch, which compares the 3D radial distance between the RTG code solution and the ‘known’ position input with the QuickStart initiation request. If this distance exceeds 25 meters on the first QuickStart epoch, or 15 meters on any of the subsequent epochs in the *In Progress* period, the QuickStart is terminated, RTG navigation is reset (full pull-in required), and the QuickStart mode is reported as *Failed Proximity Limit*.

    The RTG code solution is the weighted least squares navigation solution performed with smoothed code (could be single or dual frequency depending on prefilter status) and RTG clock and orbit corrections. It is independent from the full RTG solution, which uses the phase biases, estimated by the RTG extended Kalman filter. The full RTG solution is initialized by a QuickStart operation.

Alternate StarFire™ Satellite

Select this option to *manually* force the receiver to use a licensed StarFire™ satellite or user-defined satellite in case of poor reception or during routine maintenance of the StarFire™ Network.

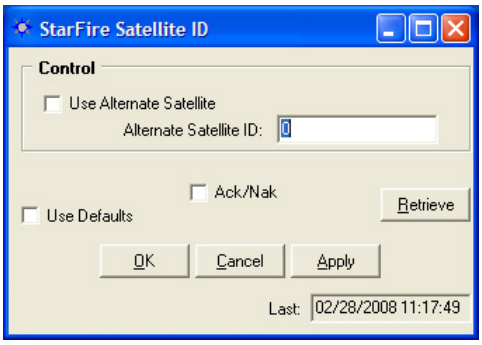


Figure 75: StarFire Satellite ID Window

The automatic satellite selection is based on the license type and current GPS position.

✓ Select *Receiver* > *Setup* > *StarFire™* > *Alternate StarFire™ Satellite*. The *StarFire™ Satellite ID* window opens (see Figure 75).

✓ Click the check box to the left of *Use Alternate Satellite.*

✓ Type in a valid satellite ID in the *Alternate Satellite ID* field:

- An available licensed StarFire™ satellite. (Table 4 identifies StarFire™ Satellites by Network.)

  Or

- The user-defined StarFire™ satellite (if defined).

Table 3: StarFire™ Satellites – Software v4.2.26 and Earlier

Network	Satellite ID	Longitude	Satellite Name	Uplink Site
Net 1	402	98W	PAC-E	Laurentides
	609	109E	IND-E	Perth
	525	25E	IND-W	Burum
Net 2	358	142W	PAC-C	Santa Paula
	643	143.5E	PAC-W	Auckland
	484	15.5W	AOR-E	Southbury

Table 4: StarFire™ Satellites – Software v5.1.6 and Later

Network	Satellite ID	Longitude	Satellite Name	Uplink Site
Net 1	402	97.65W	PAC-E	Laurentides
	609	109E	IND-E	Perth
	525	25E	IND-W	Burum
Net 2	358	142W	PAC-C	Santa Paula
	678	178E	POR	Auckland
	484	15.5W	AOR-E	Southbury

The Longitude 178E (POR) is tentatively set to change to 143.5E (PAC-W) on May 13, 2009. The Satellite ID will also change from 678 to 643.

✓ Click the check box for *Ack/Nak* to enable this response if desired.

✓ Click the *Apply* button and then the *Retrieve* button:

- If the satellite ID is accepted, it remains in the *Alternate Satellite ID* field, and the check box remains checked.
- If the satellite ID is not accepted, the *Alternate Satellite ID* field displays “0”, and the check box is blank.

✓ Confirm the manual selection of the alternate satellite on either of these tabs:

- Select *View > DB – StarFire™ Satellites*. The *DB-StarFire™ Satellites* tab opens (see Figure 84). Click the *Retrieve* button. The *Mode* for the alternate StarFire™ satellite is *Manual*.
- Select *View > D3 – LBM DSP Status*. The *D3-LBM DSP Status* tab opens (see Figure 82). Click the *Retrieve* button. *Yes* is the entry in the field to the left of *Use alternate satellite*.

Failed Search

Whether from loss of reception or lack of initial acquisition, after a 5 minute failed search for a StarFire satellite, the receiver automatically searches for another available StarFire satellite.

This functionality only applies to:

✓ Software later than v3.1.17

✓ Receivers licensed for both StarFire Net 1 and Net 2

✓ Receivers only licensed for StarFire Net 1 in areas where signals from 2 StarFire satellites overlap and may be available.

Configure Message Output

Only with direction from NavCom, select this option to schedule messages for output that are pertinent to the StarFire™ L-Band Module (LBM).

✓ Select *Receiver > Setup > StarFire™ > Configure Message Output*. The *LBM Messages* window opens (see Figure 76).

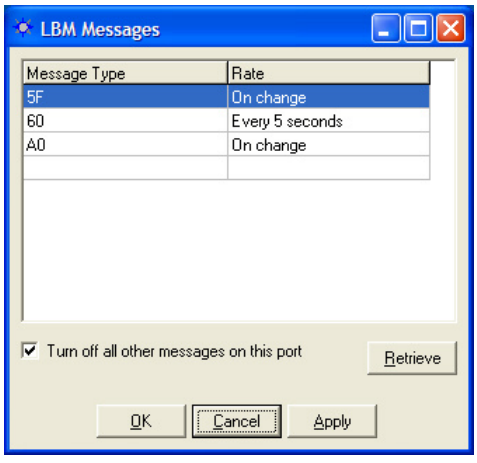


Figure 76: LBM Messages Window

Define Satellite

With direction from NavCom, select this option to add (or delete) one licensed user-defined StarFire™ satellite to be available for automatic or manual selection (see Figure 77). The user-defined satellite is a new satellite in the StarFire™ network or a backup StarFire™ satellite.

Only one satellite can be user-defined. A new user-defined satellite overwrites the previous user-defined satellite.

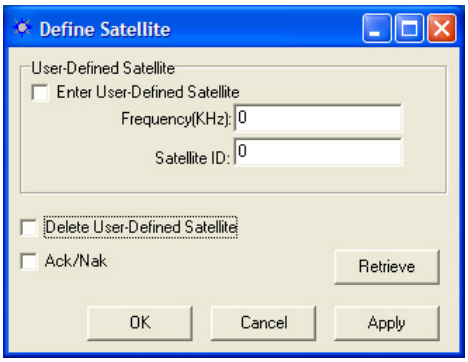


Figure 77: Define Satellite Window

Enter User-Defined Satellite

- ✓ Select *Receiver* > *Setup* > *StarFire™* > *Define Satellite*. The *Define Satellite* window opens (see Figure 77).
- ✓ Click the check box to the left of *Enter User-Defined Satellite*.
- ✓ With direction from NavCom, enter the *Longitude* and the *Satellite ID* for the user-defined satellite.
- ✓ Click the *OK* button.
- ✓ Confirm that the entry of the user-defined satellite is successful:
  - Select *View* > *DB - StarFire™ Satellites*. The *DB-StarFire™ Satellites* tab opens (see Figure 84).
  - Click the *Retrieve* button.
  - The new user-defined satellite is listed on row 7 of the tab.

Delete User-Defined Satellite

- ✓ Select *Receiver* > *Setup* > *StarFire™* > *Define Satellite*. The *Define Satellite* window opens (see Figure 77).
- ✓ Click the check box to the left of *Delete User-Defined Satellite*.
- ✓ Click the *OK* button.
- ✓ Confirm that the user-defined satellite is deleted:
  - Select *View* > *DB - StarFire™ Satellites*. The *DB-StarFire™ Satellites* tab opens (see Figure 84).
  - Click the *Retrieve* button.
  - Row 7 on the tab is blank if the user-defined satellite is deleted.

View Menu – StarFire™ Information

The messages on the *View* menu that pertain to the StarFire™ subscription service are:

- ✓ AE – Version Information
- ✓ D0 – LBM Identification Block
- ✓ D1 – LBM License Status
- ✓ D2 – Point Radius
- ✓ D3 – LBM DSP Status
- ✓ D5 – LBM License Cancel History
- ✓ DB – StarFire Satellites
- ✓ DD – LBM License Cancel Codes

The output for these messages is described in the sections below.

StarFire™ Licensing Terminology

Table 5 lists the StarFire™ licensing terminology that is used on various tabs.

Table 5: StarFire™ Licensing Terminology

Terms	Description
Precise	Indicates that the license type is a StarFire™ license.
World Wide or Land Only	Indicates the license type in regard to valid areas of StarFire™ operation: • World Wide: Valid globally. • Land Only: Valid only on land (or near land as defined by NavCom).
Calendar Time or Run-Time (Elapsed Time)	Indicates the license type in regard to duration of StarFire™ operation: • Calendar Time: The receiver is licensed for a specified duration. • Run-Time: The receiver is licensed at a per day rate, within a calendar period (i.e., 60 days use over 360 day period).
Active or Inactive	Indicates the current status of the StarFire™ license.
Canceled or Expired	Indicates how the StarFire™ license was terminated: • Canceled: Terminated by the user. • Expired: The end date for the license is reached or all the run-time days are used.

AE – Version Information

The *AE-Version Information* tab provides various version and serial numbers.

✓ Click the *Retrieve* button to view the current output data:

- *Digital Card Serial Number:* Provide this serial number to NavCom when requesting a new StarFire™ license. For further details on the StarFire™ Signal Network, its capabilities, terms and conditions visit *www.navcomtech.com* or send an email inquiry to *sales@navcomtech.com*.

The *D0-LBM Identification Block* tab (see Figure 79) and the *D1-LBM License Status* tab (see Figure 80) display the serial number for the StarFire™ receiver.

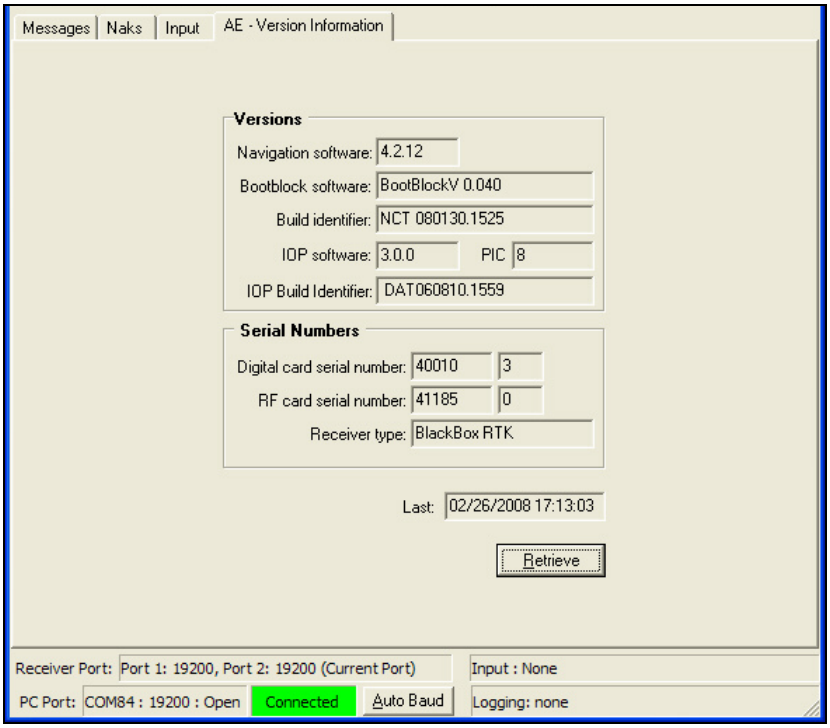


Figure 78: AE – Version Information

D0 – LBM Identification Block

The *D0-LBM Identification Block* tab provides the current *LBM* (StarFire™) *software* version number.

✓ Click the *Retrieve* button to view the current LBM software version number.

To load LBM software, use the *Load Unit* window (see Figure 125).

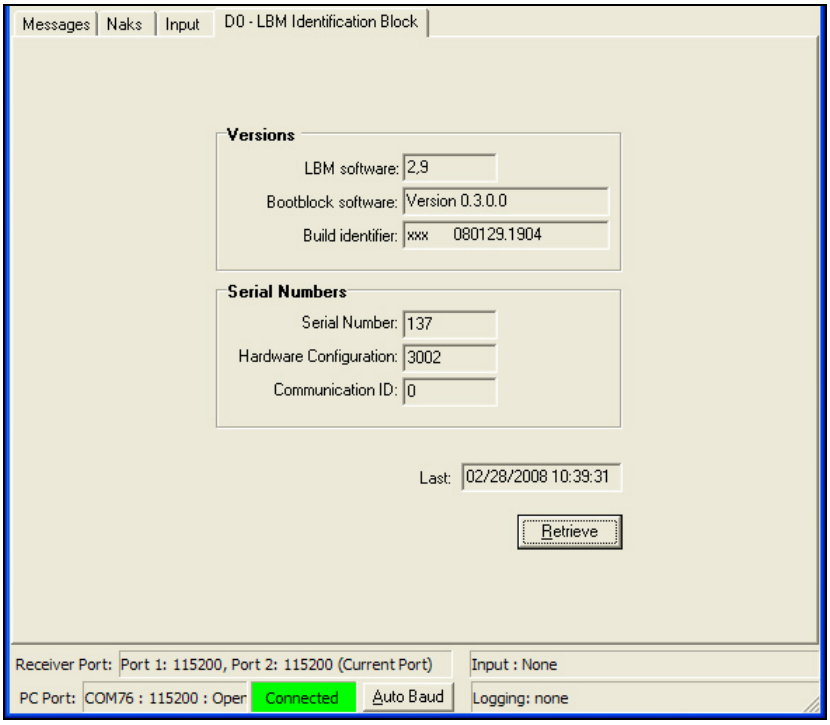


Figure 79: D0 – LBM Identification Block

D1 – LBM License Status

The *D1-LBM License Status* tab provides information about the StarFire™ license in use and, if purchased, the back up StarFire™ license.

✓ Click the *Retrieve* button to view the current output data:

- *Serial Number:* Provide this serial number to NavCom when requesting a new StarFire™ license. For further details on the StarFire™ Signal Network, its capabilities, terms and conditions visit *www.navcomtech.com* or send an email inquiry to *sales@navcomtech.com*.
- *Net Authorization*: The licensed StarFire™ Network in use: *1*, *2*, or *All Nets*. Table 3 and Table 4 identify StarFire™ Satellites by Network.
- *License Type / Region Selection*: Refer to Table 5 for a description of the StarFire™ licensing terminology.

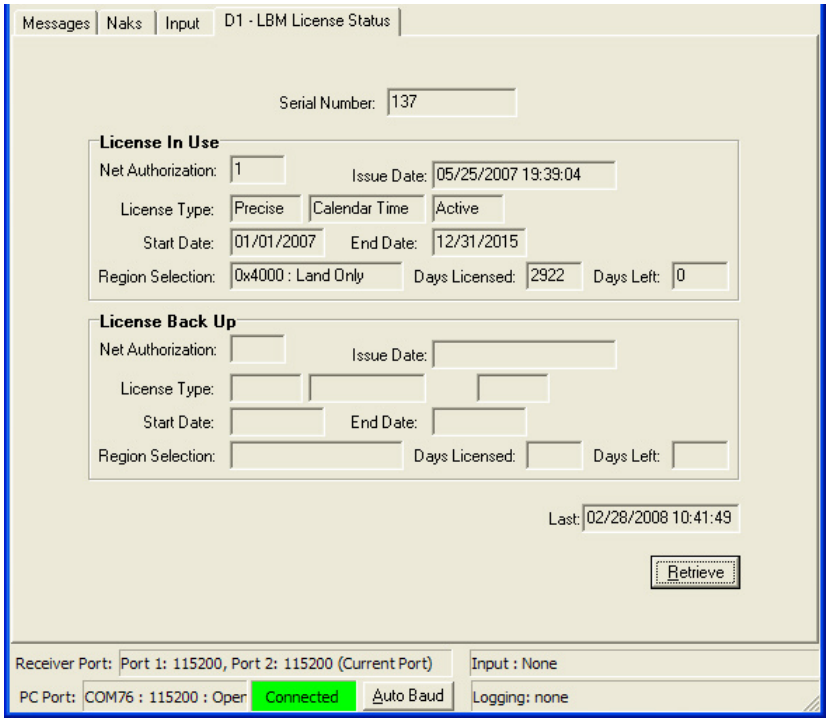


Figure 80: D1 – LBM License Status

D2 – Point Radius

This feature applies only to receivers with a Land Only StarFire™ license. The Point Radius definition is separate from the StarFire™ license. It allows the use of StarFire™ if the user is outside the boundary lines of a Land Only StarFire™ license, but on a land mass (i.e., an island).

The user must provide the coordinates to NavCom Customer Service for the Point Radius definition. NavCom provides StarFire™ use at the coordinates and within a determined radius. The Point Radius definition is only for one point and radius circle.

✓ Click the *Retrieve* button to view the *Latitude* and *Longitude* of the point and the *Radius* in kilometers.

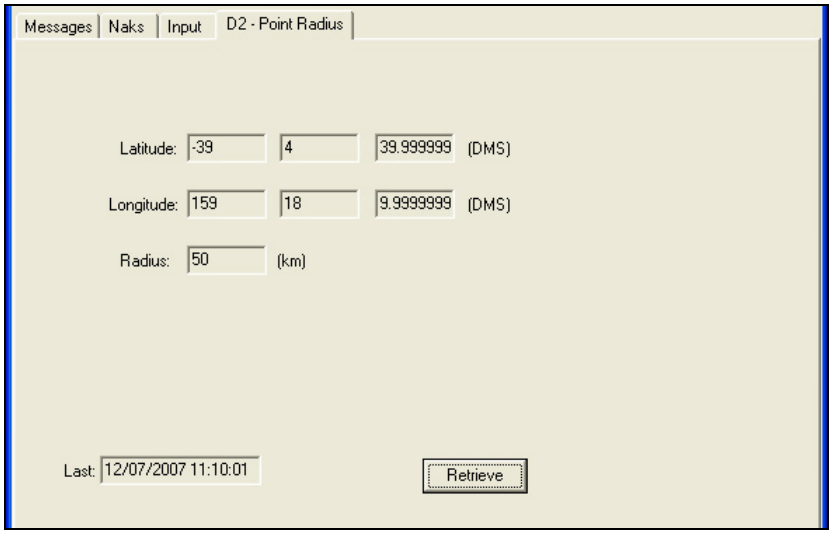


Figure 81: D2 – Point Radius

D3 – LBM DSP Status

The *D3-LBM DSP Status* tab provides information about the current performance of the StarFire™ satellite in use.

✓ Click the *Retrieve* button to view the current output data:

- *SF Satellite ID:* The ID for the currently used StarFire™ satellite.

Refer to Table 3 and Table 4 for StarFire™ satellites.

- *Tracked baseband freq:* For NavCom internal use only
- *SF signal C/NO:* The StarFire™ signal strength:

  < 0 Not Tracking
  < 4 Weak
  4-8 Good
  > 8 Strong

- *Authorization status:* For NavCom internal use only
- *Use alternate channel:* Indicates whether or not the satellite used is manually selected ("Yes" or "No"). The manually selected satellite may be a licensed StarFire™ satellite or the user-defined satellite (if defined). Refer to the section above, *Alternate StarFire™ Satellite*, for details.

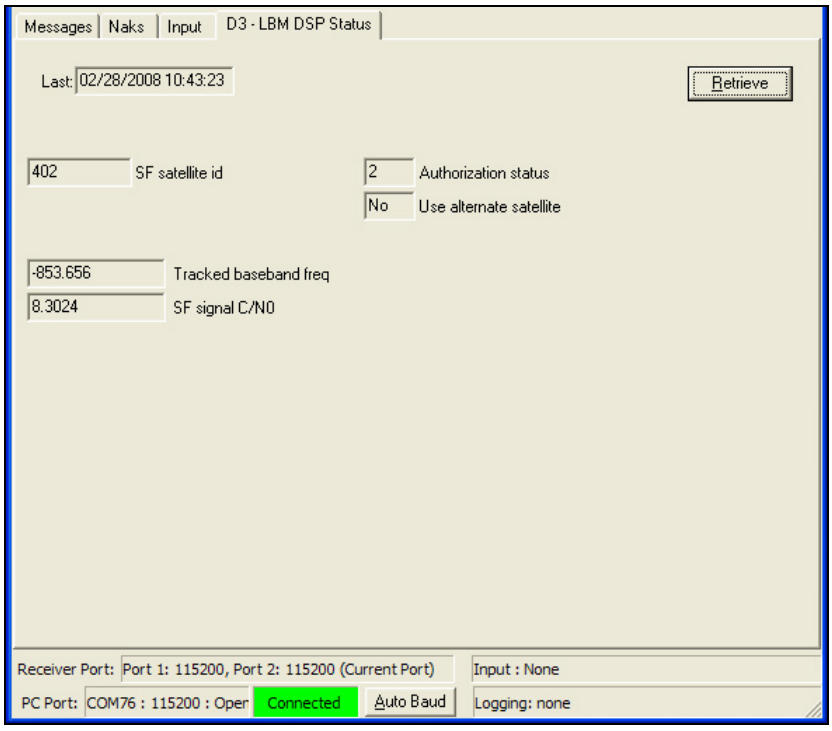


Figure 82: D3 – LBM DSP Status

D5 – LBM License Cancel History

The *D5-LBM License Cancel History* tab provides the history of the last two StarFire™ license cancellations.

Refer to the *DD-LBM License Cancel Codes* tab for cancel codes to affirm the cancellation of the last two StarFire™ licenses before the expiration dates (see Figure 85).

✓ Click the *Retrieve* button to view the current output data:

- *License Type / Cancel Reason:* Refer to Table 5 for a description of the StarFire™ licensing terminology.
- *Unused Time:* The remaining time on the StarFire™ license at the time of cancellation.

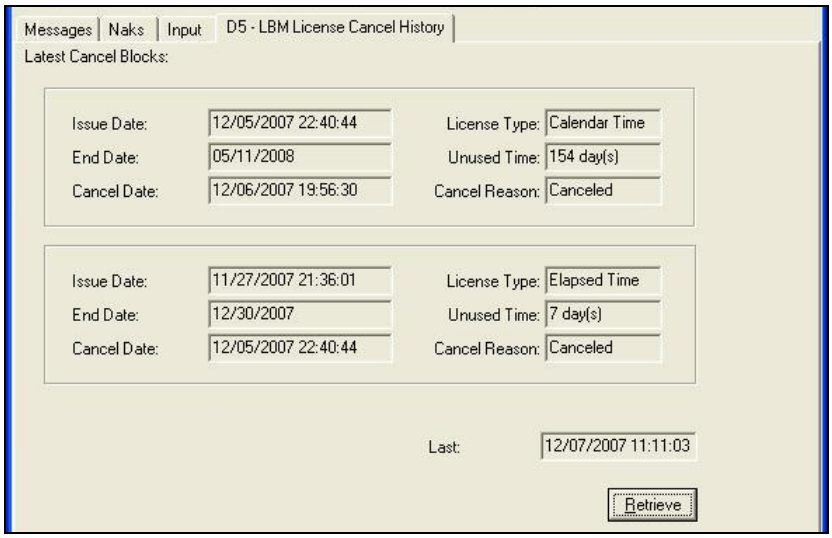


Figure 83: D5 – LBM License Cancel History

DB – StarFire™ Satellites

The *DB-StarFire™ Satellites* tab provides a list of the licensed StarFire™ Satellites in the StarFire™ Network(s) purchased by the user. The tables below identify StarFire™ Satellites by Network.

In addition, the *DB-StarFire™ Satellites* tab lists the licensed user-defined satellite if it is defined. It is the seventh satellite in the list.

Refer to the section, Define Satellite, in *Chapter 6* for details on the user-defined satellite.

Table 6: StarFire™ Satellites – Software v4.2.26 and Earlier

Network	Satellite ID	Longitude	Satellite Name	Uplink Site
Net 1	402	98W	PAC-E	Laurentides
	609	109E	IND-E	Perth
	525	25E	IND-W	Burum
Net 2	358	142W	PAC-C	Santa Paula
	643	143.5E	PAC-W	Auckland
	484	15.5W	AOR-E	Southbury

Table 7: StarFire™ Satellites – Software v5.1.6 and Later

Network	Satellite ID	Longitude	Satellite Name	Uplink Site
Net 1	402	97.65W	PAC-E	Laurentides
	609	109E	IND-E	Perth
	525	25E	IND-W	Burum
Net 2	358	142W	PAC-C	Santa Paula
	678	178E	POR	Auckland
	484	15.5W	AOR-E	Southbury

The Longitude 178E (POR) is tentatively set to change to 143.5E (PAC-W) on May 13, 2009. The Satellite ID will also change from 678 to 643.

✓ Click the *Retrieve* button to view the current list of licensed StarFire™ satellites, and the user-defined satellite (if defined).

- *Mode:* Displays *Automatic* to indicate that the receiver is set to automatically select the highest licensed available satellite from the list. Displays *Manual* to indicate that the satellite in use is manually selected.

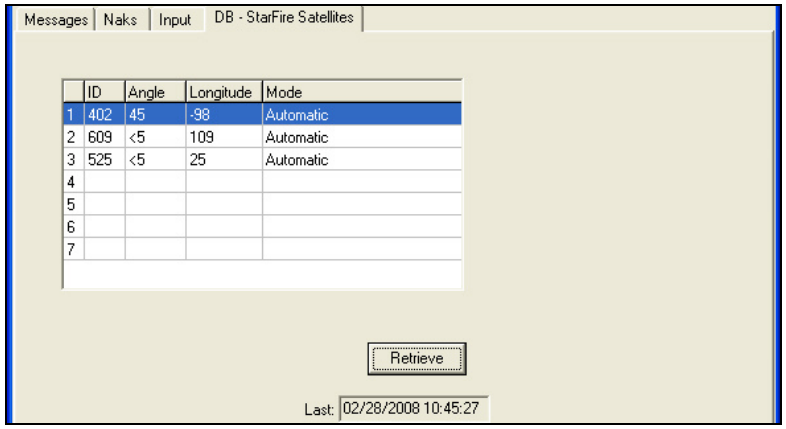


Figure 84: DB – StarFire Satellites

DD – LBM License Cancel Codes

The *DD-LBM License Cancel Codes* tab provides cancel codes to affirm the cancellation of the last two StarFire™ licenses before the expiration dates.

✓ Click the *Retrieve* button to view the current output data:

- *Cancel Code:* Affirms the cancellation of the StarFire™ license before the expiration date.
- *License Type:* Refer to Table 5 for a description of the StarFire™ licensing terminology.

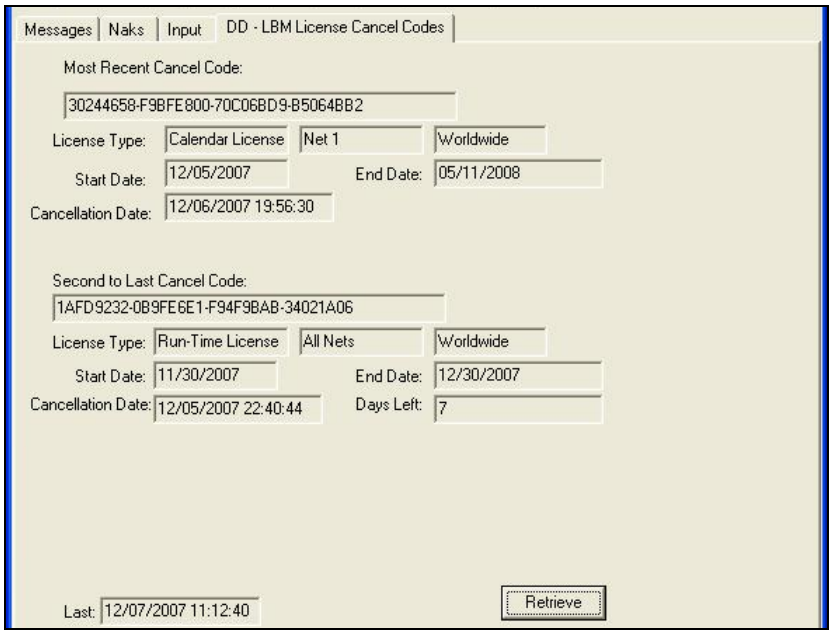


Figure 85: DD – LBM License Cancel Codes

Chapter 7 .....Setup Message Output Lists

This chapter provides guidance to schedule and configure messages for output in the:

- ✓ *NCT Binary Messages Window*
- ✓ *NMEA Messages Window*

In addition, this chapter describes the use of the *View* menu to access the output data of common NCT Binary Messages, and provides details on the output for messages 86-Channel Status, A0-Alerts, B0-Raw Measurements, B1-Solution Plot, B1-Solution, B2-Satellite Selection, and B2-Satellite Selection Plot.

Refer to the *Technical Reference Manual* for details of the control and output data message formats utilized by the GPS receiver.

Refer to *Chapter 8 Log Output Data* for instructions to log NCT Binary and NMEA Messages.

Factory Default Output Messages

The factory default for the GPS receiver is to output 7 NCT binary messages via the Control Port COM 2 (see Table 8), and 2 NMEA messages via the Data Port COM 1 (see Table 9).

The user has full control over utilized message types and their associated rates.

Factory Default NCT Binary Messages

Table 8: Factory Setup Proprietary Messages COM 2

Msg	Rate	Description
44	On Change	Almanac
81	On Change	Ephemeris
86	On Change	Channel Status
A0	On Change	Alert Message
AE	600 Seconds	Identification Block
B0	On Change	Raw Measurement Data
B1	On Change	PVT Solution

The term “On Change” indicates that the receiver will output the specified message only when the information in the message changes. On occasion, there may be an epoch without a message block output.

Message Descriptions

- ✓ 44 Packed Almanac:
  Data corresponding to each satellite in the GPS constellation, including: GPS Week number of collected almanac, GPS Time of week [in seconds] of collected almanac, almanac reference week, almanac reference time, almanac source, almanac health, pages 1-25, and sub-frames 4 and 5.
- ✓ 81 Packed Ephemeris:
  Individual satellite tracking information including: GPS Week number of collected ephemeris,

GPS Time of week [in seconds] of collected ephemeris, IODC, and sub-frame 1, 2, and 3 data.

- ✓ 86 Channel Status:
  Receiver channel status information containing: the GPS week, GPS Time of Week, NCT-2000 or NCT-2100 Engine status, number of satellites viewed/tracked, PDOP, tracked satellite identity, satellite elevation and azimuth, C/No for the L1 and L2 signals, and correction age for each satellite.
- ✓ A0 Alert Text Message:
  Details message receipt and processing.
- ✓ AE Identification Block:
  Details the receiver software versions (NCT-2000 or NCT-2100, and IOP) and digital serial numbers.
- ✓ B0 Raw Measurement Data:
  Raw Measurement Data Block containing: the GPS Week, GPS Time of Week, Time Slew Indicator, Status, Channel Status, CA Pseudorange, L1 Phase, P1-CA Pseudorange, P2-CA Pseudorange, and L2 Phase. This data stream is repeated for each individual tracked satellite.
- ✓ B1 PVT (Position, Velocity, and Time):
  Provides: GPS Week number, satellites used, latitude, longitude, navigation mode, and DOP information.

Factory Default NMEA Messages

Table 9: Factory Setup NMEA Messages COM 1

Msg	Rate	Description
GGA	Every One Second	GPS Fix Data
VTG	Every One Second	Course Over Ground & Ground Speed

Though the output rate defaults to 1Hz, the data output rate can be changed to *On Change*. Making this selection in the NMEA output list will better reflect the navigation rate selected in the *Rover / Navigation & Tracking Setup* window (see Figure 18).

Message Descriptions

- ✓ GGA GPS Fix Data:

  Time, position and fix related data.
- ✓ VTG Course Over Ground & Ground Speed:

  The actual course and speed relative to the ground.

NCT Binary Messages

NCT Binary Message Output List: Add, Configure, or Delete Messages

Open Message Output List

✓ Select *Receiver* > *Messages* > *NCT output* from the menu bar. The *NCT Binary Messages* window opens with the current message output list (see Figure 86).

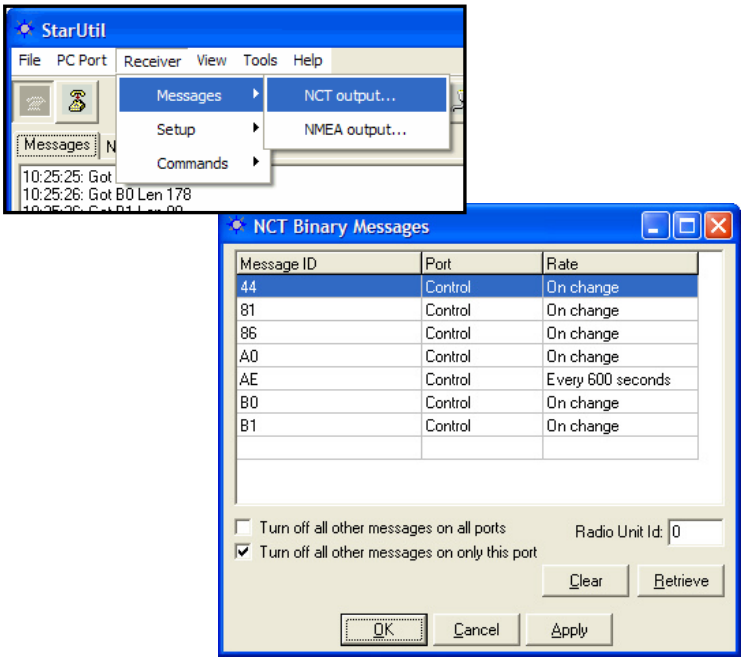


Figure 86: NCT Binary Message Output List

After making any settings in the sections below, click the *Apply* button and then click the *Retrieve* button to confirm that the receiver accepts the settings.

Add Messages

✓ Right-click in a blank *Message ID* cell. A menu opens with a list of commonly used messages (see Figure 87).

✓ Click on a message in the menu to add it to the list or click *Other* to type in the hex ID of a message. Message IDs are defined in the *Technical Reference Manual*.

The default port of a new message is *Control*, and the default rate is *On Change*. Refer to the next section to configure the port and/or rate if necessary.

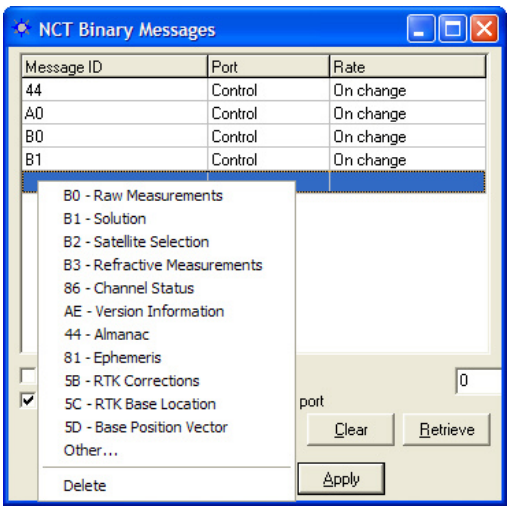


Figure 87: NCT Binary Message ID Menu

Configure Messages

✓ *Port:* Right-click on the *Port* cell to select a port, based on where the message is needed, for example, the control port or the data port (see Figure 88). *LBM* is the StarFire™ logical port; never assign any messages for this port without NavCom direction.

To configure a message for more than one port, the user must schedule a second instance of the message to the desired port.

Refer to the section, *Schedule Messages to Log*, in *Chapter 8* for instructions to log message output data to the Memory Module Card (MMC).

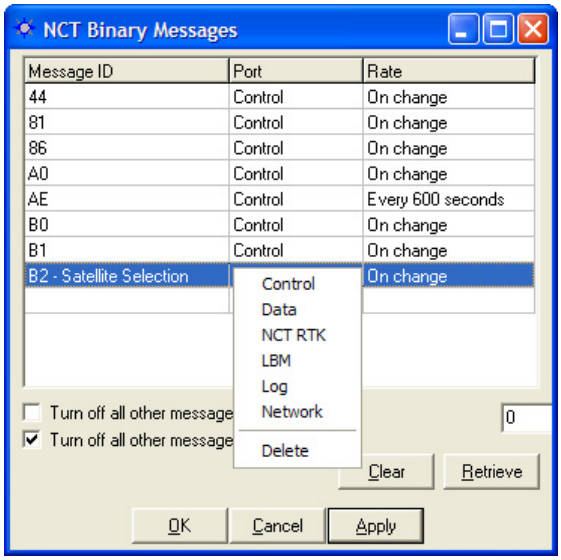


Figure 88: NCT Binary Messages Port Menu

✓ *Rate:* Use of the default rate value (*On Change*) is recommended for messages with a consistent periodic rate. The term *On Change* indicates that the receiver will output the specified message each time new data is available. Refer to the description of the *Navigation Rate* option on the *Rover / Navigation & Tracking Setup* window for more information.

For a message that is not frequently updated, schedule a rate other than *On Change*. For example, message AE, scheduled at *On Change*, outputs only when new software is uploaded to the receiver. Since that may be infrequent, the rate is scheduled by default to *Every 600 seconds* (see Figure 89).

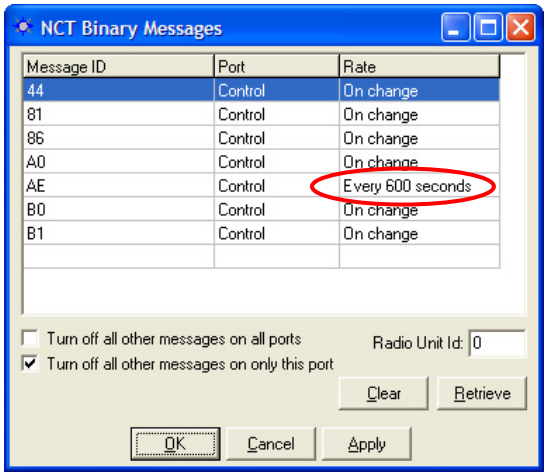


Figure 89: Example of a Specific Period

✓ Right-click on the *Rate* cell to open the menu to schedule the frequency of output for a message (see Figure 90).

- *Specific Rate:* Select 1Hz, 2Hz, 5Hz, 10Hz, 25Hz, or 50Hz. NCT binary messages do not output at 10Hz or above unless the user purchases a license for those navigation rates.

Most applications utilizing ≥ 5Hz require higher port baud rate settings, otherwise the data port buffer will overflow.

- *Specific Period:* Enter a value in seconds in the *Rate* cell.
- *Other:*
  - *All SVs:* Not Applicable
  - *On Trigger:* Select this option to schedule the GPS receiver to accept an event input pulse to synchronize external incidents requiring precise GPS time tagging, such as aerial photography. For example, the action of a camera's aperture creates an input pulse to the Event port. The GPS receiver outputs position and time information relative to each photograph taken. Refer to *Chapter 10 1PPS/Events* for more information.
  - *Special Value:* Not Applicable

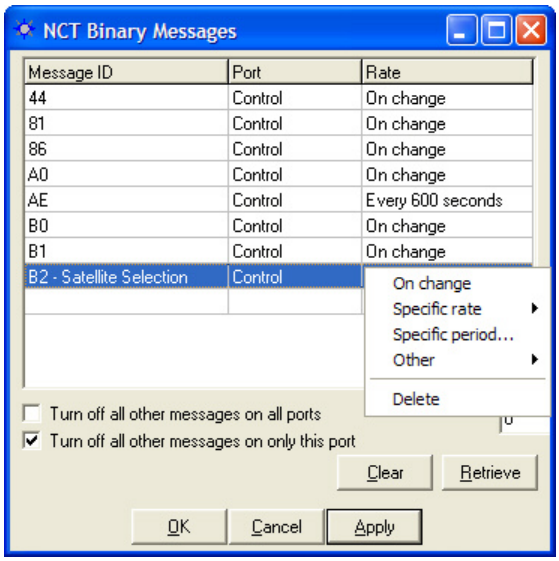


Figure 90: NCT Binary Messages Rate Menu

This action is not complete until the *Apply* button or *OK* button is clicked. Failure to send the newly scheduled rate(s) causes the previous rate(s) to be retained.

Delete Messages

To delete one or more messages:

✓ Right-click on a message. A menu opens. Select *Delete* at the bottom of the menu to delete the message.

Or

✓ Click on a message to highlight it. Press the *Delete* key on the keyboard.

✓ Press the *Clear* button to clear all messages from the list so that new messages may be easily added.

This action is not complete until the *Apply* button or *OK* button is clicked. Failure to send the deleted list causes the previous list to be retained.

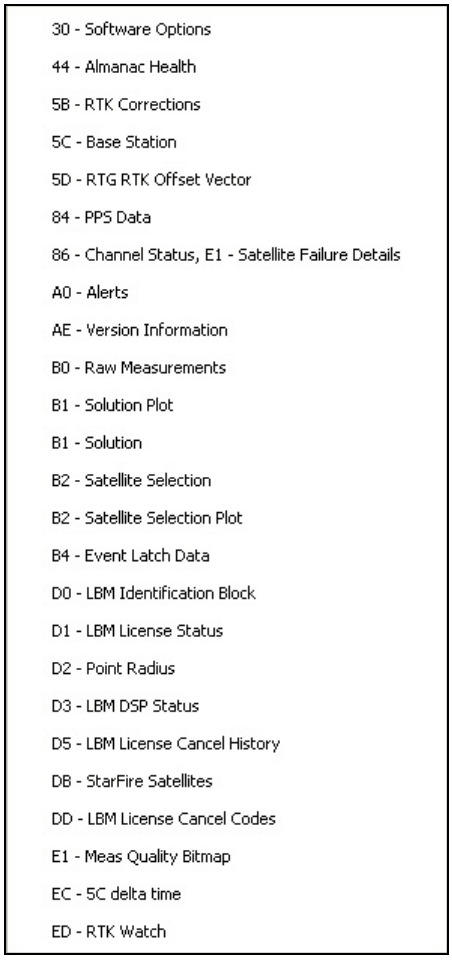
View NCT Binary Message Output Data

The *View* menu provides access to the output data of common NCT Binary Messages (see Figure 91).

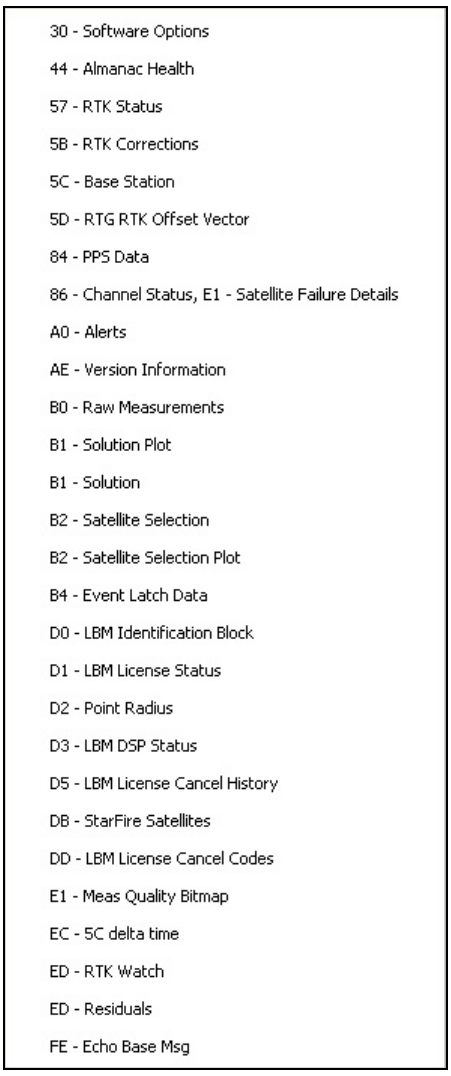
Refer to the sections below for details on the output data for messages 86-Channel Status, A0-Alerts, B0-Raw Measurements, B1-Solution Plot, B1-Solution, B2-Satellite Selection and B2-Satellite Selection Plot. Refer to Figure 38 to view the 30-Software Options tab. Refer to the section, *View Menu – StarFire™ Information*, in *Chapter 6* for details on messages pertaining to the StarFire™ subscription service.

The output data for *E1-Meas Quality Bitmap, ED-RTK Watch, ED-Residuals,* and *FE-Echo Base Msg* is used only in consultation with NavCom Customer Support, generally to troubleshoot a problem. Those message tabs are not shown in this guide.

✓ Select *View* from the menu bar to open a menu of message outputs to view.



StarUtil-2000 View Menu



StarUtil-2100 View Menu

Figure 91: View Menu

✓ Click a message on the *View* menu. A tab for the message opens (see Figure 92).

Drag the tab to the desktop to view the message output in a window. Drag the window back to StarUtil to view again as a tab.

Some messages, such as 86, B0, and B1, must be scheduled for output to view data. For other messages, such as 30 and AE, click the *Retrieve* button on the tab to view data.

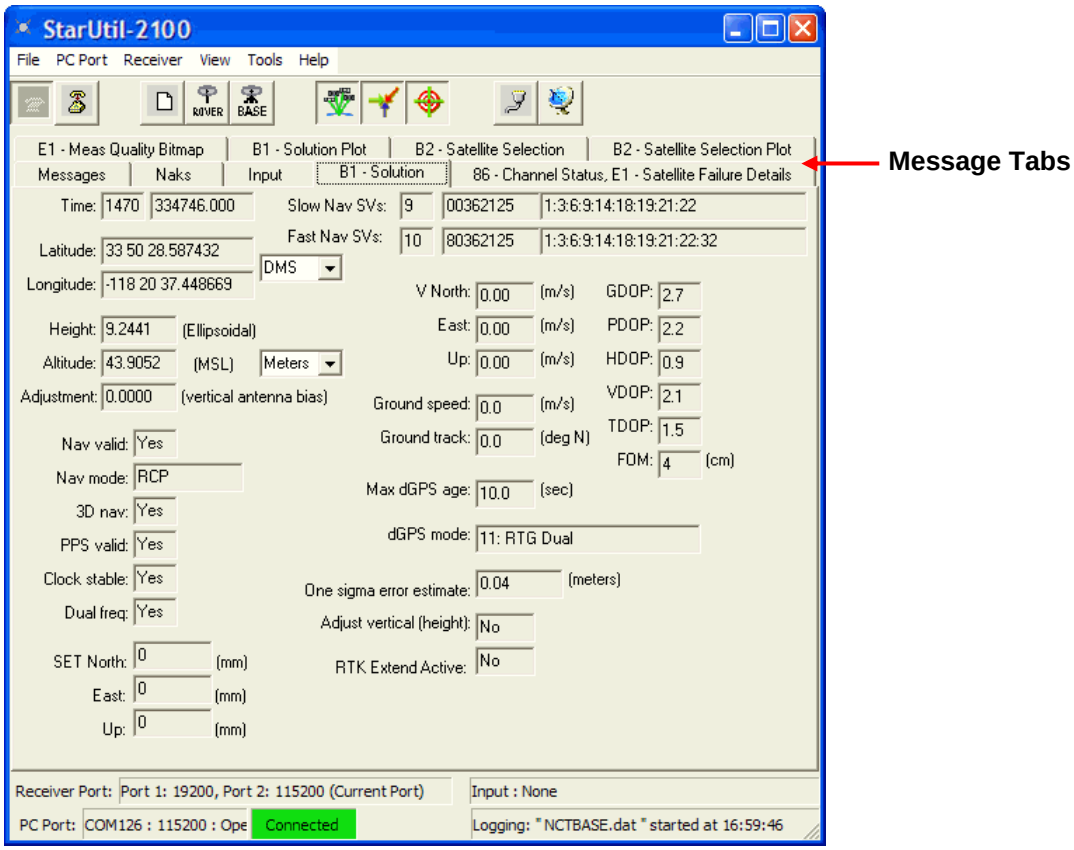


Figure 92: Message Tabs

✓ In addition to the *View* menu, click the icons to view:


Channel (Satellite) Status


B1 Solution


B1 Solution Plot

86 Channel Status – E1 Satellite Failure

The *86-Channel Status* tab is a powerful tool that provides instantaneous diagnosis of signal quality and performance (see Figure 93).

This message must be scheduled for output to view data. If not scheduled, select *Receiver > Messages > NCT output* from the menu bar. The *NCT Binary Messages* window opens. Add this message to the output list (see Figure 87).

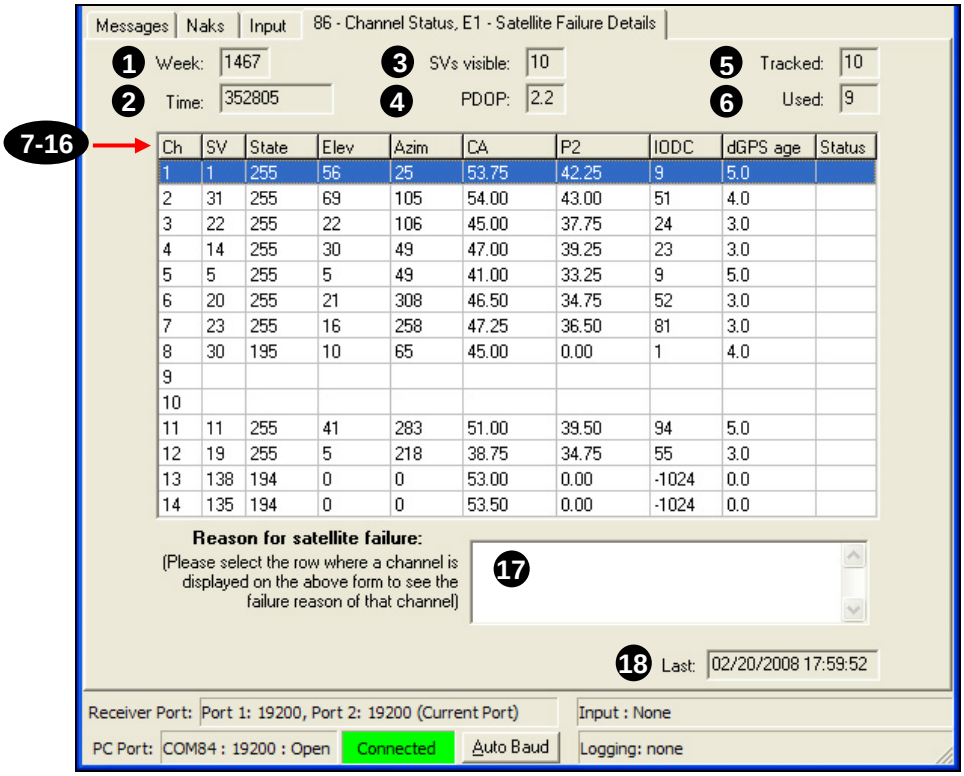


Figure 93: 86 – Channel Status

1. **Week:** GPS Week number (Refer to the *Technical Reference Manual*)
2. **Time:** GPS Seconds into the week (Refer to the *Technical Reference Manual*)
3. **SVs Visible:** *Satellite Vehicles Visible*. The number of GPS satellites visible according to the current almanac stored in NVRam based on the user-defined elevation mask and current position.
4. **PDOP:** *Position Dilution of Precision*. During periods of optimal performance, PDOP is typically between 2 and 5, based on the satellites used.
5. **Tracked:** The number of GPS satellites currently tracked by the receiver.
6. **Used:** Of the number being tracked, the actual number of GPS satellites currently being used in the navigation filters to determine position, velocity, and time.
7. **Ch:** The channel number of the receiver.
8. **SV:** The GPS or WAAS satellite number assigned to that particular channel. The valid GPS PRN range is 1-32. The valid WAAS PRN range is 120-138.
9. **State:** The NCT proprietary satellite tracking value assigned to each satellite tracked that indicates the type of tracking mode the satellite is in. This value ranges between 0 and 255,

with 255 being optimal for GPS performance, and 194 indicating decoding of SBAS corrections. Lower values indicate that the satellite is not available for use. This may be due to lack of dGPS corrections, cycle slips, acquisition process, etc.

10. **Elevation:** The vertical angle of the satellite off the horizon ranging from 0 degrees to a zenith of 90 degrees. The typical value for PRN's 120 to 138 is 0.
11. **Azimuth:** The horizontal angle of the satellite relative to the receiver position in reference to North ranging from 0 (360) to 359 degrees. The typical value for PRN's 120 to 138 is 0.
12. **CA:** The L1 signal-to-noise value, which will vary depending on satellite elevation and any obstructions between the satellites and the receiver. Optimal performance range for L1 C/N0 is 46dB to 52dB, although higher and lower values can be noted. A value > 50 is typical of a satellite with 50º elevation or higher and a clear view of the sky.
13. **P2:** The L2 signal-to-noise value, which will vary depending on satellite State. Optimal performance range for L2 C/N0 is 42dB to 48dB, although higher and lower values can be noted. The typical value for PRN's 120 to 138 is 0.
14. **IODC:** *Issue of Data Clock.* Indicates the issue number of the data as provided from the GPS satellite in accordance with ICD-200C.
15. **dGPS Age:** The age of the current aided navigation correction. This value changes depending on the correction source, and the correction interval. The typical value for PRN's 120 to 138 is 0.
16. **Status:** The channel tracking status of each individual channel.
17. **Reason for satellite failure:** The reason for poor tracking or unreliable position information for a selected channel/satellite.
18. **Last:** Shows the MM:DD:YYYY and HH:MM:SS of the last 0x86 message update.

A0 – Alerts

The *A0-Alerts* tab displays alerts in real time only. No alerts are archived.

B0 – Raw Measurements

This message must be scheduled for output to view data. If not scheduled, select *Receiver > Messages > NCT output* from the menu bar. The *NCT Binary Messages* window opens. Add this message to the output list (see Figure 87).

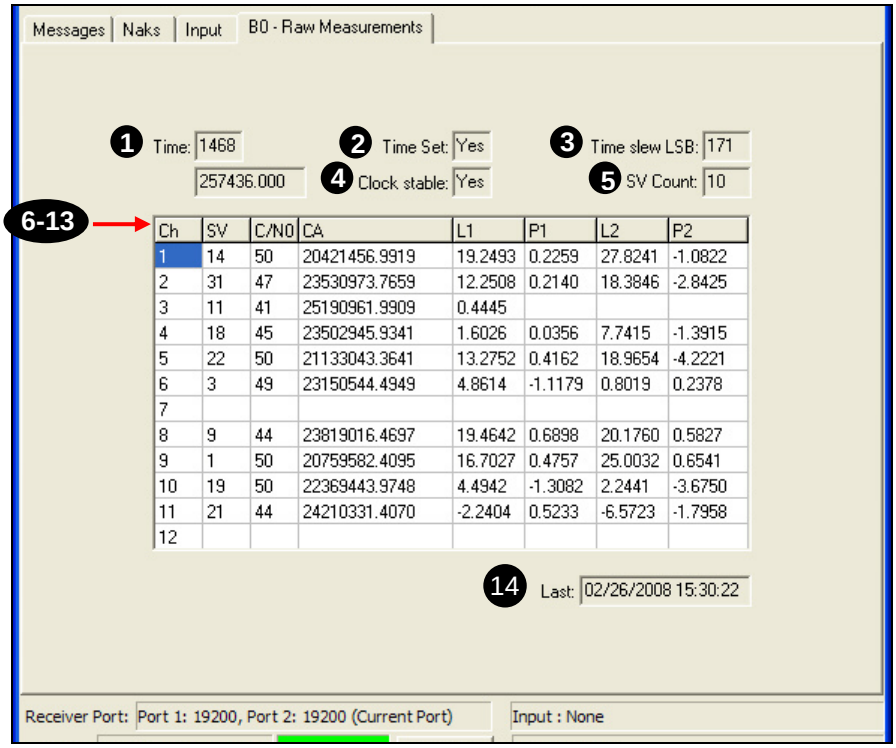


Figure 94: B0 – Raw Measurements

1. **Time:** GPS Week number and GPS Seconds into the week (Refer to the *Technical Reference Manual*)
2. **Time Set:** The values are *Yes* or *No*.
3. **Time slew LSB:** The least significant bit for clock drift. The range is from 0 to 255.
4. **Clock Stable:** The values are *Yes* or *No*. The offset is less than 2 parts per million.
5. **SV Count:** The number of GPS satellites currently tracked by the receiver.
6. **Ch:** The channel number of the receiver.
7. **SV:** The GPS satellite number assigned to that particular channel. The valid GPS PRN range is 1-32.
8. **C/NO:** *Carrier-to-noise ratio*. The signal strength indictor.
9. **CA:** *Coarse Acquisition code.* The number of meters (range measurement) to the satellite.
10. **L1:** The L1 frequency. The number of carrier cycles between the satellite and the receiver.
11. **P1:** The P1 pseudorange.
12. **L2:** The L2 frequency. The number of carrier cycles between the satellite and the receiver.
13. **P2:** The P2 pseudorange.
14. **Last:** Shows the MM:DD:YYYY and HH:MM:SS of the last 0xB0 message update.

B1 – Solution

This message must be scheduled for output to view data. If not scheduled, select *Receiver > Messages > NCT output* from the menu bar. The *NCT Binary Messages* window opens. Add this message to the output list (see Figure 87).

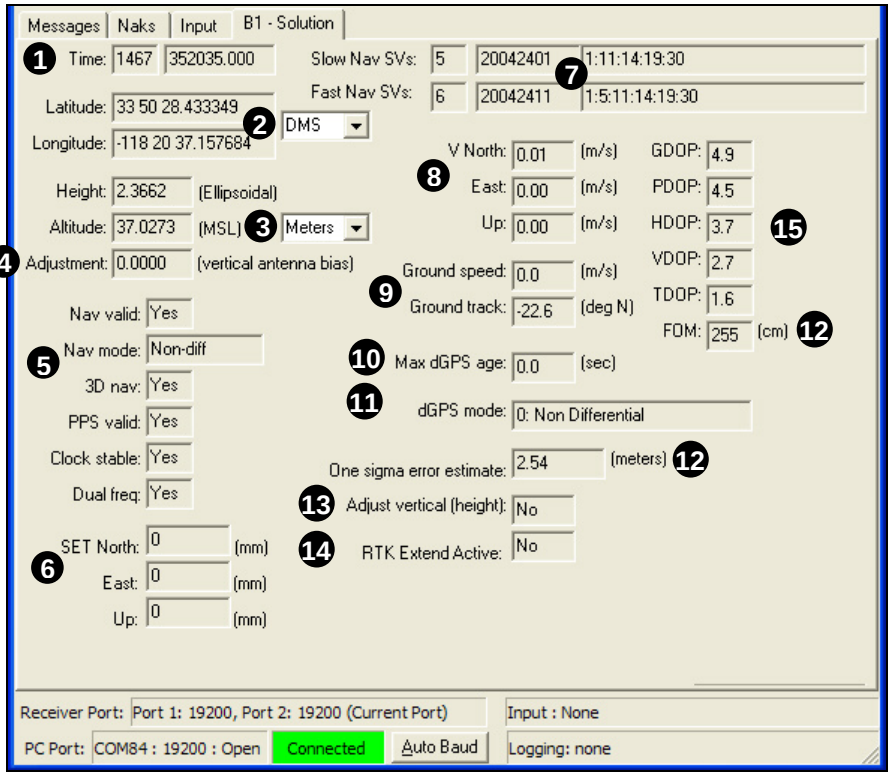
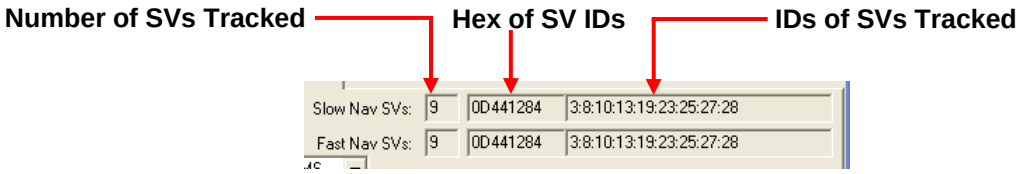


Figure 95: B1 – Solution

1. **Time:** GPS Week number and GPS Seconds into the week (Refer to the *Technical Reference Manual*)
2. **Latitude/Longitude:** Select DMS, Deg, DM, or Rad from the drop-down list.
3. **Height/Altitude:** Select Meters or Feet. The unit of measurement applies to Height, Altitude, and Vertical Antenna Bias.
4. **Vertical Antenna Bias Adjustment:** Bias adjustment value for the antenna model in use. Click the icon to set the bias in the *Vertical Antenna Bias* window (see Figure 21).
5. **Nav:** Various indications of navigation. If disconnected from the receiver, *Nav mode* toggles to *Failure code*. If the value for *3D nav* is *No*, the receiver is in 2D navigation. *PPS valid* indicates whether or not 1PPS (One Pulse Per Second) output is valid. Refer to *Chapter 10 1PPS/Events* for more information.
6. **SET:** *Solid Earth Tides.* Positions with SET provide better vertical (primarily) and horizontal positioning accuracy, to account for gravitational effects placed on terrain from celestial bodies (i.e. the Sun, Moon, etc.). Refer to the description of the *Use SET Corrections* option on the *Rover / Navigation & Tracking Setup* window.

7. Slow and Fast Nav SVs:



Hex	Binary	IDs of SVs Tracked
0D441284	00001101010001000001001010000100	00001101010001000001001010000100 28 25 27 23 19 13 10 8 3

8. Velocity: The vectors for satellite velocity.

9. Ground Speed and Track: The speed over ground and direction of travel (true, not magnetic).

10. Max dGPS age: The maximum amount of time in seconds for all received corrections in the current position record. Click the ROVER icon on the toolbar to set the Max dGPS age on the *Rover / Navigation & Tracking Setup* window (see Figure 16). The displayed time must be within the max dGPS age limit, which is 1200 seconds. The default max dGPS age limit is 300 seconds.

11. dGPS mode: The current dGPS navigation mode. The common modes are:

0: Non-differential

1: RTCM type 1 and 9 code

3: WAAS code dual

11: RTG dual

20: NCT-RTK

Refer to message 0xB1, W22 in the *Technical Reference Manual* for the complete list of dGPS navigation modes.

12. FOM: The DOP *Figure Of Merit* is the estimated uncertainty in the navigation solution. *FOM* is the same as the **One sigma error estimate**. (Refer to the *Technical Reference Manual*)

13. Adjust vertical (height): Indicates whether or not there is a bias adjustment value for the antenna model in use (see Item 4 above).

14. RTK Extend Active: The value, *Yes* or *No*, indicates whether or not RTK Extend™ is active. If the value is *Yes*, the *dGPS mode* is *11: RTG Dual* (see Item 11 above) when RTK is not available. The FOM follows mode 11, but the positioning accuracy will stay at RTK levels (approx. 1cm) during the RTK Extend™ period.

15. DOP: *Dilution of Precision.* A class of measures of the magnitude of error in GPS *position* fixes due to the orientation of the GPS satellites with respect to the GPS receiver. There are several DOPs to measure different components of the error: *GDOP* (Position and Time), *PDOP* (Dimensional Position), *HDOP* (Horizontal Position), *VDOP* (Vertical Position), and *TDOP*. The maximum PDOP value is 25.5.

B1 – Solution Plot

This message must be scheduled for output to view data. If not scheduled, select *Receiver* > *Messages* > *NCT output* from the menu bar. The *NCT Binary Messages* window opens. Add this message to the output list (see Figure 87).

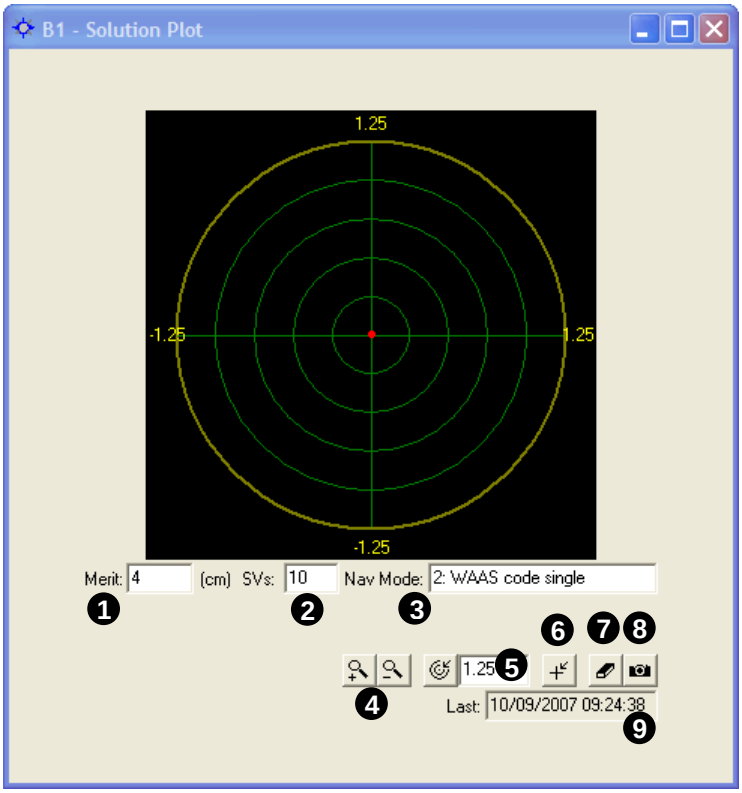


Figure 96: B1 – Solution Plot

1. **Merit:** The *Figure Of Merit* is the estimated uncertainty in the navigation solution.
2. **SVs:** The current number of satellite vehicles being tracked.
3. **Nav Mode:** The current navigation mode (see B1 – Solution, Item 11 above).
4. **Zoom in/ Zoom Out**
5. **Set scale:** Enter a scale value in meters and click the *Set scale* button . Each time the plot is scaled, previously displayed plot points are erased.
6. **Set origin:** Click to set the origin source. The *B1 – Plot Origin* window opens (refer to the instructions below).
7. **Erase:** Clear the plot.
8. **Snapshot to paste buffer**
9. **Last:** Shows the MM:DD:YYYY and HH:MM:SS of the last update of the plot.

Set the Origin Source

✓ Click the icon to open the *B1 – Plot Origin* window (see Figure 97).

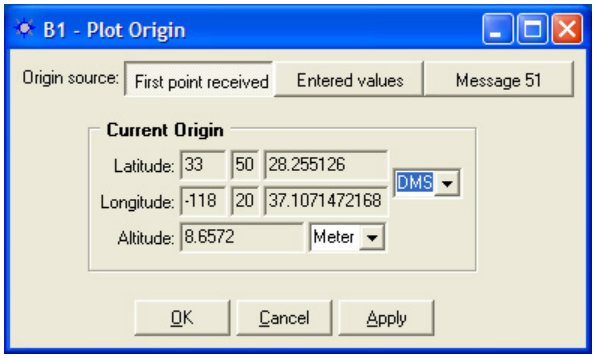


Figure 97: B1 – Plot Origin Window

✓ Set the origin source from the:

- *First Point Received:* (default) Select DMS, Deg, DM, or Rad from the drop-down list for Latitude and Longitude. Select Meters or Feet from the drop-down list for Altitude. Click the *Apply* button. The first point received is plotted in the center of the crosshairs.
- *Known Latitude and Longitude:* Click the *Entered values* button. Type in the known Latitude and Longitude. Select DMS, Deg, DM, or Rad from the drop-down list for Latitude and Longitude. Select Meters or Feet from the drop-down list for Ellipsoidal Height. Click the *Apply* button. The origin is plotted from the entered values.
- *Base Position:* Click the *Message 51* button. Click the *Apply* button. The origin is plotted from the current base position stored in NVRAM. If a base receiver is reconfigured as a rover, and if a position is stored in NVRAM, it can be retrieved to use as the origin.

B2 – Satellite Selection

The B2 – Satellite Selection tab lists all the current satellite vehicles (SVs) visible above the horizon in a 0° to 360° view.

This message must be scheduled for output to view data. If not scheduled, select *Receiver > Messages > NCT output* from the menu bar. The *NCT Binary Messages* window opens. Add this message to the output list (see Figure 87).

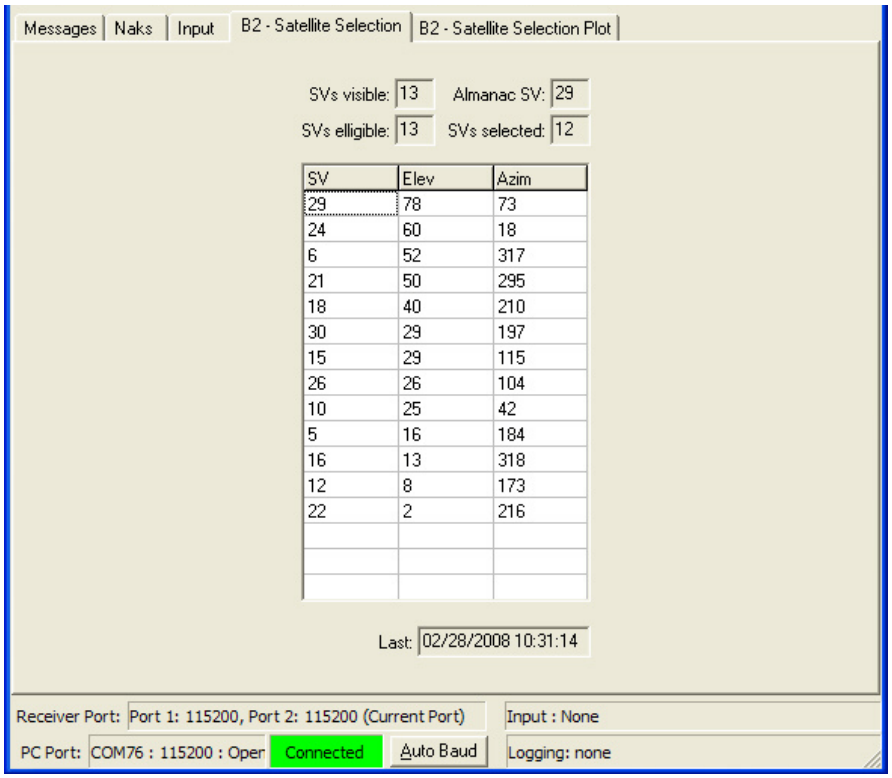


Figure 98: B2 – Satellite Selection

B2 – Satellite Selection Plot

This display shows the relative satellite positions relative to the current GPS receiver position. Each successive ring indicates 15° of increased elevation, where the outer ring represents the horizon.

Message B2 must be scheduled for output to view data. If not scheduled, select *Receiver* > *Messages* > *NCT output* from the menu bar. The *NCT Binary Messages* window opens. Add this message to the output list (see Figure 87).

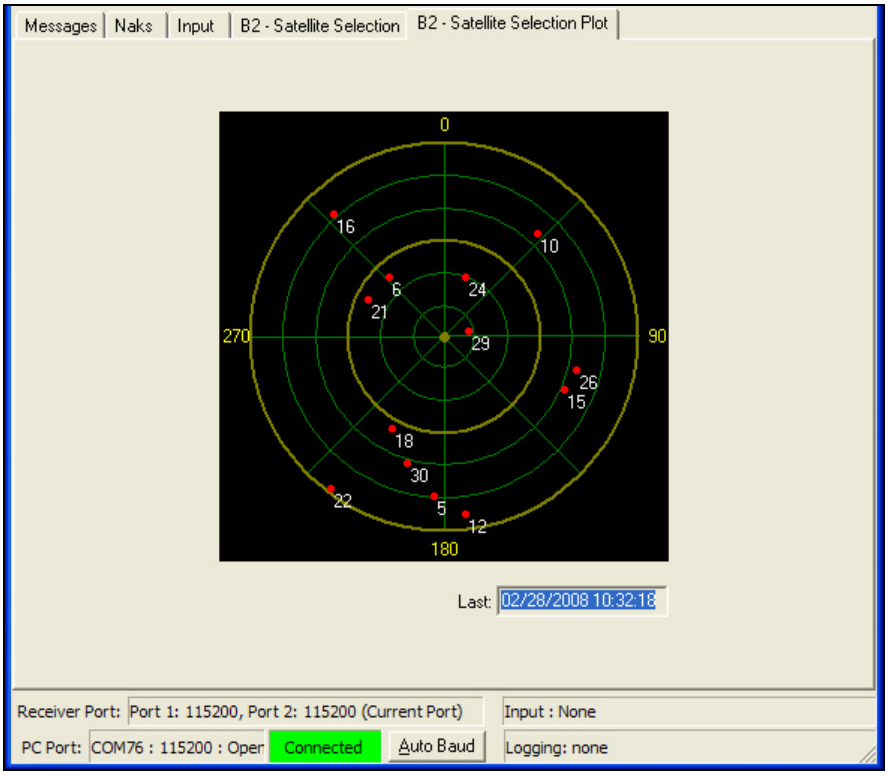


Figure 99: B2 – Satellite Selection Plot

NMEA Messages

This section provides steps to add NMEA messages to an output list, and to configure and delete messages from the list. The receiver has the ability to output industry standard NMEA-0183 data strings, and one NCT Proprietary NMEA-0183 type string.

✓ Select the output port for NMEA messages from the *Unit Port Configuration* window. Refer to *Chapter 2 Establish Communications/Configure Unit Ports* for details.

⚠ NMEA messages cannot be output on the same port that is used for Control.

Refer to the section, *View and Log NMEA Data,* in *Chapter 8* for instructions to view and log NMEA message output data.

NMEA Message Output List: Add, Configure, or Delete Messages

■ Open Message Output List

✓ Select *Receiver* > *Messages* > NMEA *output* from the menu bar. The *NMEA Messages* window opens with the current message output list (see Figure 100).

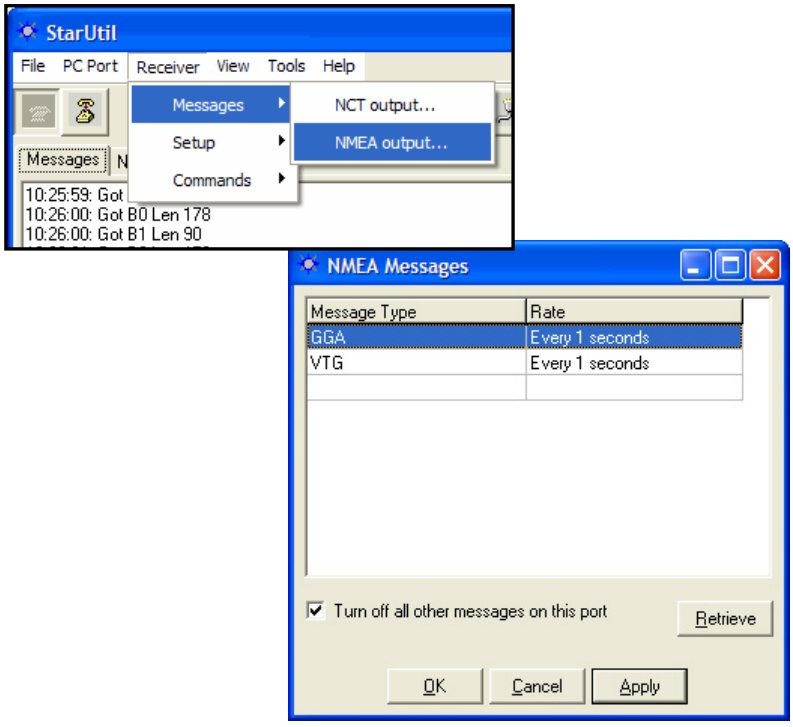


Figure 100: NMEA Message Output List

After making settings in the sections below, click the *Apply* button and then click the *Retrieve* button to confirm that the receiver accepts the new settings.

Add Messages

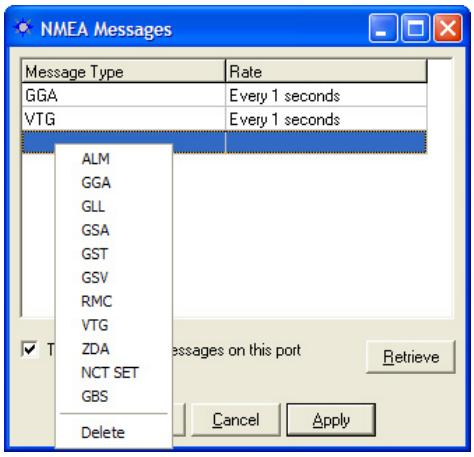


Figure 101: NMEA Message Type Menu

✓ Right-click in a blank *Message Type* cell. A menu opens with a list of messages (see Figure 101).

✓ Click on a message in the menu to add it to the message output list. *On Change* is the default rate for every message added to the list.

Use of the default rate *On Change* is generally recommended for all NMEA messages. Go to the next section for details.

Configure Message Rate

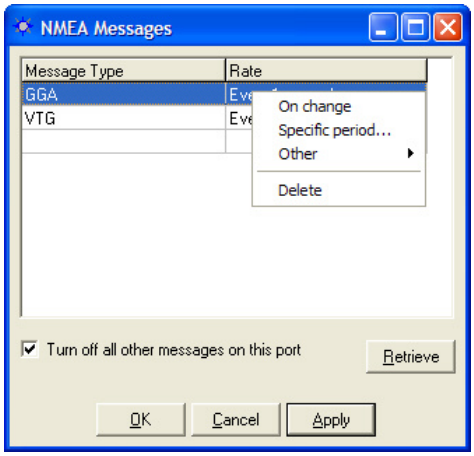


Figure 102: NMEA Rate Menu

✓ *Rate:* Right-click on the *Rate* cell to open the menu to schedule the frequency of output for a message (see Figure 102). Use of the default rate *On Change* is generally recommended for all NMEA messages, including GGA and VTG. Change the rate for GGA and VTG to *On Change*, if desired.

The term *On Change* indicates that the receiver will output the specified message each time new data is available.

The NMEA messages GGA, RMC, and VTG match the output of the navigation rate up to 10 Hz max when scheduled as *On Change*. Refer to the description of the *Navigation Rate* option on the *Rover / Navigation & Tracking Setup* window

for more information. The receiver must be optioned for a multi-hertz Navigation Rate to achieve multi-hertz NMEA output.

✓ The options on the *NMEA Rate* menu are:

- *Specific Period:* Enter a value in seconds in the *Rate* cell.
- *Other:*
  - o *All SVs:* Not Applicable
  - o *On Trigger:* Not Applicable
  - o *Special Value:* Not Applicable

■ Delete Messages

✓ Right-click on a message. A menu opens. Select *Delete* at the bottom of the menu to delete the message.

✓ Click on a message to highlight it. Press the *Delete* key on the keyboard.

This action is not complete until the *Apply* button or *OK* button is clicked. Failure to send the deleted list causes the previous list to be retained.

NMEA GGA Station ID Field 14

The *GGA Option* on the *Rover / Navigation & Tracking Setup* window determines how a GGA message is output (see Figure 103):

- *NMEA Station ID:* Accept this default option to output a GGA message that strictly conforms to the NMEA Standard v3.01.
- *NCT Station ID:* Select this option to populate the *Differential Reference Station ID* field with values that indicate which StarFire™ satellite is being tracked (1st digit) and the navigation mode (2nd digit). See Appendix B for the NCT Station ID matrix.

The differential reference station is field 14 in the NMEA GGA message.

Click the ROVER icon on the toolbar to open the *Rover / Navigation & Tracking Setup* window.

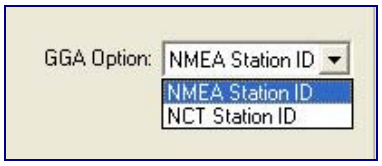


Figure 103: GGA Option

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Chapter 8 .....Log Output Data

This chapter provides instructions to log output data for NCT Binary Messages and NMEA Messages. Log data from either of the physical ports, or to the onboard 64 Megabyte Memory Module Card (MMC). This data can be used in a number of industry standard GPS data analysis programs either in NCT Binary format, after conversion to RINEX format, or by using the NMEA output.

Log NCT Binary Data Externally

The data from NCT Binary Messages scheduled for output may be:

- ✓ Logged continuously in a single file
- ✓ Logged in 24-hour data file splits

Almanac & Ephemeris data currently in the receiver's NVRam is automatically downloaded to the data file when logging is initiated, regardless of whether the Almanac & Ephemeris messages are scheduled for output in the NCT Binary Messages window.

- ✓ Click the icon on the toolbar to log data to a file. The data logging window opens (see Figure 104). The *Current Status* area of the window indicates: if logging is enabled, if the scheduler [24-hour splits] is enabled, and the path to the log file.

To open the data logging window from the menu bar, select *File > Log Data to File*.

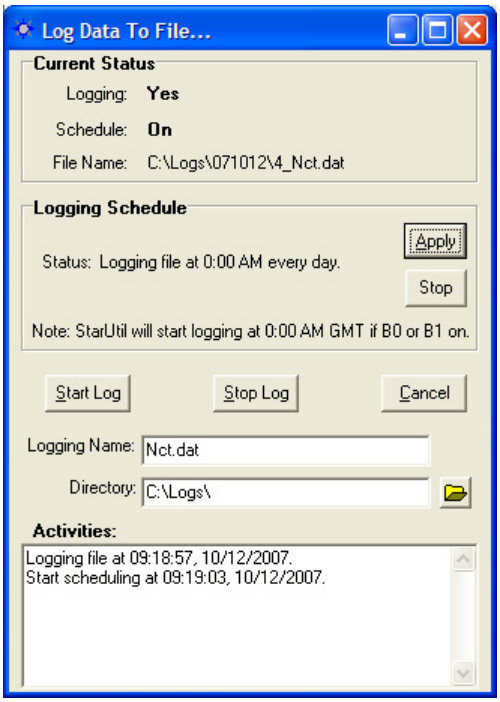

Figure 104: NCT Binary Messages Data Logging Window

Log Data in Single File

- ✓ Rename the *NCT.dat* file, if desired.
- ✓ Click the button to select a directory in which to save the file.

StarUtil creates a folder under the selected directory, named in the yymmdd format. For example, the directory path d:\NavComWorking\Data would become d:\NavComWorking\Data\yymmdd.

- ✓ Click the *Start Log* button to begin logging the output data. Click the *Stop Log* button to stop logging.

Log Data in 24-hour File Splits

- ✓ Click the button to select a directory in which to save the data files.
- ✓ Click the *Apply* button in the *Logging Schedule* area of the window to start logging in 24-hour data file splits. Click the *Stop* button to stop logging.

The file splits restart at 00:00:00 GMT, and create a new folder name at each 24-hour period.

Log NCT Binary Data Internally Via Memory Module Card (MMC)

An onboard 64MB Memory Module Card (MMC) is used to internally log NCT Binary data. The basic procedure to log one or more messages to the MMC is:

- ✓ In the *NCT Binary Messages* window, schedule a second instance of the desired NCT binary message(s) to the *Log* port.
- ✓ Open the *MMC Directory*. The user must format the MMC on first use only.
- ✓ Start internal logging from the *MMC Directory*. The user names the data file.
- ✓ Close internal logging. The user may sort, download, and delete the data files in the *MMC Directory*.

If power is turned off during internal logging, internal logging resumes on power up. A new file is created with an extension of .001. A new file is generated and the extension value incremented for each power off-on cycle, if logging is not manually stopped by the user.

This feature allows the user to configure and start logging in the office, then power off the receiver and move it to a remote location. At the remote location, no setup time for logging is necessary. As soon as power is applied to the receiver and it initializes, internal data logging begins.

Schedule Messages to Log

This section provides steps to schedule one or more messages in the *NCT Binary Messages* window to log internally to the MMC. StarUtil provides two ways, manual and automatic, to schedule the messages.

The maximum log rate is 1Hz. A higher rate or *On Change* may overflow the buffer.

Manually Schedule Internal Logging

- ✓ Select *Receiver* > *Messages* > *NCT output*. The *NCT Binary Messages* window opens with the current message output list.
- ✓ Right-click in a blank *Message ID* cell, and add the second instance of a message. The port and rate are automatically assigned and must be changed.
- ✓ Right-click in the *Port* cell to change the port assignment. Select *Log* from the menu that opens.
- ✓ Right-click in the *Rate* cell to change the rate to *1Hz*. Select *Specific Rate* > *1Hz* from the menus.
- ✓ Repeat the steps above for desired message(s). Figure 105 displays examples of messages scheduled to be logged.
- ✓ Click the *Apply* button and then click the *Retrieve* button to confirm that the receiver accepts the new setting(s).

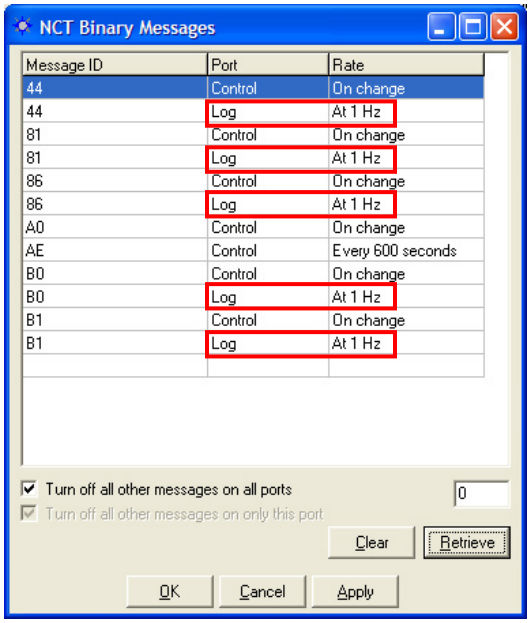

Figure 105: Log Messages Internally

Automatically Schedule Internal Logging of Most (but not all) of the Default NCT Binary Messages

- ✓ Select *Tools* > *MMC Internal Data Logging*. The *MMC Directory* opens.
- ✓ Click the *Schedule Default Messages* button (see Figure 106). The *NCT Binary Messages* window opens. Second instances of the default messages 44, 81, 86, B0, and B1 are scheduled and assigned to the *Log* port. (Second instances of the default messages A0 and AE are not scheduled to log.)
- ✓ For each message to be logged, right-click in the *Rate* cell to change the rate to *1Hz*. Select *Specific Rate* > *1Hz* from the menus.
- ✓ Click the *Apply* button and then click the *Retrieve* button to confirm that the receiver accepts the new setting(s).

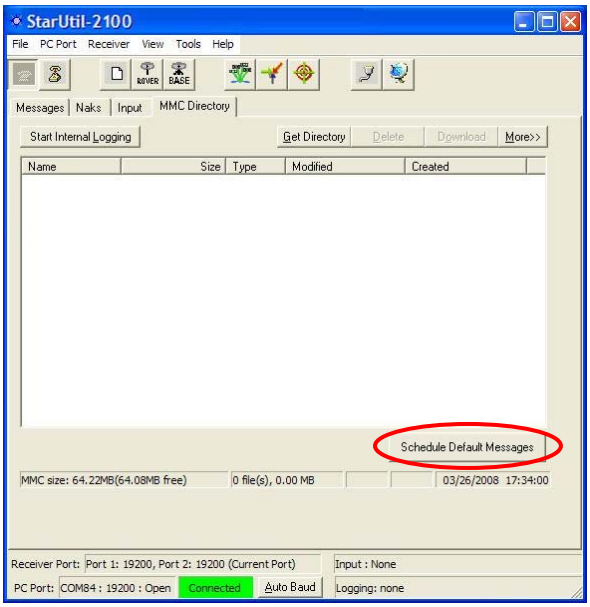

Figure 106: Schedule Default Messages Button

Format the MMC

This section provides steps to format the Memory Module Card (MMC). The MMC must be formatted only the first time it is used. Go to the next section if the MMC is already formatted.

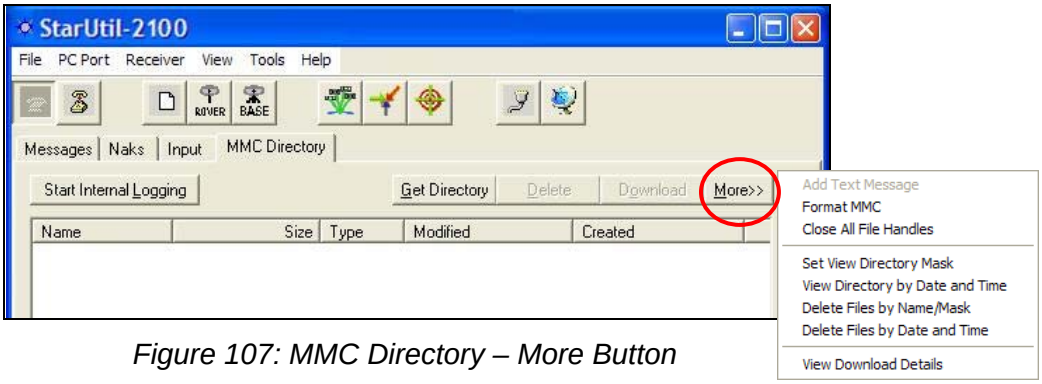

Figure 107: MMC Directory – More Button

- ✓ Select *Tools > MMC Internal Data Logging* to open the *MMC Directory*.
- ✓ Click the *More* button (see Figure 107). A menu opens.
- ✓ Click the *Format MMC* menu item. A warning window opens.
- ✓ Click *OK* to format the MMC disk. The *Format MMC* window opens.
- ✓ Type in a *MMC Format Label*. A specific label name is not required. The example in Figure 108 uses the serial number of the GPS receiver.

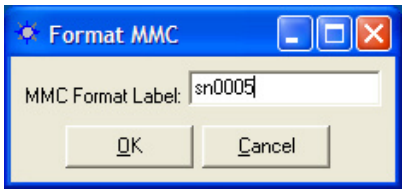

Figure 108: MMC Format Label

- ✓ Click *OK*. Wait until the MMC is formatted successfully.

Log Data Internally

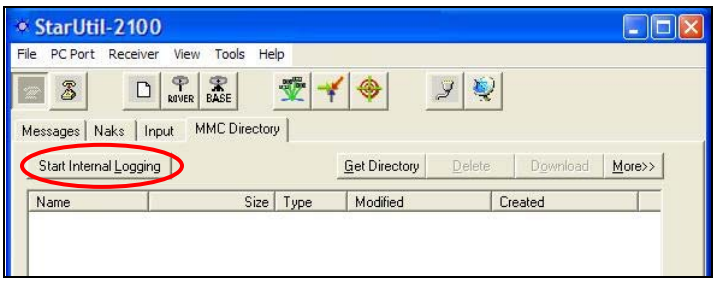

Figure 109: Start Internal Logging Button

- ✓ Select *Tools > MMC Internal Data Logging* to open the *MMC Directory* if it is not already open.
- ✓ Click the *Start Internal Logging* button to log data from the messages scheduled to output to the *Log* port (see Figure 109). A window opens to enter a file name (see Figure 110).

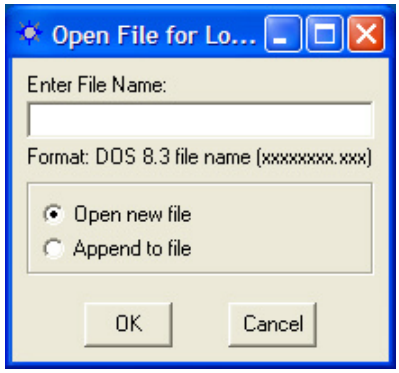

Figure 110: Enter File Name For Logging

✓ In the *Open File for Logging* window (see Figure 110):

- Enter the logging file name in MS-DOS 8.3 format. Use any file extension. A common extension is *.dat*.
- Select to open a new file or append to an old file.

✓ Click Ok. Logging starts. The data file is displayed in the *MMC Directory*. The *Start Internal Logging* button changes to the *Close Internal Log* button. A status bar opens at the bottom of the window. Refer to Figure 111.

The directory information in the *MMC Directory* window does not auto-update. Click the *Get Directory* button to update the current file information.

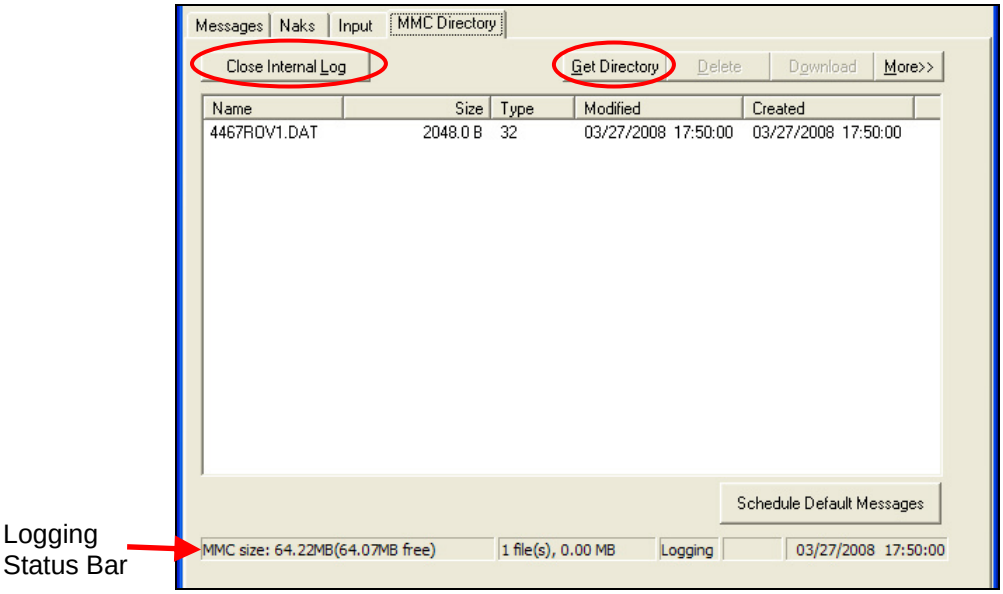

Figure 111: MC Directory Internal Logging

✓ When logging is complete, click the *Close Internal Log* button.

Download, Sort, Delete Files

Download Data File from MMC Directory

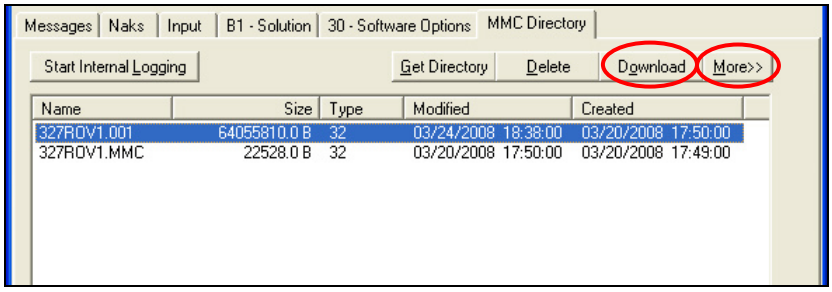

Figure 112: Download File From MMC Directory

File download is only via COM1. A warning opens if attempting to download a file from COM2. (Operation and configuration of the MMC can be via either COM1 or COM2.)

Refer to Figure 112 for the steps below:

- ✓ Select one or more files to download.
- ✓ Click the *Download* button. The *Save As* window opens.
- ✓ Browse to a download location, select it, and click the *Save* button. A window opens with the download progress.

To download one file at a time as a whole file or specified sectors only, use the *Download Details* window. Click the *More* button and select the *View Download Details* menu item. The *Download Details* window opens (see Figure 113).

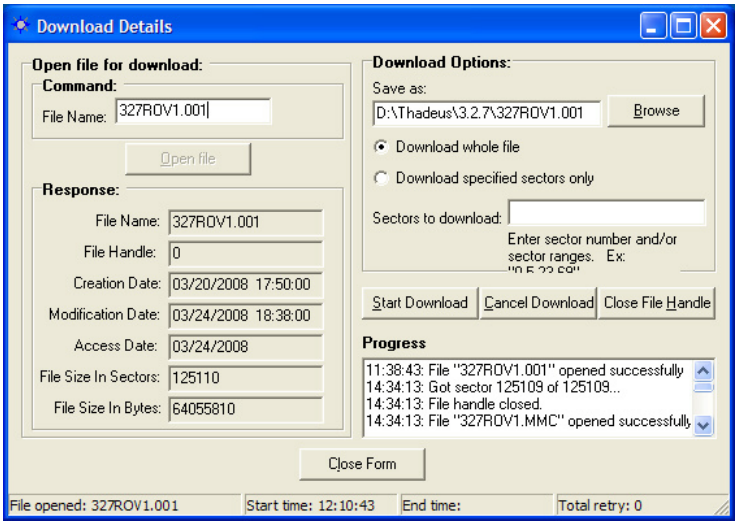

Figure 113: Download Details Window

Sort Data Files in MMC Directory

- ✓ Click the *More* button. A menu opens with options to sort the files.

Delete Data Files from MMC Directory

- ✓ Select one or more files to delete, and then click the *Delete* button.

View and Log NMEA Data

This section provides guidance to setup the NMEA viewer, and steps to view and/or log NMEA message output.

NMEA Viewer Setup

To view and/or log NMEA message output, a second instance of StarUtil must be run, and NMEA messages must be output from the *Data* port. They cannot be output on the same port that is used for *Control*.

If desired, the user may use any ASCII RS232 port viewer instead of StarUtil.

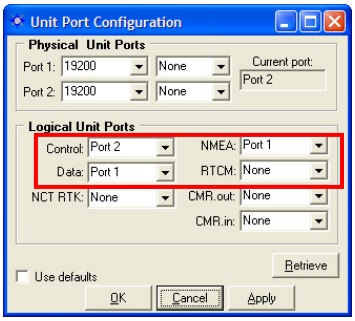

Figure 114: NMEA Set To Data Port

View NMEA Data

✓ Select *Tools* > *NMEA Viewer* from the menu bar. The viewer opens with data output from the scheduled NMEA messages (see Figure 115).

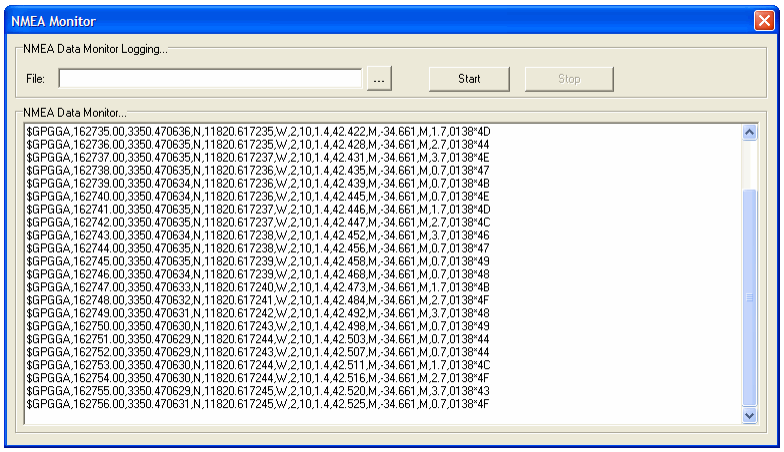

Figure 115: NMEA Viewer

Log NMEA Data

Refer to Figure 116 for the steps below:

✓ Click the [...] button to create a log file. A window opens.

✓ Rename the *NMEA.log* file, if desired, and save it in a folder. The NMEA Viewer window displays the path.

✓ Click the *Start* button to begin logging the output data. Click the *Stop* button to stop logging.

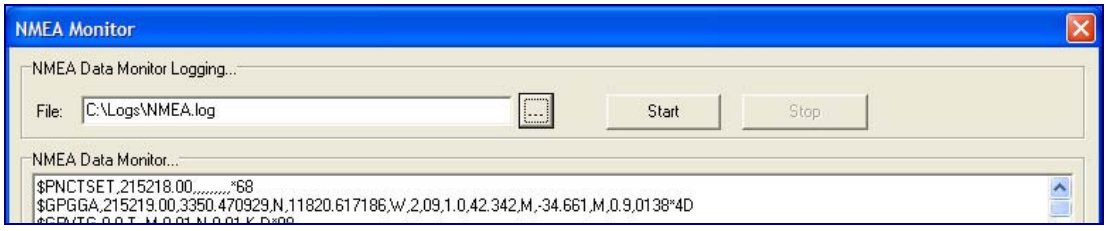

Figure 116: NMEA Logging

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Chapter 9 .....Load Software

This chapter provides instructions to:

- ✓ Load purchased software options to the receiver:
  - Fast Update Rates – Position (10Hz >)
  - Fast Update Rates – Raw Data (10Hz >)
  - Other features that may become available at future dates
- ✓ Load module software updates (free) to the receiver

Refer to *Chapter 6 StarFire™ Operation* for instructions to load the license for the StarFire™ subscription service.

RTK Extend™ is a software option only available in NavCom Technology receivers that are StarFire™ capable and use the NCT-2100 GPS engine. To upload RTK Extend™, perform the instructions in the section below, *Load Purchased Software Options*.

The user may upload software via StarUtil or the Install Utility. The Install Utility is included with the software ensemble files. This guide only includes instructions for upload via StarUtil. Refer to the *Install Utility User Guide* for instructions in its use (see *Related Documents* in the fore-matter).

How to Purchase Software Options

Contact a NavCom authorized representative, or the NavCom Sales Department (sales@navcomtech.com) to purchase software options. The user receives a software options file via email to install purchased options. The file contains an options code to upload into the receiver. The user must also determine the Software Options Type to upload with the options code.

The options code is receiver dependant and cannot be uploaded into multiple receivers. Archive the software options file in case a reload is necessary.

Load Purchased Software Options

The receiver must be navigating at the time of the software options update for the receiver to accept the update.

1. Save the software options file to the hard drive.
2. Open the software options file in any text file viewer, for example, Microsoft Notepad.
3. Copy the options code at the bottom of the file (see example in Figure 117).

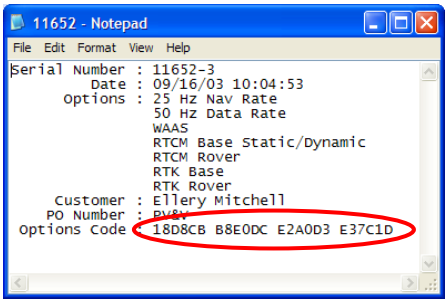

Figure 117: Software Options Code

4. Select *Tools > Load Software Options* in StarUtil. The *Software Options* window opens.
5. Paste the options code into the *Software Options* window (see example in Figure 118).

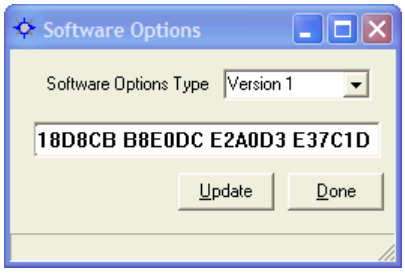

Figure 118: Software Options Window

To load software options, the user must also select the *Software Options Type*. The GPS unit serial number or the GPS digital card serial number is used to determine the *Software Options Type*.

6. Refer to Figure 119 to locate:
   - The GPS unit serial number on the rear of the receiver

     Or
   - The GPS digital card serial number. Select *View > AE - Version Information*. A tab opens that includes the digital card serial number.

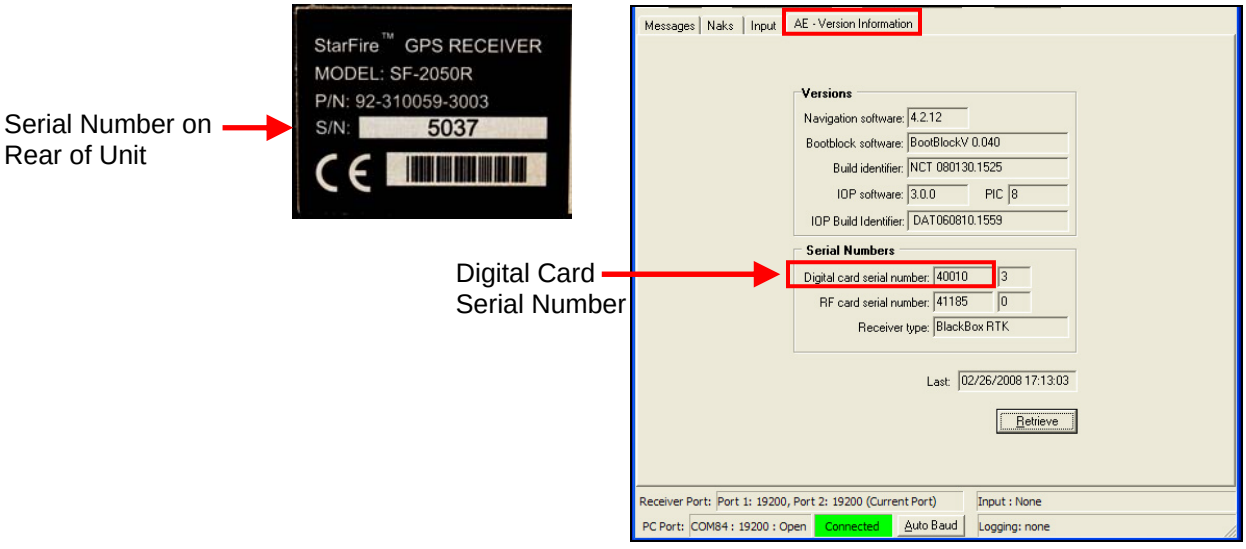

Figure 119: Unit & Digital Card Serial Numbers

7. Refer to Table 10 to determine the correct *Software Options Type*.

Table 10: Software Options Type

Software Options Type	Digital Card Serial Number	Unit Serial Number
Version 1	< 40,000	< 5000
Version 2	> 40,000	> 5000

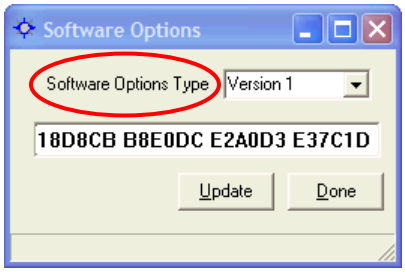

Figure 120: Software Options Type

8. Select *Version 1* or *Version 2* from the *Software Options Type* drop-down menu (see *Figure 120*).
9. Click the *Update* button.
10. Click the *Done* button to close the window.
11. Select *View > 30 – Software Options* to verify a successful update of the software options. A tab opens.
12. Click the *Retrieve* button to view the current software options. Figure 121 shows an example of a successful update. The options on the *30 – Software Options* tab match the options in the software options file.

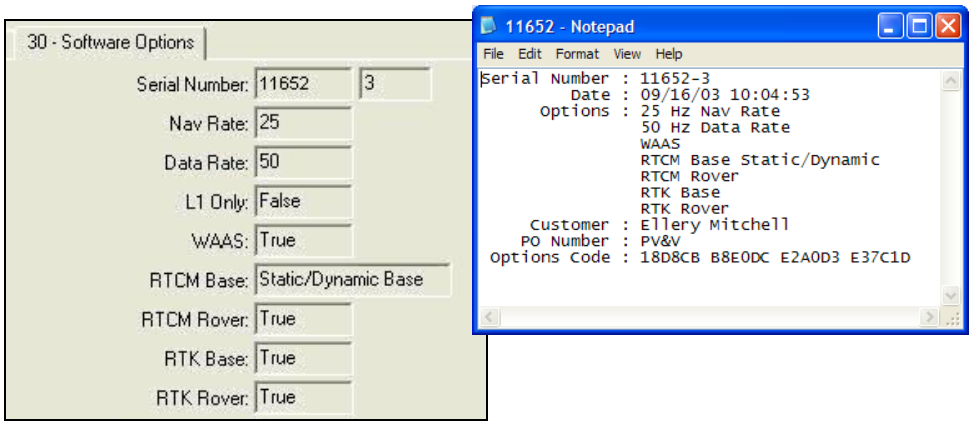

Figure 121: Software Options

RTK Extend™

Verify Successful Upload

✓ Select *View > 30 – Software Options*. Click the *Retrieve* button on the *30 – Software Options* tab. The *RTK Extend™* field displays *True* to confirm a successful upload (see Figure 122).

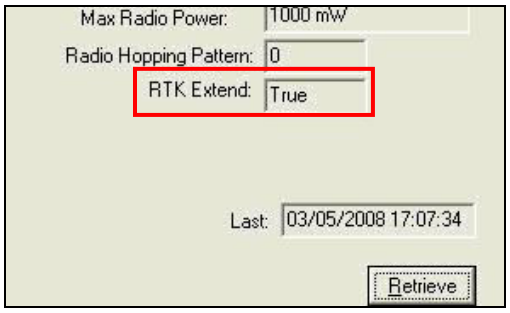

Figure 122: RTK Extend True

Enable RTK Extend

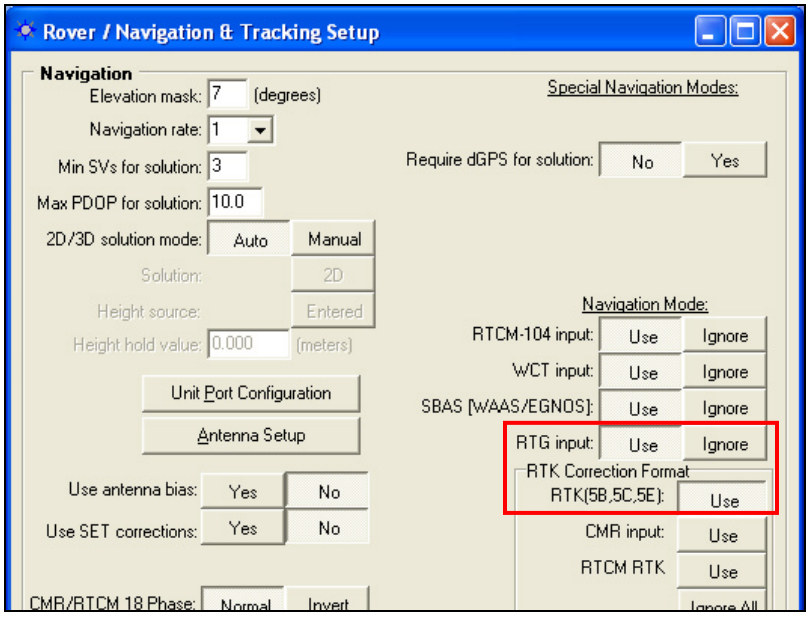

Figure 123: Rover Configured for RTK Extend

✓ To enable RTK Extend™, click the ROVER icon on the toolbar. The *Rover / Navigation & Tracking Setup* window opens.

✓ Set both *RTG Input* and *RTK (5B, 5C, 5E)* to *Use* if not already set (see Figure 123). RTK Extend™ will not function unless both controls are set to *Use*.

Verify RTK Extend Is Active

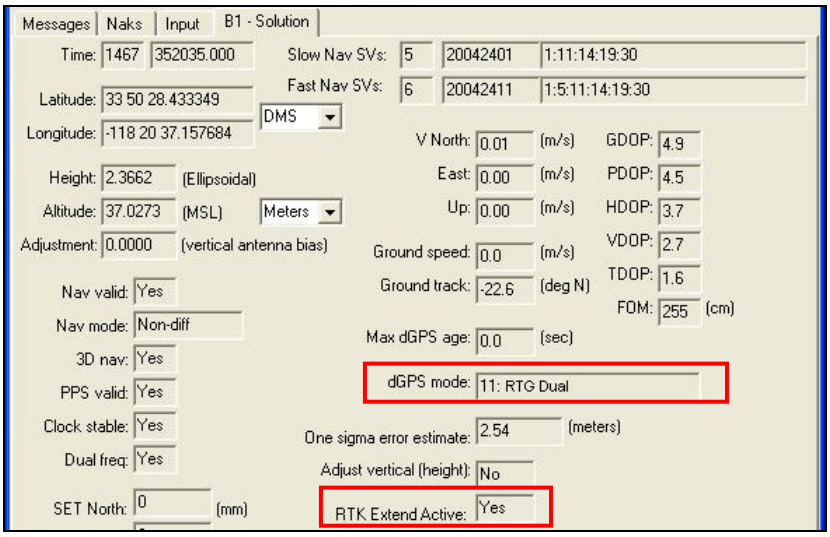

Figure 124: B1 – Solution: RTK Extend Active

✓ To verify that RTK Extend™ is active, select *View > B1 – Solution*. The *B1 – Solution* tab must display these values (see Figure 124):

- *RTK Extend Active: Yes*
- *dGPS mode: 11: RTG Dual*

The FOM follows mode 11, but the positioning accuracy will stay at RTK levels (approx. 1cm) during the RTK Extend™ period.

Load Module Software Updates

Periodically check NavCom Release Notes for descriptions of software updates to receiver software. Current and archived Release Notes are available on the NavCom web site: http://www.navcomtech.com/Support/DownloadCenter.cfm?category=releasenotes.

NavCom Customer Support provides software updates described in the Release Notes. Submit a request for software updates via the Request Support web page. Depending on GPS model and module to be updated, the user may receive three files, one .BIN and two .HEX files (refer to Table 11).

Table 11: GPS Model Configuration

GPS Model	Module		
	GPS	IOP	LBM (StarFire™)
SF-2050	✓	✓	✓
SF-2040	✓	✓	✓
NCT-2030M	✓	✓	
RT-3010	✓	✓	
RT-3020	✓	✓	
NCT-2000D	✓		
NCT-2100D	✓		

The user may upload software via StarUtil or the Install Utility. The Install Utility is included with the software ensemble files. This guide only includes instructions for upload via StarUtil. Refer to the *Install Utility User Guide* for instructions in its use (see *Related Documents* in the fore-matter).

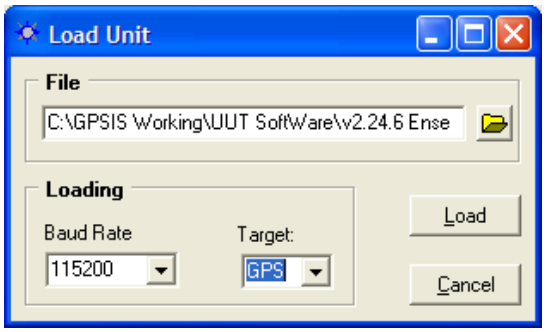

Figure 125: Load Unit Window

The receiver must be navigating at the time of the software update for the receiver to accept the update.

Refer to Figure 125 for the steps below:

- ✓ Save the software update files to the hard drive. (Archive the files in case a reload is necessary.)
- ✓ Select *Tools > Load Software*. The *Load Unit* window opens.
- ✓ Click the button to browse to and select a software update file. The path to the file appears in the *Load Unit* window.
- ✓ Select the *Baud Rate*. It *only* applies to the upload of the software update file.
- ✓ Select the appropriate *Target*:
  - *GPS*: (the default)
  - *IOP:* Must be loaded at 19200 baud rate.
  - *LBM*: StarFire™ software (must be loaded at 19200 baud rate). Do not use the *Load Unit* window to load the StarFire™ license. Refer to the section, *Load StarFire™ License*, in *Chapter 6*.
- ✓ Click the *Load* button. A window opens to display the progress of the upload. Another window opens to indicate a successful upload. Click the *OK* button.
- ✓ Repeat the steps above for each module to be updated. Select the appropriate module from the *Target* drop-down list.
- ✓ Install the new version of StarUtil included with the software update files.
- ✓ Uninstall the old version of StarUtil.

Chapter 10 .....1PPS/Events

This chapter provides guidance to configure the Events input and the 1PPS output pulse according to application requirements:

- ✓ *Event:* The receiver accepts an event input pulse to synchronize external incidents requiring precise GPS time tagging, such as aerial photography. For example, the action of a camera's aperture creates an input pulse to the Event port. The receiver outputs position and time information relative to each photograph taken.
- ✓ *1PPS:* The 1PPS pulse output from the receiver is synchronized with GPS time. This pulse is used for a variety of Time/Mark applications where relative timing is required.

Refer to the *Technical Reference Manual* (TRM) for message details. Refer to the GPS user guide for hardware interfacing specifics and wiring.

- ✓ Select *Receiver > Setup > PPS and Event Latch* from the menu bar. The *PPS and Event Latch* window opens (see Figure 126).

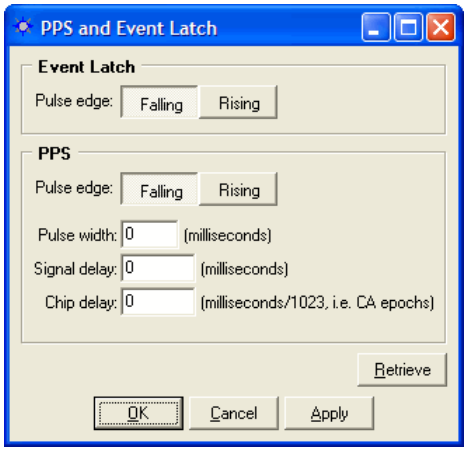

Figure 126: PPS and Event Latch Window

Event Latch

- ✓ The Events Input can be triggered on the Falling or Rising edge of the input pulse.
- ✓ Add message B4 to the *NCT Binary Messages* window and set the Rate to *On Trigger* (see Figure 127). The Event Latch Message 0xB4 is output only when the chosen pulse edge of the incoming event is sensed by the receiver.

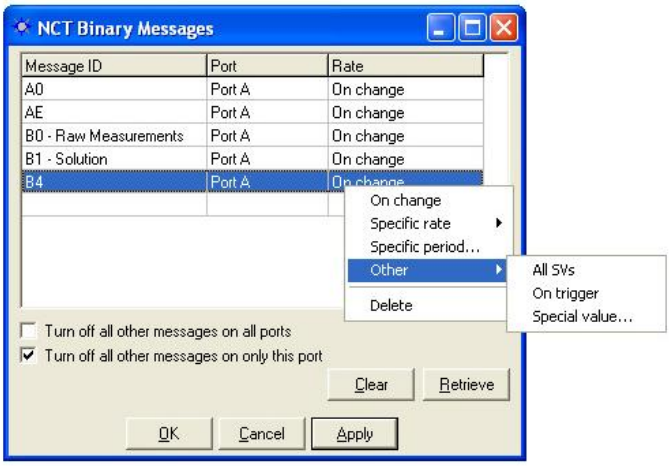

Figure 127: Event Latch Message 0xB4 On Trigger Configuration

✓ Select *View > B4 – Event Latch Data* to view:

- *Time:* The time the event took place.
- *Time FOM:* 10x TDOP.
- *Last:* Shows the MM:DD:YYYY and HH:MM:SS of the last received event.

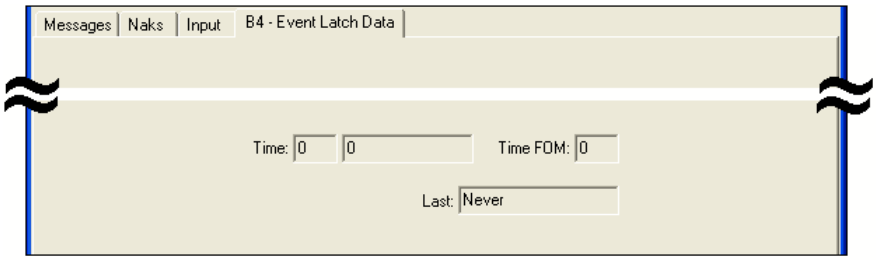

Figure 128: B4 – Event Latch Data

PPS

✓ The 1PPS output can be triggered on the Falling or Rising edge of the output pulse. Set the characteristics of the 1PPS pulse according to application requirements (see Figure 126).

✓ Add message 16 to the *NCT Binary Messages* window and set the Rate to *On Change*. The 1PPS Message 0x16 is output.

✓ Select *View > 84 – PPS Data* to view the *Time* the 1PPS took place, the *Time FOM*, and the *Last* output pulse.

The process for outputting the 0x84 message and other data is:

- Signal received from satellite
- 0xB0 message generated
- 0xB1 message generated
- 0x84 message generated
- Remaining binary messages generated
- NMEA messages generated

The binary messages have a latency of <20ms.

Chapter 11 ..... Ack/Naks & General Commands

This chapter provides instructions to select the Ack/Nak response ports and access general commands.

Ack/Nak means Acknowledged/Not Acknowledged. ACK indicates a successful operation. NAK indicates a failure in executing a command.

Select Ack/Nak Response Ports

✓ Select *Receiver* > *Setup* > *Select Ack/Nak Response Ports* to configure the Control, Data, and/or Diagnostic Ports for Ack/Nak response. The *Select Logical Ports* window opens (see Figure 129).

Select *Diagnostic Port* for models RT-3010 & RT-3020 *only* (with internal radio).

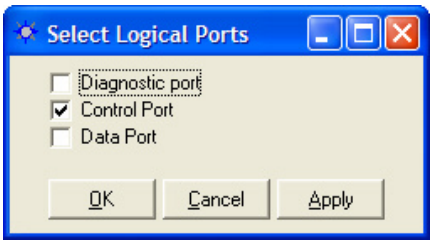

Figure 129: Select Ack/Nak Ports

Key Command

✓ Select *Receiver* > *Commands* > *Key* to open the *Key Command* window (see Figure 130).

Use the *Key Command* window only in consultation with NavCom Customer Support to input special receiver operating functions, generally to troubleshoot a problem.

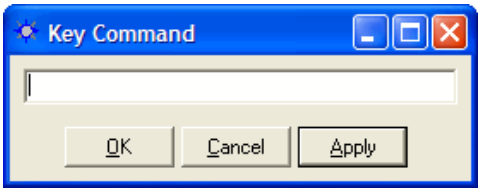

Figure 130: Key Command Window

Get Ephemeris

✓ Select *Receiver* > *Commands* > *Get Ephemeris* to retrieve the current ephemeris in the receiver and output it via the Control Port.

Almanac Commands and Almanac Health

Get Almanac

✓ Select *Receiver* > *Commands* > *Get Almanac* to retrieve the current almanac in the receiver and output it via the Control Port.

Get Almanac Into File

✓ Select *Receiver* > *Commands* > *Get Almanac Into File* to retrieve the current almanac in the receiver and output it via the Control Port to a user defined file location. This file can then be uploaded into another receiver.

Send Almanac From File

✓ Select *Receiver* > *Commands* > *Send Almanac From File* to upload an almanac file to another receiver via the Control Port.

44 – Almanac Health

✓ Select *View* > *44 – Almanac Health* to view almanac health by PRN (see Figure 131):

- *H* – Healthy
- *U* – Unhealthy
- *UK* – Unknown

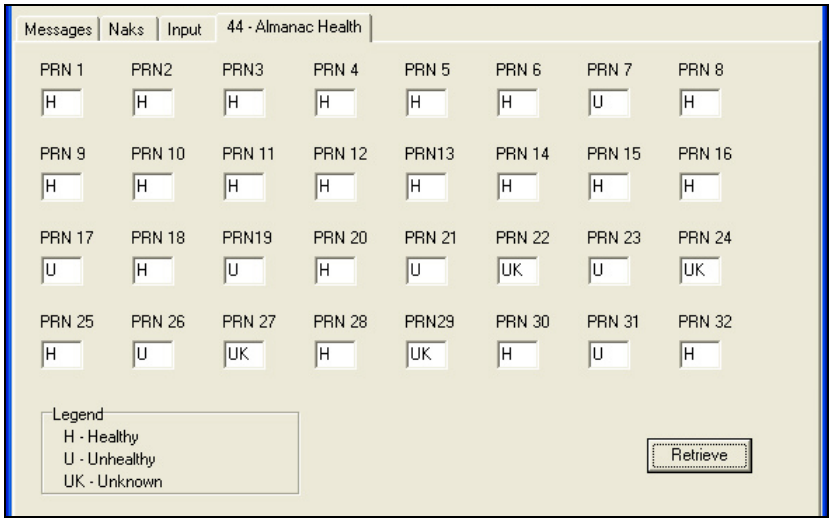

Figure 131: 44 – Almanac Health

Configuration Reset

✓ Select *Receiver* > *Commands* > *Configuration Reset* to reset the receiver to factory default settings. This command does not reset the position, time, almanac, and ephemeris, but resets all other user settings to the factory default.

External Device Configuration Window (Pass-Through)

The *External Device Configuration* window is a Pass-Through tool used to send/receive text data from one serial port on the receiver to the other serial port. This is useful when configuring an external device connected to the Data, RTK, or NMEA logical port. It is also useful to transmit ASCII text to a remote radio.

✓ Select *Receiver* > *Setup* > *External Radio*. The *External Device Configuration* window opens (see Figure 132).

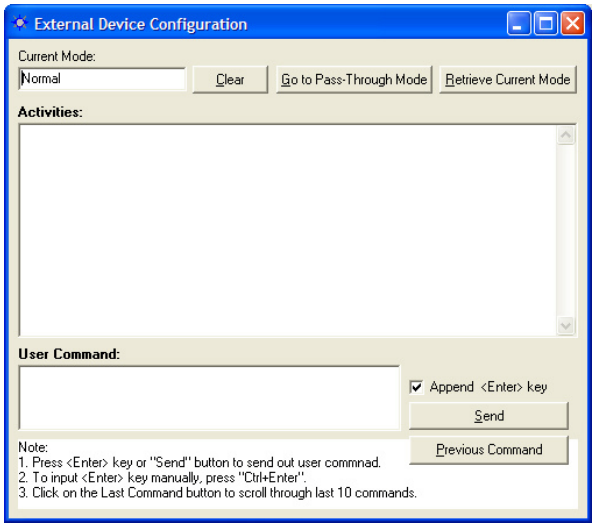

Figure 132: External Device Configuration Window

Initial Position

Depending on Latitude & Longitude, the user may occasionally be required to enter an initial position in order to start navigating in the shortest period of time.

Refer to Figure 133 for the steps below:

✓ Select *Receiver* > *Setup* > *Initial Position*. The *Set Receiver Position* window opens. The settings in the window apply to NCT binary message 0x46.

✓ Click the *Set Time* box to change the elapsed time since the beginning of the week in seconds if known. It is not mandatory to set this field since once a satellite is tracked GPS Week Number, and GPS Week Seconds automatically update. After the receiver starts tracking satellites, time cannot be set since the time from the satellite is assumed to be more accurate.

✓ Click the *Set Position* box to change the initial position the receiver will use to track satellites. Typically, a position within 500km is close enough to pickup satellites and acquire almanac and ephemeris information. Enter the position in *DMS* or *DM* format. Enter the ellipsoidal height in meters or feet.

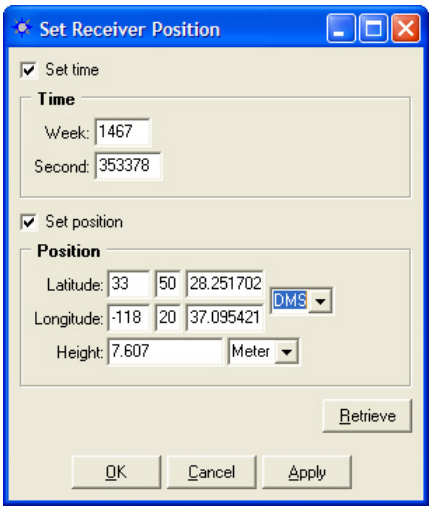

Figure 133: Initial Position

✓ Click the *Apply* button and then click the *Retrieve* button. The receiver uses the newly entered position to locate its first satellite and update almanac and ephemeris information. Collection of a new almanac requires 12.5 uninterrupted minutes of continuous satellite tracking. Allow the receiver to track satellites for 30 minutes to ensure a good almanac is collected the first time it is turned on or after a reset command.

Save System Configuration

This tool writes system configuration information to a text file, which is generally emailed to NavCom Customer Support to troubleshoot a problem. *The file does not contain user configured parameters, and cannot be uploaded into the receiver.*

The system configuration text file is a list of NCT messages that have been queried for a single instance from the receiver. These messages are not necessarily messages that have been scheduled for output from the *NCT Binary Messages* window.

Refer to Figure 134 for the steps below:

✓ Select *Tools > Save System Configuration* to write system configuration information to a text file. The *Configuration File Save* window opens.

✓ Enter a filename, select a folder, and click the *Save File* button.

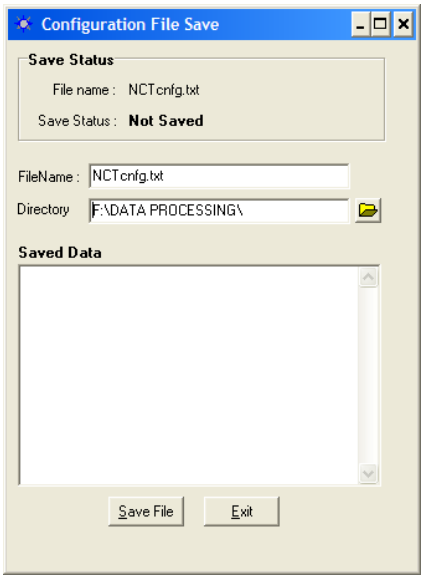

Figure 134: Save System Configuration

Power Management

Refer to Figure 135 for the steps below:

✓ Select *Tools > Power Management* to configure the receiver power-up status. The *Power Management* window opens.

✓ Select one of these options:

- *I/O Switch:* Sets the control of the power On/Off status exclusively via the front panel On/Off button.
- *On With Power:* Sets the receiver to automatically power up when DC voltage is sensed at the input circuitry.

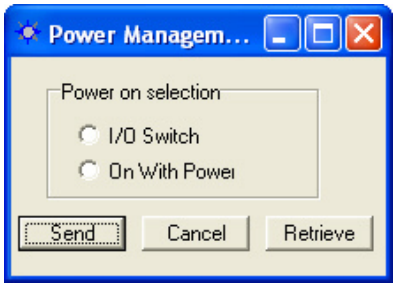

Figure 135: Power Management

A .....NCT Solid Earth Tide (SET) Message Format

The SET message output via the NMEA port is a NavCom proprietary NMEA type message. It conforms to the header, checksum, and electrical characteristics of a standard NMEA string, but is not recognized by the NMEA governing body as an officially sanctioned message.

Table 12 details the information contained in this example NCT SET output message:

$PNCTSET,214040.00,-0.060,-0.018,0.110,,,,,*47

Table 12: NCT Solid Earth Tide (SET) NMEA message

$PNCTSET	hhmmss.ss	xxxx.xxx	xxxx.xxx	xxxx.xxx	xxxx.xxx	xxxx.xxx	xxxx.xxx	xxxx.xxx	xxxx.xxx	xxxx.xxx	*hh
Label	UTC	SET dN (meters)	SET dE (meters)	SET dU (meters)	PT dN (meters)	PT dE (meters)	PT dU (meters)	Ocean Loading dN (meters)	Ocean Loading dE (meters)	Ocean Loading dU (meters)	CK SUM

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B .....NCT Station ID NMEA GGA Field 14 Definitions

Tables 11 and 12 detail the information contained in field 14 of the NMEA GGA message when the *GGA Option* on the *Rover / Navigation & Tracking Setup* window is set to NCT STATION ID (see Figure 25). The format of field 14 is a 3 digit integer value as denoted below as XYY, where X is the StarFire™ satellite beam in use and YY is the GPS correction signal type being used.

The navigation mode in field 14 of the GGA NMEA message is the same as the navigation mode of the 0xb1 NCT Binary message.

Table 13: Beam Selection; ID X

ID (X)	DOWNLINK BEAM	
	Software v4.2.26	**Software v5.1.6**
0	None selected, or error	None selected, or error
1	PAC-E (98W)	PAC-E (97.65W)
2	IND-E (109E)	IND-E (109E)
3	IND-W (25E)	IND-W (25E)
4	PAC-C (142W)	PAC-C (142W)
5	PAC-W (143.5E)	POR (178E)
6	AOR-E (15.5W)	AOR-E (15.5W)
7	- reserved -	- reserved -
8	- reserved -	- reserved -
9	Forced to unknown frequency (Manual selection)	Forced to unknown frequency (Manual selection)

Refer to Table 3 and Table 4 for Satellite IDs.

Table 14: Navigation Mode; ID YY

ID (YY)	GPS CORRECTION SIGNAL
00	Non dGPS
01	dGPS, RTCM type 1 or 9, Single Freq
02	WAAS/EGNOS/MSAS/GAGAN, Single Freq., (See GSA for SBAS ID in use)
03	WAAS/EGNOS/MSAS/GAGAN, Dual Freq., (See GSA for SBAS ID in use)
04	Reserved
05	Reserved
06	StarFire RTG, Single Freq. (no “Tide” Adjustment)
07	Reserved
08	Reserved
09	Reserved
10	dGPS, RTCM type 1 or 9, Dual Freq
11	StarFire RTG, Dual Freq. (no “Tide” Adjustment)
12	Code base Nav, Single Frequency, NCT Proprietary Format
13	Code base Nav, Single Frequency, RTCM 18/19
14	Code base Nav, Single Frequency, RTCM 20/21
15	Code base Nav, Single Frequency, CMR
16	Code base Nav, Dual Frequency, NCT Proprietary Format
17	Code base Nav, Dual Frequency, RTCM 18/19
18	Code base Nav, Dual Frequency, RTCM 20/21
19	Code base Nav, Dual Frequency, CMR
20	RTK Mode, NCT Proprietary Format (5e/5c or 5b/5c)
21	RTK Mode, RTCM 18/19
22	RTK Mode, RTCM 20/21
23	RTK Mode, CMR
24	StarFire RTG, Single Freq., Adjusted for “Tides”
25	StarFire RTG, Dual Freq., Adjusted for “Tides”
26	RTK Extend

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