Verify QC

User Manual

Version 1.20

VERIPOS

A4	01.05.2017	Axiom application information updated	AR	RR	RR	-
A3	12.01.2017	VERIPOS Hardware Compatibility section added	AR	RR	RR	-
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CONTENTS

1. INTRODUCTION

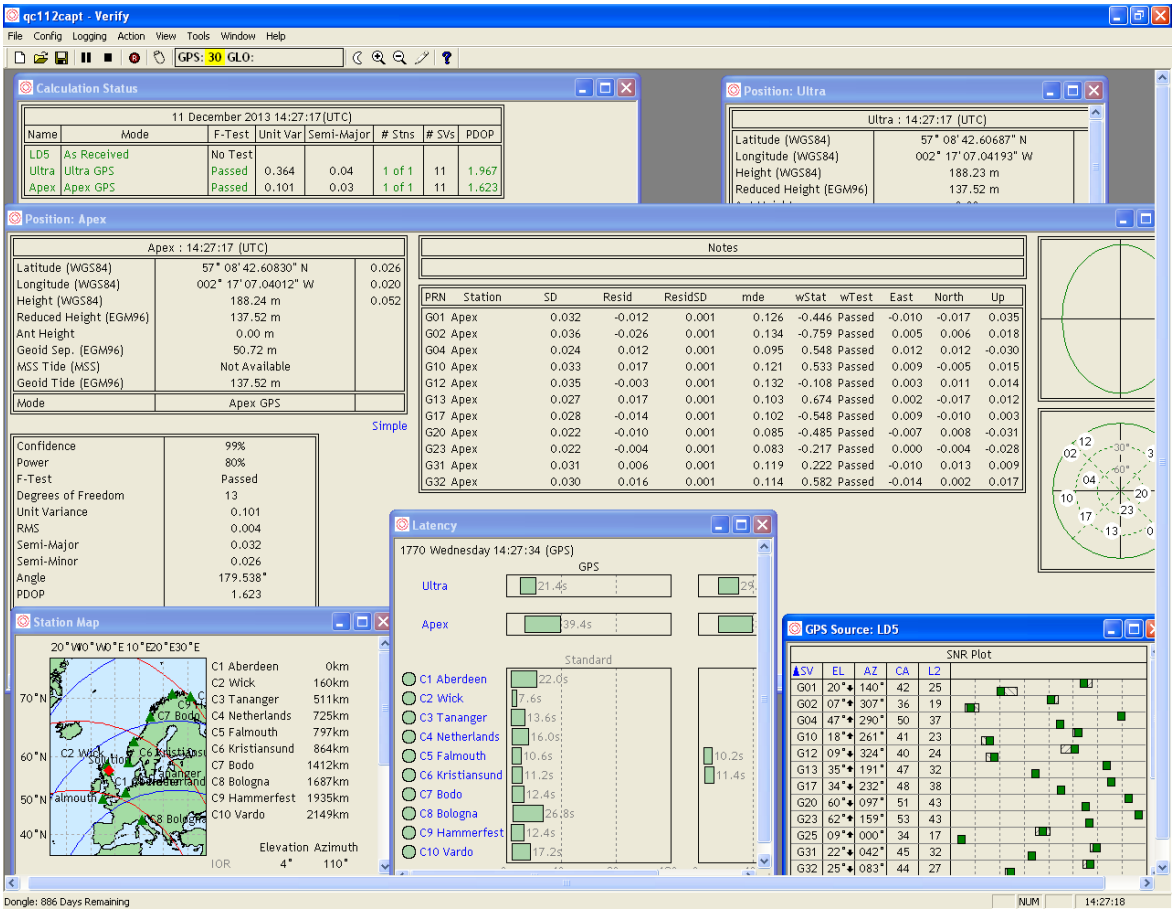
This manual covers the:

- Installation
- Configuration
- Operational procedures

of the VERIPOS Verify QC software for Microsoft Windows 7® and XP®.

The Verify QC suite of processing software provides real-time position with quality control information for the professional positioning user. It contains full calculation configuration flexibility with performance monitoring.

The Verify QC functionality is scalable in concept. It is expandable with many specific features enabled through a USB/Parallel software key (dongle) providing user flexibility and simplicity of operation. The software provides a window into the complete position derivation process by capturing both GNSS observation and received augmentation data. Multiple calculation permutations can be configured providing complete visibility of all parameters with associated quality control.



Verify QC Example Screen

Verify QC can receive and output data using serial, TCP/IP communications and data files. It operates in real-time whilst retaining full functionality in post-processing mode.

The Verify QC software is dongle protected. An enabled dongle will need to be attached to the PC running Verify QC before the software can be used. You may install Verify QC on a Window OS PC without an enabled dongle but it will not run without an enabled dongle being attached.

Principal features of Verify QC for Windows 7® and XP® are: -

- intuitive use - simple to operate and use
- user configurable
- supports a range of different GNSS receivers
- supports all VERIPOS data broadcast services
- accepts corrections from 3rd party non-VERIPOS sources e.g. IALA
- capable of multi-reference station and single station GPS-only, GLONASS-only and GPS/GLONASS calculations
- capable of use of high accuracy Precise Point Positioning (PPP) calculations
- capable of real-time tidal calculations
- provides statistical analysis and QC information
- compliant with UKOOA recommendations
- unlimited number of position calculations
- raw and computed data can be logged for analysis and replay
- output position solutions (no limit) and associated QC information
- supports TCP/IP communication

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For further information visit the VERIPOS Online Support System (VOSS) web site http://help.veripos.com

2. INSTALLING VERIFY QC

The Verify QC software can be supplied preinstalled on a PC or you can install from a CD inserted into a PC CDROM drive. Note that you can install Verify QC without having an activated dongle but will not be able to run the application.

See Appendices for details on installing Verify QC.

2.1 PC REQUIREMENTS

Installation requires a PC with Windows® 7 or XP operating system. This is the operating system platform supported by VERIPOS. The PC is typically provided by VERIPOS to ensure compatibility. Contact VERIPOS for specification details.

2.2 DONGLE DRIVER INSTALLATION

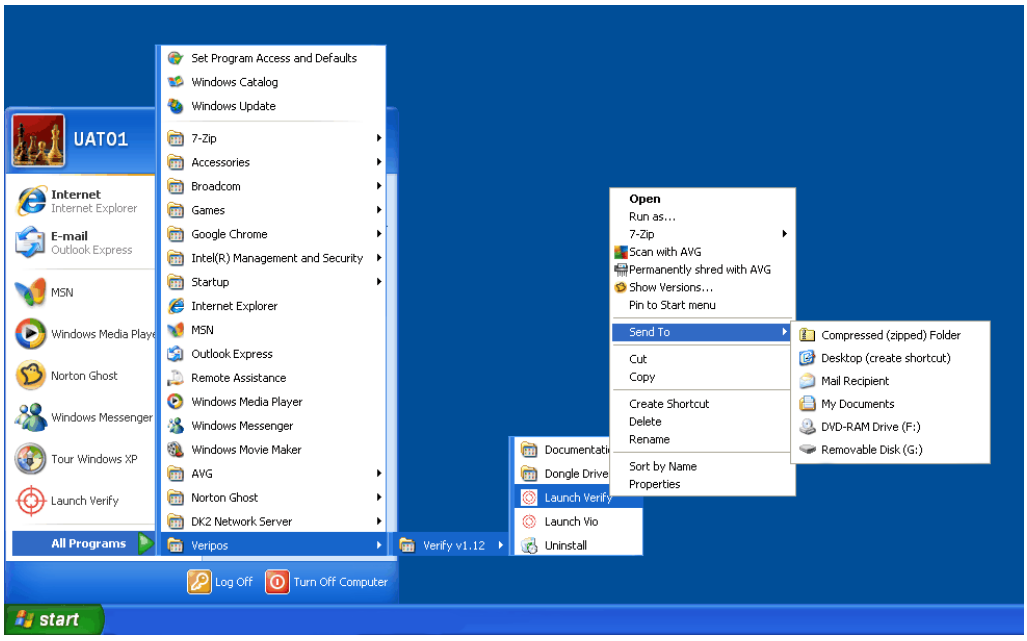
Verify QC requires a Dongle driver to be installed on the PC.

See the Help section in this manual or contact VERIPOS for details or if you require assistance.

2.3 AUTOMATIC SOFTWARE START UP

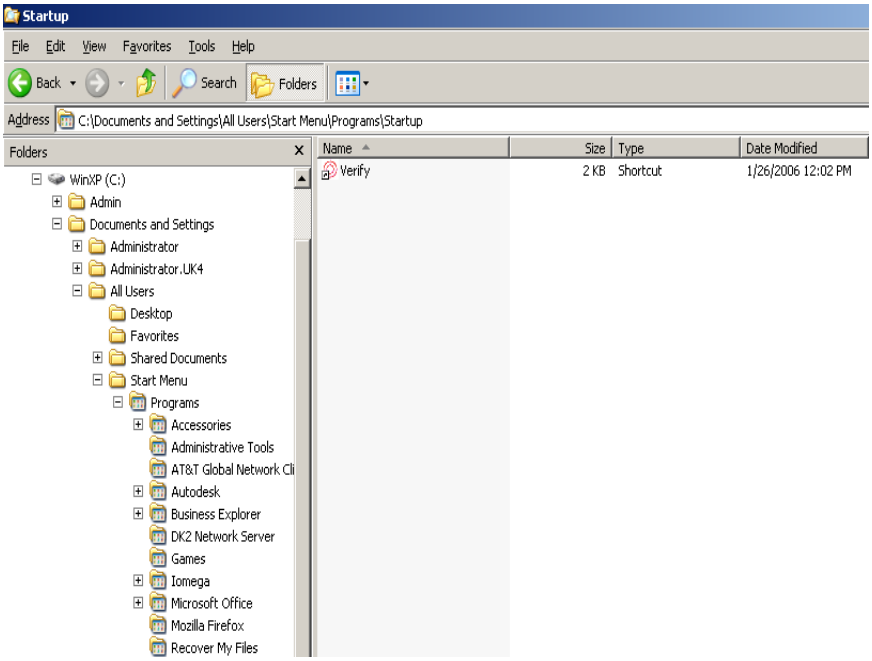
Verify QC can be configured to start automatically on PC boot up by carrying out the following: -

Windows XP
Create a shortcut to Verify QC on the desktop.



Verify QC Shortcut

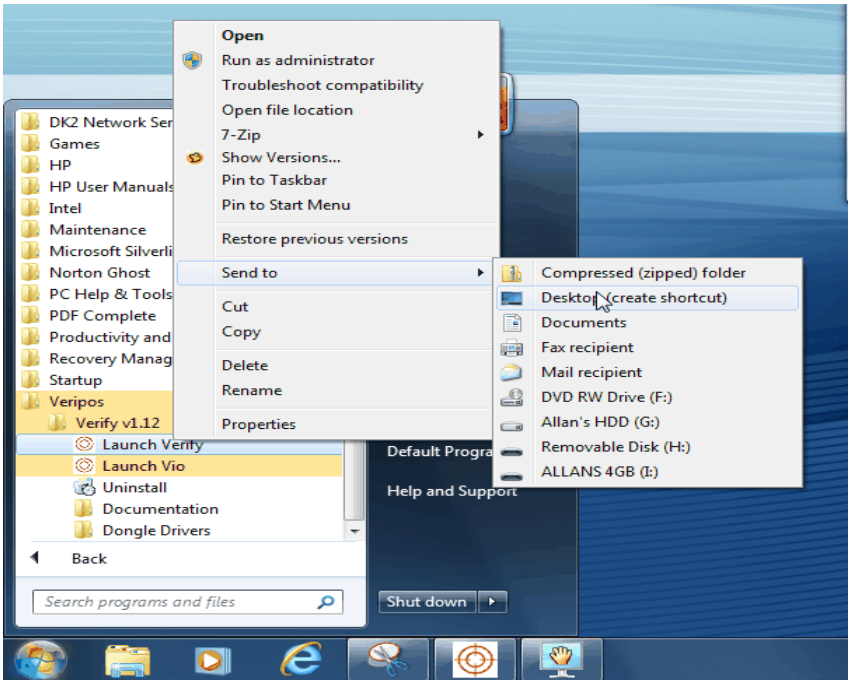
Copy the shortcut to the folder "*C:\Documents and Settings\All Users\Start Menu\Programs\Startup*" to complete the "auto start" set up.



Start Menu

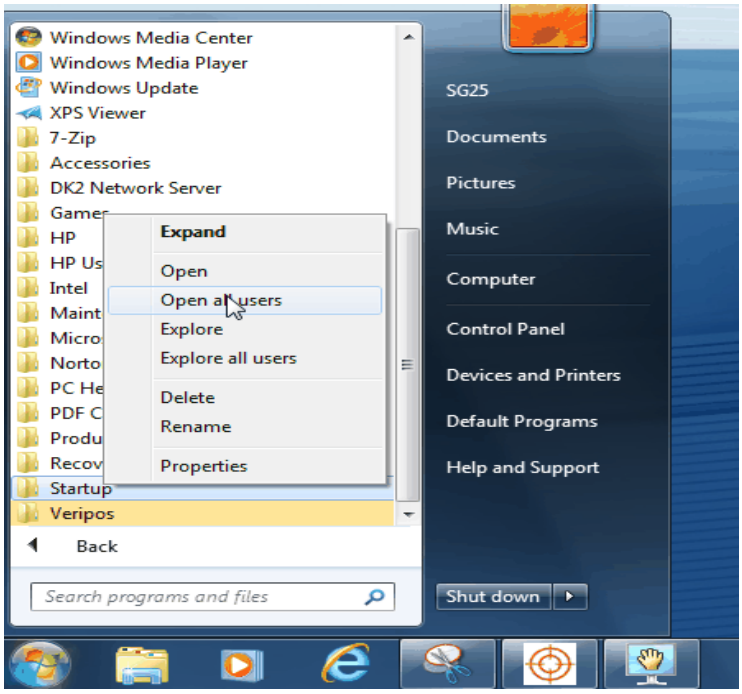
Windows 7

Create a shortcut to Verify QC on the desktop.

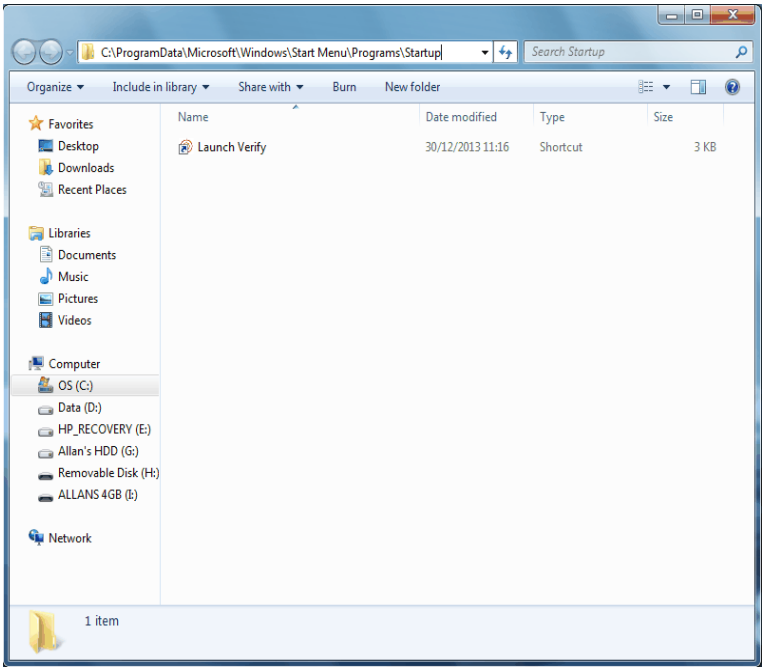


Verify QC Shortcut

Click Start→All Programs→Right-click on ‘Startup’→Select ‘Open all users’:



Copy the shortcut to the folder “*C:\ProgramData\Microsoft\Windows\Start Menu\Programs\Startup*” to complete the “auto start” set up.

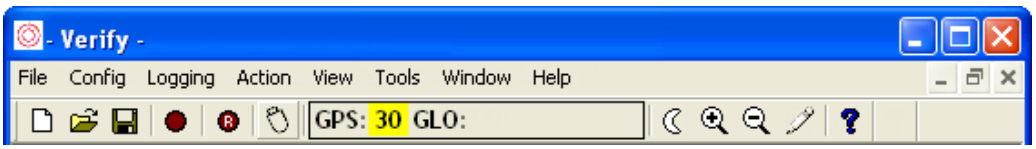


3. FUNCTIONAL OVERVIEW

To custom configure Verify QC the user can work from left to right along the menu bar to complete the Verify QC software configuration.

3.1 MENU STRUCTURE

Menu icons along the top menu bar contain all the necessary dropdown menus to configure, operate and adjust Verify QC for optimum operation.



Verify QC Main Menu Structure

Functions are shown in icons on the task bar below the menu bar. These help you to;

- Create a New Configuration
- Open an Existing Configuration
- Save your Configuration
- Start logging data
- Start RINEX logging (operates when enabled)
- Archive logged data
- Disable GPS / GLONASS satellites
- Switch to night-time mode / day-time mode
- Increase font size
- Decrease font size
- Add notes to the configuration change log
- About Verify QC dialogue showing software version number

3.2 DONGLE DEPENDANT FUNCTIONS

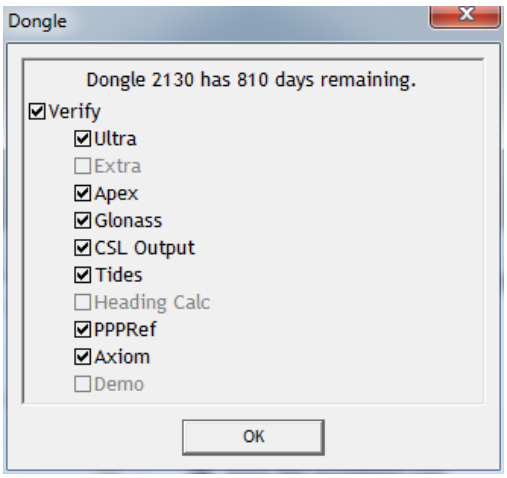
An enabled dongle is required to operate Verify QC.
By default the dongle will support VERIPOS Standard calculation and associated functions. A dongle can be enabled for additional software features.

Access to more advanced software functions is controlled by your dongle. To confirm the functions enabled on your dongle its status can be viewed under *Help/Dongle/View…*

This manual describes all the Verify QC functions and views. Where functions described in this manual are optional and additional this is stated.

The current dongle dependent Verify QC software functions are listed below:

- Ultra: introduces the Ultra calculation and associated functions. Ultra is a PPP (Precise Point Positioning) calculation offering decimetre level accuracies
- Apex: introduces the Apex calculation and associated functions. Apex is a PPP (Precise Point Positioning) calculation offering decimetre level accuracies
- GLONASS: introduces a combined GPS+GLONASS calculation and associated functionality. Note: The combined GPS+GLONASS calculations are only available when a Topcon, Septentrio AsteRx or NovAtel receiver is selected
- CSL Output: introduces an additional interface for output of P2/94 records to the Concept Systems Limited (CSL) ViGPS process in various CSL navigation products
- Tides: Tide calculation (including Mean Seas Surface) and associated functions. Tides requires Apex or Ultra service to be enabled on your dongle. The Tides calculation estimates the real-time tide at the users' location
- PPP Ref: introduces a virtual base station RTCM Output based on the current PPP position, which is used as a virtual reference station location. This function allows highly stable and accurate DGPS corrections to be calculated and then be output to external DGPS systems or a telemetry link
- Axiom: Use with the 4D Veripos positioning software suite - *Axiom*.
- Demo: the demo function allows users to replay predefined demonstration datasets using associated fixed configurations. To make use of this requires the Verify QC Demo Data CD. **This feature should only be enabled if specifically requested as a dongle enabled for *Demo* will prevent Verify QC from operating normally in real-time.**



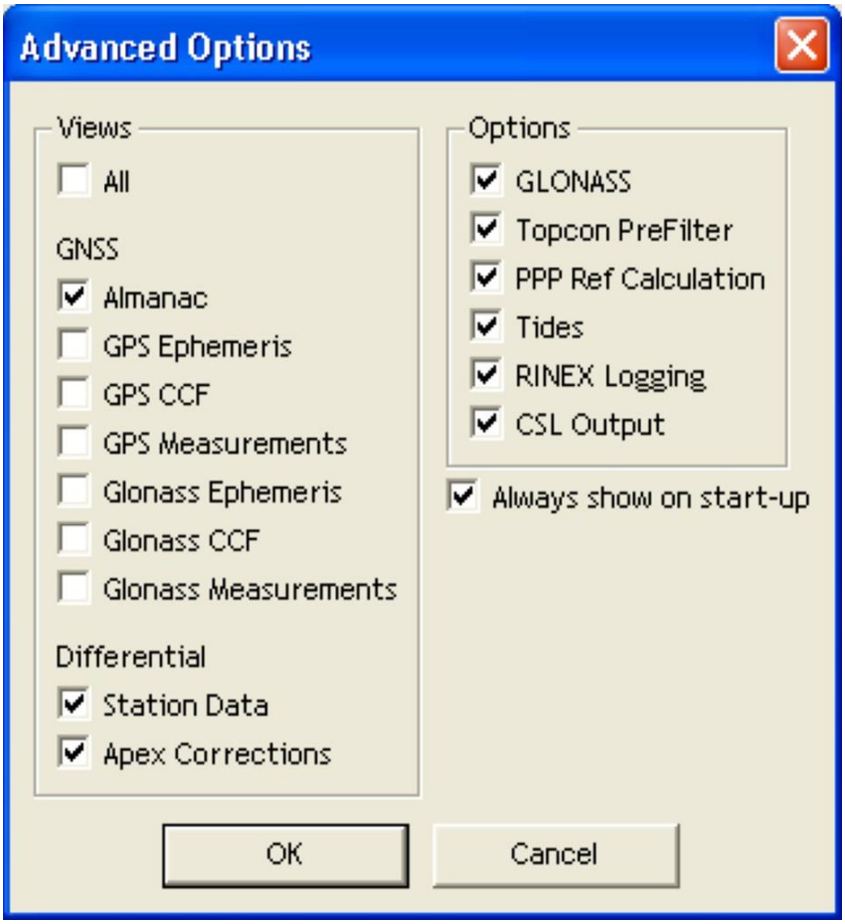
You can check the dongle enable status in *Help/Dongle/View…*

If a function you require is absent contact the VERIPOS helpdesk for information, assistance and to order a dongle upgrade.

3.3 USER SELECTABLE FUNCTIONS

You can customise the appearance of Verify QC. A number of advanced views can be enabled and a number of advanced software options can be disabled to simplify the appearance of the software.

The dialogue to do this is accessed via *Tools/Advanced Options*.



Advanced Options dialogue

The Advanced Options dialogue can also appear on initial start-up of the software.

Enabling / disabling views or options will affect which configuration dialogues and associated views are accessible through the Verify QC menu structure.

A number of Advanced Views have been deselected by default. However, by default all options enabled on the Verify QC dongle will appear enabled in a new configuration.

Options will be presented depending on the features available from the selected GNSS card.

If views are enabled (ticked), their enable status is stored in the Verify QC configuration file. An updated view menu structure will be available when Verify QC is run.

Further views may be selected as the options under Views are not all dongle dependent. Those Options not supported by the dongle are *greyed out.*

Options selected or deselected are stored when you save the configuration file and will be in place when you reopen the configuration file.

This manual covers all Verify QC functions and views. If any are absent, please first check the dongle enable status, under *Help/Dongle/View…* and your selections under *Tools/Advanced Options*.

3.4 TOPCON / JAVAD PREFILTER

Topcon and Javad receivers set a status flag for each GNSS satellite measurement. The Topcon PreFilter allows Verify QC to filter out satellites the receiver has deemed non optimal before presenting the data to the calculations.

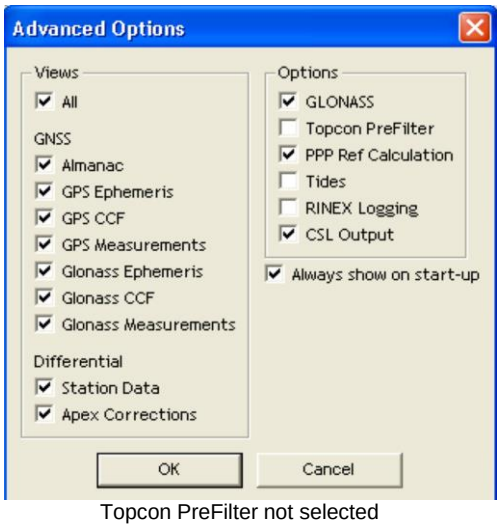
If the Topcon Prefilter option is un-ticked, the PreFilter is disabled and Verify QC will only use its filter within its calculations to determine sub optimal satellites.

The PreFilter is enabled as default. To disable the PreFilter, Follow these steps:

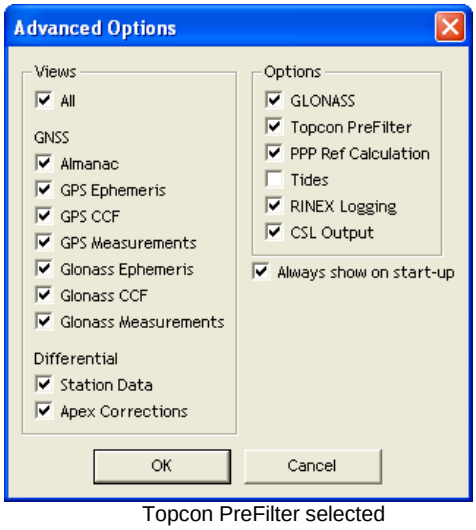
Note: The Topcon PreFilter option is greyed out until the GNSS receiver type is set in the menu option Config /GNSS Receiver.

1 In the *Config/GNSS Receiver*…menu, select the *Topcon/Javad* card

2 In *Tools/Advanced Options*, select (tick) or deselect (un-tick) Topcon PreFilter option



Topcon PreFilter not selected

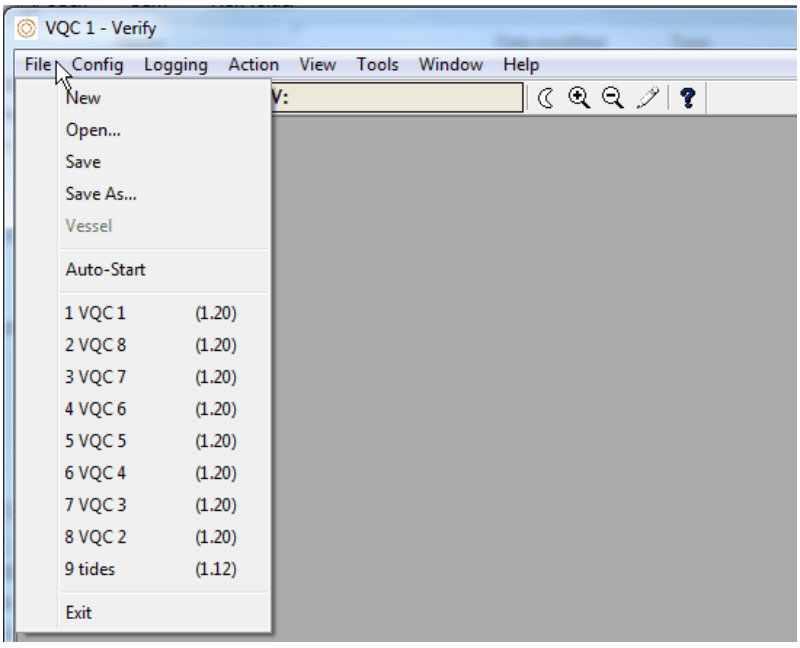


Topcon PreFilter selected

3.5 FILE

The standard Windows commands "*File/New*, *File/Open…, File/Save*, *File/Save As…* and *File/Exit"* allow the user to create a new configuration file and save it or open configuration files for editing.

Notes: The Verify QC configuration file should be saved and a backup copy created and stored in a safe area. If a configuration is running and New or Exit is selected, a warning appears to save or cancel the existing configuration. Creating a new configuration will close the existing configuration.



File Menu Structure

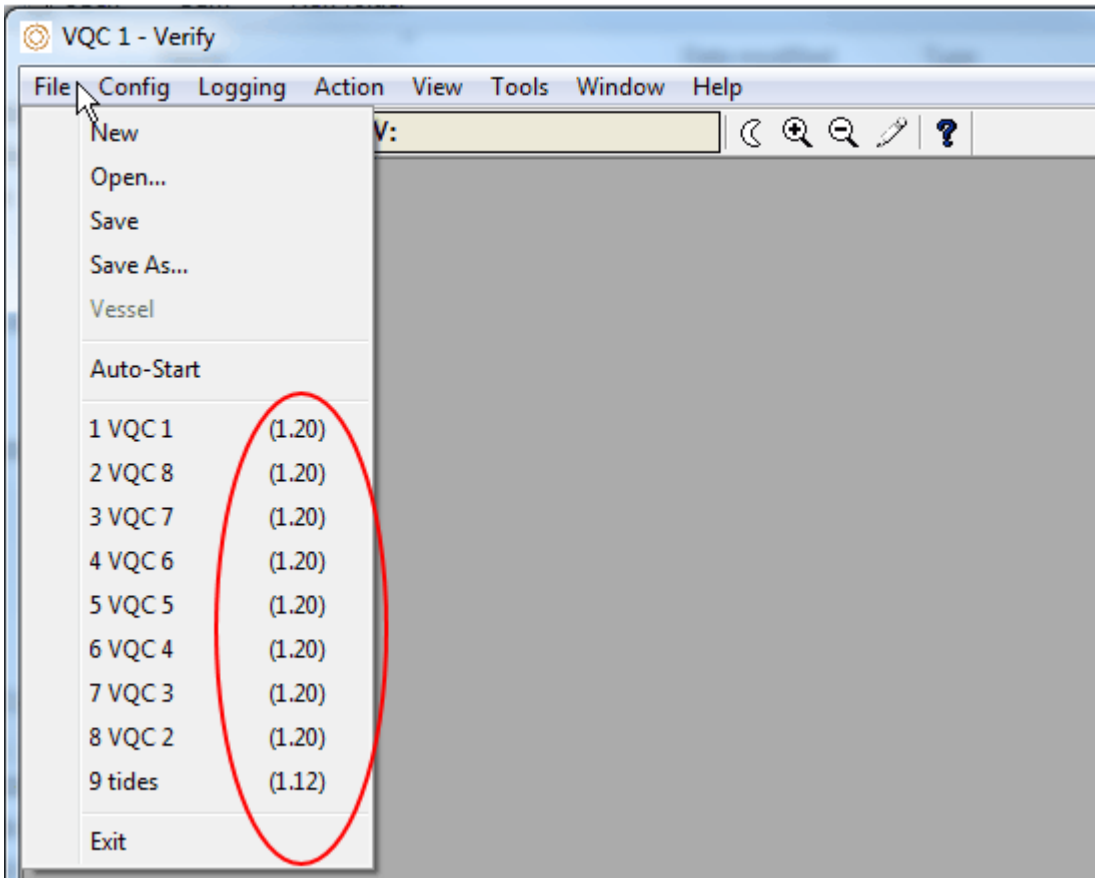
3.5.1 Auto Start

Selecting Auto-Start ensures the last saved configuration file will re-open automatically when Verify QC is started.

If you do not require to use the last saved configuration when Verify QC starts, you can close this configuration, create a new configuration file or open a previously saved file.

3.5.2 Existing Verify QC Configuration Files

Verify QC 1.20 can also use configurations saved using earlier software versions although some configuration settings may have been added or adjusted for the functionality in the latest software version. A warning message will appear to advise you are using an earlier software configuration. When opening existing configuration files from the File Menu the version in which the configuration was saved in is shown in brackets;



Note: Users are recommended to check over all settings in their configuration file after upgrading to a later Verify QC software version.

3.5.3 Vessel Configuration

A vessel configuration can be saved at commissioning stage with options preconfigured such as External RTCM or data outputs.

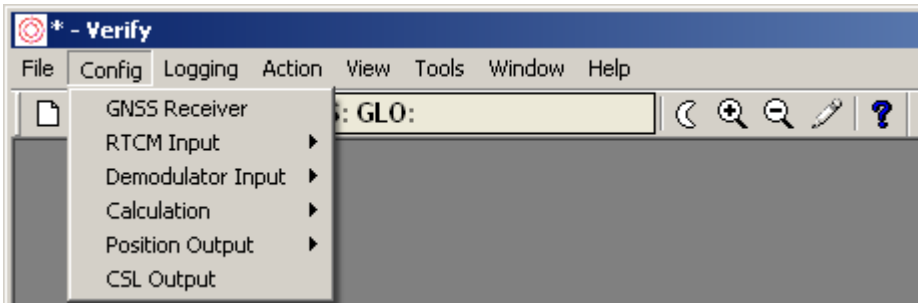
The *Vessel* configuration file cannot be overwritten by the user, if the option is selected the user will be prompted with a Save As dialogue to save the file under a different name.

For information regarding the setup and use of the *Vessel* option, please contact the VERIPOS Helpdesk.

4. CONFIGURATION

The configuration menu is used to set up all parameters within Verify QC.

Time and care must be taken to ensure all parameters are entered or selected correctly during the configuration process. Failure to do so may affect the performance of Verify QC operation.



Config Menu Structure

The configuration menu is structured so that the software can be configured in a logical order.

The primary steps are:

1. Configure GNSS receiver input
2. Configure RTCM inputs
3. Configure Demodulator Input (if applicable)
4. Set elevation mask and Geoid Model
5. Configure DGNSS calculations
6. Select backups to Apex and/or Ultra calculations
7. Configure advanced calculations as for example Tides and PPP Ref
8. Configure Position Outputs
9. Configure other outputs as for example CSL Output

4.1 CONFIGURE GNSS RECEIVER

Prior to configuring the GNSS Receiver, check the following points concerning GNSS antenna installation:

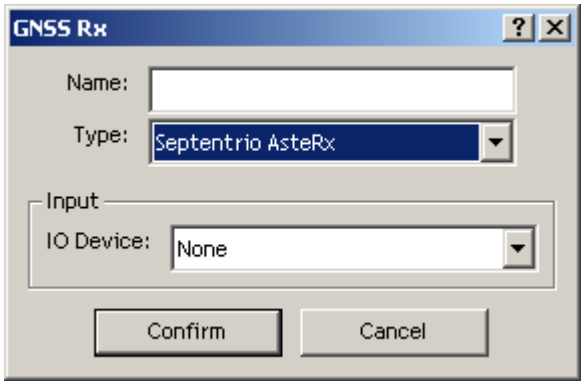
- the antennas is installed with the best possible view of the open sky, avoiding any masking or possibility of interference
- cable runs must be short to avoid any effect on the L2 signal to Noise Ratio values or degradation of VERIPOS correction services performance

Note: Offsets are not required during setup of the GNSS receiver as the positions generated by Verify QC are referenced to the phase centre of the GNSS antennae.*

* The offset between the base of the antenna and the antenna phase centre differs for each antenna type. For example the VERIPOS AD410 antenna has an offset of 45mm between the bottom of the antenna base and the L1 phase centre. If using a different antenna this information should be obtained from the manufacturer.

4.1.1 Configuring the GNSS Receiver

Select "*Config/GNSS Receiver"* and enter the information described in the following sections.



GNSS Receiver

4.1.1.1 GNSS Name

When no entry is made against "*Name"* for a GNSS receiver the default name of 'GNSS Rx' is inserted automatically.
For ease of reference it is recommended to change this name to the name or model of the GNSS receiver used. E.g. 'Topcon', 'Septentrio', 'Trimble' etc.

Where more than one Verify QC system is installed on a vessel, it is good working practice to give the receivers unique and more descriptive names such as "Port/Fwd", "Starboard/Aft" or "Primary" and "Secondary".

This makes it easier to distinguish between the systems and aids troubleshooting.

4.1.1.2 GNSS Type

Selections of GNSS receiver types are available and are viewed in this drop down menu. Consult your order confirmation details to determine the receiver card installed in your VERIPOS hardware.

A list of the current GNSS receiver types and default baud rate used is available in the Appendix.

Note: If using a Topcon or Javad receiver please refer to the Topcon Prefilter section (Section 3.4) of this manual.

4.1.1.3 IO Device

The *IO Device* section supports GNSS receiver inputs from Serial Port, Client Socket or Datagram.

Serial Port, Client Socket and Datagram connection details are detailed in the Appendix.

For Serial Ports Verify QC must initially be configured to match the existing baud rate of the receiver so communications may be established.

Three steps are required:

- set Verify QC to match the existing receiver baud rate setting (see reference table in Appendices)
- where the baud rate is less than 57600 the receiver baud must then be reset to 38400 or greater. Use *Action/Receiver/Set receiver baud rate* tool
- finally adjust the GNSS Receiver IO Device setting in Verify QC to match the revised receiver baud rate

Notes: a minimum baud rate of 38400 is required for correct system operation. Receivers with initial settings lower than this value should be reset to 38400 once communications have been established.

The above procedure can be used to reset the baud rate for most receivers.

Where you do not know the receiver baud rate, try using default serial port baud rates as detailed in the Appendix. If problems are encountered with matching Verify QC with the default serial port setting of GNSS receivers then these setting must be changed by reference to the manufacturer instructions.

Alternatively use the Verify QC tool under *Action/Receiver/Establish baud rate.*

Click "**Confirm***"* once all GNSS receiver input settings have been made. Verify QC will then configure the GNSS receiver and enable output on the selected port for operation with the software.

Where using an IP connection to your receiver e.g. when using a Veripos LD5, enter the IP address and port number. For Veripos equipment the information is available from the Quick Guides or the Operations manual for the receiver, downloadable from VOSS.

To check that communications are established:

1. open the IO view from the main menu (View/IO)
2. For serial connections check the GNSS data and check the baud rate is correct

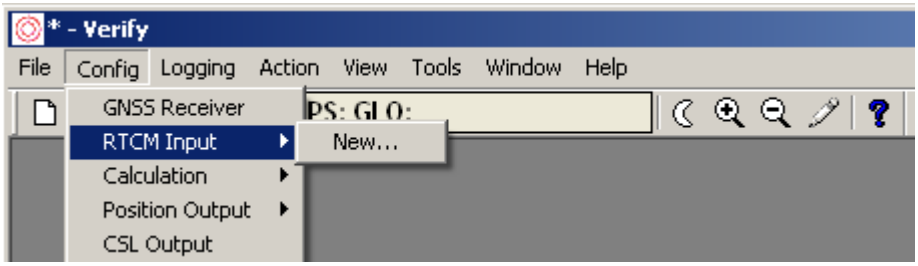
    a. successfully decoded data appears as green text within the IO view
    b. scrolling text is shown in red where data cannot be decoded (incorrect receiver type or incorrect baud rate)
    c. no text appears is no data is received

Where red text is shown, or no text is displayed users should step through possible baud rate settings of the GNSS receiver and ensure these settings match in the GNSS receiver and Verify QC.

4.2 CONFIGURE RTCM INPUT

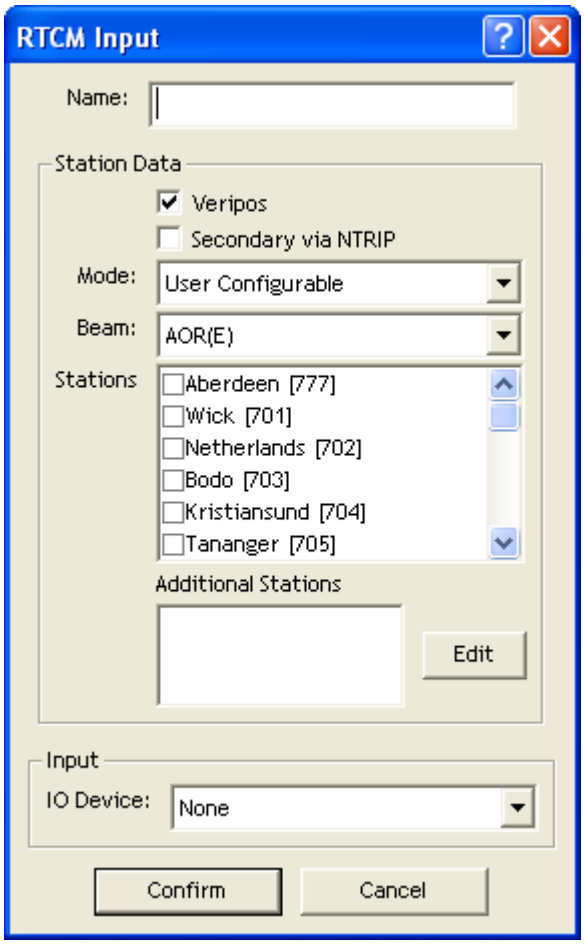
4.2.1 Configure RTCM Input

To add an RTCM input click "*Config/RTCM Input/New…*"



RTCM Input

This will open the following dialogue:



RTCM Input dialogue

4.2.1.1 RTCM Name

If using more than one RTCM Data link it is good working practice to allocate a more descriptive *Name* to each link. This allows each link to be easily identified by the operator.

The use of a descriptive naming convention will assist in distinguishing the RTCM source when operating Verify QC.
If no name is entered for an RTCM input, name will default to the VERIPOS beam name.

There are no *software* limitations to the number of RTCM data links that can be interfaced into Verify QC.

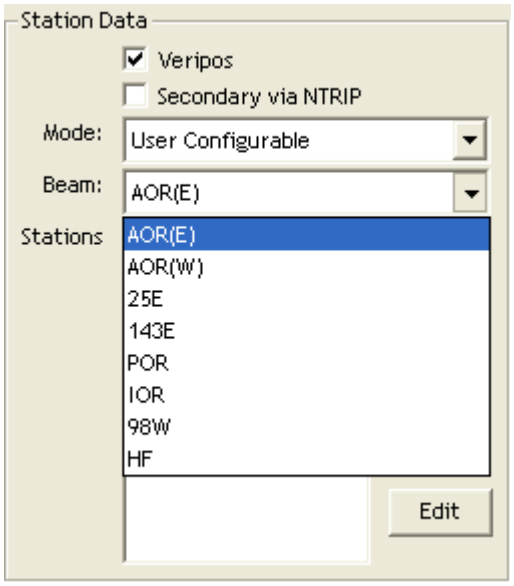
4.2.1.2 RTCM Beam

Once RTCM Input has been named, use the drop down menu to identify the *Beam* supplying the RTCM message.

Selecting the correct beam is important as each one has a predefined list of VERIPOS stations.

Note: The beam selection in the receiver and Verify QC need to be paired, i.e. selecting a Beam in Verify QC only determines which stations are displayed in the station list; it does not control which Beam is selected in the VERIPOS demodulator.

The demodulator must also be configured to use this same Beam – see demodulator manual.



RTCM Beam

VERIPOS recommend users tick the *VERIPOS* station data type box. This allows the user to select from the predefined lists of reference stations that are available on each VERIPOS downlink beam and ensures that the Ultra and Apex corrections will be decoded and available.

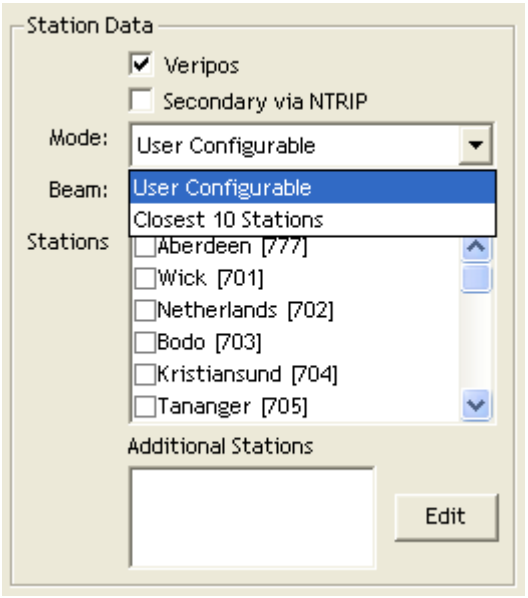
The *Secondary via NTRIP* must be ticked if the RTCM is being received via NTRIP. When the *Secondary via NTRIP* is box ticked, if the RTCM being received via L-Band antenna were to drop out Verify QC v1.20 switches to use NTRIP RTCM corrections.

4.2.1.3 Mode

Verify QC can automatically detect the 'Closest 10 Stations' received on the RTCM input for decoding. The beam and station then do not need to be selected and are removed from the dialogue.

VERIPOS recommends that when selecting 'Closest 10 Stations' all available stations are enabled on the demodulator RTCM output port.

Alternatively if "Mode' is set to 'User Configurable' the user can manually select a preferred list of stations from the 'Stations' list for decode by Verify QC.



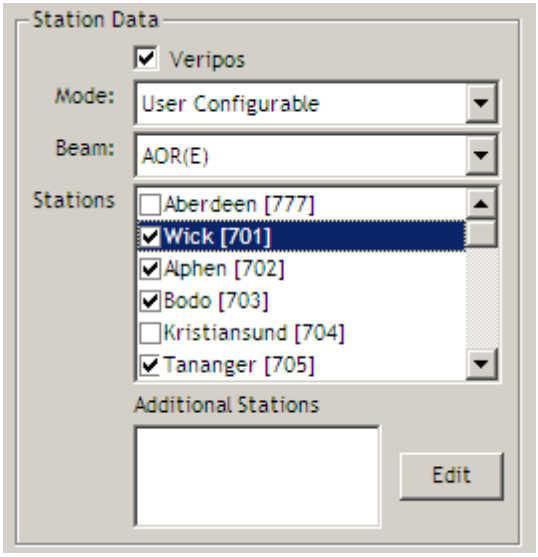
RTCM Mode selection

4.2.1.4 RTCM Stations

If the user has selected 'User Configurable', next select the actual *Stations* to be decoded by Verify QC.

Note: Use VeriChart planning software available from help.veripos.com to determine the stations appropriate for the work area. Verify QC will NOT use any selected stations that are 2500km or more from the users' location.

The reference station selection in the demodulator and in Verify QC need to be matched such that all stations required for calculations in Verify QC are also enabled on the corresponding RTCM output port of the demodulator.

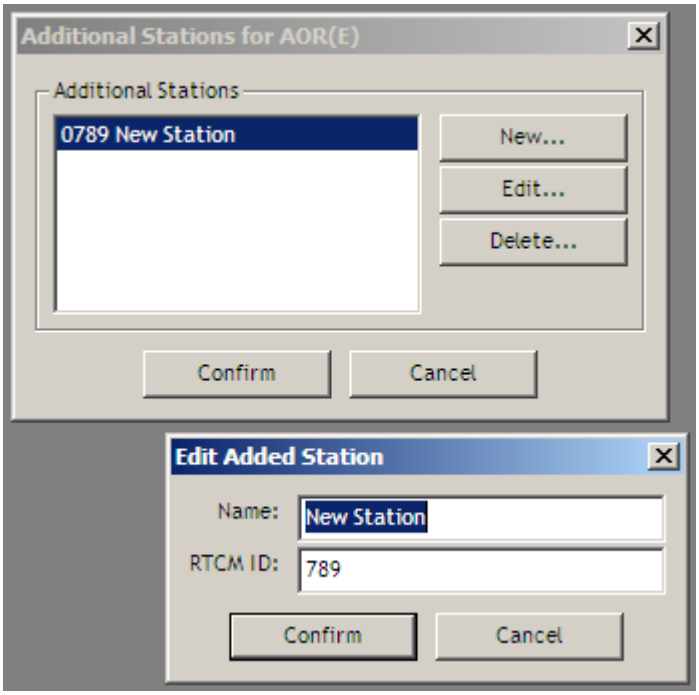


RTCM Stations

4.2.1.5 Additional Stations

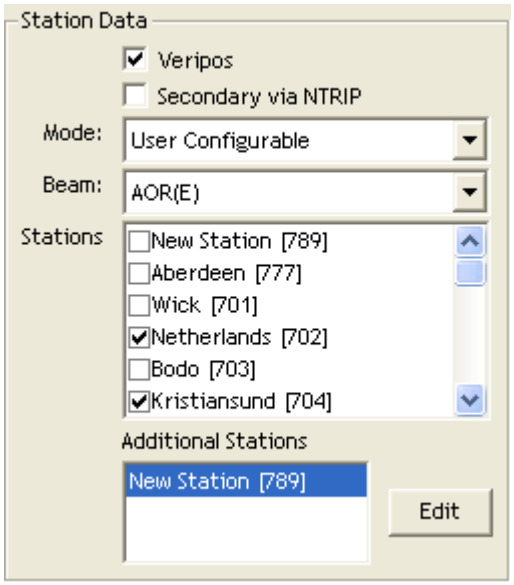
Previously undefined VERIPOS stations can be added to the station list of a VERIPOS beam. You will need to add these when VERIPOS announces a new station available on that beam.

Users can add a station by selecting ‘Edit’ under Additional Stations. The Additional Stations dialogue will open and new stations can be defined, edited or deleted:



Additional Stations dialogue

Added stations will be included in the Stations list for selection.



Additional Stations

When adding <u>new</u> stations:

- ensure the new station was indeed added to the selected beam
- the demodulator configuration must be update separately to enable stations on its RTCM output port. See the demodulator manual

4.2.1.6 IO Device

IO Device section supports demodulator status inputs via Serial Port, Client Socket and Datagram.

Serial Port, Client Socket and Datagram connection details are detailed in the Appendix.

Note: Demodulator Status messages require <u>different</u> IO Device and physical connection from the one used to input the RTCM messages.

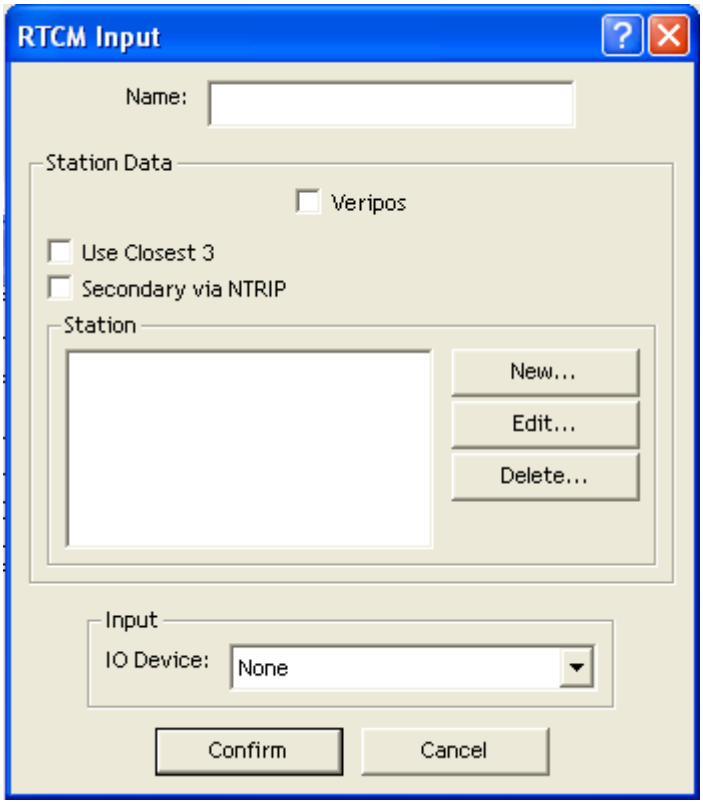
4.2.1.7 Use of Non-VERIPOS RTCM stations

Verify QC is capable of using non-VERIPOS corrections. These corrections should comply with the RTCM SC104 V2 format.

Stations need to be coordinated in the ITRF reference frame to ensure compatibility with the VERIPOS reference station network.

Note: VERIPOS cannot guarantee the performance of position calculations that include correction data from 3rd party non-VERIPOS RTCM stations.

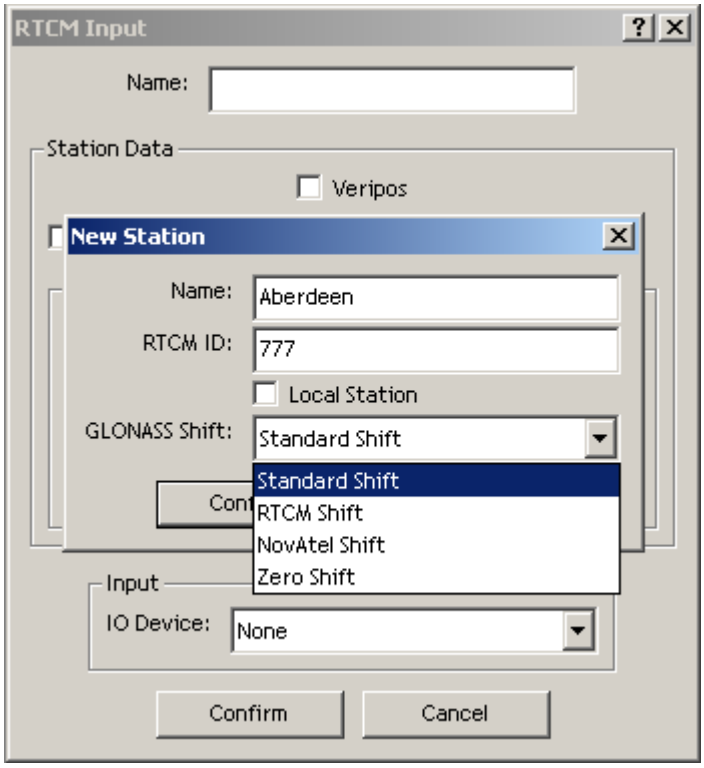
When interfacing a non-VERIPOS RTCM source, uncheck the VERIPOS box. The RTCM Input dialogue will change to the following layout:



Non-VERIPOS RTCM Stations

Click on "***New***".

A New Station dialogue helps you to define non-VERIPOS stations.



New Station

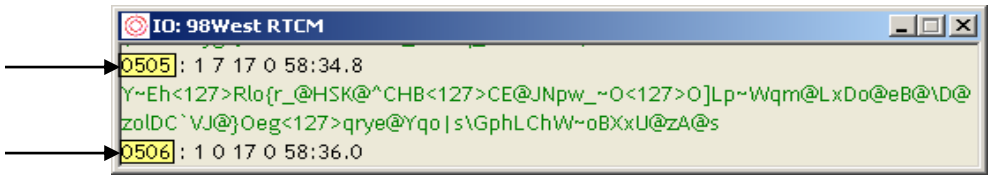
Enter the station *Name* and *RTCM ID*. The RTCM ID is obtained from the reference station provider.

If the RTCM ID is unknown it can be read from the RTCM message header in the Verify QC IO view after the Device IO settings have been entered.

Select "*View/IO"* then right click and change the input source to RTCM.

The RTCM ID is stamped at the start of the decoded RTCM header information in each message.

In the example below, RTCM messages with ID 0505 and 0506 are being input.



View IO View

Verify QC requires the RTCM Type 3 (and when using GLONASS stations, the RTCM Type 32) to determine the reference station location. Where not present the station data will be rejected by Verify QC.

In order to use reference stations that do not provide Type 3 and/or Type 32 message, but are at a short range, the user needs to tick the box 'Local Station'. Verify QC will then assume that this station is at the users' location, not apply any differential tropospheric and ionospheric models, and subsequently use this correction data.

The GPS-to-GLONASS datum shift used by the reference station receiver is normally detected automatically from the Type 3 and Type 32 messages. Users of non-VERIPOS stations need to select the datum shift between the GPS and GLONASS reference frames for the non-VERIPOS stations.

Options available are:

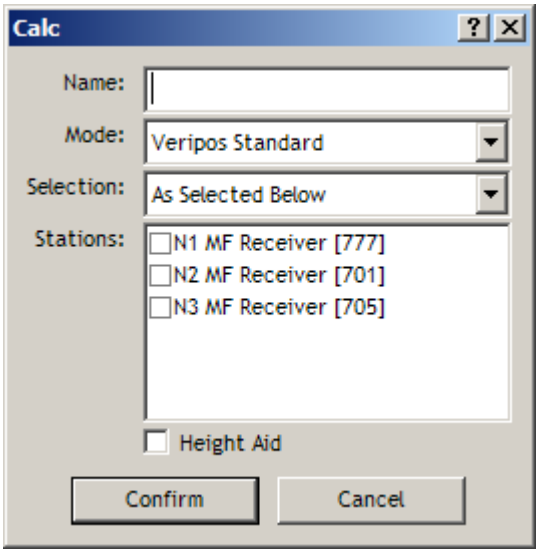
- Standard shift (Topcon/Javad default)
- RTCM shift (RTCM v2.3)
- NovAtel shift (NovAtel default)
- Zero Shift

These shifts have the following predefined Helmert parameters:

Shift	dX (m)	dY (m)	dZ (m)	rX (rad)	rY (rad)	rZ (rad)	Scale
Standard	0.0	0.0	1.0	0.0	0.0	-1.00e-6	1.0
RTCM	0.0	0.0	0.0	0.0	0.0	-1.66e-6	1.0
NovAtel	0.0	2.5	0.0	0.0	0.0	-1.90e-6	1.0
Zero	0.0	0.0	0.0	0.0	0.0	0.0	1.0

If the RTCM decoding of non-VERIPOS stations is to be automatic then the option 'Use Closest 3 'should be selected. The manual station configuration area is then made

unavailable in the dialogue. Verify QC will then automatically select the closest 3 stations based on their coordinates in the RTCM Type 3 messages and label them with identifiers N1, N2 and N3. These stations will appear in the 'Config/Calculation/New GNSS Calc…' dialogues with name 'N1 {*RTCM Input Name [ID]*}' etc, as for example in the dialogue below:



Closest Non-VERIPOS Station Names

Note: stations that do not broadcast RTCM Type 3 message will not be detected by the automatic 'Use Closest 3' process and therefore cannot be used in Verify QC position calculations.

4.2.1.8 IO Device

The *IO Device* section supports RTCM inputs via Serial Port, Client Socket and Datagram.

Serial Port, Client Socket and Datagram connection details are detailed in the Appendix.

Guideline settings for RTCM data: -

- Baud Rate : 9600
- Data Bits: 8
- Parity: None
- Stop Bits: 1

Users should consult the demodulator manual to confirm the settings.

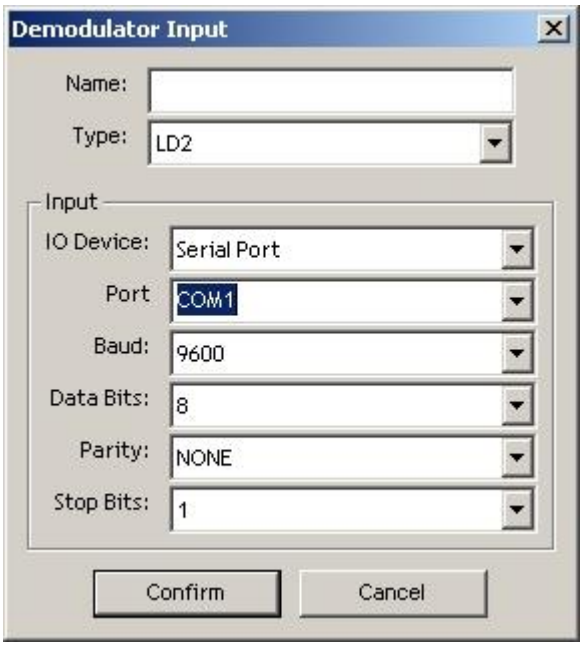
4.2.2 Editing Existing RTCM Inputs

The *Config/RTCM* menu lists all configured RTCM inputs.
Input can be selected separately for editing, deletion or change of order as required.

4.3 DEMODULATOR INPUT

The demodulator input is the Demodulator Status message from the L-Band Demodulators in VERIPOS IMUs.

To add a Demodulator Input click "*Config/Demodulator Input/New…"*



Demodulator Status

4.3.1.1 Type

Verify QC supports Demodulator Status messages from each of the following IMUs:

- LD2/S
- LD3/S
- LD4
- LD5
- LD6
- LD7

To determine how the messages are output from each IMU types refer to the relevant IMU manual.

4.3.1.2 IO Device

The *IO Device* section supports Demodulator inputs via Serial Port, Client Socket and Datagram.

Guideline settings for Demodulator input data: -

- Baud Rate : 115200
- Data Bits: 8
- Parity: None
- Stop Bits: 1

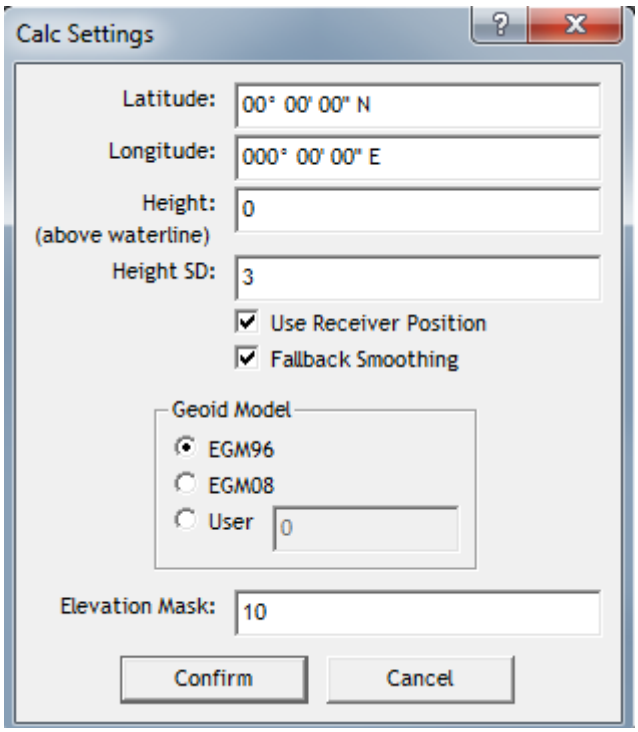
Users should consult the demodulator manual to confirm the settings.

4.4 CALCULATION

There are no *software* limitations to the amount of calculations that can be configured in Verify QC. Limits are defined by the user hardware, particularly the availability of processor and memory resources.

4.4.1 Settings

Click **"***Config/Calculation/Calc Settings"* to bring up the Calc Settings dialogue box.



Calc Settings

It is advisable (but not essential) to enter a trial point into Verify QC to start the positioning process. Entering the current approximate position as a trial point will speed up the calculation process.

Alternatively *Receiver Position* can be used and the trial point will be based on the uncorrected position as output by the GNSS receiver.

It is necessary to enter the user's location when referencing the calculated positions to the Trial Point in the Track Plot and Time Series windows. This is of help when comparing a static point to the computed positions within Verify QC.

4.4.1.1 Height

This measurement is the height of the GNSS antenna phase centre* above the waterline of the vessel.

* Offset between the base of the antenna and the antenna phase centre differs for each type. e.g. the AD410 antenna has an offset of 45mm between the bottom of the antenna base and the L1 phase centre. If using other types of antennae this offset must be ascertained.

The height information is used for Geoid Tides and height aided DGNSS calculations.

The antenna height is used in Tides to reduce the antenna location to the waterline before calculating the GeoidTide values only. Hence changes to this parameter will have an immediate effect on the estimated GeoidTide values but will not influence the estimation of the UltraTide values.

Height aiding can be used to add an extra observation to the position calculation in order to provide additional cover for periods when the GPS constellation is weak or insufficient to calculate a position.

Height and *Height SD* values are used when Height Aiding is selected during calculation setup.

If the *Height SD* value is reduced, the weighting of *Height* value will increase.
(See relevant sections in this manual.)

The *Height SD* value entered should represent the total uncertainty of:

- the accuracy of the GPS antenna height measurement
- the expected fluctuations in antenna height due to vessel movements caused by swell
- changes in draft and tides
- the accuracy of the Geoid model

Note: Height Aiding does not fix the height.

Note: height aiding should not be used in land locked waterways (the Geoid and Mean Sea Levels do not coincide). Height aiding is <u>not</u> applied to the Apex and Ultra calculations.

4.4.1.2 Fallback Smoothing

The Fallback Smoothing option is enabled by default. When enabled, this smooth's the transition between the Apex/Ultra solutions and their fallback /backup solutions. This is accomplished by breaking down the distance between solutions and transitioning from the previous solution to the active solution in smaller increments over time, the solution position doesn't immediately jump.

When the Fallback Smoothing option is unchecked, the transition will not be smoothed, therefore will immediately switch between the previous and active solutions as soon as they become active and a position jump will be observed between calculations.

The Fallback Smoothing option is primarily for use with the VERIPOS Axiom application, where Fallback Smoothing should be disabled.

4.4.1.3 Geoid Model

Users can select the EGM96, EGM08 Geoid/Spheroid Separation Model or an externally derived separation value, by selecting the *User* radio button. By default the system uses EGM96. This geoid model is also used within the Geoid Tides functionality.

A User defined separation value should be maintained as the user moves around the area.

Note: The User option should only be used when the exact Geoid/ellipsoid separation from an alternative source or model is known.

4.4.1.4 Elevation Mask

The user elevation mask sets the minimum elevation at which a satellite will be used in the position calculations. By default the elevation mask is set to 10º.

The VERIPOS reference stations are all configured to provide corrections above a 7º elevation mask.

Changing the elevation mask in Verify QC can affect which reference stations are used for corrections, as the following logic is applied:

User elevation mask ≥ 10º	correction elevation mask = 10º
User elevation mask < 10 º and ≥ 5 º	correction elevation mask = user elevation mask
User elevation mask < 5º	correction elevation mask = 5º

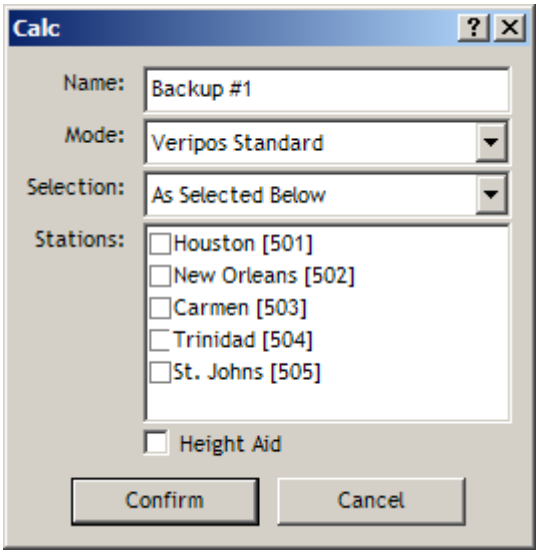
A higher mask setting may be useful where satellites at slightly higher elevations are suffering poor signal to noise ratios or intermittent masking.

Note: setting the elevation mask does not change the GNSS receiver configuration. Verify QC manages the elevation mask setting of the GNSS receiver, which is automatically set to 0º.

Note: the VERIPOS Apex and Ultra calculations use a fixed elevation mask of 7º.

4.4.2 New DGNSS Calc

Click "*Config/Calculation/DGNSS Calculation/New DGNSS Calc…"* to configure a new calculation.



DGNSS Calculation dialogue

4.4.2.1 DGNSS Calc Name

Allocate a name to the calculations in the Name box. Use a descriptive name to make it easy to identify the individual calculations when viewed in the Calculation Status window ("*View/Calculation/Status"*).

If left blank Verify QC will assign a name automatically based on the number of reference stations selected. e.g. when 5 stations are selected the software will assign the name "Network of 5". When one station is selected the name of that station will be assigned as the name of the calculation.

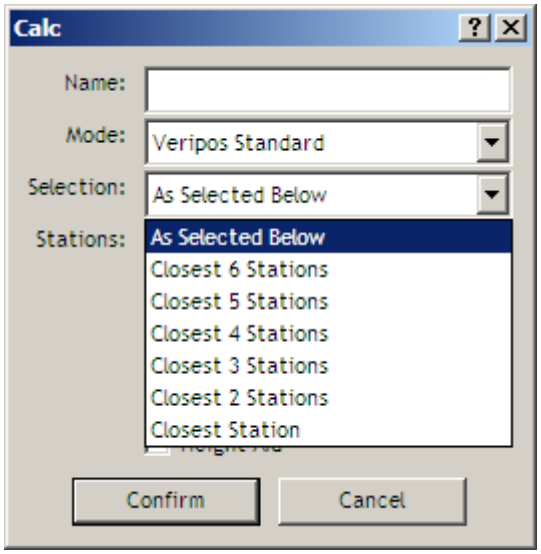
4.4.2.2 DGNSS Calc Mode

Choose the desired calculation *Mode* (Uncorrected, VERIPOS Standard, VERIPOS Standard² or GLONASS Only). Please note that the VERIPOS demodulator will have to be enabled accordingly for the individual services required within Verify QC.

4.4.2.3 DGNSS Calc Selection

When **'***Selection'* is set to '*As Selected Below'*, the user can manually select a preferred list of stations from the **'***Stations***'** list for use within the calculation. This list is derived from the stations that were defined under 'Config/RTCM Input...'

Alternatively, a 'Closest Station' calculation can be created. Verify QC can automatically select the closest between 1 and 6 stations within a 1500km range for use within a calculation. Choosing one of these settings means manual selection of stations is no longer presented as an option.



DGNSS Calculation Selection

The following logic is applied for the station selection for 'Closest Stations' calculations:

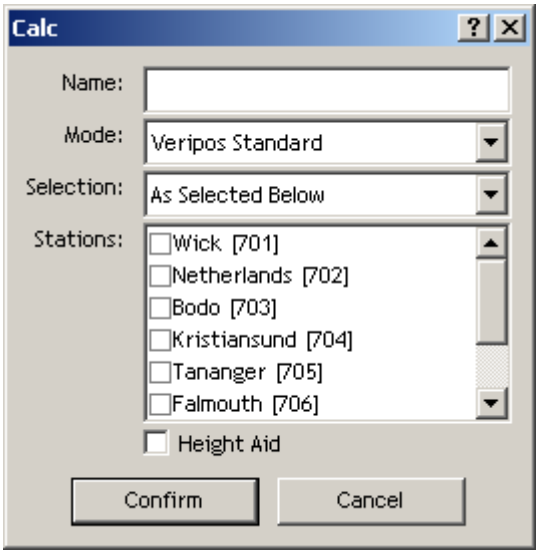
1. Only stations within 1500km range are selected
2. Only VERIPOS stations are selected – non-VERIPOS stations are excluded
3. A 'Standard' calculation only selects stations with RTCM Type 1 messages
4. A 'GLONASS Only ' calculation only selects stations with RTCM Type 31 messages
5. A 'Standard²' calculation first selects stations which provide both RTCM Type 1 and RTCM Type 31 messages. The remaining station slots are then filled with stations that only provide RTCM Type 1 messages

4.4.2.4 DGNSS Calc Stations

Where 'As Selected Below' is selected users can select the Stations to be used in the calculations.

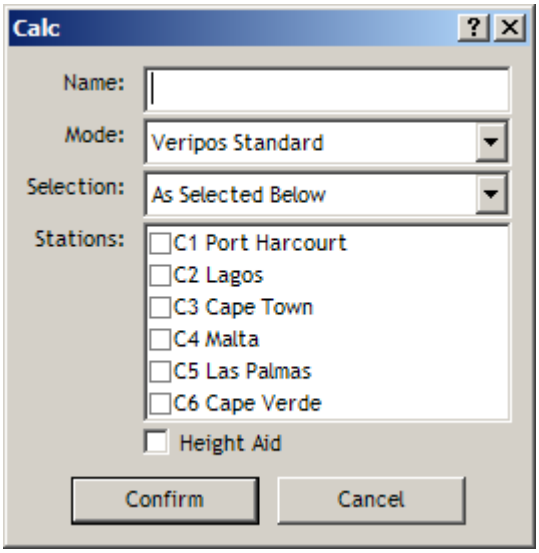
All reference stations that were defined on each of the RTCM inputs will be available in the *Stations* box in the calculation dialogue box.

Select the required reference stations by ticking that box in the list. If more than one station is to be selected highlight the range of stations to be used and select a tick box. This will tick all of your highlighted stations.



DGNSS Calculation Stations

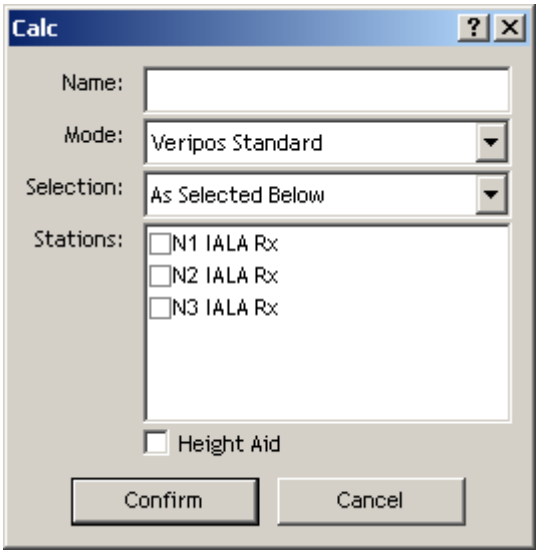
The stations will appear differently if you selected 'Closest 10 Stations' under the RTCM Input. Then the closest VERIPOS stations all have a prefix Cn in front of their name:



DGNSS Calculation Stations – using Closest RTCM Input Stations

Selecting C1 and C3 means that the 1st and the 3rd closest stations will be used in the calculation - independent of their station name or station ID. This means that the data for the closest 4th station will automatically take the place of the closest 3rd station in case the latter is no longer received.

Similarly, closest non-VERIPOS stations all have a prefix Nn in front of their names:



DGNSS Calculation Stations – using Closest non-VERIPOS RTCM Input Stations

Using these closest RTCM Input feature allows the user vessel to roam a larger (or even a Global) area without the need to closely monitor or update the station selection.

Checking the *Height Aid* tick box adds an observation based on the height entered in the Calc Settings dialogue.

Note: Enabling height aiding allows the Standard, GLONASS Only and Standard² calculations to work with as little as 3 GNSS satellites. This can be beneficial in environments with significant masking or in geographic areas of higher ionospheric disturbance where scintillation can effectively reduce the amount of satellites in view, or when working in areas that are subject to masking of satellites.

4.4.3 Ultra

This menu option is available only with an Ultra enabled dongle.

VERIPOS Ultra service is based on the Precise Point Positioning (PPP) technique. Using this technique the GNSS orbit and clock errors in the GNSS systems are corrected and remaining system errors are estimated or mitigated to a high degree of accuracy giving a position solution with a decimetre level accuracy.

The Ultra calculation is automatically made available when the dongle is enabled for Ultra.

The **Ultra calculation** is possible where the conditions exist as follows:

1. The Verify QC dongle is enabled for Ultra.
2. GPS receiver has dual channels and is receiving both frequencies.
3. The VERIPOS demodulator is enabled for the Ultra Service.
4. The Ultra “station” ID is enabled on the demodulator output port.
5. The “Veripos” check box is ticked in the Station Data dialog box.

The **Ultra GPS and GLONASS (Ultra²)** calculation requires the following additions:

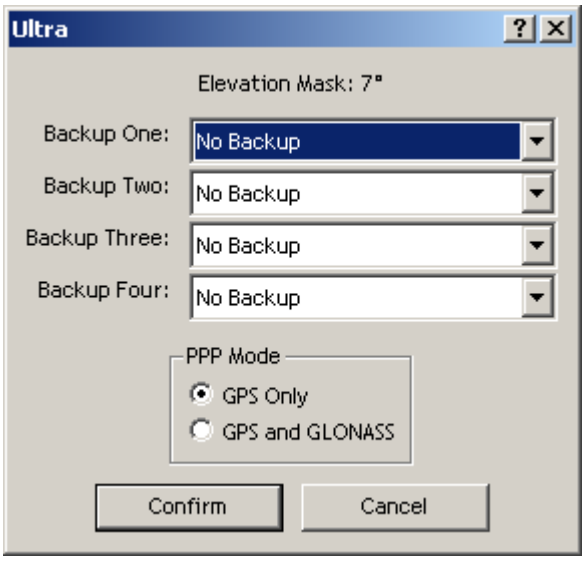
1. The Verify QC dongle is enabled for Ultra and GLONASS.
2. GNSS receiver is enabled for GPS and GLONASS, has dual channels and is receiving both frequencies.
3. The VERIPOS demodulator is enabled for the Ultra^2 Service.
4. The Ultra “GPS station” ID AND “GLONASS station” ID are enabled on the demodulator output port.

The “*Config/Calculation/Ultra”* option allows users to select the PPP Mode and up to 4 backup solutions when the Ultra solution is not available.

The backup solutions can be selected from Apex or the user defined Standard or Standard^2 calculations (see ‘*New DGNSS Calc*’ section in this manual).

The PPP Mode dictates which constellation is used in the Ultra calculation.
This will be GPS Only or GPS and GLONASS.
PPP Mode is available if Ultra and GLONASS options are enabled on the dongle and GLONASS is ticked in Advanced Options.

If GLONASS is not enabled on the dongle or ticked in Advanced Options, the Ultra calculation will be GPS Only.



Ultra dialogue

The logic of the backup process is as follows:

1. *An Ultra solution will be output if the calculation is in ‘Ultra’ mode and has a minimum of 5 satellites reported in the ‘Calculation Status’ view*
2. *Alternatively, the ‘Backup One’ solution will be output provided its mode is ‘Differential’ or ‘Reduced Differential’*
3. *Alternatively, the ‘Backup Two’ solution or the ‘Backup Three’ solution or the ‘Backup Four’ solution will be output provided its mode is ‘Differential’ or ‘Reduced Differential’*
4. *Alternatively, an uncorrected solution will be output*

Steps 2,3 & 4 are omitted from the process if no backup solutions have been selected.

A smoothing process is used during switches between the different stages of the backup process allowing Verify QC to seamlessly fall back without steps or interrupting in the Ultra position output. The smoothing process removes the initial difference between the previous and current calculation stage over a 100sec time period.

4.4.4 Apex

This menu option is available only with an Apex enabled dongle.

VERIPOS Apex service is based on the Precise Point Positioning (PPP) technique. Using this technique the GNSS orbit and clock errors in the GNSS systems are corrected and remaining system errors are estimated or mitigated to a high degree of accuracy giving a position solution with a decimetre level accuracy.

The Apex calculation is automatically made available when the dongle is enabled for Apex.

The **Apex calculation** is possible where the conditions exist as follows:

1. The Verify QC dongle is enabled for Apex.
2. GPS receiver has dual channels and is receiving both frequencies.
3. The VERIPOS demodulator is enabled for the Apex Service.
4. The Apex “station” ID is enabled on the demodulator output port.
5. The “Veripos” check box is ticked in the Station Data dialog box.

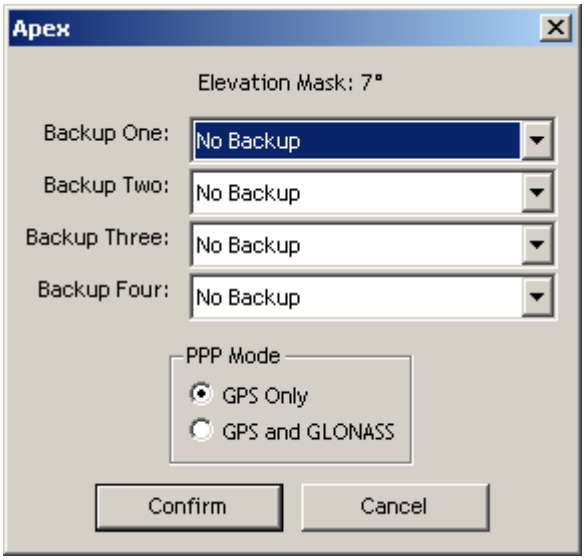
The **Apex GPS and GLONASS (Apex^2)** calculation requires the following additions:

5. The Verify QC dongle is enabled for Apex and Glonass.
6. GNSS receiver is enabled for GPS and GLONASS, has dual channels and is receiving both frequencies.
7. The VERIPOS demodulator is enabled for the Apex^2 Service.
8. The Apex “GPS station” ID AND “GLONASS station” ID are enabled on the demodulator output port.

The “*Config/Calculation/Apex”* option allows users to select the PPP Mode and up to 4 backup solutions for when the Apex solution is not available.

The backup solutions can be selected from Ultra or the user defined Standard or Standard^2 calculations (see ‘New DGNSS Calc’ section in this manual).

The PPP Mode dictates which constellation is used in the Apex calculation. This will be GPS Only or GPS and Glonass. The PPP Mode is available if Apex and Glonass options are enabled on the dongle and Glonass is ticked in Advanced Options. If Glonass is not enabled on the dongle or ticked in Advanced Options the Apex calculation will be GPS Only.



Apex dialogue

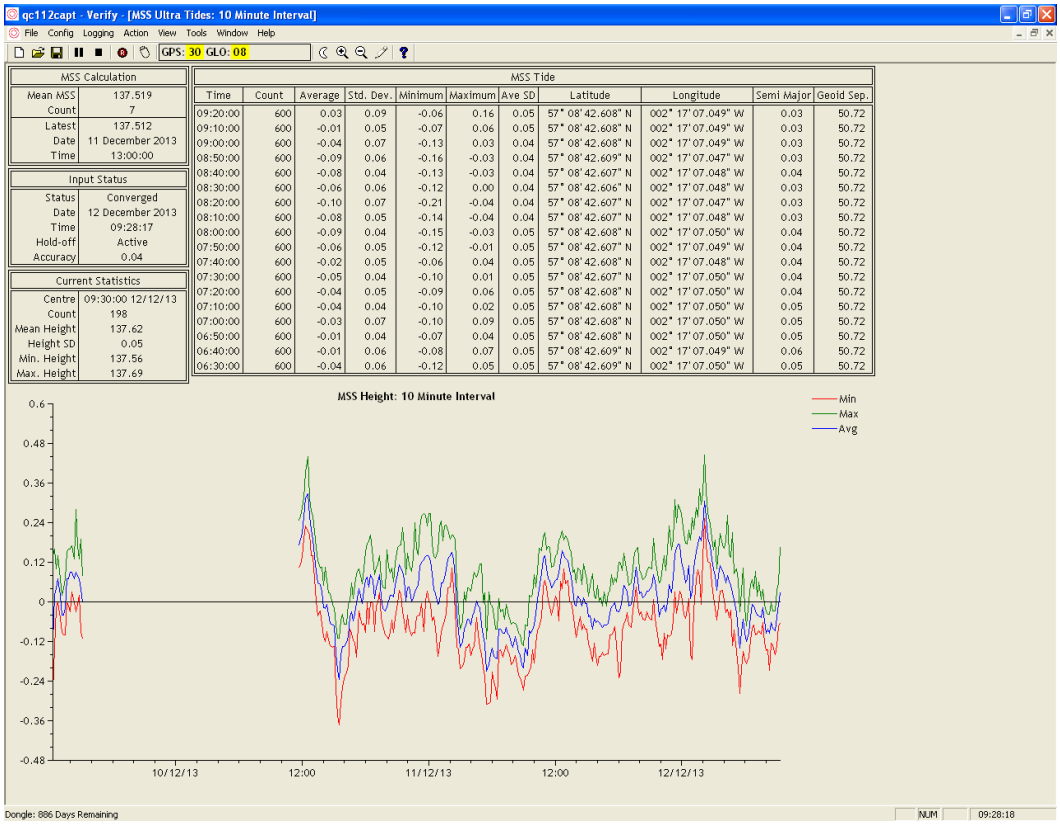
The logic of the backup process is as follows:

1. An Apex solution will be output if the calculation is in 'Apex' mode and has a minimum of 5 satellites reported in the 'Calculation Status' view
2. Alternatively, the 'Backup One' solution will be output provided its mode is 'Differential' or 'Reduced Differential'
3. *Alternatively, the 'Backup Two' solution or the 'Backup Three' solution or the 'Backup Four' solution will be output provided its mode is 'Differential' or 'Reduced Differential'*
4. Alternatively, an uncorrected solution will be output

N.B. Steps 2,3 & 4 are omitted from the process if no backup solutions have been selected.

A smoothing process is used during switches between the different stages of the backup process allowing Verify QC to seamlessly fall back without steps or interrupting in the Apex position output. The smoothing process removes the initial difference between the previous and current calculation stage over a 100sec time period.

4.4.5 MSS Tides



Tides calculation is available only with dongles specifically enabled for Tides and Apex and/or Ultra. If the dongle is not Tides enabled, the MSS Tides menu option will NOT be shown in the Config menu.

Tides calculation creates Tides estimates relative to two different vertical references:

- MSS Tides. This is calculated relative to Mean Sea Surface.
- Geoid Tide, relative to the Geoid model selected in the Calculations settings dialogue. It is an instantaneous tide estimate generated soon after the Tides calculation is initialised

  The MSS Tides calculation requires 39 hours of historic height information to be available before a tide estimate can be generated

4.4.5.1 Tides Directory

Select the location for the Tides log files.

A detailed description of all parameters contained in the Tides log files is included in the Appendix.

4.4.5.2 Tides Position

The position input is defined here. Users can choose from Apex and Ultra, depending on which features have been enabled on the dongle.

4.4.5.3 Talker

Choose the Talker between VQC and Standard.
If Standard is selected then the talker ID in the tide output files (TideInfo.txt & Doodson.txt) will be **'$UltraTide' OR $ApexTide** (depending on PPP solution used for the Tides calculation).

When VQC is selected the talker ID will be **'VQCnnnTide'**, where *nnn* represents the Verify QC version number. For example if Verify QC v1.20 is used, it will have a talker ID of **'VQC120Tide'.**

4.4.5.4 Tides Interval

Interval is the period over which the height information is averaged to remove the impact of heave. A 10 minute averaging interval is recommended for the Tides calculation.

4.4.5.5 Output every second

When this box is checked the interval of the real time output of tides message is 1 second. The message is repeated for the period set in the Tides Interval and is updated with the new values after the interval has passed.

The Tides logged files (Tides Info and Sprint) are unaffected by this check box, they are updated after the interval period.

4.4.5.6 Time Reference

The Time reference is the time stamp format used in the UltraTides (TidesInfo) message.

- HH:MM:SS: This time format is Hour, Minutes, Seconds in UTC
- GPS: This time format is seconds starting at 00:00:00 6th Jan 1980

4.4.5.7 Output Format

MSS Tides can output the Tides information via Serial Port, Server Socket or Datagram in addition to the Tides information being logged to file

The Output Format selects the format of data that will be output on the selected IO Device. The output format can be set to UltraTide or SPRINT. Details of these formats can be found in ***Appendix G***.
The *UltraTide* output will not include values for Doodson, MSS Tide and Draft for the first 39hrs of use. Verify QC will re-calculate all Tide values and update the existing ***TideInfo.txt*** file once it has enough data to populate the Doodson filter. Any separate records made using real-time output will not benefit from this feature.

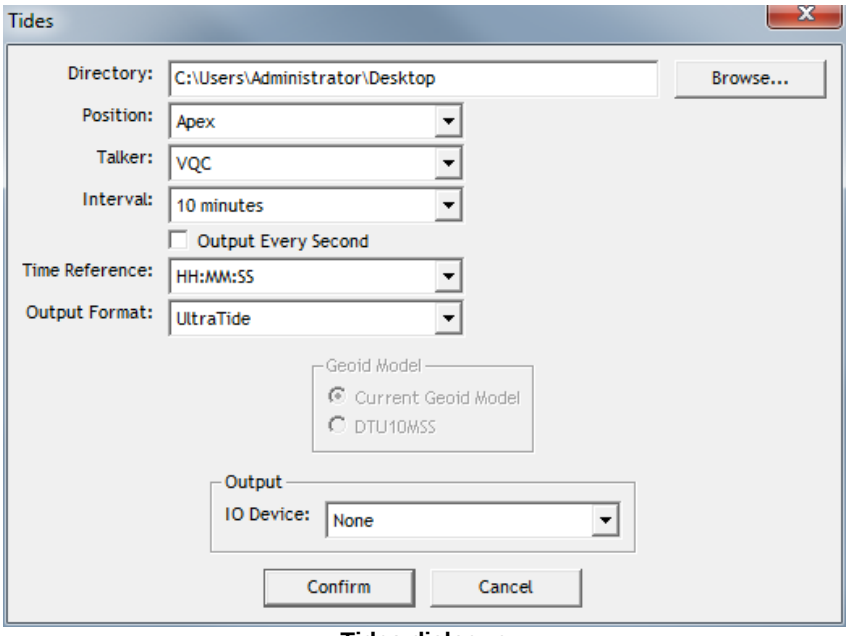
4.4.5.8 Geoid Model

Verify QC v1.20 supports the use of a Mean Sea Surface (MSS) model, relative to which the user can estimate tides. The Mean Sea Surface is the displacement of the sea surface relative to a mathematical model of the earth. It closely follows the Geoid (approximated by

EGM models), though with additional Mean Dynamic Topography deviations due to currents etc. The Geoid Model has 3 options available and can be selected from *"Config/Calculation/Settings…"*. For further information regarding geoid models within Verify-QC see section 4.4.1.3.

Currently the DTU10MSS model is unavailable for use with Verify-QC. As a result the DTU10MSS will remain unavailable for selection within the Tides configuration.

Select "*Config/Calculation/MSS Tides"* to configure the Tides calculation.



Tides dialogue

4.4.5.9 IO Device

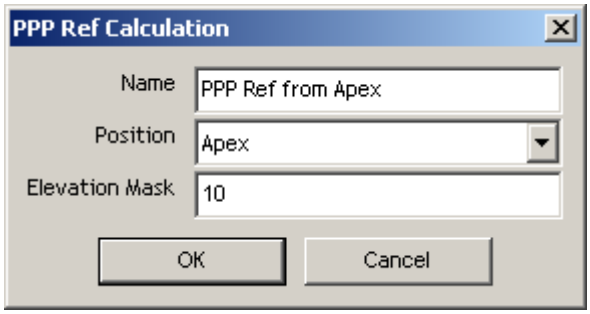
The *IO Device* section supports Real time Tides output via Serial Port, Server Socket or Datagram.

4.4.6 PPP Ref Calculation

The PPP Ref calculation (Config/Calculation/PPP Ref/Calculation) uses the current position of the Apex or Ultra calculation as a 'virtual reference station' location, for which real-time DGPS corrections in RTCM format are calculated. This calculation is specific to VERIPOS. This function allows highly stable and accurate DGPS corrections to be calculated and then be output to external DGPS systems or a telemetry link.

4.4.6.1 PPP Ref Name

PPP Ref Name (is used to allocate a name to the PPP Ref calculation)



PPP Ref calculation dialogue

4.4.6.2 PPP Ref Position

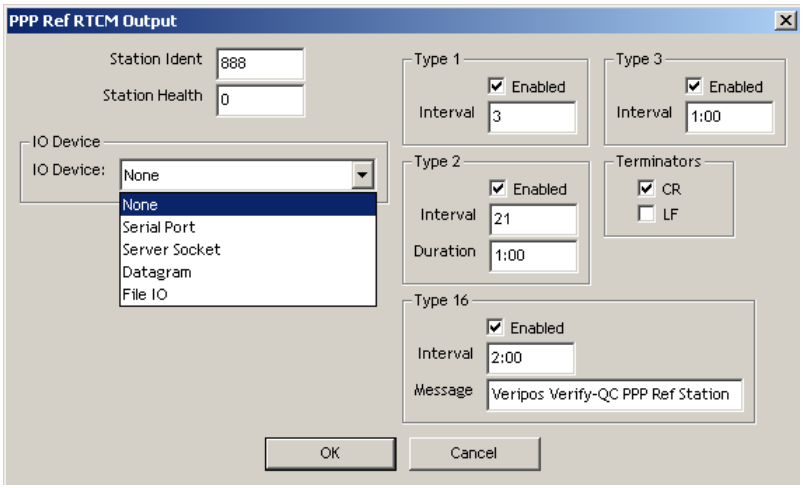
This allows the PPP solution to be used as the reference position for the PPP ref process to be selected. Users can select, depending on their availability, from Ultra or Apex.

4.4.6.3 PPP Ref Elevation Mask

This sets the user elevation mask for PPP Ref calculation.

4.4.6.4 PPP Ref RTCM Output

The actual RTCM output parameters and IO Device settings are configured in a second dialogue (*Config/Calculation/PPP Ref/RTCM Output)*.



PPP Ref RTCM Output dialogue

4.4.6.5 PPP Ref Station Ident

Use this to set the RTCM Station ID of the PPP Ref corrections (between 0-1023).

4.4.6.6 PPP Ref Station Health

Use this to set the RTCM Station Health of the PPP Ref corrections (between 0-7

As defined in RTCM v2.3, where 0 is healthy and 7 is unhealthy.

4.4.6.7 PPP Ref IO Device

The *IO Device* section supports RTCM output via Serial Port, Server Socket, Datagram and to File IO. Details are in the Appendix.

4.4.6.8 PPP Ref RTCM Settings

The PPP Ref calculation can output the RTCM messages required for a single-frequency DGPS calculation, i.e. Type 1, Type 2 and Type 3 messages.
PPP Ref also supports Type 16 messages to keep DGPS systems up to date on the source of the DGPS corrections.
Each of these messages can be enabled and their output intervals set.

The output interval of Type 1 and Type 2 messages is defined in seconds.
The output interval of Type 3 and Type 16 messages is set in minutes.

4.4.6.9 PPP Ref Terminators

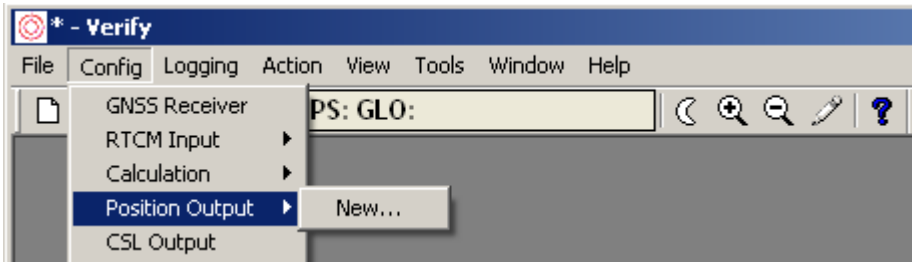
By default a carriage return (CR) is added to each RTCM message. The CR can be removed. An additional option exists to add a Line Feed (LF) to each RTCM message.

4.5 POSITION OUTPUT

There are no *software* limitations in the Verify QC to the number of outputs that can be configured.

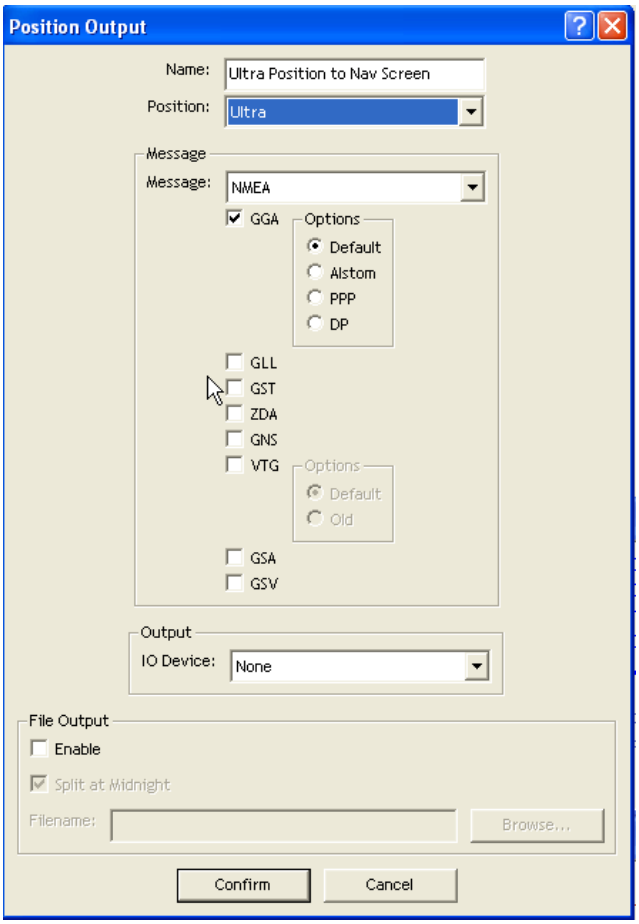
4.5.1 New

Click "*Config/Position Output/New…*"



New Output

This will open the following dialogue:



Output Name

4.5.1.1 Position Name

A *Name* can be given to the output. Use a name that indicates which calculation is being output and the external system connected.

4.5.1.2 Position

Select the *Position* calculation to be used. The pull down menu displays the list of all user configured calculations.
Apex and Ultra will be included where these are enabled on the dongle.

4.5.1.3 Position Message

Select the *Message* type to output from:

- NMEA
- WesternGeco TRINAV
- WesternGeco TRINAV V3
- VERIPOS UKOOA Output
- VERIPOS UKOOA2 Output
- GPLCT
- Veripos Applications - (Axiom)*****

The NMEA message type allows users to select one or more NMEA sentences.
Of these the GGA (DP), GLL, GST, ZDA, GNS, VTG (Default) GSA and GSV all conform to the NMEA v3.0 standard.

Further options exist for the GGA and VTG sentences. Options are:

- GGA (Default) - number of SV's can exceed 12 and sentence length can exceed 82 characters. Increased precision (7 decimals for Lat & Lon)
- GGA (Alstom) - number of SV's is limited to 12 and the sentence length can exceed 82 characters. The latency value equals the actual latency divided by 12 for DGNSS solutions and divided by 36 for the Ultra and Apex solutions
- GGA (PPP) - number of SV's can exceed 12 and sentence length can exceed 82 characters. The DGPS QI parameter offers the full range from 0-9. It will show 5 for an Ultra or Apex solution and 2 for a differential Standard or Standard² solution. Increased precision (7 decimals for Lat & Lon)
- GGA (DP) - fully NMEA-0183 v3.0 compatible string. Number of SV's is limited to 12 and the sentence length is restricted to 82 characters
- VTG (Default) - conforms to NMEA v3.0 standard
- VTG (Old) - conforms to NMEA v2.3 standard

The Axiom String is a proprietary string for use with VERIPOS INS software (Axiom).

Note: The 'Veripos Applications – Axiom' should not be output to vessel DP or survey software. This output is for output to the VERIPOS Axiom software only.

Detailed descriptions of Verify QC position output messages are contained in Appendices.

4.5.1.4 IO Device

The *IO Device* section supports position output via Serial Port, Server Socket and Datagram.

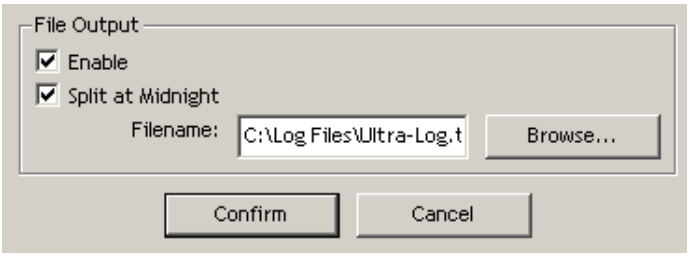
See Appendices for details.

4.5.1.5 File IO

The File Output option allows the user to log the output to the messages text file as well as output to the IO Device.

Click in the box for Enable and Browse to the location the file is to be stored.

The split at Midnight option creates a new file at midnight and attaches a date stamp to each filename.



File Output

Note: User also has the option to amend any existing output settings (Config/Position Output).

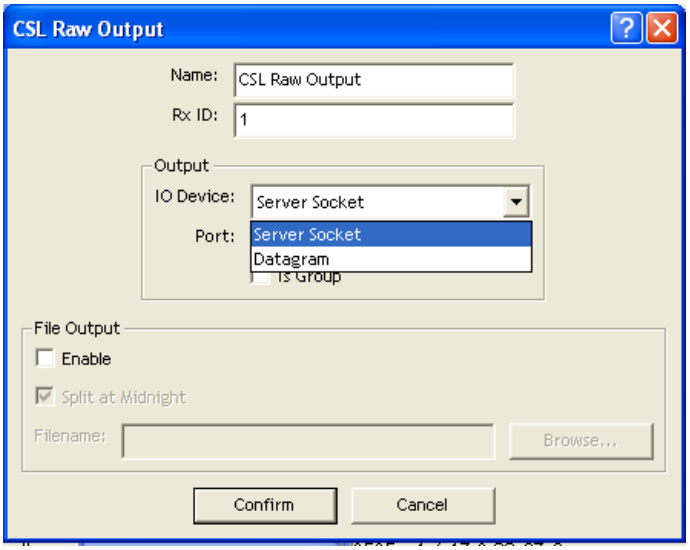
4.6 CSL OUTPUT

Note: this menu option is available only with a "CSL Output" enabled dongle.

The CSL Raw Output option allows users to output a series of records to the Concept Systems Limited (CSL) ViGPS* process (built into CSL navigation products).

This process can accept satellite data over an Ethernet or serial connection and convert it to CSL format.

*For further information contact CSL www.csl.co.uk . CSL are a subsidiary of ION.



CSL Raw Output

Allocate a name to the output. If no name is entered it will default to ‘CSL Raw Output’.

The *Rx ID* output must be enabled for it to become active. It is in the range of 0-99 and is used by the receiving application to identify the source of the CSL Raw messages.

The *IO Device* section supports CSL Raw output via Server Socket, Datagram and File Output.

See the Appendix for details.

5. VERIPOS HARDWARE COMPATIBILITY

Verify QC version 1.20 is compatible with all VERIPOS IMU types, with the exception of those listed below:

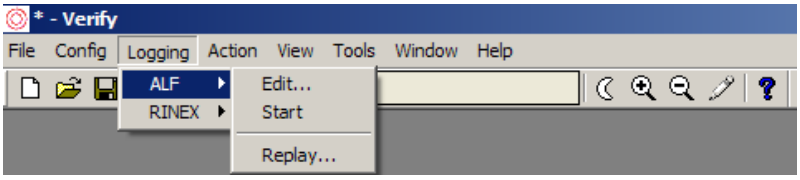
- LD5 on software version **6.0.0.12**
- LD5 on software version **8.0.0.7 and above**
- LD6 on software version **101.0.0.9**
- LD6 on software version **103.0.0.8 and above**

6. LOGGING

5.1 – Automatic ALF logging

Verify QC can log all raw GNSS data and raw RTCM data to files in the proprietary Verify QC logging format.
Verify QC can also log the GPS data in RINEX (**R**eceiver **IN**dependent **EX**change) format.

Note: Verify QC automatically maintains a copy of all raw GPS and RTCM input data in proprietary files. It keeps the last 72 hours of logged data for the current configuration. This data is sufficient for most problem diagnostic requirements. (Subsets of the data may be copied to other locations and sent to VERIPOS). The user only needs to manually configure logging if it is required for own needs or to meet the survey specification.



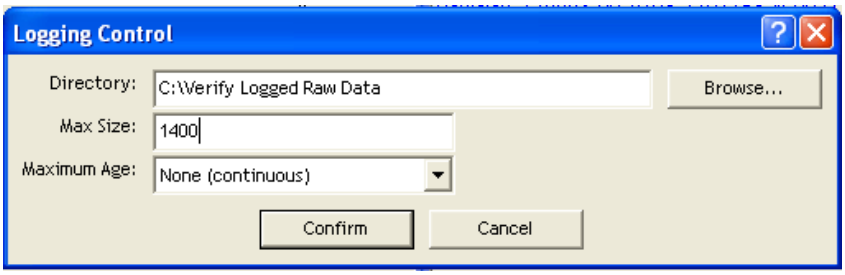
Logging menu structure

6.1 ALF

Verify QC can be configured to log all GNSS data and RTCM data to files in the proprietary Verify QC logging format. The data can be archived and replayed at a later time to provide the same information as seen real time, enabling additional offline analysis to be undertaken.

6.1.1 Edit

"Logging/ALF/Edit…" allows the user to set up the logging path and the desired file size prior to starting the logging process.



Logging Control

Enter the logging file "*Max Size"*. Default is 1400kB.

Files are logged for fault finding may be emailed and the recommended file size is 1400kB.

When logging data for review and archive purposes the recommended file size is 2000-5000kB. The maximum allowable file size is 10,000kB.

Once a file reaches the set maximum file size, Verify QC will open a new, additional file automatically and assign a unique name using date and time of file creation.

QC 1.20 allows archiving of data to a USB memory stick in the root directory.

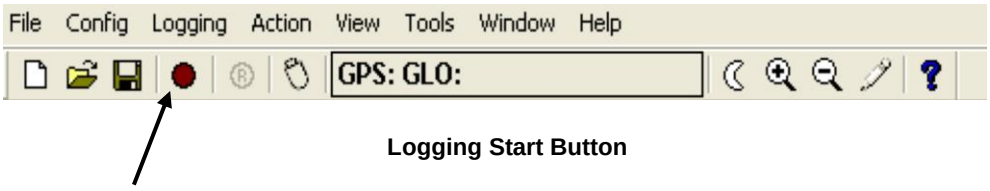
Within the 'Maximum Age' field, Verify QC offers options to clear old log files at intervals of:

- None (continuous) – **Default**
- Daily (24 hour)
- Weekly (7 day)
- Monthly (31 day) N.B. a **31 day month** will be used irrespective of the calendar, to allow for overlap and data recovery.

6.1.2 Start

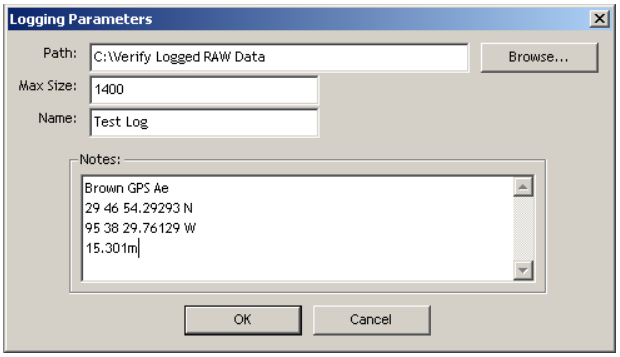
Click on the red 'record' button in the tool bar to start logging.

Alternatively *"Logging/ALF/Start"* starts data logging and confirms the logging control settings.



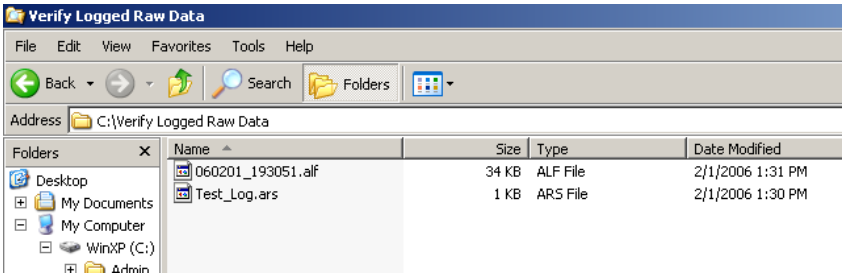
Logging Start Button

A name for the logging session and useful information can be added. This will show when selecting a log for replay. VERIPOS recommend adding information on the hardware and software configuration and operating environment. This aids analysis of the replay and provides an opportunity to describe any specific areas for review.



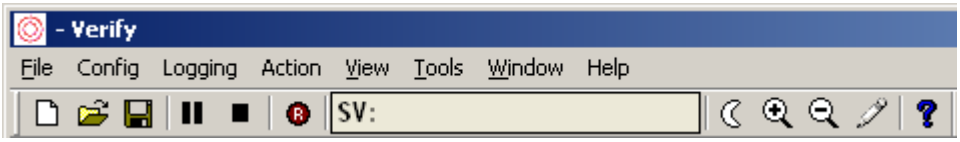
Logging Parameters

Information you enter is stored in the Logging Schedule (**.ars** file) in the same directory as the Verify QC logging files. *Name* field is used as the filename.



Path to logging schedule file

Once *Path* and *Notes* fields have been completed click "***OK"*** to start the log.
When logging commences Verify QC menu options and the toolbar will update to include "Pause" and "Stop" buttons.



 - Pause  - Stop

Logging Buttons

6.1.3 Replay

Replay allows replay of previously logged ALF data.

In order to replay data the user must use the same configuration files that were used to log the data, in addition to actual logged data.

Verify QC configuration comprises up to four different configuration files:

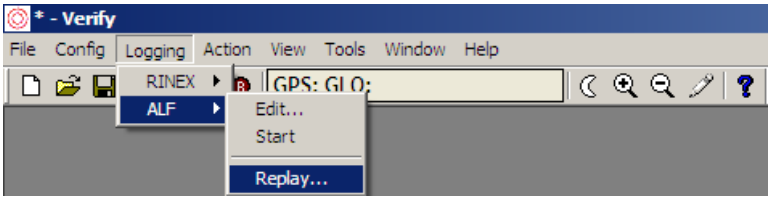
Extension	Description
.ver	**Verify QC Configuration File**
.alm	**Almanac File -** contains the GPS Almanac Information.
.aps	**Persistence File** - contains information regarding the screen layout when the user last saved the configuration.
.t3m	**Type 3 Message File** - contains the position of the reference stations used in the configuration.

Logged data comprises two different file types:

Extension	Description
.alf	**Log Files** - contains all the raw data.
.ars	**Logging Schedule File** - contains the sequence of the log files. Also contains the *Name* and *Notes* that the user added when starting the logging session.

Note: VERIPOS recommend replay is used only with offline Verify QC systems

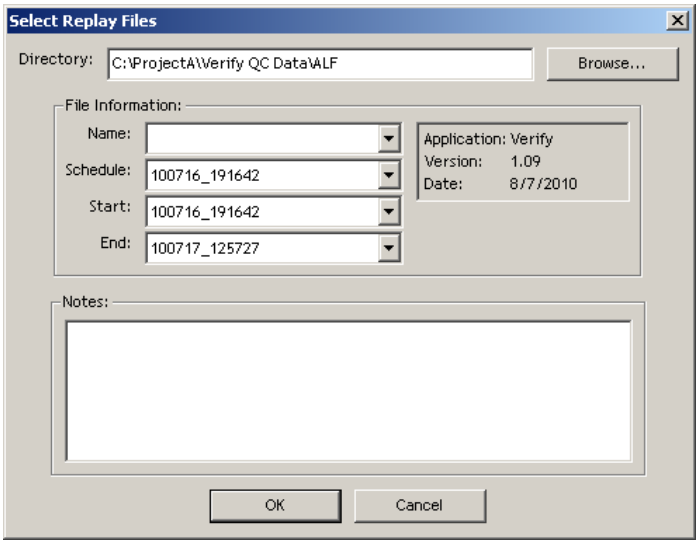
To set replay parameters, click "*Logging/ALF/Replay…"*



Replay

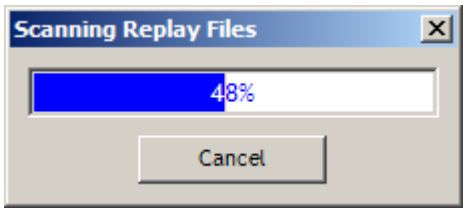
The following dialogue box will be displayed.

Directory is the same as that set under "*Logging/ALF/Edit"*.
Use the "**Browse"** button if required to locate the logged data.



Select Replay Files

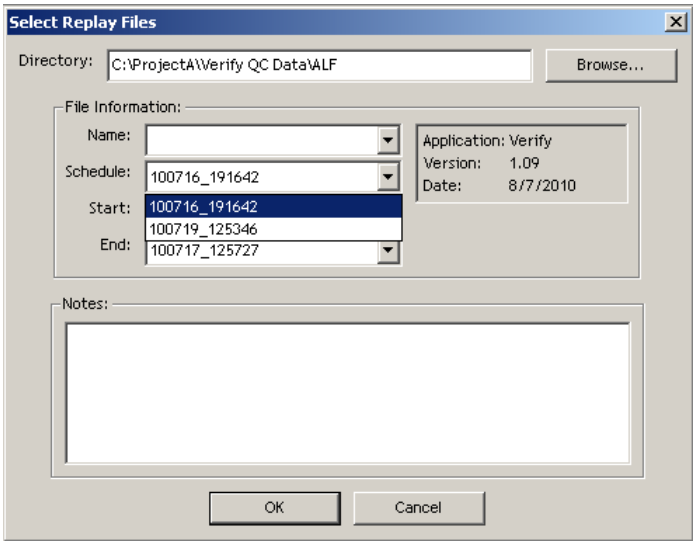
Verify QC will start scanning the logging directory for logging files and show a progress bar



Replay Files Progress Bar

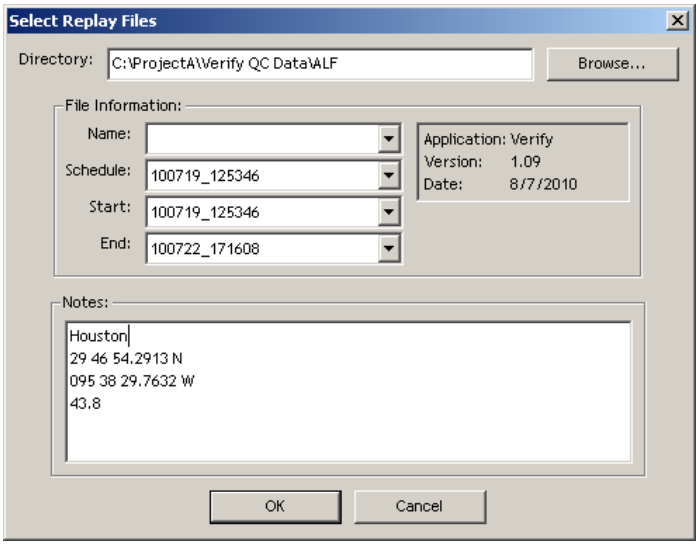
When the logging session and logging file availability have been determined, select the *required Logging Schedule from the drop down at "Schedule".*

Note: Different schedules will only be available if there are more than one set of logged data in the selected directory



Replay Schedule Selection

Start and stop times will be displayed and the replay period can be amended using drop down menus.



Time span of Replay data

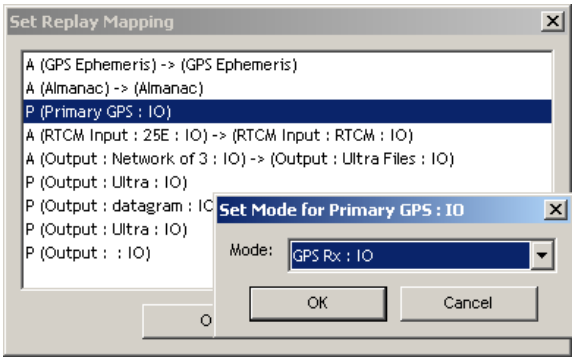
After replay period is set click "***OK".*** Review the replay mapping window and confirm all data to be replayed is active (displays an A in the left hand column).

If passive (P) and you require it to be active -

Double click on the data string to display the "*Set Mode"* menu.

Change the mode to active and click "***OK"***.

Similarly an active string can be made passive if not required in the replay.



Activating Replay Data

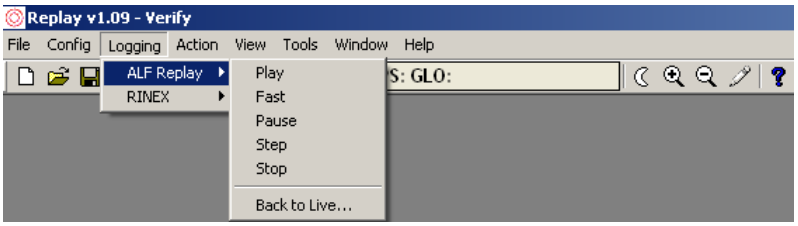
When Replay Mapping has been set, click "***OK".***

The Verify QC toolbar changes to include the following control buttons:

- Play
- Fast Forward
- Pause
- Step
- Stop
- End Replay Mode

Replay Control Buttons

Replay is controlled with Tool bar buttons or using the "*Logging/ALF Replay"* menu.



Replay Controls

Pause replay at any time to allow current status and data analysis.
The step forward facility helps in this process.

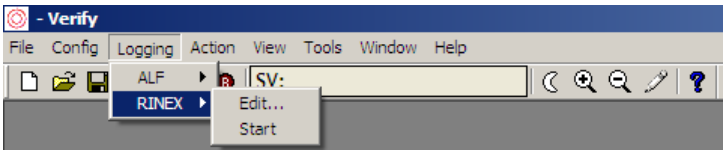
When the data is being replayed, the user can open views, output data as GGA text files and monitor calculations as if the system was operating in live mode.

Input functions are disabled with software in replay mode.

If replay is used with the 'online' computer and data inputs are still active, the user can revert to live mode using the "*Logging/ALF Replay/Back to live"* (not recommended in practice).

6.2 RINEX

Verify QC software supports RINEX v2.10 standard and can log GPS data files in the RINEX format. Logging intervals of 1, 15 and 30 seconds are available.

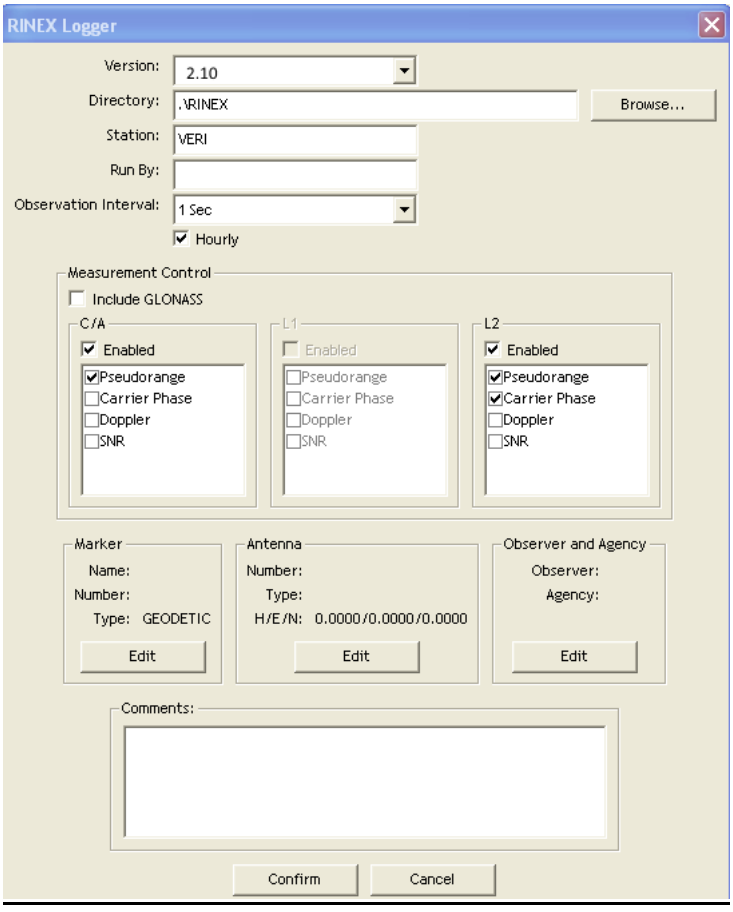


RINEX Logging menu

RINEX logging must be ticked in *Tools/Advanced Options* before RINEX logging can be used.

Use "*Logging/RINEX/Edit…*" to bring up the RINEX Logger dialogue box.

The RINEX Logger dialogue appears:



RINEX Logging

6.2.1.1 RINEX – Version

RINEX files that comply with the v2.10 standard can be logged.

6.2.1.2 RINEX Station

This is for entering a four character *Station* identifier, which will be used as the first 4 characters of the RINEX log files.

6.2.1.3 RINEX Run By

The operators' name may be entered.

6.2.1.4 RINEX Observation Interval

The files are automatically split at midnight if an interval is not selected.

The drop down menu allows users to select RINEX *Logging Interval* of 1, 15 or 30 seconds. RINEX data at a one second interval will amount to approximately 100Mb per day.

A one second interval is recommended or even required for dynamic users.
15 and 30 second intervals are more suited to static users.

Hourly creates a new file every hour.

6.2.1.5 Measurement Control

The three *Measurement Control* dialogue boxes C/A, L1 and L2 are used to select the GNSS observation types to be recorded in RINEX files.

Note: which observation types are available is GNSS receiver dependant. Observations not available from the receiver will be greyed out.

If the receiver only outputs C/A measurements - L1 and L2 dialogue boxes will be greyed out. Similarly, if receiver outputs C/A and L1 measurements but not L2, the L2 dialogue box will be greyed out.

The *Marker*, *Antenna*, *Observer* and *Comments* inputs allow configuration of the header within the RINEX file. It is recommended these are as complete as possible to aid post-processing and identification.

Click '**Confirm'** to complete the RINEX logging configuration.

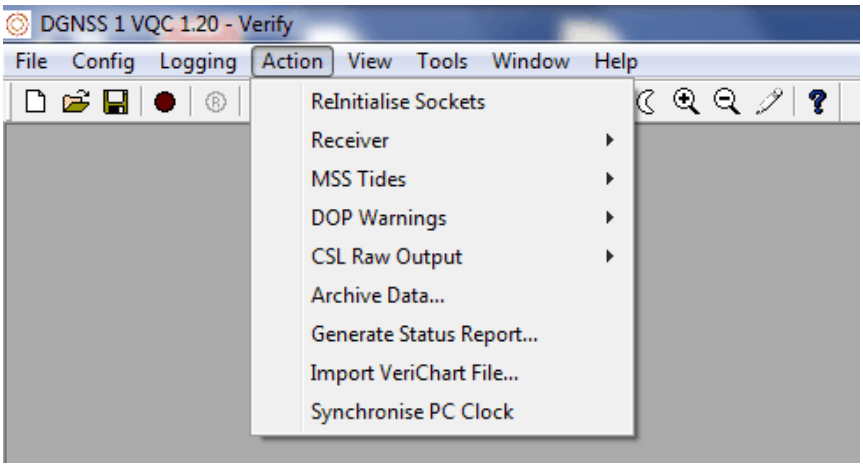
Following this the 'Record', 'Play' and 'Pause' control buttons are visible in Tool Bar.

Note: users are required to manually start RINEX logging after setting the following parameters for measurement control.

Manually start RINEX logging by selecting the ***"Start RINEX Logging"*** control button on the toolbar or "*Logging/RINEX/Start* ".

7. ACTION

The Action drop down menu allows for commands to be sent to the processes as shown in the screen below:



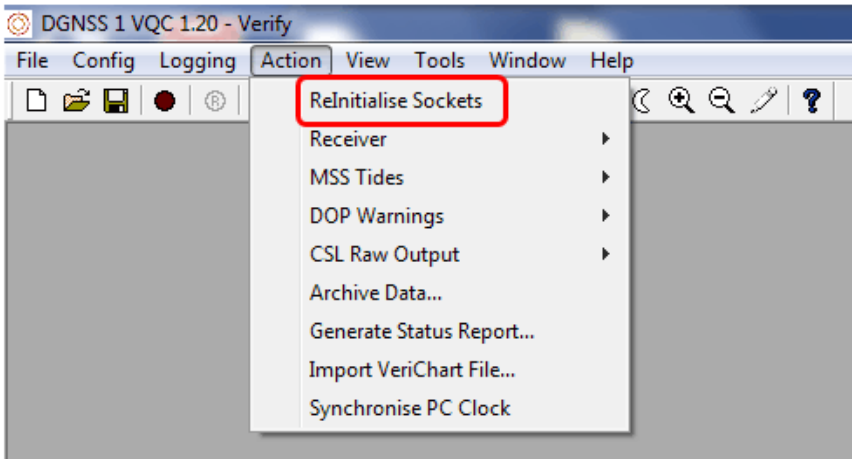
Action Menu

7.1 REINITIALISE SOCKETS

The *ReInitialise Sockets* option is only available when either an LD5 or LD6 is selected within the *Config/GNSS Receiver*.

This option is designed to restore LAN RTCM and demodulator inputs following a temporary loss of connection. For example, if RTCM data is input to Verify QC via LAN and the physical LAN connection between Verify QC and the receiver was temporarily lost for more than a few seconds, the RTCM data will not return automatically. In such an occurrence, go to *Action/ReInitialise Sockets* to restart the connection and the RTCM data input should then be restored.

Note: There is no requirement for to use this feature when using any GNSS receivers other than LD5 or LD6.
Serial RTCM and Demodulator inputs will recover automatically.
Raw GNSS inputs (both LAN and serial) will recover automatically following a loss of connection.



7.2 RECEIVER

Note: GLONASS entries in the menu are only available if the dongle has been enabled for GLONASS.
Establish and Set receiver Baud Rate entries are only available when a GNSS receiver has been connected using a serial port and set to communicate at matching baud rates.

7.2.1 Details

"Action/Receiver/Details" displays details of connected receiver hardware and software. Details vary on the receiver type used. Typically they include the receiver serial number and firmware version.

Receiver Details View

The view will populate only when Verify QC is connected to a receiver.
This example is for a Topcon receiver.

7.2.2 Initialise

"*Action/Receiver/Initialise"* sends commands to configure the receiver for use with Verify QC.

Note: this does not set or change the communication parameters. *Interface the GPS receiver to Verify QC using "Config/GNSS Rx" prior to using this command.*

Users are not required to initialise the receiver once the software is operational.

Required when setting up a new system or when Verify QC stops receiving data from the GNSS Receiver.

7.2.2.1 GPS/GLONASS Request Ephemeris

The command requests the latest GPS or GLONASS ephemeris data from the receiver.

These settings can be accessed via *"Action/Receiver/GPS/Request Ephemeris"* and "*Action/Receiver/GLONASS/Request Ephemeris"*.

Verify QC will actively request the ephemeris during normal software operation as required. Users are not required to request the ephemeris once the software is operational.

7.2.2.2 Request Almanac

"Action/Receiver/GPS/Request Almanac" and "*Action/Receiver/GLONASS/Request Almanac"* - requests the latest GPS or GLONASS almanac data from the receiver.

Verify QC actively requests the almanac. Not required once the software is operational.

7.2.2.3 Request Iono

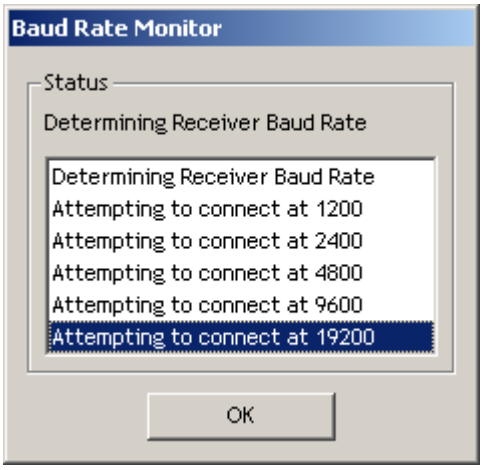
"*Action/Receiver/GPS/Request Iono"* requests the latest GPS ionospheric model information from the receiver.

Verify QC actively requests the ionospheric model information. Not required once the software is operational.

7.2.3 Establish Baud Rate

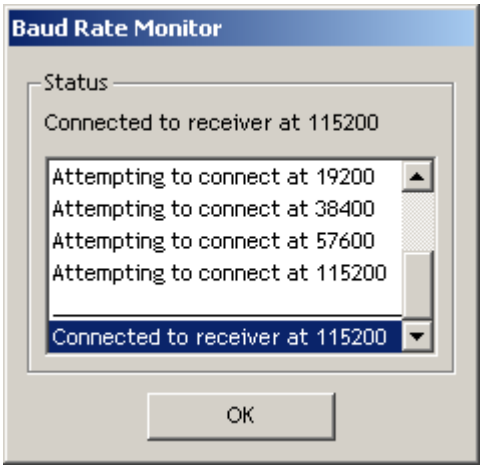
Note: the receiver IO Device must first be set up as Serial Port for this function to work within Verify QC.
If this is not done prior to use the option to establish a baud rate with the connected GNSS receiver will not be available.

Selecting *Action/Receiver/Establish Baud Rate* will open the Baud Rate Monitor status window. Verify QC will start to cycle through the range of baud rates and attempts to establish a connection with the GNSS Receiver.



Establish Baud Rate status window

Once Verify QC detects the receiver current baud rate setting it will report that it is connected to the receiver at this specific baud rate. See the example dialogue below.



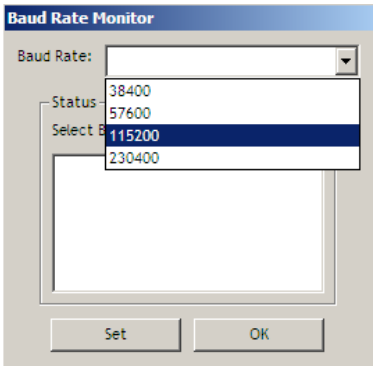
Establish Baud Rate status window

7.2.4 Set Receiver Baud Rate

This feature is particularly useful if the initial baud rate was too low for the GNSS receiver data to flow continuously.

Note: you cannot change the baud rate until you have established communications with the receiver via a serial port. See earlier sections describing the procedure for set up of serial port GPS comms.

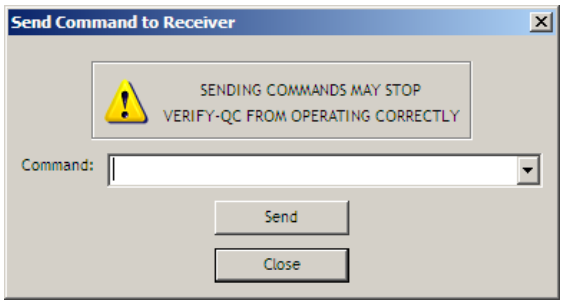
Selecting *Action/Receiver/Set Receiver Baud Rate* to select a different baud rate. The software sends commands to the receiver to change the baud rate and attempts connection at this new baud rate.



Set Receiver Baud Rate dialogue

7.2.5 Send Command

"*Action/Receiver/Send Command"* allows specific commands to be sent to the receiver. These must conform to the receivers' proprietary command structure.
Refer to manufacturer's documentation for details.



Send Message

Note: take care when sending additional commands to the receiver. These may interfere with normal operation of Verify QC.

7.3 MSS TIDES

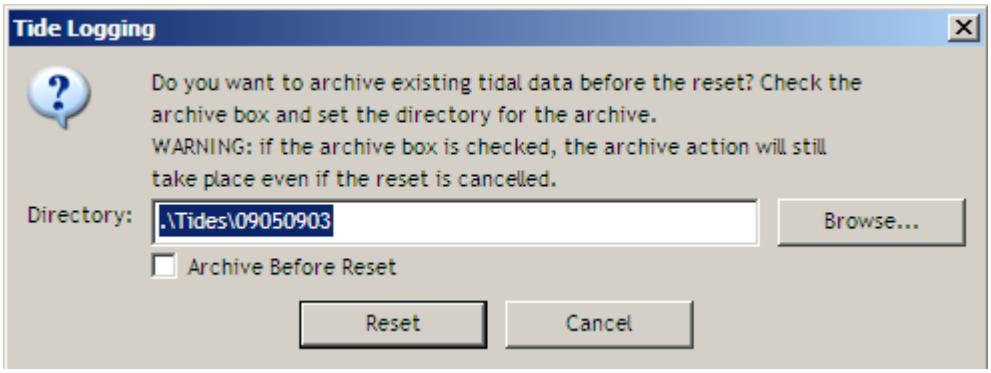
Note: the Tides function is a dongle controlled, advanced function of the Verify QC software. Ensure your dongle is enabled for MSS Tides.

It can be used with VERIPOS Apex and Ultra services. The MSS Tides function allows a vessel to determine local tidal height.

7.3.1 Reset

It is possible to reset the Tide calculation process manually when the work area changes or essential input information is known to have changed such as the antenna height above the waterline. Previously logged data is deleted and the Tides logging process starts afresh.

Following reset the MSS Tide calculation requires an initialisation period of 39 hours.
A Geoid Tide calculation gives an instantaneous tides estimate.



Tides Reset Dialogue Box

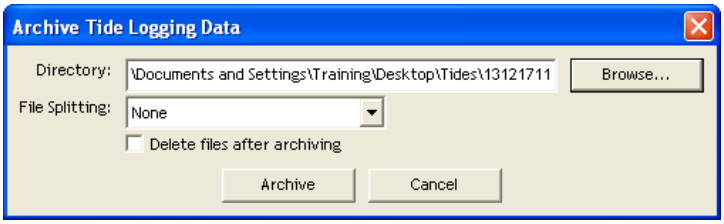
A tick box option to archive logged Tide information is presented before resetting.
Select an archive location where the two log files will be stored using "**Browse…"**

7.3.2 Archive

Logged Tide information can be archived whilst the Tide calculation is active.
Archiving the tide log files will not automatically reset the process.
The Archive function will copy the Tides logging files to a selected directory.

Files may be split using the drop – down box between daily, weekly or monthly.
Note that the Monthly option covers a **31 day** period.

To delete an existing Tides logging file, select the '*Delete files after archiving'* tick box.



Tides Archive Dialogue Box

The file naming conventions for logged archived data will vary dependant on the file splitting option which is selected:

- None – TideInfo.txt
- Daily – TideInfo_YYMMDD.txt
- Weekly – TideInfo_GPSWWWW.txt (WWWW is the GPS week number)
- Monthly – TideInfo_YYMM.txt

Note: Sprint.txt and Doodson.txt file naming conventions will follow the same pattern as above. For weekly files, Sunday is defined as the first day of the week.

7.4 POP UP DOP WARNINGS

DOP Warnings inform the users about future periods of bad geometry or low satellite count. They appear at the centre screen with an audible alarm.

Advance DOP warnings alert the user about the weakness of the available GNSS constellation in the work area. More detailed information is available from the DOP View when the icon button is selected.

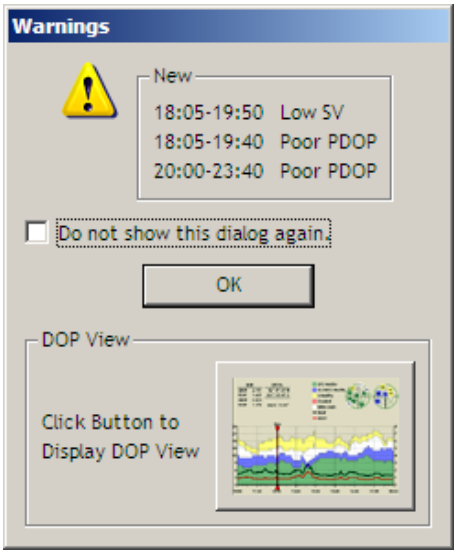
The DOP Warnings appear if the number of SV's is <6 and if PDOP is >10 during the next 12 hours.

The DOP view shows the elevation mask setting.

It may be possible to increase the number of satellites and improve the DOP by reducing this elevation mask under *Config/Calculation/Settings*.

This dialogue permits DOP warnings to be disabled.

Restore DOP warnings in *Action/DOP Warnings/Display Current DOP Warnings*.



Example DOP Warning Pop-up

The above example shows two periods of poor DOP and one period of low satellite numbers forecast over the coming 12 hour period.

Verify QC's program menu is locked-out when the warning pop-up box is open.

The pop-up will disappear when the warning is acknowledged. Access to Verify QC's program menu is restored.

Additional DOP warnings for the next 12 hours are shown in the 'Info Bar' at the bottom left of the Verify QC main program window. These are independent of the DOP warning enable/disable status.

7.4.1 Disable

The DOP warning feature can be disabled by ticking the 'Do not show this dialogue again' box or select "*Action/DOP Warnings/Disable*".

The DOP warning status can be reversed by selecting "*Action/DOP Warnings/Enab*.".

7.4.2 Display Current DOP warning

To recall the most recent warnings select "*Action/DOP Warnings/Display Current DOP Warnings*."

7.5 CSL RAW OUTPUT

7.5.1 Output Ephemeris / Ionospherics / UTC

These options force the instant output of Ephemeris, Ionospheric and UTC CSL Raw records on the configured CSL Raw Output IO device.

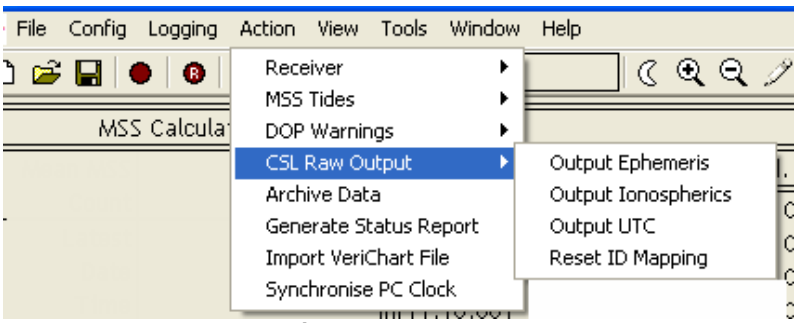
7.5.2 Reset ID Mapping

The CSL Output Format requires the RTCM Station IDs to be in a 2 digit format (00 to 99). The RTCM Format allows station IDs from 0000 to 1024. As a result Verify QC maps the stations received within Verify QC to the 2 digit format. This is done by assigning the first received reference station to 00, the second received reference station to 01 and so on until all received stations have been mapped to a 2 digit code.

Selecting the menu item *Reset ID Mapping* allows the ID number scheme (0 – 99) to be reset

Note: These functions apply where the dongle is enabled for CSL output and Verify QC is providing an output to a Concept Systems Limited navigation system.

These actions are available under *Action/CSL Raw Output/*



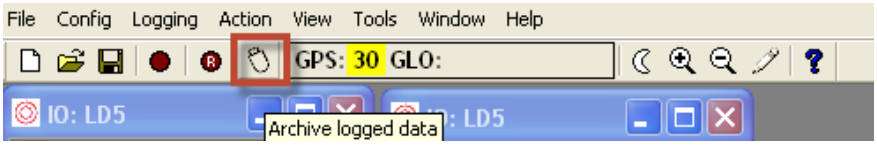
Action CSL Raw Output

7.6 ARCHIVE DATA

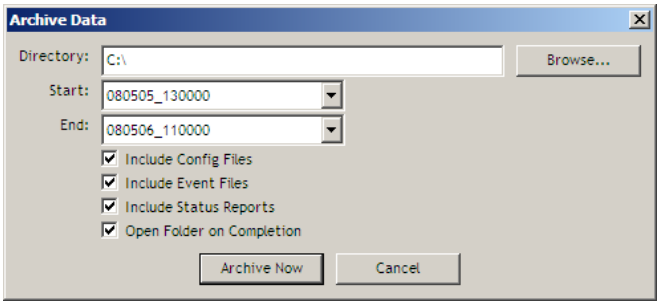
Verify QC maintains automatically a copy of all raw GPS and RTCM input data in proprietary (ALF) file format. By default the last 72 hours of logged data is retained. Archived data for previous configurations is retained for 7 days before being removed automatically.

"*Action/Archive Data*" selects all or a continuous subset of data and copies it to another location.

Verify QC 1.20 adds an icon shortcut to the main control bar:



This feature has been implemented for when software performance issues are identified and data and configuration files have to be forwarded to VERIPOS for further analysis.



Archive Data

To archive data click "**Browse**" and select the location. Verify QC will scan automatically and display the available logged data files with the start/end times available in drop down menus. File name syntax is YYMMDD_HHMMSS.

The Verify QC configuration and status files to be archived are selected by ticking check boxes.

Note 1: Data can only be archived after the configuration has been saved.

Note 2: Archiving current data will not delete it. Verify QC will always keep the last 72 hourly log files.

Note 3: The automatic logging function is independent of the normal (manual) Verify QC data logging function (configured under: Logging/ALF or RINEX/ Edit).
Continuous manual logging of Verify QC data is configured at "Logging/Edit" and requires a manual start. Manual log files are limited to a maximum size of 10MB.

Note 4: Manually logged data cannot be archived using the archive data function. This data should be recovered using windows Explorer for saving.

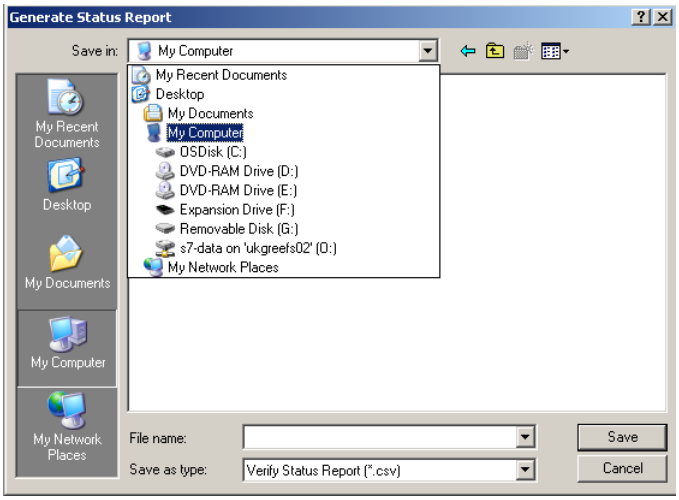
7.7 GENERATE STATUS REPORT

Verify QC automatically generates a ‘Status Report’ at midnight.

The report contains information about the availability of GNSS measurements, GNSS cycle slips, GNSS satellite health status, the availability of RTCM messages and the availability of positions.

Should the user require an *ad hoc* report select A*ction/Generate Status Report*.

Select the location and filename of the report and click Save.



Generate Status Report

7.8 IMPORT VERICHART FILE

Verify QC contains a station list for the global VERIPOS network, valid on the date of software release.

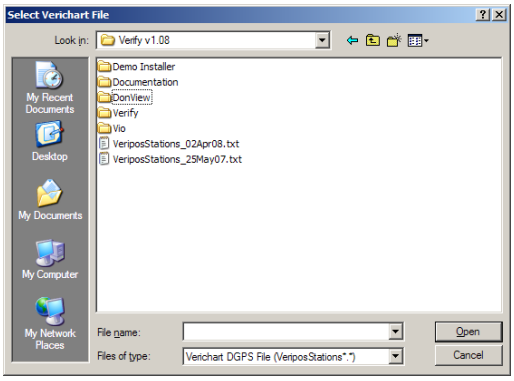
VERIPOS recommend an update is downloaded on a regular basis.

Information is contained in Verichart Station Configuration File format.

The updated station list is on the VERIPOS support website:

http://help.veripos.com

Use “Action/Import Verichart File” to import a file into Verify QC.



Import Verichart File

When the file is loaded updated global station information is used to display the coverage on the Station Map.

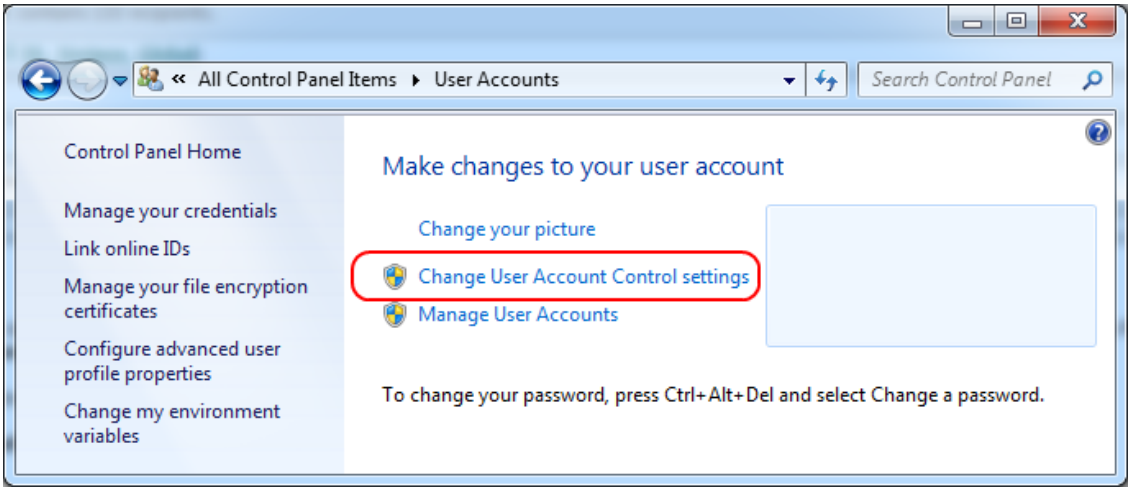
7.9 SYNCHRONISE PC CLOCK

Use “Synchronise PC Clock” facility to adjust the PC time to Verify QC system time (GPS time).

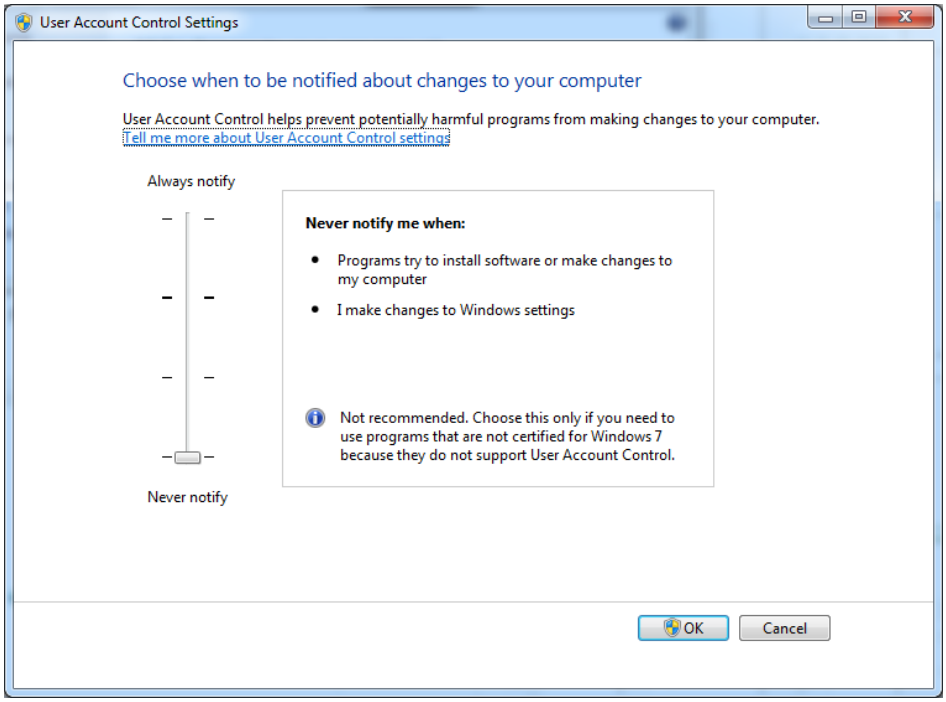
The Synchronise PC Clock option will not work in Windows 7 unless the User Account Control option is set to ***Never Notify.***

To Set the UAC follow the steps below:

Open **Control Panel** – **User Accounts** and select the option for ***Change User Account Control Settings***

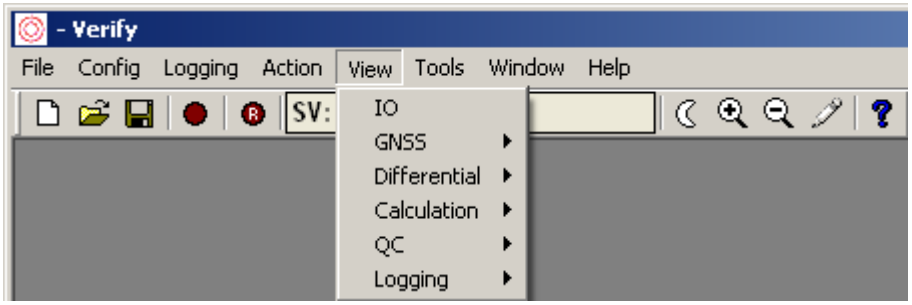


Set the UAC to ***Never Notify*** and select **OK.**
After clicking OK restart the PC to apply changes.


User Account Control Settings
Choose when to be notified about changes to your computer
User Account Control helps prevent potentially harmful programs from making changes to your computer.
Tell me more about User Account Control settings
Always notify
Never notify
Never notify me when:
Programs try to install software or make changes to my computer
I make changes to Windows settings
Not recommended. Choose this only if you need to use programs that are not certified for Windows 7 because they do not support User Account Control.
OK
Cancel

8. VIEW

The View menu contains all views available to the user for monitoring the data input, data quality, positioning and QC status of Verify QC.



View menu structure

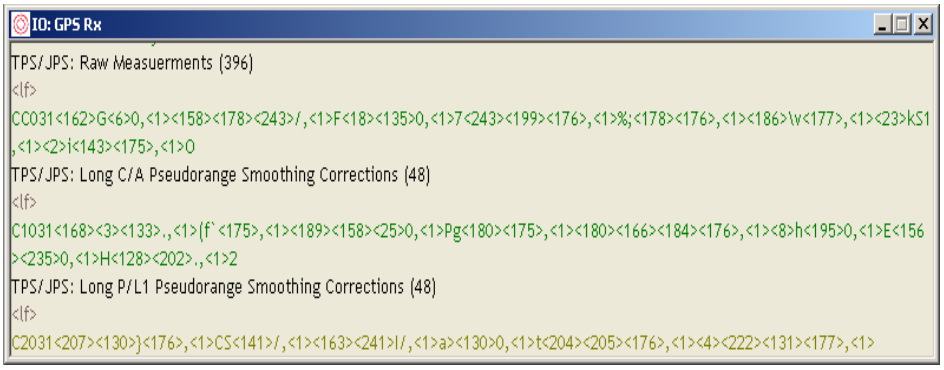
When Verify QC has been configured for use* the user can select the required display screen information.
It is recommended that only windows required for the current operation are opened.

Verify QC does not require windows open on the screen to function correctly.

Note: *The range of options available in the View menu is dependent on the dongle enable status or your settings. View these at Tools/Advanced Options.*

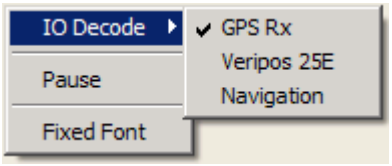
8.1 IO

Select "*View/IO*" to display scrolling IO data. This terminal window allows the user to view the data input and output on a specified port. Correct decoding of the input data is printed in green with the decoded data header printed in black. If input data is NOT decoded correctly or is corrupted it will be printed in red or not at all. Output data is printed in blue.



IO View

Right clicking in the IO view allows the user to change the data source.
All defined inputs to, or outputs from Verify QC can be monitored.

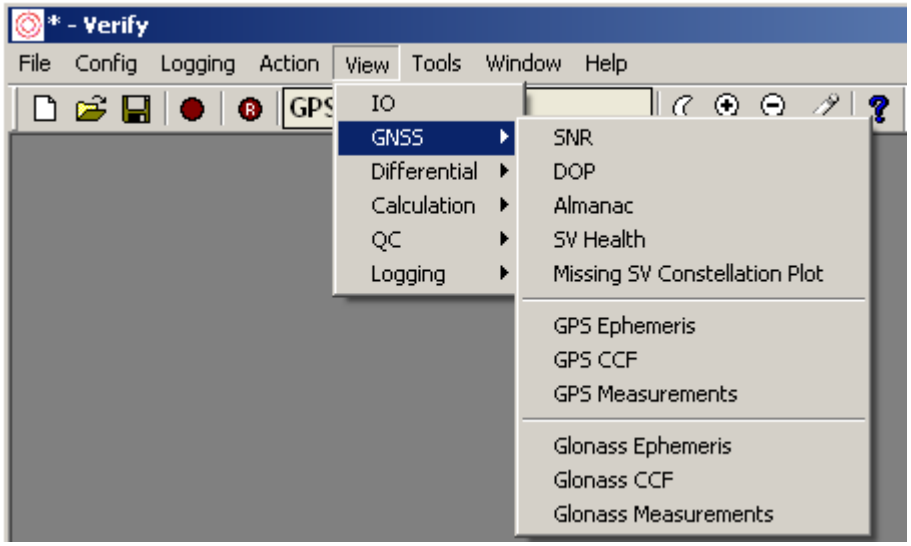


View IO Options

Pause and Fixed Font options are available to aid data interpretation.

8.2 GNSS

The *GNSS* menu section contains views relating to the GNSS receiver and satellites.

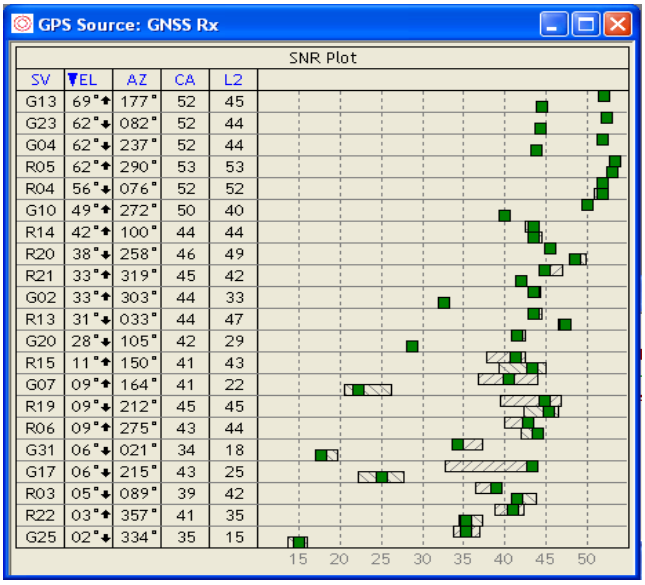


View GNSS Menu

8.2.1 SNR

SNR displays the Signal to Noise Ratios, measured in dbHz for each GPS/GLONASS satellite in view.
The following characteristics are displayed by the various GPS receiver types: -

- A stronger signal is displayed when the signal indicator moves to the right side of the window
- The width of the signal indicator summarises the recent variation in signal strength
- A large hatched area indicates unstable tracking
- When the signal strength becomes critical the colour of the signal indicator changes to yellow and then red Parameters are set in the system.
- Satellites at higher elevations have higher signal strengths and are less prone to noise. All signals are normal in the figure below

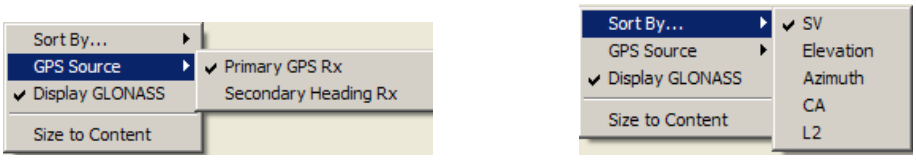


SNR Measurements View

GPS satellites are identified by their PRN number and are preceded by a 'G'. GLONASS satellites by their slot number and are preceded by a 'R'. The slot number for GLONASS refers to the transmit frequency slot for each satellite. GPS uses a pseudo random code number (PRN) to identify satellites.

Clicking SV, AZ, EL L1 or L2 changes the vertical order in which the window displays the data.

Right clicking will do the same using a menu. This allows selection of the 'GPS Source'. (Feature only available when a second GNSS receiver input is configured for the Heading Calculation).



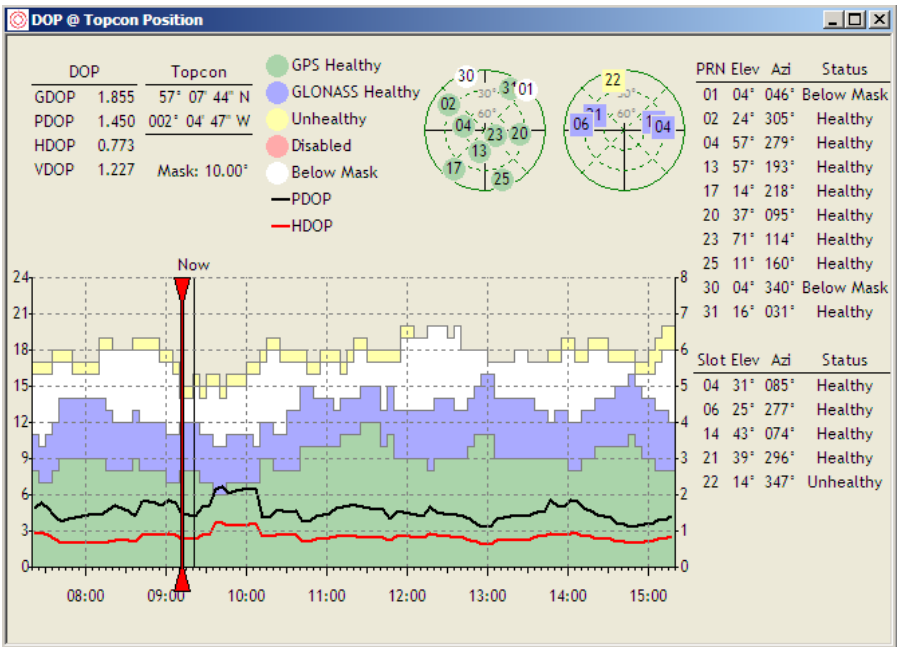
SNR View Options

SNR View:

SV	Space Vehicle. For GPS satellites this is the Pseudo Random Noise code, a unique identifier for each satellite. GLONASS satellites use the slot number as unique identifier for each satellite. (Indicates the unique slot in the GLONASS constellation)
EL	Elevation. The elevation angle measured in degrees that the satellite resides above the horizon at the user location
AZ	Azimuth. This is a horizontal angle measured in degrees from the north direction to the direction of the satellite. This is relative to the user's location.
CA & L2	This is the SNR value, measured in dBHz, of the carrier at frequencies L1 and L2 respectively L2 frequency is only available when using a dual frequency receiver with a dual frequency antenna.

8.2.2 DOP

The DOP view displays data available from the GPS/GLONASS Almanac providing a 6, 12 or 24hour window used when planning. The range of information includes satellite status and location as well as the number of useable satellites above the elevation mask at the users' location.



DOP View

Keyboard space bar is used to animate the display illustrating satellite geometry changes over time. Holding down space bar causes the vertical bar to move along the time axis until the space bar is pressed again.

All associated information on the view is updated.

Use left or right arrow keys to adjust the display at 6 minute intervals. The 'time' bar can be dragged with the mouse to any required location.

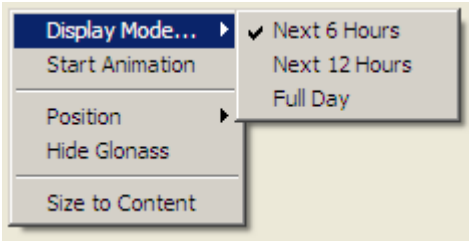
DOP View Key

Line Colour	Detail
Black	Predicted PDOP
Red	Predicted HDOP
Green and Blue	Healthy GPS and GLONASS satellites above the elevation mask
White	Satellites below the mask
Yellow	Unhealthy satellites (unavailable for positioning)
Red	Disabled

The animation can also be started by right clicking on the DOP view and selecting 'Start Animation'.

By default the DOP view predicts the Next 6 Hours.

Time windows of the DOP view can be increased to the Next 12 Hours, to display a Full Day. Set the Display Mode using right click in the DOP view.



DOP View Display Mode

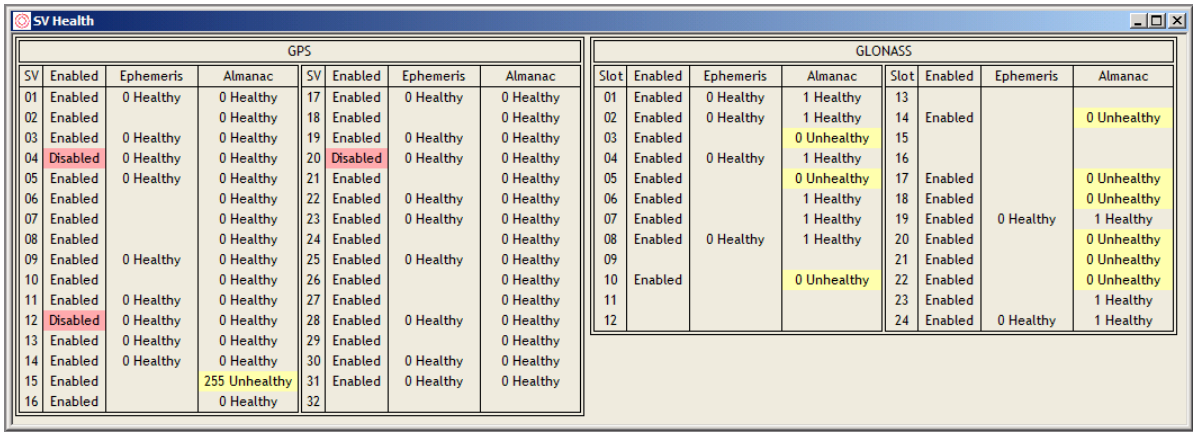
Right click can also be used to hide GLONASS constellation details.

8.2.3 Almanac

This is an Advanced View. See Appendices for detailed description.

8.2.4 SV Health

"View/SV Health" displays the current health status of all the GPS and/or GLONASS satellites in view.



SV Health View

GPS SV Health

SV	Identifies the GPS satellite PRN number
Enabled	Satellites enabled or disabled by the user in the current Verify QC software configuration
Ephemeris	Shows the satellite health status based on ephemeris data. This is the primary source of satellite health status. The information is available only for satellites tracked at the user location. The number indicates the health flag as per the GPS ICD.
Almanac	Shows satellite health status based on the ephemeris data. This is the secondary source of satellite health status. Information is available for all satellites in the constellation. The number indicates the health flag per GPS ICD.

GLONASS SV Health

Slot	Identifies the GLONASS satellite slot number
Enabled	Satellites enabled or disabled by the user in the current Verify QC software configuration
Ephemeris	Gives satellite health status based on ephemeris data. This is the primary source of satellite health status. The information is available only for satellites tracked at the user location. The number indicates the health flag as per the GLONASS ICD.
Almanac	As for GPS satellites

The individual GPS and GLONASS sections can be displayed or hidden by ticking the system name.

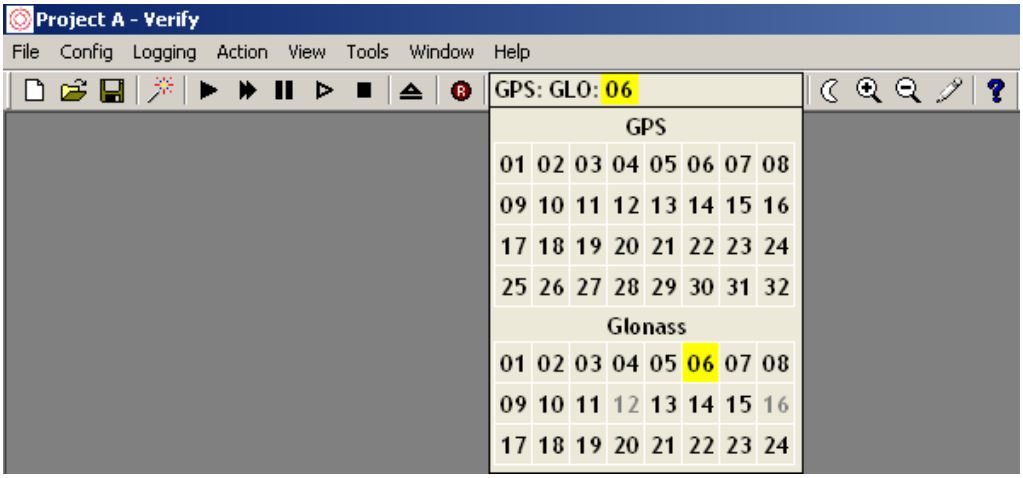
SV Health View Options

Unhealthy satellites transmit a warning flag uploaded by satellite ground control during maintenance operations. Verify QC uses this flag to temporarily prevent the data from these satellites from being used in position calculations.

Disabled satellites have been manually flagged by the user for exclusion from the position calculations. This option covers a scenario in which a satellite goes “rogue” and transmits bad data without being flagged unhealthy.

GPS/GLONASS satellites - users can disable satellites in the matrix on the Verify QC menu bar at the top of the screen.
Unhealthy satellites are already shown in yellow. Individual satellites can be disabled and removed from all calculations by clicking on the satellite number. This number will be in red to indicate its disabled status.

Click on the satellite number to Toggle between enable/disable.



SV Disable/Enable

Note: Use this facility with caution. The status of any disabled satellite should be frequently reviewed. Leaving healthy satellites in a disabled condition can seriously reduce positioning accuracy and stability.

8.2.5 Missing SV Constellation Plot

The missing SV Constellation Plot indicates satellite observations missing for one or more epochs. Verify QC uses the GPS and GLONASS almanac to determine the satellites above the user's elevation mask and their visible position. If a GPS or GLONASS observation is not received a dot with the GPS PRN/GLONASS slot number is indicated on the colour constellation plot.

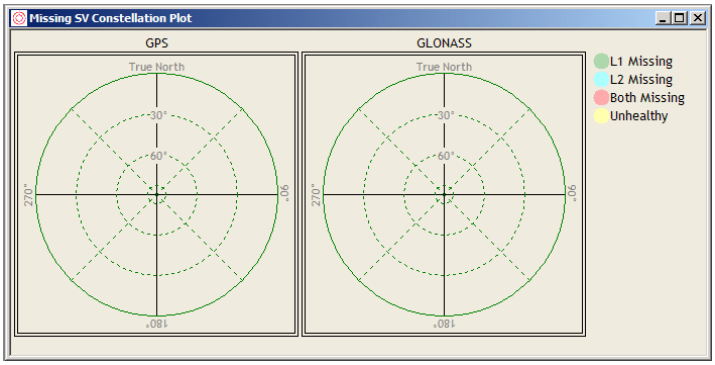
Colour provides additional information on the missing observation type as indicated by the on-screen legend.

Possible causes of missing satellites are: -

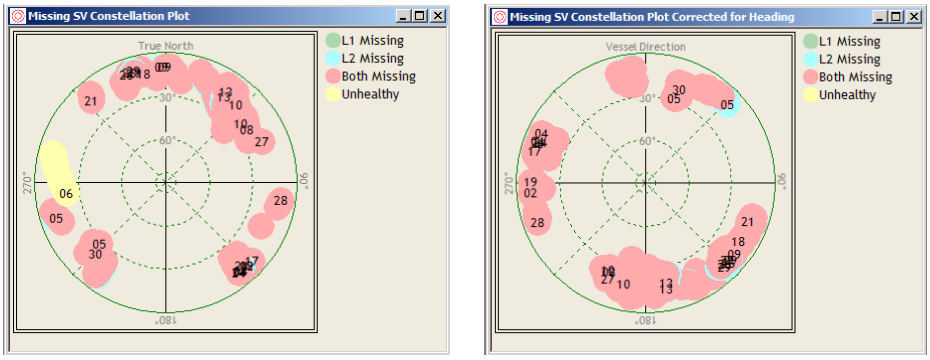
- masking
- intermittent tracking due to external interference
- intermittent tracking due to low signal levels
- unhealthy satellites

Observations for unhealthy satellites will be missing continuously. These create a yellow arc on the plot.

When unhealthy satellites are not reported as being unhealthy by the receiver they will appear as a red arc on the plot.

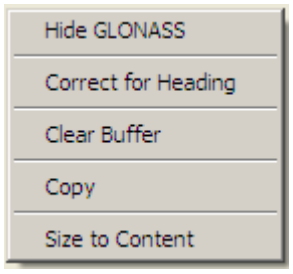


Missing SV Constellation Plot View



Missing SV Plot – Poor Tracking/Corrected for Heading

View options are selected by right clicking on the view.
GLONASS can be hidden.



Missing SV Constellation Plot View Options

By default the missing satellites are plotted with azimuths relative to the *True North* direction. These can be corrected for heading such that the constellation plot becomes 'fixed' to the vessel and relative to the *Vessel Direction*.

This allows vessel specific masking areas to be identified by the user.

Calculated heading is less accurate when the vessel has a very low velocity.
The correction for vessel heading takes place only when the vessel velocity **exceeds 3km/hr**.

Switching the view to “Correct for Heading” may reduce the number of points on the constellation plot.

The plot will display missing satellite data for the last 24 hours.
Clear the buffer by right clicking on the view and select this option.

8.2.6 GPS Ephemeris

This is an Advanced View. See appendices for a detailed description.

8.2.7 GPS CCF

This is an Advanced View. See appendices for a detailed description.

8.2.8 GPS Measurements

This is an Advanced View. See appendices for a detailed description.

8.2.9 GLONASS Ephemeris

This is an Advanced View. See appendices for a detailed description.

8.2.10 GLONASS CCF

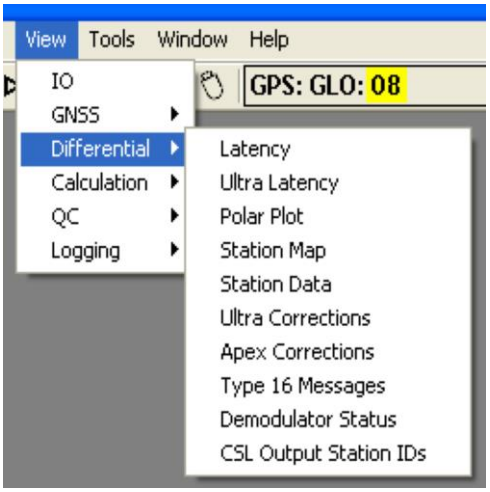
This is an Advanced View. See appendices for a detailed description.

8.2.11 GLONASS Measurements

This is an Advanced View. See appendices for a detailed description.

8.3 DIFFERENTIAL

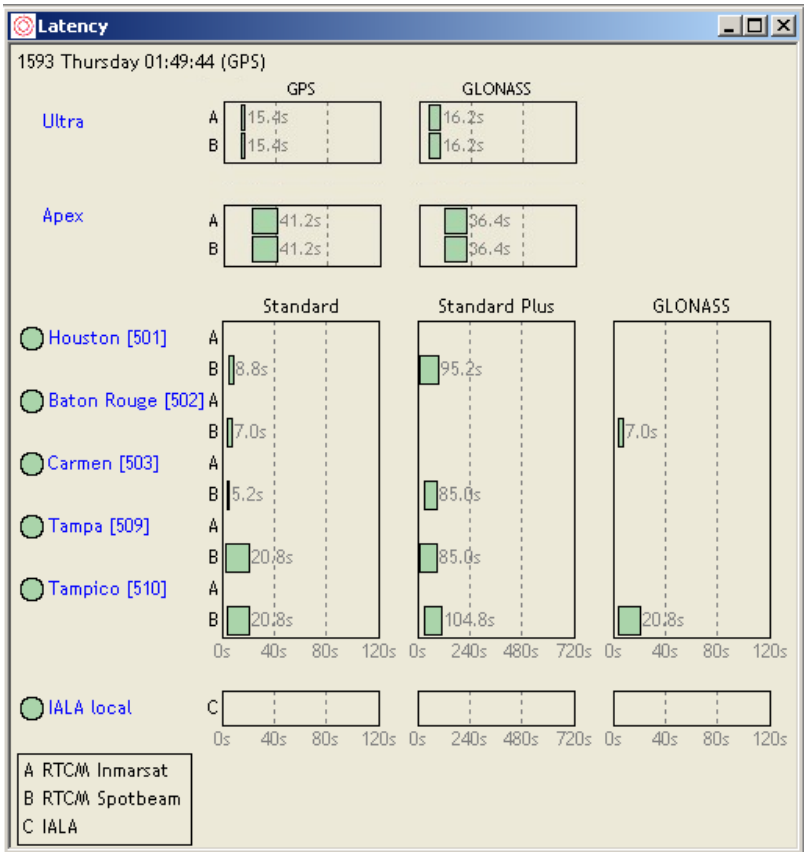
The Differential menu contains all views relating to correction data.



View Differential Menu

8.3.1 Latency

The “View/Differential/Latency” view displays information about the age of the correction data for all stations and services with RTCM inputs.



Latency View

The view contains separate columns for the various differential services provided by VERIPOS.

The VERIPOS Ultra and VERIPOS Apex messages contain orbit & clock correction data for the GPS and GLONASS satellites.

VERIPOS 'Standard' messages contain correction data for the L1 GPS ranges at the reference stations.

VERIPOS 'GLONASS' messages contain correction data for the L1 GLONASS ranges at the reference station

The green circle next to the reference station name indicates the receipt of the reference station location information. This circle is red if this information has not yet been received (viewed at start-up). Verify QC will not use differential corrections from a reference station until its location is known. The station locations are saved to file so that Verify QC does not wait to reacquire them every time the configuration is restarted.

The left-hand edge of the bar shows how old the current correction was when first received by Verify QC. Since the messages are time stamped when generated by the reference station, Verify QC is able to determine their age.

The right-hand side of the bar advances across the display until a new correction is received. Values next to the bar show the current age (latency) of the current correction message.

A threshold of 120 sec applies for Type 1 and Type 31 messages. When this threshold is exceeded data is rejected and the calculation mode changes to uncorrected as shown in the Calculation Status view.

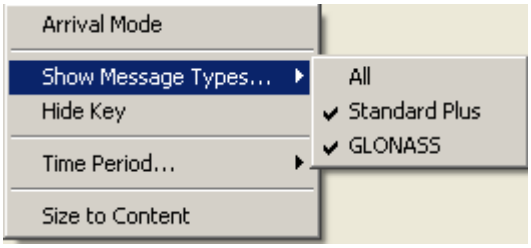
A threshold of 360 seconds applies to the Ultra and Apex correction messages and when this is exceeded the calculation mode Ultra and Apex become uncorrected.

The latency bar moves from left to right as the latency increases.

A traffic light colour scheme applies to the latency bars: -

Colour	Latency (%)
Green	less than 50% of the threshold
Yellow	latency exceeds 50% of the threshold
Red	latency exceeds 75% of the threshold

The view can be customised to hide the GLONASS column or to hide the key. The *Time Period* can also be changed - this will not affect the latency thresholds for each of the correction message types. The *Key* helps to identify each RTCM input.



Latency View Options

The Latency View can operate in a Standard or Arrival Mode. Users can set the mode by right click on the screen.

In *Arrival Mode* the Latency view only shows the age of the corrections when they arrive.

In *Standard Mode*, the columns show the correction latency as bars.

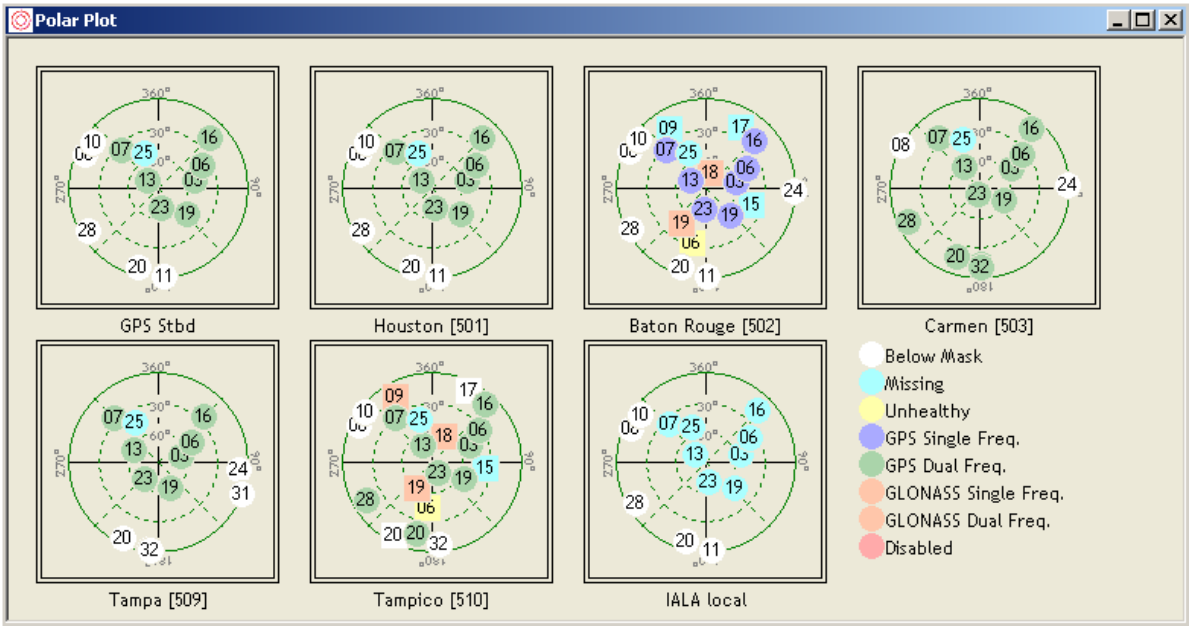
Clicking on blue reference station names will open a Differential Data view for the station.

Clicking on the blue Ultra name opens the VERIPOS Ultra Corrections view. Similarly, the VERIPOS Apex Corrections view can be opened by clicking on the blue Apex name.

8.3.2 Polar Plot

Polar Plot displays information regarding the GPS and GLONASS satellite constellations at the users' location and at the reference stations.
This view shows which satellites are in the sky and the status of these satellites.

Information is based on the reference station location and received GNSS almanac information. The polar plot will be empty if this information is absent.



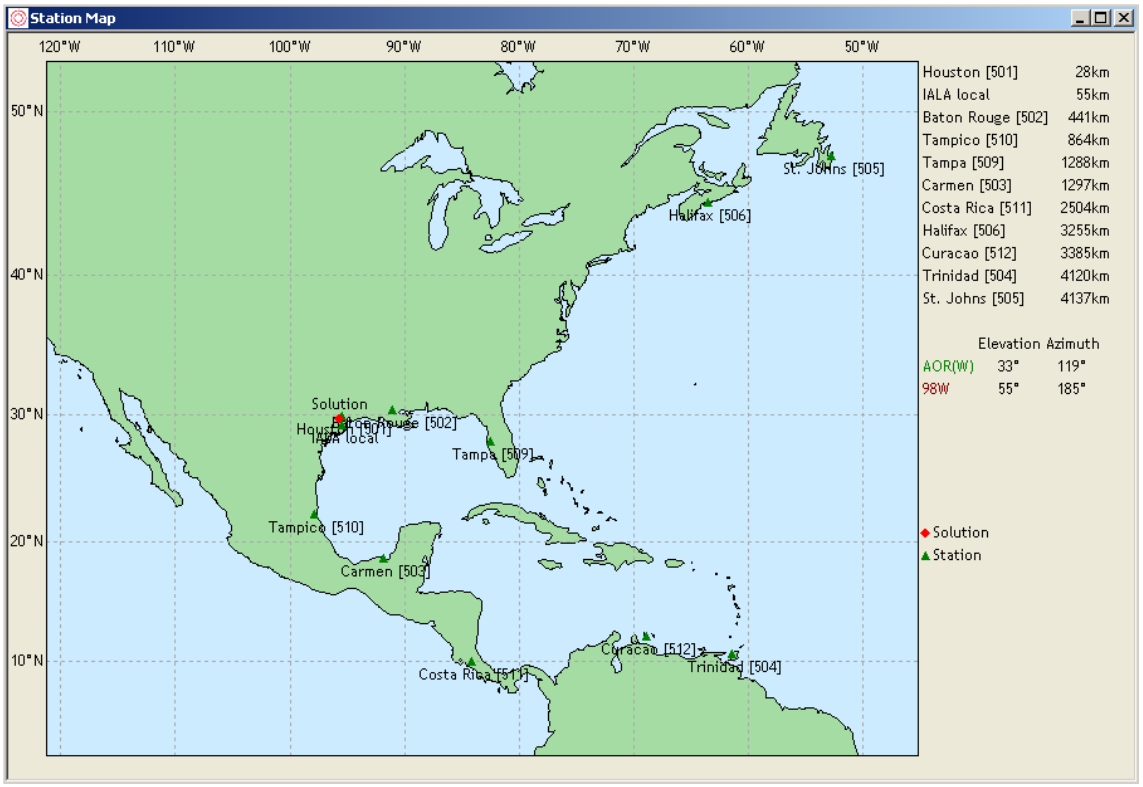
Polar Plot View

The polar plot is used to indicate the status of the corrections and the local observations. The legend at the right hand side of the chart gives an interpretation for each colour used.

Details for GLONASS constellation can be hidden - right click on the view and select 'Hide GLONASS'.

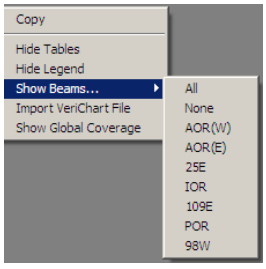
8.3.3 Station Map

"View/Differential/Station Map" opens a map of the user work area. The map is scaled automatically to fit the users' location and the location of all reference stations selected in RTCM inputs and from which station location information has been received.



Station Map View

Options are available using right click.



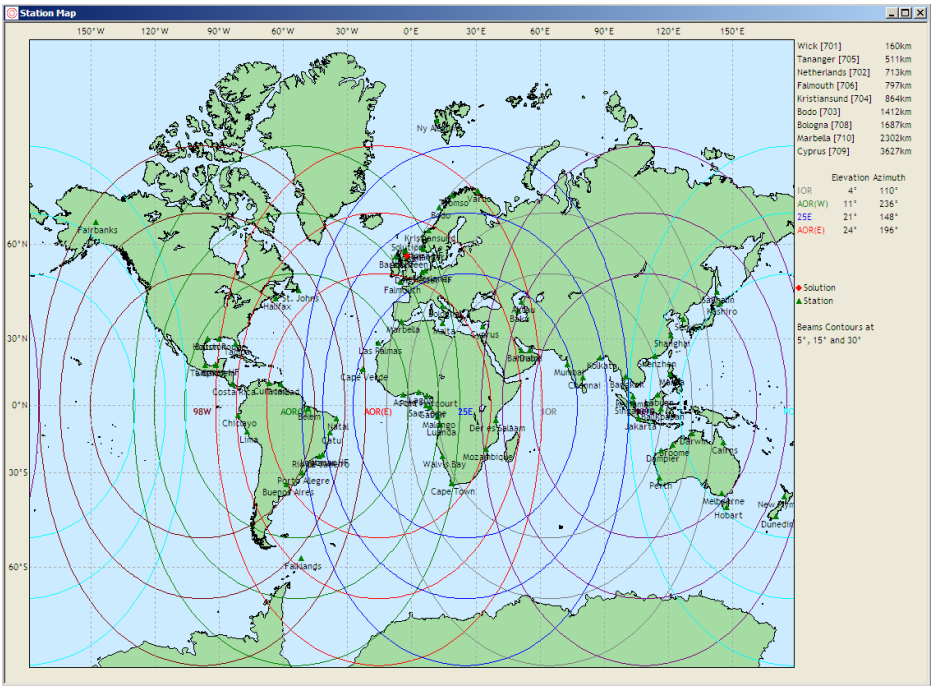
Station Map View Options

The map can be copied as an image and the tables and legend can be hidden.

By default the map will zoom in to the user location and the stations for which corrections have been received.

The map can be changed to show the VERIPOS coverage, displaying all stations in the global VERIPOS network.

It can also be adjusted to show the 5º, 15º and 30º elevations of all satellite delivery links.



Station Map View – Global Coverage

Use the mouse to draw a box on the map and zoom to that area. Use zoom out / zoom in icon to move back to the previous map.

8.3.4 Station Data

This is an Advanced View. See appendices for a detailed description.

8.3.5 Ultra Corrections

This is an Advanced View. See appendices for a detailed description.

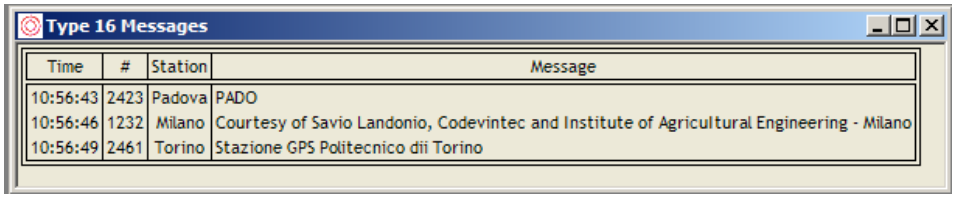
8.3.6 Apex Corrections

This is an Advanced View. See appendices for a detailed description.

8.3.7 Type 16 Messages

View/Differential/Type 16 Messages opens a view showing details for received Type 16 messages.
Reference stations may issue additional station information or status updates by sending a Type 16 message containing ASCII information up to 90 characters long.

The Type 16 messages view lists for one (or more) stations the time of the last received message, the number of times the same message has been received, the station name and the message.

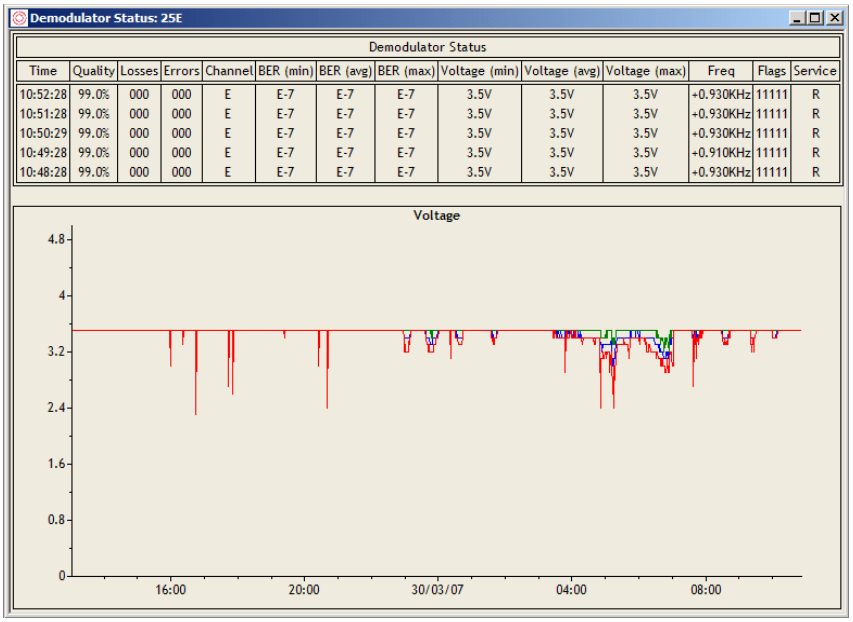


Type 16 Messages View

8.3.8 Demodulator Status

When the Demodulator Status input is enabled on one or more VERIPOS RTCM inputs this view will display the status information.
View presents a table with decoded information from the last 5 demodulator status messages and a time series view, with the minimum (red), mean (blue) and maximum (green) voltage values for the last 24 hours.

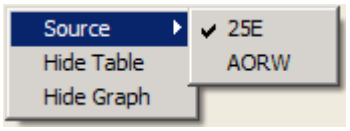
Note: this feature does not support the status messages output by VERIPOS LD2S or LD3-G2 demodulators.



Demodulator Status View

Demodulator Status Table

Time	time of the demodulator status message
Quality	Quality Figure representing the percentage of error free data blocks received since the previous status message
Losses	number of received data block sync losses recorded since the previous status message
Errors	number of encoded data block errors recorded since the previous status message
Channel	VERIPOS satellite beam selected
BER	minimum, average and maximum values of the bit error rate (BER) recorded since the previous status message Range E5 – E7.
Voltage	minimum, average and maximum values of signal strength voltage recorded since the previous status message. 2.0 – 3.5v.
Freq	tuning frequency offset for the demodulator
Flags	representation of the five status flags or diamonds displayed on the Signal Status Page. The state of the flags is recorded throughout the time interval. It will read 11111 if no losses have been detected. If one or more flags changes state during the time interval, the corresponding bit in the TEST message will change to 0 and remain in this state until the start of the next measurement interval
Service	service identifier. R or V refers to a VERIPOS provided service. U indicates an unrecognised service. In the event of significant interruption of the received signal, this field may appear blank



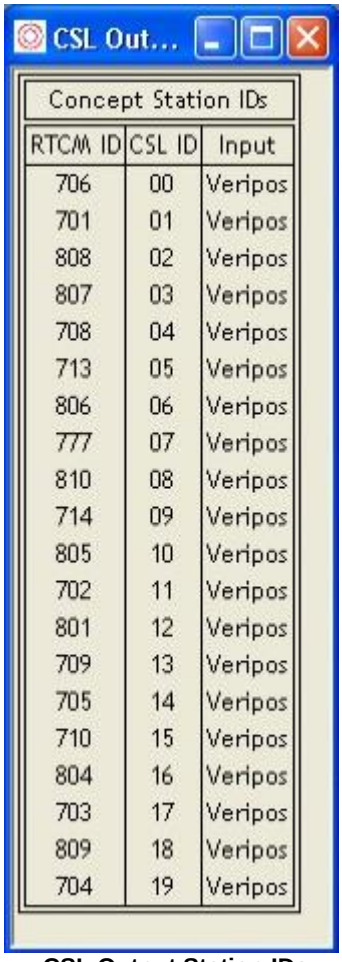
Demodulator Status View Options

Right clicking on the view menu allows the user to view the demodulator status information of another demodulator source or simplify by hiding the table or the graph.

8.4 CSL OUTPUT STATION IDS

The CSL Output Format requires the RTCM Station IDs to be in a 2 digit format (00 to 99). The RTCM Format allows station IDs from 0000 to 1024. As a result Verify QC maps the stations received within Verify QC to the 2 digit format. This is done by assigning the first received reference station to 00, the second received reference station to 01 and so on until all received stations have been mapped to a 2 digit code. If the CSL IDs to be allocated exceeds 99, internally Verify QC shall to continue to number upwards, e.g. 100, 101, 102 etc. In the CSL output it will however restart at 00. In the CSL ID index table it will show 00*, 01*, 02* to indicate that these ID's are duplicates.

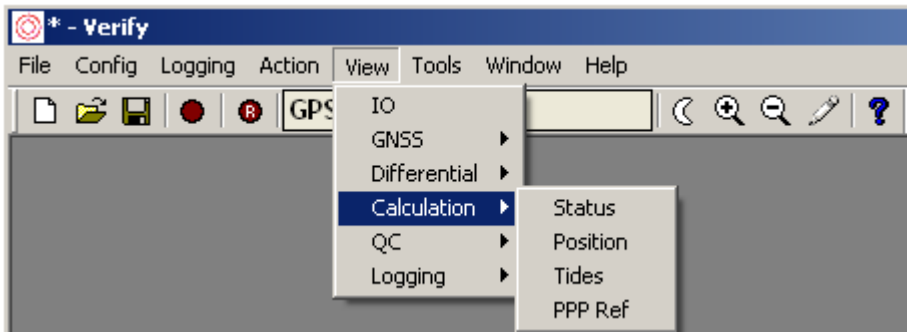
This view shows the station mapping for the configuration in use.



CSL Output Station IDs

Calculation

The *Calculation* menu contains all the views relating to the calculations

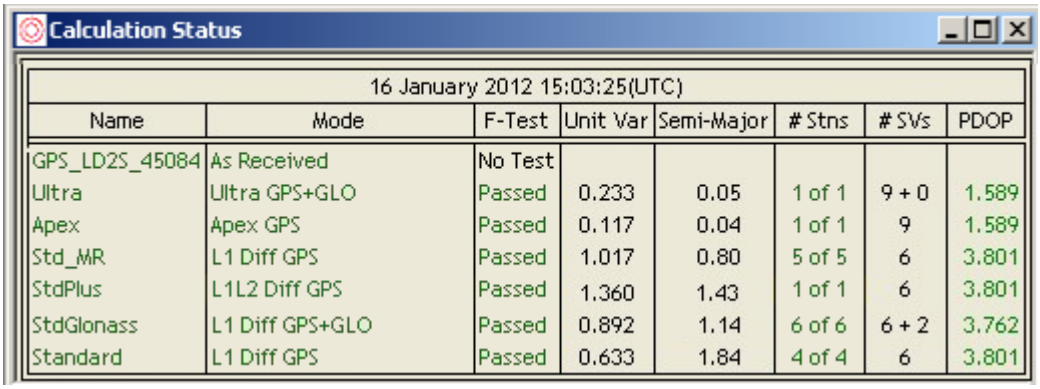


View Differential Menu Structure

8.4.1 Calculation Status

The Calculation Status view displays the current status of the configured calculations to give an indication of the quality of these calculations. All calculations setup in the Configure Calculations page are listed.

Ultra and Apex calculations will only be shown if the dongle has been enabled for these services.



Name	Mode	F-Test	Unit Var	Semi-Major	# Stns	# SVs	PDOP
GPS_LD2S_45084	As Received	No Test					
Ultra	Ultra GPS+GLO	Passed	0.233	0.05	1 of 1	9 + 0	1.589
Apex	Apex GPS	Passed	0.117	0.04	1 of 1	9	1.589
Std_MR	L1 Diff GPS	Passed	1.017	0.80	5 of 5	6	3.801
StdPlus	L1L2 Diff GPS	Passed	1.360	1.43	1 of 1	6	3.801
StdGlonass	L1 Diff GPS+GLO	Passed	0.892	1.14	6 of 6	6 + 2	3.762
Standard	L1 Diff GPS	Passed	0.633	1.84	4 of 4	6	3.801

Calculation Status View

The top of the table shows the current date and time in UTC.

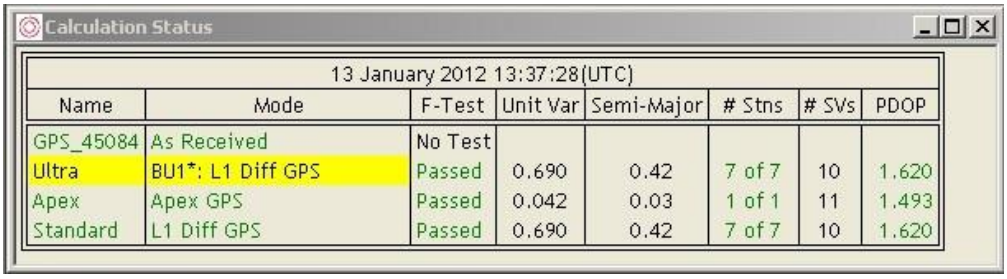
***Note*:** Clicking the **left** mouse button on a calculation name will open up a Position view containing more detailed calculation status information, with toggle between *advanced* and *simple* views.

Calculation Status Data

Name	Name allocated to the calculation by the user
Mode	Current mode of the calculation. This is the prime indicator of the current calculation status. Possible modes are: - ▪ As Received – indicates the position as generated by the external GPS receiver ▪ No Position ▪ No Solution ▪ Uncorrected – no differential correction has been applied ▪ L1 – Solution using single frequency measurements ▪ L1/ L2 – Solution using Dual frequency measurements ▪ Diff – differential corrections have been applied for all stations ▪ Reduced– differential corrections have been applied for some stations ▪ GPS – Solution using GPS Constellation only ▪ GPS+GLO – Solution using GPS and GLONASS Constellations ▪ Uncorrected (Settling) – Ultra initialisation fixes ▪ Ultra DGPS (Settling) – initial Ultra orbit & clock corrected fixes ▪ Ultra (Settling) – Ultra converging ▪ Ultra – Ultra converged ▪ Apex DGPS (Settling) – initial Apex orbit & clock corrected fixes ▪ Apex (Settling) – Apex converging ▪ Apex – Apex converged ▪ BU 1: 'Backup One calculation mode' ▪ BU 2: 'Backup Two calculation mode' ▪ Reduced Diff - data from some stations is not received → BU1 or BU2 indicate the Ultra or Apex calculation is currently unavailable and that the Backup One or Backup Two calculation is being output. The * indicates that backup smoothing is active. The backup smoothing is used in the transition from Ultra or Apex to BU1 or BU 1 to BU 2 and vice versa to ensure a seamless transition avoiding a step in the position.
F-Test	An indication of the overall fit of the observations to the statistical model. The F-Test does not detect the source of any errors but gives an indication as to the pass or failure status of the test.
Unit Var.	The ratio between actual and modelled errors. Values range around 1. Spikes in the unit variance indicates outliers and erroneous pseudo-range measurements.
Semi Major	95% semi-major axis of the error ellipse shown in the Track Plot view
# Stns	Number of reference stations for which corrections are being used in the calculation
# SVs	Number of satellites used in the calculation. Combined GPS and GLONASS calculations follows the syntax 'x + y' with x being the number of GPS satellites and y being the number of GLONASS satellites
PDOP	Positional Dilution of Precision indicates the strength of the geometry for determining a 3D position estimate and a basic accuracy indicator

If Verify QC detects a problem in a position calculation the name of the calculation in the Calculation Status view changes colour. A yellow background indicates a warning about possible position quality degradation whilst red text indicates a calculation failure.

Other possible causes of the name field changing to yellow will be the loss of a reference station or a high DOP value, as shown below.

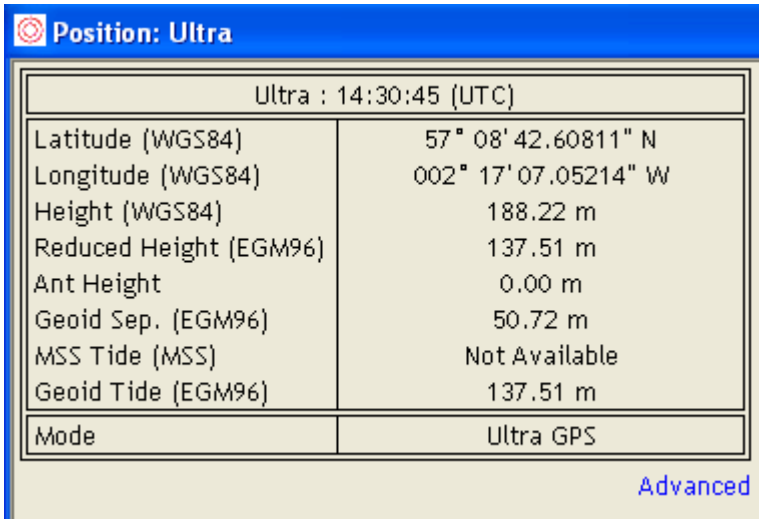


Calculation Status Warning

8.4.2 Position

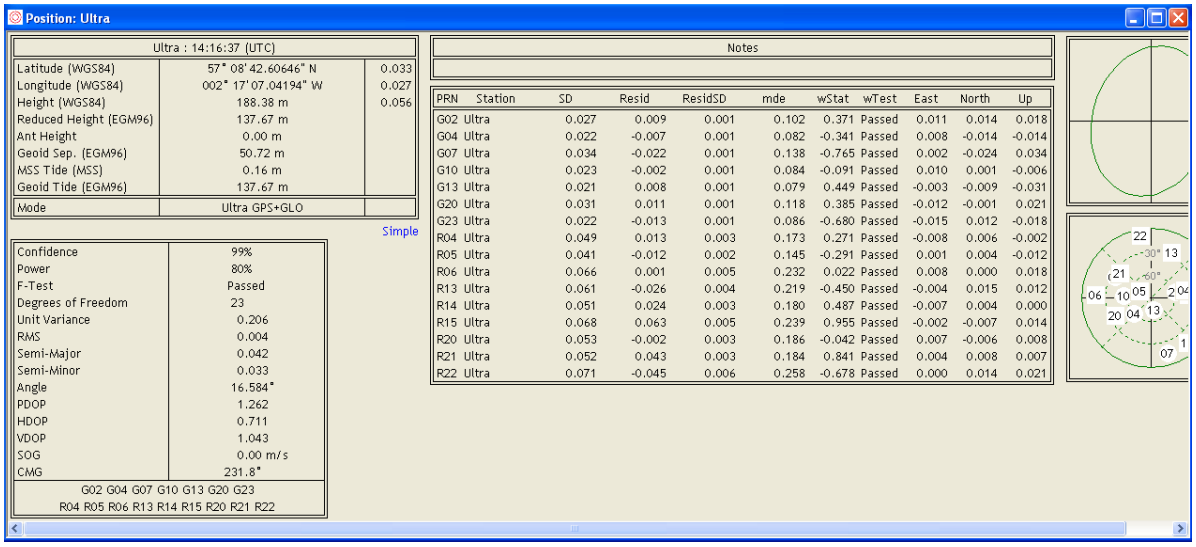
View/Calculation/Position first opens the 'Simple' version of the position view. This displays the calculation name, the time (UTC) and the geographical coordinates.
No statistical parameters are shown.

Height is the height above the Geoid model, selected by the user in *Config/Calculation/Settings* either EGM96, EGM08 or a user defined Geoid separation.



Simple Position View

Advanced (bottom right) opens the view showing calculation statistics.



Advanced Position View

Right clicking in this window allows editing of the position calculation or copying contents to clipboard for use in another word application.

Position View Options

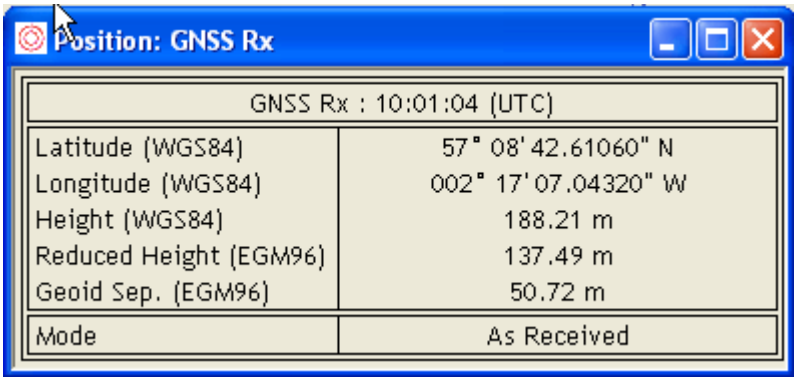
The Advanced Position View includes several sections including:

- Positions Table
- General Statistics Table
- Notes Table
- Error Ellipse View
- Constellation View

Position Table

The Position table displays the calculation name, the time (UTC) and the geographical coordinates. These include the height above the WGS84 reference ellipsoid. Using the Geoid model selected by the user in *Config/Calculation/Settings* (EGM96, EGM08 or a user defined Geoid separation) this ellipsoidal height is also split into a Geoid separation and height above this Geoid. The reference for each coordinate and height value is indicated between brackets.

The right hand column gives standard deviation of the individual coordinate components. The bottom row displays current calculation mode.

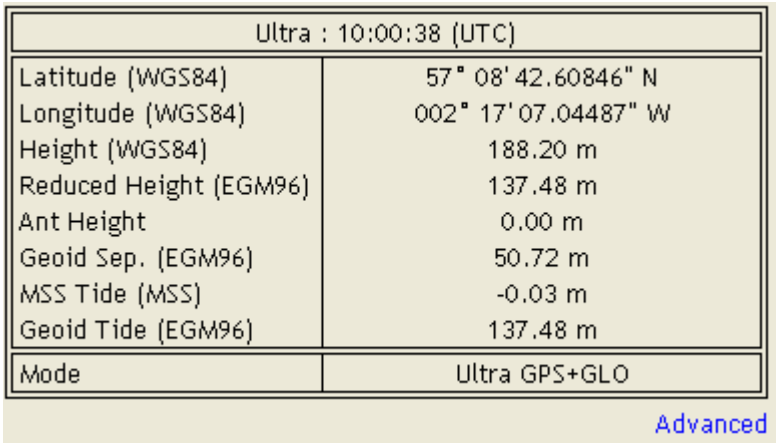


Position View – Position Table

Position Table

When the Tides function (dongle dependent) is enabled, the Position Table for Apex or Ultra will include three extra rows,

Additionally, the user will enter height of the antenna above the waterline and the calculated MSS Tide and Geoid Tide values, which are displayed.



Position View – Position Table

General Statistic Table

The General Statistics Table provides the main statistical parameters associated with the calculated position.

Confidence	99%
Power	80%
F-Test	Passed
Degrees of Freedom	21
Unit Variance	0.209
RMS	0.005
Semi-Major	0.036
Semi-Minor	0.031
Angle	160.900°
PDOP	1.479
HDOP	0.815
VDOP	1.235
SOG	0.01 m/s
CMG	169.5°
G11 G14 G17 G19 G20 G28 G32 R04 R05 R06 R13 R14 R20 R21 R22	

Position View – General Statistics Table

This table displays the following information: -

Confidence	reliability of the position indicating that 99% of the positions are contained within the error ellipse
Power	measures the tests ability to reject the null hypothesis when it is actually false
F-Test	indication of the overall fit of the observations to the statistical model. The F-Test does not detect the source of any errors; it will give only an indication as to the pass or failure of the test.
Deg. Of Freedom	number of additional observations compared to the unknown quantities that are being solved for. When the number of observations equals the number of unknowns there is no redundant information in the position calculation
Unit Var.	the ratio between the actual and modelled errors. The expected value of unit variance is 1. Occasional small values are of no concern; however large values can indicate a bias in the data. Spikes in the unit variance indicate outliers and erroneous pseudo-range measurements
RMS	Root Mean Square is a statistical measure of the scatter of computed positions around a “Best Fit” position solution. This is shown in meters
Semi-Major	Semi-Major axis of the error ellipse produced by the calculation
Semi-Minor	Semi-Minor axis of the error ellipse produced by the calculation
Angle	direction of the Semi-major axis from the centre of the error ellipse
DOP	Dilution of Precision is a measure of the strength of the satellite geometry at the receiver. The DOP value can be used as a multiplier to the standard deviation of the GPS measurements to derive an estimated standard deviation of the position
PDOP	Positional DOP is a 3 dimensional measure of the accuracy composed of Horizontal DOP and Vertical DOP
HDOP	Horizontal DOP is a two dimensional measure of the accuracy of the horizontal position
VDOP	Vertical DOP is an indicator of the strength of the calculation in the height component
SOG	Speed over the Ground
CMG	Course Made Good

The bottom row of the General Statistic Table lists the PRN number (G) of the GPS satellites used in the calculation. Slot numbers (R) of the GLONASS satellites is displayed.

Notes Table

The Notes Table lists statistical parameters.

Notes

PRN	Station	SD	Resid	ResidSD	mde	wStat	wTest	East	North	Up
G11	Ultra	0.021	-0.017	0.001	0.079	-0.903	Passed	-0.004	0.000	-0.025
G14	Ultra	0.028	0.007	0.001	0.110	0.267	Passed	-0.018	0.011	0.012
G17	Ultra	0.031	0.023	0.001	0.118	0.828	Passed	0.011	0.013	0.005
G19	Ultra	0.030	-0.002	0.001	0.123	-0.077	Passed	-0.013	-0.026	0.049
G20	Ultra	0.026	-0.010	0.001	0.099	-0.402	Passed	0.010	-0.014	0.012
G28	Ultra	0.029	0.007	0.001	0.111	0.277	Passed	0.015	-0.002	0.010
G32	Ultra	0.021	0.016	0.001	0.079	0.859	Passed	0.001	0.000	-0.030
R04	Ultra	0.071	0.015	0.005	0.250	0.213	Passed	-0.007	0.004	0.016
R05	Ultra	0.044	0.026	0.002	0.155	0.610	Passed	-0.004	0.009	-0.015
R06	Ultra	0.046	0.012	0.002	0.159	0.264	Passed	0.002	-0.005	-0.004
R12	Ultra	0.072	-0.018	0.005	0.252	-0.257	Passed	0.004	0.002	0.013
R13	Ultra	0.065	-0.023	0.005	0.230	-0.365	Passed	0.000	0.008	0.005
R14	Ultra	0.071	-0.052	0.005	0.251	-0.772	Passed	-0.007	0.004	0.017
R20	Ultra	0.050	0.015	0.003	0.173	0.319	Passed	-0.006	-0.007	0.007
R21	Ultra	0.040	-0.034	0.002	0.145	-0.879	Passed	0.005	0.008	-0.026
R22	Ultra	0.059	-0.048	0.004	0.205	-0.840	Passed	0.005	0.007	-0.002

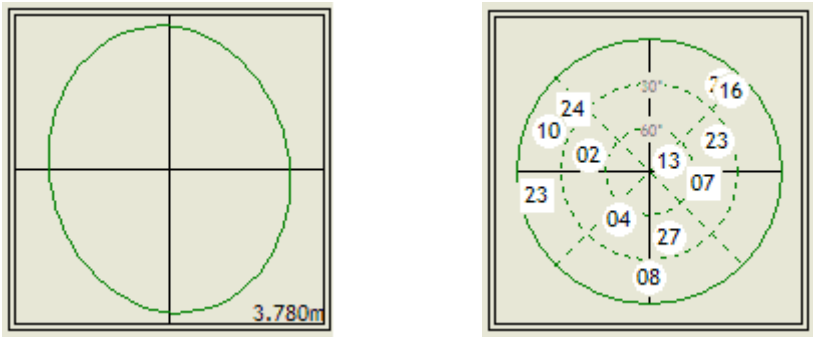
Position View – Notes table

This table displays the following information: -

Notes	displays general information such as a reference station being out of range, missing data or data being rejected
PRN	a unique identification PRN or slot number for each GPS and GLONASS satellite respectively.
Station	reference station name
SD	standard deviation of the corrected pseudo-range
Resid	residual of the corrected pseudo-range in the position computation
ResisSD	standard deviation of the residual
mde	Marginally Detectable Error is the smallest error identified by the w-test with a probability of 80%
wStat	figure used in the w-test
wTest	w-test is used to prove the null hypotheses by testing against a series of alternative hypothesis. These are formulated to describe any possible error pattern, or combination of error patterns. If the error turns out to be statistically significant for any of the alternative hypotheses the null hypotheses will be rejected in favour of the particular alternative, if no alternative then the null hypothesis will be accepted. If this w-test matched the proposed error patterns with the error patterns found in the observation, and if no match is found, the null hypothesis is accepted
East	component of external reliability on the measurement, i.e. the effect an error the size of the mde would have on the East component of the position
North	a component of external reliability on the measurement, i.e. the effect an error the size of the mde would have on the North component of the position
Up	component of external reliability on the measurement, i.e. the effect an error the size of the mde would have on the North component of the position

Error Ellipse and Constellation View

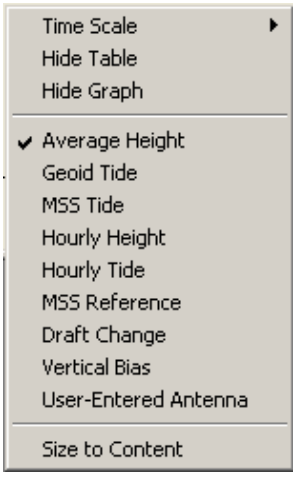
The error ellipse and its scale (default scale is 5m) are displayed with the constellation of the GPS and GLONASS satellites. GPS satellites are white circles. GLONASS satellites are white squares.



Position View – Error Ellipse and Constellation View

8.4.3 Tides

View/Calculation/Tides opens the Tides table and a time series view. The view options are accessible via right click.



Tides View Menu Options

The user can choose from nine time series:

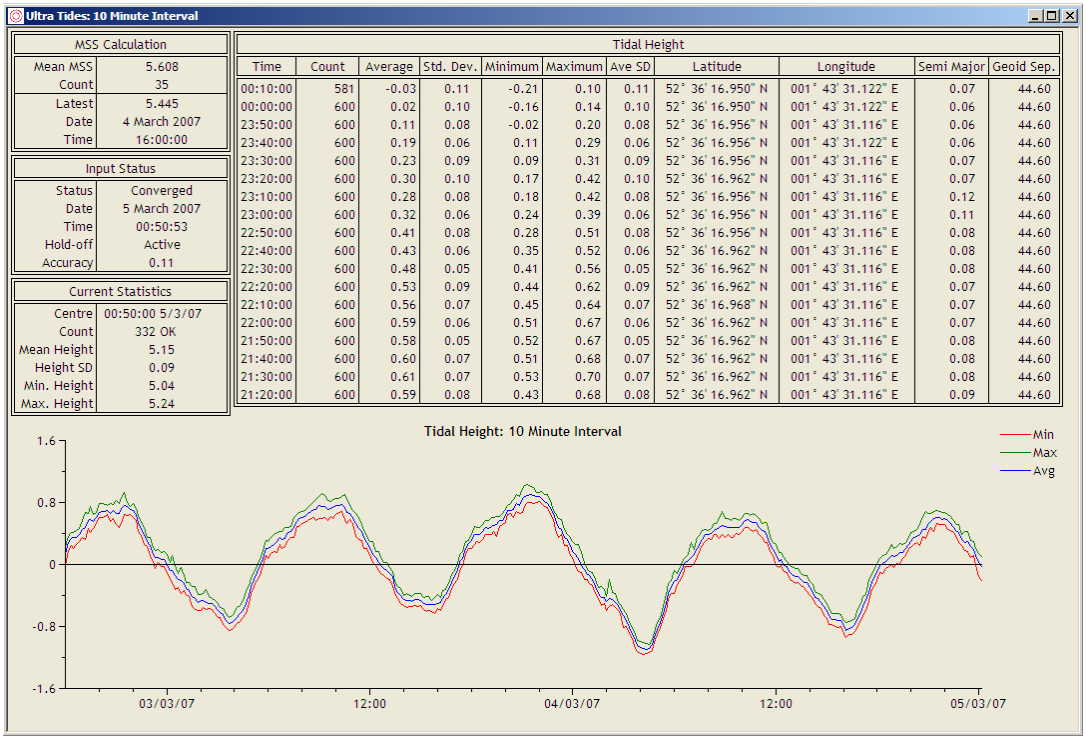
Antenna Height:	a time series plotting the minimum, maximum and mean height of the GPS antenna relative to the user selected Geoid model. Points are added at the user selected interval
Geoid Tide:	a time series, plotting the minimum, maximum and mean height of the vessel waterline relative to the user selected Geoid model. Points are added at the user selected interval
MSS Tide*	Time series plotting the minimum, maximum and mean height of the vessel waterline relative to the Tide filter estimate of Mean Sea Surface. Values displayed are called the MSS Tide. Points are added at the user selected interval.

Hourly Height	Time series plotting the minimum, maximum and mean height of the GPS antenna relative to the user selected Geoid model. Points are added at an hourly interval
Hourly Tide*	Time series plotting the minimum, maximum and mean height of the vessel waterline relative to the Tide filter estimate of Mean Sea Surface. Values displayed are called MSS Tide. Points are added at an hourly interval.
MSS Reference*	Time series plotting the Tide filter estimate of Mean Sea Surface. Points are added hourly.
Draft Change	Time series plotting the change in Draft. This is calculated as the current Doodson value minus the Doodson value for the first record.
Vertical Bias	Time series plotting the vertical bias detected between MSS Tide and Geoid Tide.
User-Entered Antenna	Time series plotting the User entered height of the antenna above the waterline. As entered in **"***Config/Calculation/Settings***"**

** Estimate is only available after 39 hours of continuous operation.*
Verify QC v1.20 supports a Mean Sea Surface (MSS) model, relative to which the user can estimate tides. The Mean Sea Surface is the displacement of the sea surface relative to a mathematical model of the earth. It closely follows the Geoid (approximated by EGM models), though with additional Mean Dynamic Topography deviations due to currents etc.

The implemented model is DTU10MSS, created by the Danish National Space Institute (see http://www.space.dtu.dk/english/Research/Scientific_data_and_models/Global_Mean_sea_surface). This model has been derived by processing satellite altimetry datasets acquired over 17 years. The grid used by Verify QC has a 2-minute by 2-minute resolution and an estimated accuracy of better than 10cm.

The first five time series contain three separate lines for the minimum (red), mean (blue) and maximum (green) height or tide values.



Tides View – Table and Time Series

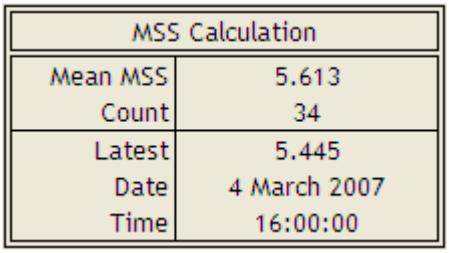
The Tides View includes several sections including the Tidal Height table, the MSS Calculation table, the Input Status Table, the Current Status table and the time series graph.

Tidal Height table

Time	Time for which information is valid
Count	Number of height samples used for deriving listed results
Average	Height average
Std. Dev.	Standard deviation of height values included in average
Minimum	Minimum of height values included in average
Maximum	Maximum of height values included in average
Ave SD	Average of the standard deviation of height values included in average
Latitude	Latitude at given time
Longitude	Longitude at given time
Semi Major	Average of semi major of height values included in average
Geoid Sep.	Separation between the Geoid and the WGS84 reference ellipsoid

MSS Calculation table

MSS	Tide filter overall estimate of MSS
Count	Sequence number of local hourly estimate of MSS
Latest	Most recent Tide filter local estimate of MSS
Date	Date for which information is valid
Time	Time for which information is valid



Tides View – MSS Calculation Table

Input Status table

Status	Status of height input into Tide filter. Can show ‘No Position’, ‘Converging’, ‘Converged’
Date	Date for which information is valid
Time	Time for which information is valid
Hold-off	Can show ‘Active’ or time until hold-off period expires
Accuracy	Shows reported standard deviation of the current height input If the standard deviation exceeds the threshold it also shows the threshold

Input Status	
Status	Converged
Date	5 March 2007
Time	11:23:37
Hold-off	19:34
Accuracy	0.24 > 0.2

Tides View – Input Status Table

Current Statistics table

Centre	Shows time and date for the current averaging period
Count	The number of accepted height input values during the current averaging period, followed by 'OK' (if count exceeds the minimum 50% required to generate a valid result)
Mean Height	Average height during the current averaging period
Height SD	Standard deviation of the the heights during the current averaging period
Min Height	Minimum height during the current averaging period
Max Height	Maximum height during the current averaging period

Current Statistics	
Centre	11:30:00 22/9/06
Count	339 OK
Mean Height	29.61
Height SD	0.11
Min. Height	29.48
Max. Height	29.71

Tides View – Current Statistics Table

8.4.4 PPP Ref

The PPP Ref calculation uses the current position of the selected Apex or Ultra calculation as a virtual reference station location.

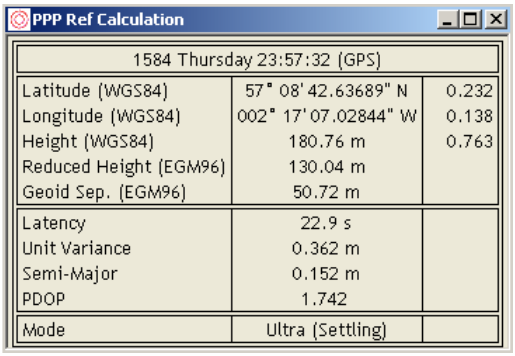
This allows highly stable and accurate DGPS corrections to be calculated, which can be output to external DGPS systems or a telemetry link.

Note: the PPP Ref calculation will only generate an RTCM output whilst the selected Apex or Ultra calculation has an converged status, i.e. respectively reports 'Apex' or 'Ultra' in the Calculation Status View

The full status of the PPP Ref calculation can be monitored using *View/Calculation/PPP Ref* ….

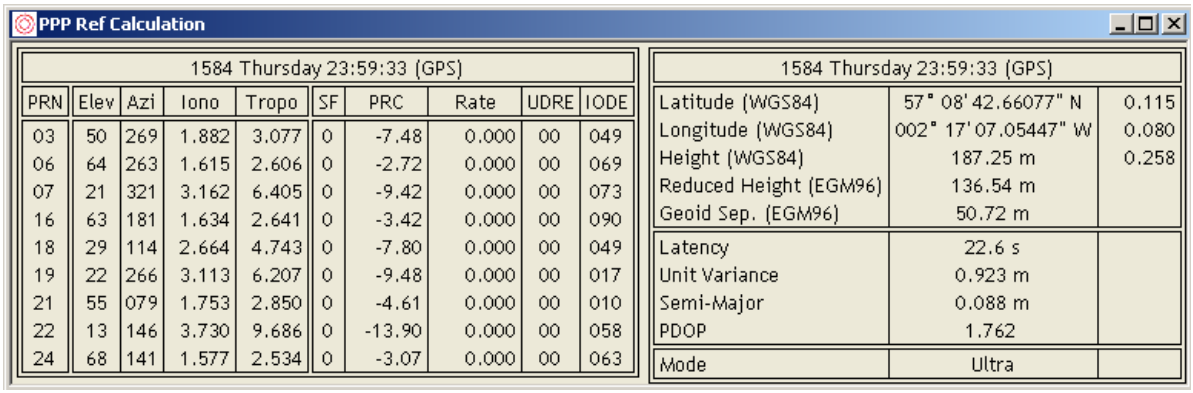
The view displays the status of the PPP position calculation (used as a virtual reference station location). Initially, following the start of the PPP calculation, only the PPP position and its calculation status (Mode) are shown in the PPP Ref view. Once the PPP calculation

is converged, i.e. reports ‘Apex’ or ‘Ultra’, the status of RTCM DGPS corrections that are currently being output is also displayed.



PPP Ref View – Position Status Table

Once the calculation Mode, depending on the selected PPP solution, reaches an ‘Ultra’ or ‘Apex’ status, the view expands to include the DGPS corrections for the satellites above the elevation mask set in the PPP Ref calculation configuration dialogue.



PPP Ref View – Position Status and Correction Data Table expanded view

PPP Ref Differential Data

PRN	Pseudo Random Noise code. A unique identification number for each GPS satellite. E.g. PRN 13 refers to the satellite that transmits the 13th weekly portion of the P code
Elev	Elevation. The elevation angle measured in degrees that the satellite resides above the horizon at the reference station location
Azi	Azimuth. This is a horizontal angle measured in degrees from the north direction to the direction of the satellite. This is relative to the reference station location
Iono	The delay in meters caused by the Ionosphere to the GPS signal from the particular satellite. An ionospheric delay value derived from the Klobuchar model in the Almanac
Tropo	The delay in meters caused by the troposphere to the GPS signal from that satellite at the reference station. Value is derived using the Hopfield model.

SF	This is the scale factor as a code which could be either 0 or 1: • 0 = scale factor for pseudo range correction is better than 0.02 meter and for range rate correction is 0.002 meter/second • 1 = scale factor for pseudo range correction is better than 0.32 meter and for range rate correction is 0.032 meter/second
PRC	PRC is the Pseudo Range Correction as observed on the L1 pseudo-range at the reference station
Rate	This is the rate of change, in meters, of the pseudo-range corrections
UDRE	User Differential Range Error. An estimate of the performance of the satellites pseudo-range as measured at the reference station in meters. This number is provided as part of the RTCM Type 1 messages in the form of a binary code 0 to 3: 0: ≤ 1 meter at 1 sigma 1: > 1 meter and ≤ 4 meter at 1 sigma 2: > 4 meter and ≤ 8 meter at 1 sigma 3: > 8 meter at 1 sigma
IODE	Data Ephemeris identifies the set of ephemeris parameters. Gives the user a means of detecting change

The PPP Ref position table displays the GPS week, day and time and the geographical WGS84 coordinates for the Apex or Ultra solution.

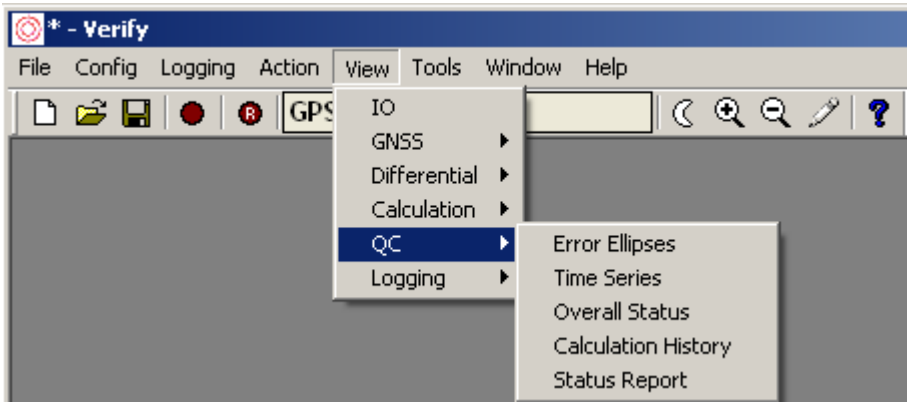
The table also includes the height above the Geoid model selected by the user in *Config/Calculation/Settings* and the separation value from this Geoid model.

The column to the right shows the standard deviation of the individual coordinate components.

The rows underneath show the latency of the last received Apex / Ultra corrections, the Unit variance, Semi-Major and PDOP of the calculated PPP Position and its calculation mode.

8.5 QC

"View/QC" accesses views displaying the position status and quality information.

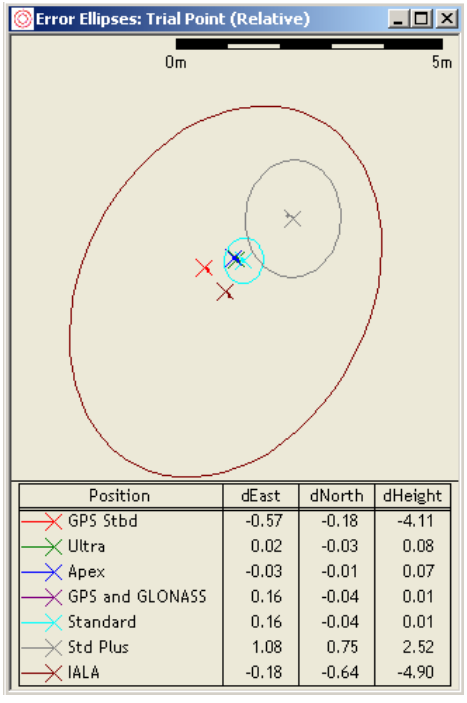


View QC Menu

8.5.1 Error Ellipses

Error Ellipses displays position error ellipses over the entire calculation setup.

Each ellipse is colour coded for ease of identification and a key displays the solution deviation compared to the selected reference solution.

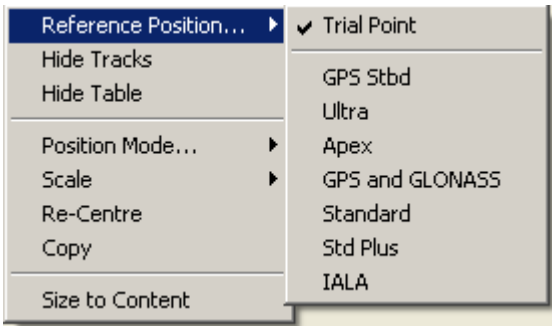


Error Ellipses View

The error ellipses view can be altered using the scroll wheel of the mouse.

Highlight the error ellipse for a specific calculation by clicking on the calculation name in the *Position* box.

Right clicking in the window allows the user to change parameters:

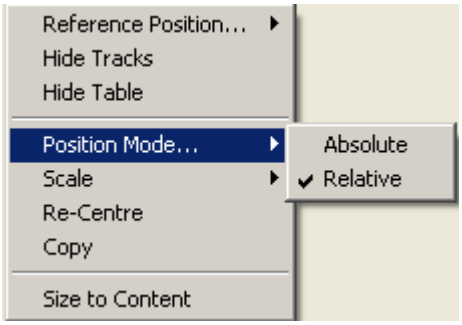


Error Ellipses View – Reference Position

The "*Reference Position…"* can be set to any of the position calculations or the Trial Point (*Config/Calculation/Settings)* if the system is stationary. The selected solution is shown in the index in bold print.

"*Hide Tracks*" allows the user to remove the track plots for all the calculations in the Error Ellipse display

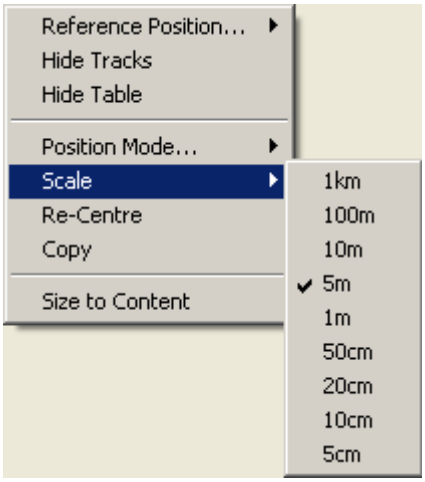
"*Hide Table*" allows the user to hide the key completely.



Error Ellipses View – Position Mode

The "*Position Mode…*" can be set to Relative or Absolute:

- Relative - Displays the position calculations relative to the Reference Position. This can be fixed (i.e. Trial Point) or moving (i.e. a Position Calculation). The chosen Reference Position remains in the centre of the screen with the other positions shown relative to it.
- Absolute - Displays all Position Calculations in their actual positions. In a moving environment, none of the positions will be centred and will all move around the screen. For a known reference position the differences are shown for each position.



Error Ellipses View – Scale

"*Scale*" can be changed and the plot *Re-Centred* to the current position. The Track Plot can be copied to the PC's clipboard as a bitmap image for pasting into applications.

8.5.2 Time Series

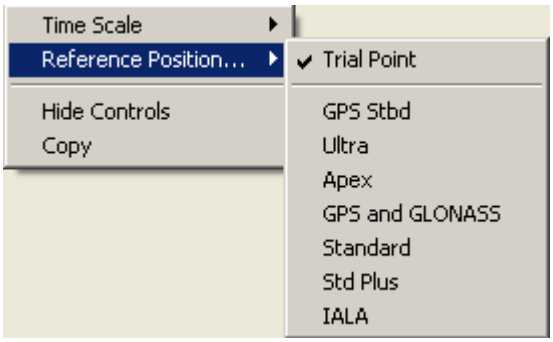
The time series plot is used to monitor the performance of positions calculated over a known period of time. Users can select one of five predefined views from the tabs at the top of the display:

- Position
- Difference
- UKOOA
- Statistics
- Scatter

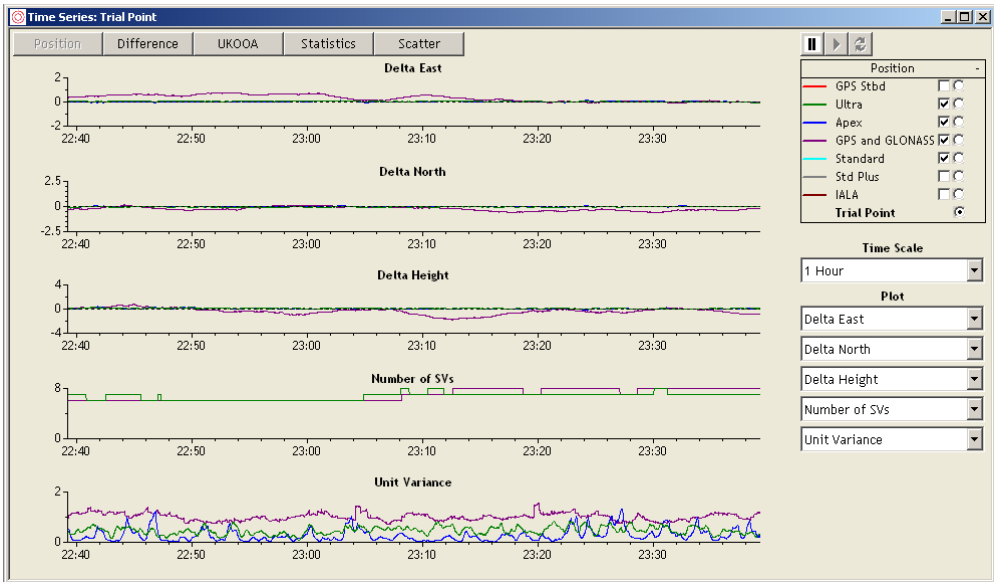
8.5.2.1 Position

The default Position view shows Delta East, Delta North & Delta Height of the calculated positions (relative to the reference position selected by the user).

Right mouse click on the view to select the reference position.



Time Series View – Reference Position



Time Series View

8.5.2.2 Difference

The Difference View show the differences in position between each consecutive position fix. This is an indication of positioning stability.

View shows the 1st differences for each calculated position including Number of SV's and the Unit Variance.

8.5.2.3 UKOOA

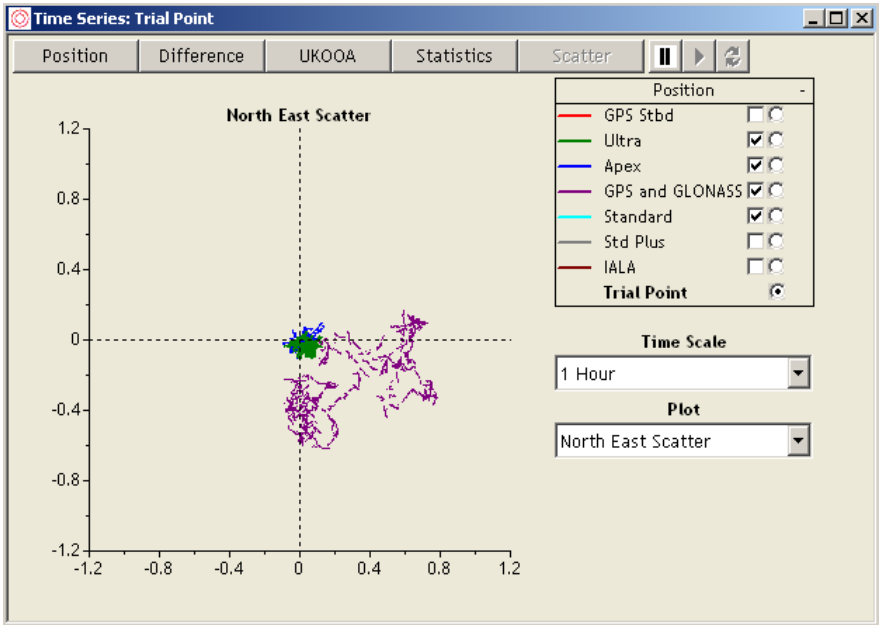
The UKOOA View shows the primary statistical parameter present within the UKOOA output. The view includes the Semi-major axis, Unit Variance, Internal Reliability, 2D External Reliability and RMS.

8.5.2.4 Statistics

Shows range of general Statistics, namely HDOP, PDOP, RMS, Number of SV's, Number of Stations and Latency.

8.5.2.5 Scatter

The Scatter View shows a 2D North-East scatter plot of the positions.
This view has the following appearance: -



Time Series View – Scatter Plot

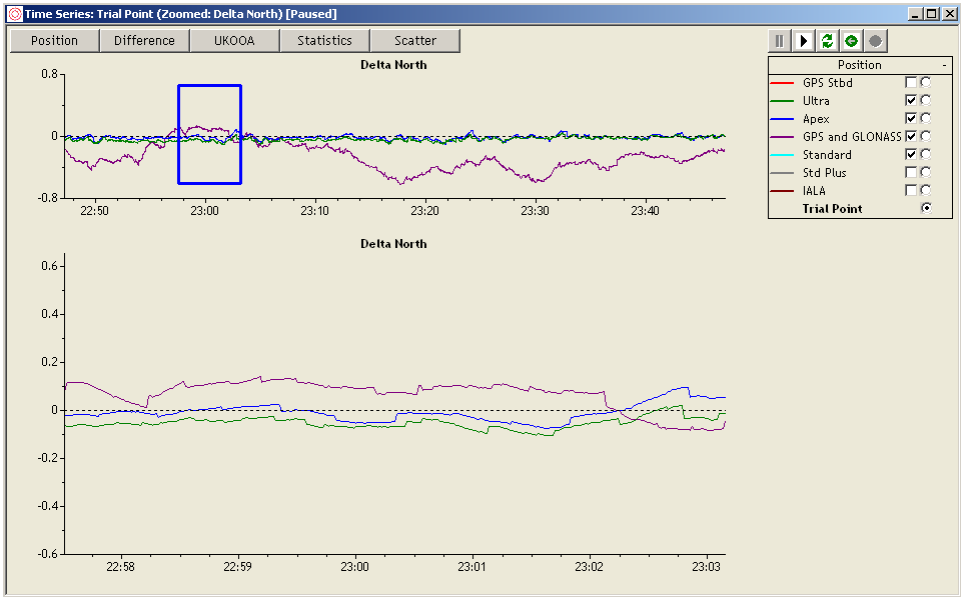
In addition to selecting the five predefined views, users can customise each view with the *Time Scale* and *Plot* pull down menus to the right of the screen.

Right click on the view and select *"Show Controls/Hide Controls*".

A graph for a calculation can be highlighted by clicking on the calculation name in the *Position* selection box.

The *Position* selection box can be hidden or shown. Use the + icon to expand the display. When the box is open the user can select the calculations required for plotting (select the square boxes) and selecting the calculation, or Trial point - to be used as the reference position (tick the round box).

Moving the pointer over a particular time series or scatter plot changes the cursor to a zoom magnifying icon and a box can be dragged over a selected area - right mouse button - to start the area to be reviewed. This pauses the view, adds a magnified graph of the selected area at the bottom of the screen and a small, full graph at the top of the screen:



Time Series View – Zoom

Zoom in as many times as required. Icon functions:

Pauses the live update view to review a previous period

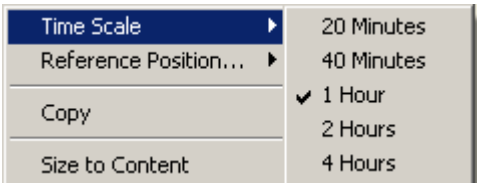
Play option puts the user into real time mode and jumps to current time

Refresh the screen

Back button for stepping between previous zoomed areas

Forward button for stepping between successive zoomed areas

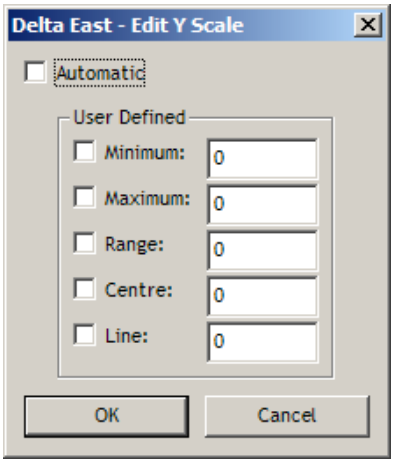
The right mouse button in the window of both the time series and scatter plot accesses menu to change the *Time Scale*:



Time Series View Options

Change the Y-scale of the vertical axis by moving the mouse pointer to the vertical axis and double clicking.

Select Automatic or customise:

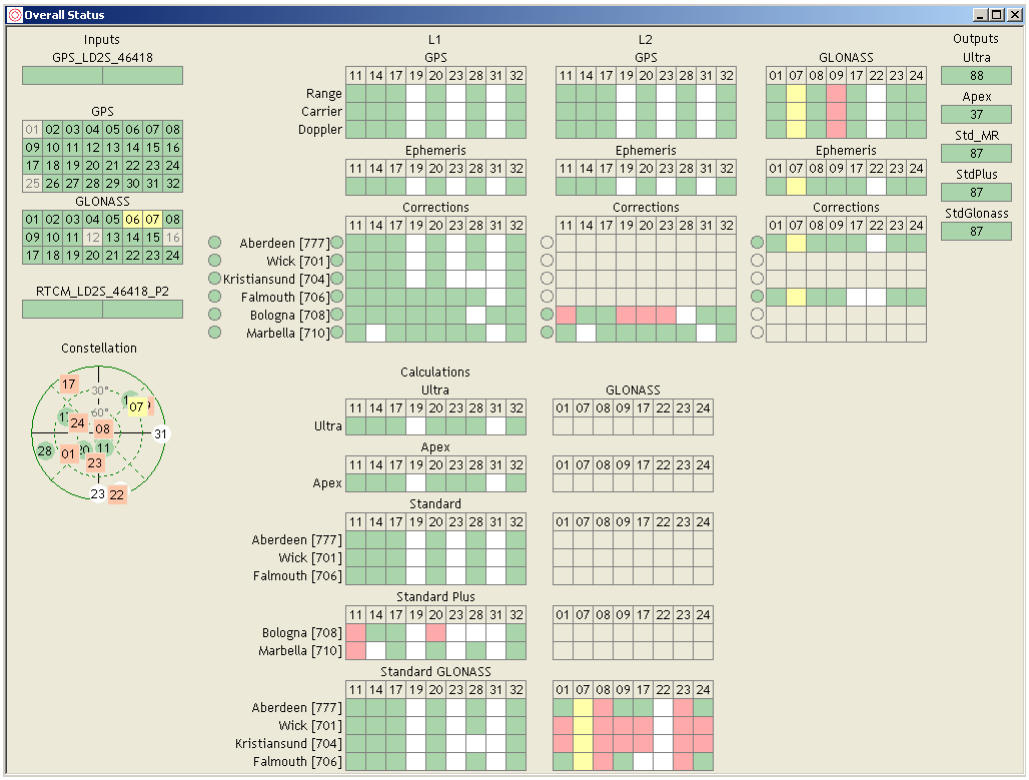


Time Series View – Y-Scale

The Time Series view can be copied to the PC's clipboard as a bitmap image for pasting into MS Paint or MS Word.

8.5.3 Overall Status

"View/Overall Status" opens a detailed summary view of the GPS/GLONASS and RTCM data input status, the calculation status and the data output status and provides a general picture of the Verify QC operational status.



Overall Status View

The overall status view has three zones. The area to the left indicates the status of the inputs, the centre area indicates the status of the received GPS/GLONASS and RTCM data and the area to the right indicates the status of the outputs. Each area is described in more detail as follows:

<u>Inputs area</u>

Receiver	Indicates if the receiver data is being received and decoded. When both halves are green the receiver data is receiving and decoding successfully. Red indicates a failure.
GPS / GLONASS	Indicates whether almanac information is available for each satellite (green). Unhealthy satellites are shown in yellow and disabled satellites are shown in red.
'RTCM Link x'	Indicates that the RTCM data for each RTCM input is being received and decoded. If both halves are green then the RTCM data is received and decoded successfully. Red indicates a failure.
Constellation	Shows the location of GPS (green circle) and GLONASS (orange square) satellites and their status (white = below elevation mask, yellow = unhealthy, red = disabled).

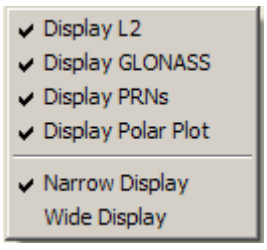
L1/L2 area

GPS / GLONASS	Indicates whether the pseudo-range, carrier and Doppler observations for satellites above the horizon have been received (green). Satellites below the elevation mask at the user end are shown in white.
Ephemeris	Indicates if GPS and GLONASS ephemeris data for satellites above the horizon have been received. Satellites below the elevation mask at the user end are shown in white.
Corrections	Indicates whether GPS L1 (Type 1), GPS L2 (Type 15) and GLONASS L1 (Type 31) corrections have been received (green) for the listed satellites at each reference station. Missing corrections are shown in red and satellites 'just above the elevation mask' at the reference station without corrections are shown in orange. Satellites below the elevation mask at the reference station are shown in white. The circle before the station name indicates whether a Type 3 with the station position has been received (green = yes, red = no). The circle after the station name indicates whether the correction data is within the latency thresholds (green < 60sec, orange < 90 sec, and red > 90sec).
Calculations	Indicates which satellites are included in the position calculation (green). Satellites not included in the calculation (due to missing GPS/GLONASS observations or their corrections, or due to w-test rejection) are shown in red, as are disabled satellites. Satellites below the elevation mask at the user end are shown in white.

Outputs area

'Output x'	Indicates the output status of each position output. Green indicates a data message output recently and the number indicates the length of message.

The appearance of the view can be changed by selecting the relevant options after right clicking on the view.



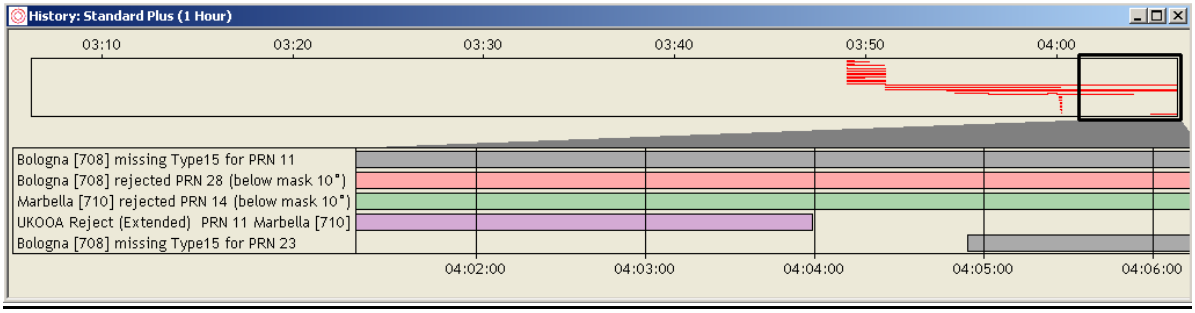
Overall Status View Options

Mouse clicking on each coloured box will open the relevant view with additional information. Clicking on the receiver input, RTCM input and position output boxes will open the IO View. Clicking on the corrections area will open the Differential Data view for that particular station. Clicking on the calculation area will open the Position view for that particular calculation.

It is also possible to open the Almanac, GPS & GLONASS Ephemeris, GPS & GLONASS Measurements, Latency and Station Map by clicking on the relevant areas.

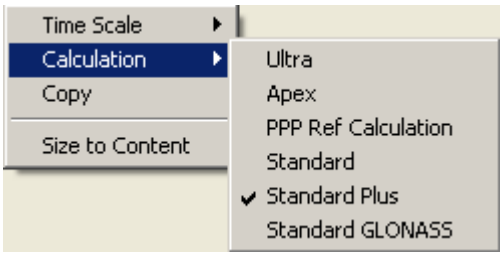
8.5.4 Calculation History

The calculation history displays a history of the main events against a time scale. The top bar provides a general overview of event happenings and the time period. The black box acts as a viewfinder and can be moved along the time axis. Depending on the overall time scale an area of 5, 30 or 60 minutes is magnified in the bottom bar. The left-hand column describes the event whilst the right-hand column shows the time-span.



Calculation History View

The time period can be changed by using the mouse to right click in the screen. Time period options are 1, 6, 12 and 24 hours. The user can select also the calculation for the calculation history to be displayed: -



Calculation History View Options

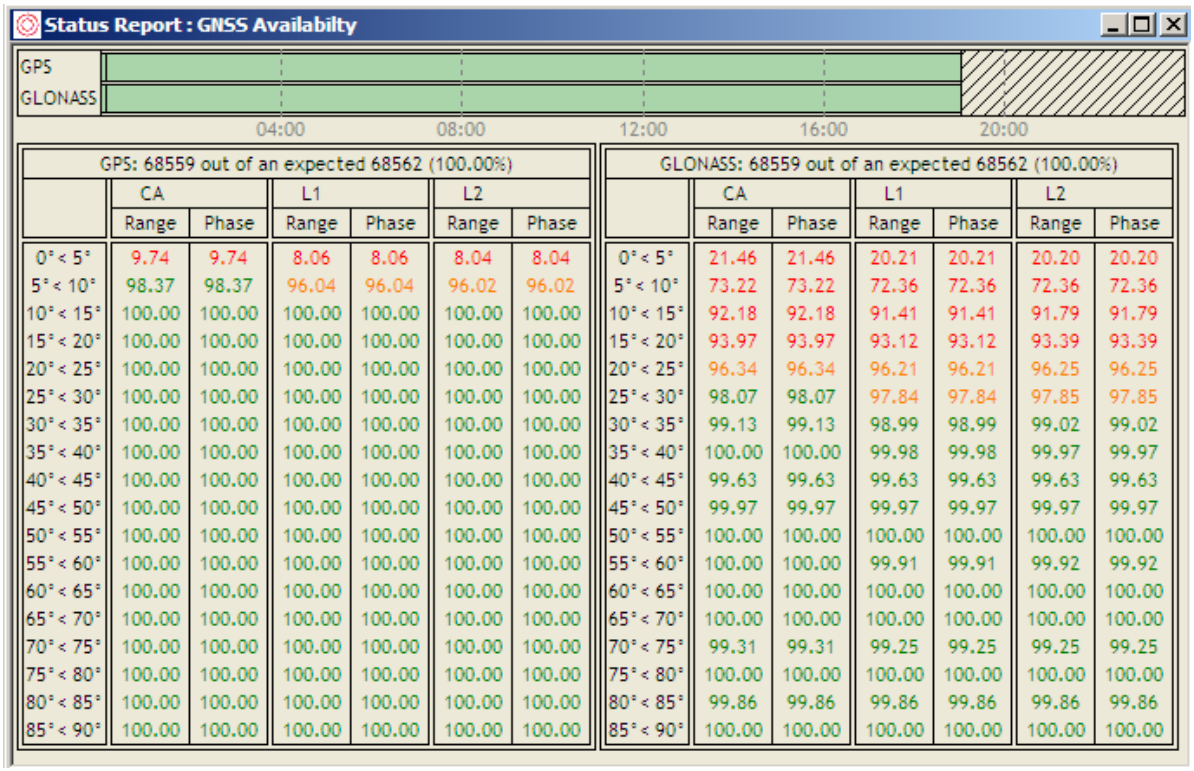
8.5.5 Status Report

The Status Report view provides 3 views to monitor the availability of GNSS measurements and correction data.

The primary view is the GNSS Availability View. The view is split into an availability bar indicating the availability of GPS and GLONASS measurement sets against the present day's 24-hour time scale and an availability table indicating the availability of GPS and GLONASS measurements against 5º elevation brackets.

The availability bar appears continuous with a green colour for all measurement sets. A missing measurement set will appear as a black vertical line to indicate a break in the GPS and/or GLONASS data input. A missing measurement set may be caused by a break in the data connection to the receiver, corruption of the data stream or total loss of data due to interference.

The availability table will, for each 5º elevation bracket, indicate what percentage of expected CA, L1 and L2 observations were received in Verify QC. Percentage values less than 100% may for example be caused by (low elevation) antenna masking or intermittent tracking due to interference.



GPS: 68559 out of an expected 68562 (100.00%)

	CA		L1		L2	
	Range	Phase	Range	Phase	Range	Phase
0° < 5°	9.74	9.74	8.06	8.06	8.04	8.04
5° < 10°	98.37	98.37	96.04	96.04	96.02	96.02
10° < 15°	100.00	100.00	100.00	100.00	100.00	100.00
15° < 20°	100.00	100.00	100.00	100.00	100.00	100.00
20° < 25°	100.00	100.00	100.00	100.00	100.00	100.00
25° < 30°	100.00	100.00	100.00	100.00	100.00	100.00
30° < 35°	100.00	100.00	100.00	100.00	100.00	100.00
35° < 40°	100.00	100.00	100.00	100.00	100.00	100.00
40° < 45°	100.00	100.00	100.00	100.00	100.00	100.00
45° < 50°	100.00	100.00	100.00	100.00	100.00	100.00
50° < 55°	100.00	100.00	100.00	100.00	100.00	100.00
55° < 60°	100.00	100.00	100.00	100.00	100.00	100.00
60° < 65°	100.00	100.00	100.00	100.00	100.00	100.00
65° < 70°	100.00	100.00	100.00	100.00	100.00	100.00
70° < 75°	100.00	100.00	100.00	100.00	100.00	100.00
75° < 80°	100.00	100.00	100.00	100.00	100.00	100.00
80° < 85°	100.00	100.00	100.00	100.00	100.00	100.00
85° < 90°	100.00	100.00	100.00	100.00	100.00	100.00

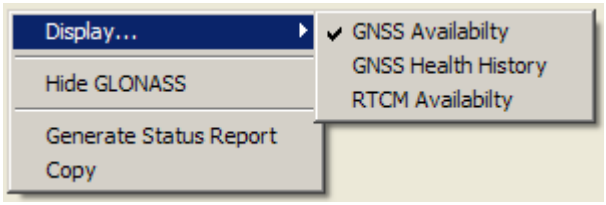
GLONASS: 68559 out of an expected 68562 (100.00%)

	CA		L1		L2	
	Range	Phase	Range	Phase	Range	Phase
0° < 5°	21.46	21.46	20.21	20.21	20.20	20.20
5° < 10°	73.22	73.22	72.36	72.36	72.36	72.36
10° < 15°	92.18	92.18	91.41	91.41	91.79	91.79
15° < 20°	93.97	93.97	93.12	93.12	93.39	93.39
20° < 25°	96.34	96.34	96.21	96.21	96.25	96.25
25° < 30°	98.07	98.07	97.84	97.84	97.85	97.85
30° < 35°	99.13	99.13	98.99	98.99	99.02	99.02
35° < 40°	100.00	100.00	99.98	99.98	99.97	99.97
40° < 45°	99.63	99.63	99.63	99.63	99.63	99.63
45° < 50°	99.97	99.97	99.97	99.97	99.97	99.97
50° < 55°	100.00	100.00	100.00	100.00	100.00	100.00
55° < 60°	100.00	100.00	99.91	99.91	99.92	99.92
60° < 65°	100.00	100.00	100.00	100.00	100.00	100.00
65° < 70°	100.00	100.00	100.00	100.00	100.00	100.00
70° < 75°	99.31	99.31	99.25	99.25	99.25	99.25
75° < 80°	100.00	100.00	100.00	100.00	100.00	100.00
80° < 85°	99.86	99.86	99.86	99.86	99.86	99.86
85° < 90°	100.00	100.00	100.00	100.00	100.00	100.00

Status Report View – GNSS Availability

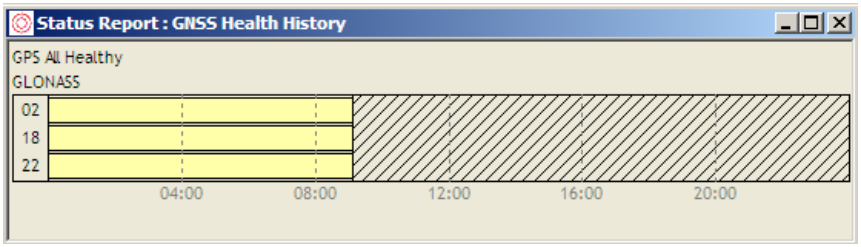
Note: which observation types are monitored depends on the GNSS receiver type. The Septentrio AsteRx2 receiver, for example, does not output L1 observations and the column therefore will appear blank when using that GNSS receiver type.

The view options dialogue, accessible via a right mouse click on the view, allows GLONASS information to be hidden and the contents of the Status Report View to be changed to show GNSS Health History information or RTCM Availability information.



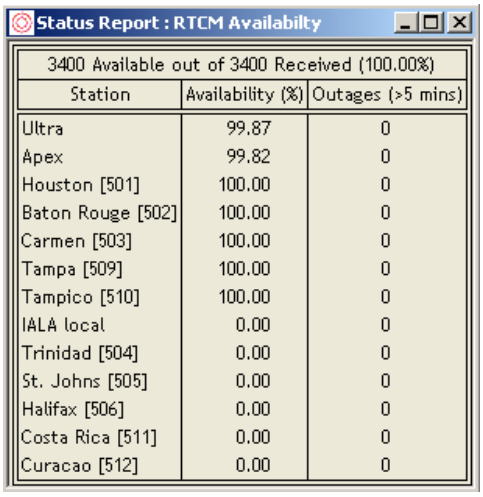
Status Report View Options

The GNSS Health History View shows the PRN or Slot Number of GPS and GLONASS satellites, and the time period they were unhealthy, against the present day's 24-hour time scale.



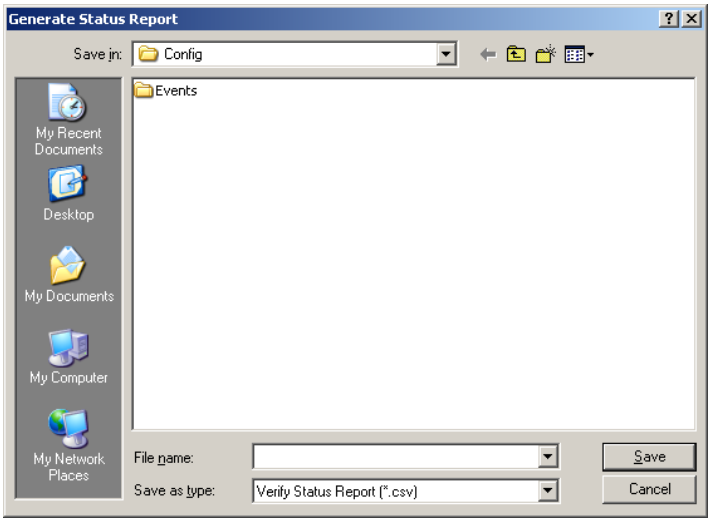
Status Report View – GNSS Health History

The RTCM Availability View shows the RTCM message availability of Ultra, Apex and individual DGPS reference stations since the start of the present day. The number of station outages exceeding 5 minutes is listed in a separate column.



Status Report View – RTCM Availability

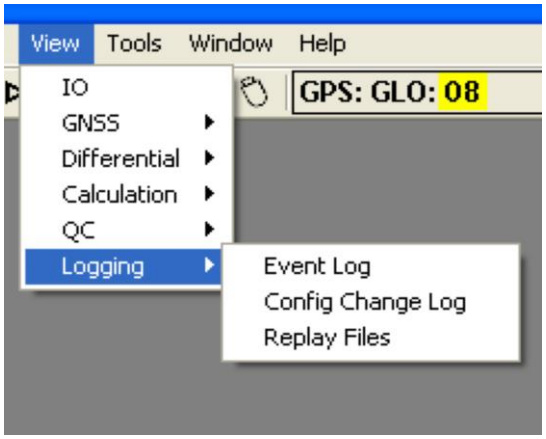
The view options dialogue allows the current status report information to be exported to an Excel file. Selecting this option will open a standard Windows browse dialogue allowing the user to select a file name and path for the status report.



Status Report View – Generate Status Report

8.6 LOGGING

The Logging menu contains all views available to the user for monitoring the logging status.



View Menu - Logging

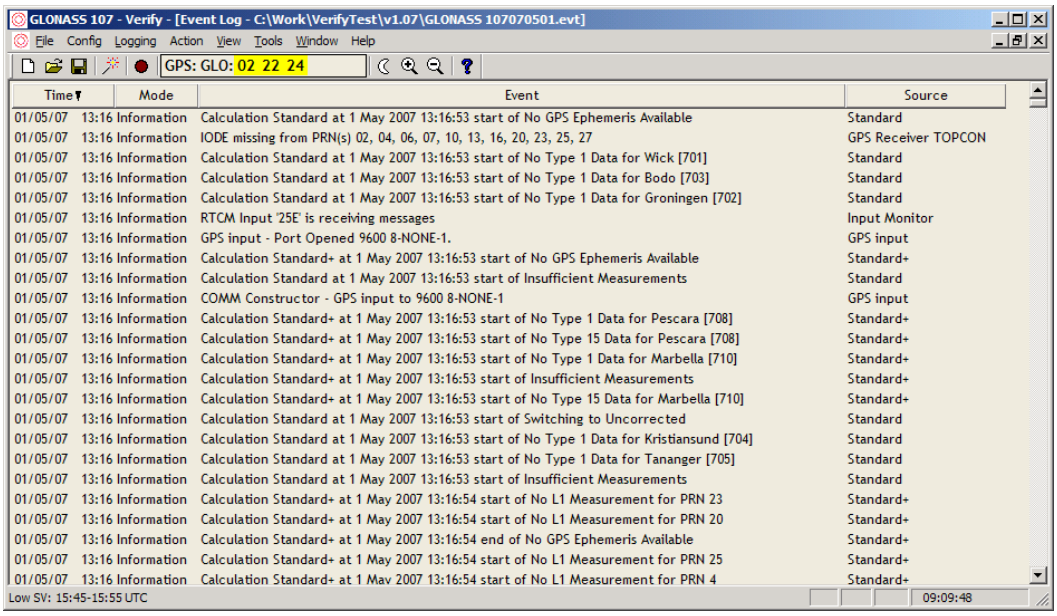
The Logging functionality contains logging of all GNSS & RTCM input data (ALF) and logging of GPS data in the Receiver Independent Exchange format (RINEX).

Verify QC will create also event logs and a record of all configuration changes.

8.6.1 Event Log

"*View/Logging/Event Log*" will display the Verify QC event for the last 4 hours.

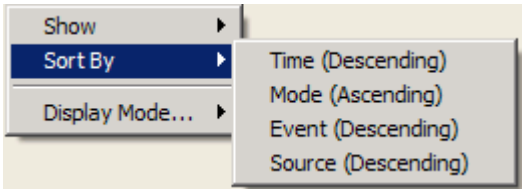
The event information is split over four columns with the heading Time, Mode, Event and Source respectively.



Event Log View

The *Time* column displays date and time information. The *Mode* column indicates if the event is for the users' information or if it constitutes a warning. Warnings are displayed when critical data inputs time out. The *Event* column provides a description of the event. The *Source* column gives an indication of which process detected the event.

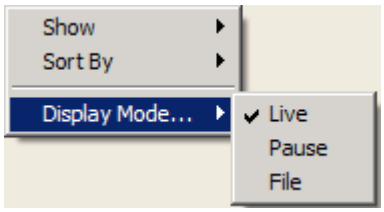
The event log can be sorted by any of the columns. Clicking on the column name changes the sort order for each column. Alternatively the sorting parameters can be set by right clicking on the view menu and selecting options under '**Sort by**'.



Event Log View – Sort By Options

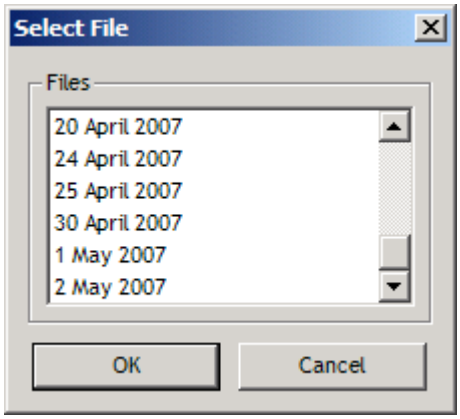
Individual columns can be hidden by right clicking on the view and selecting options under '*Show'*.

The Display Mode of the event log can be changed. The live mode can be paused or set to display a past event log file.



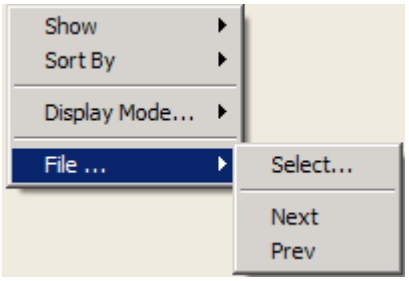
Event Log View – Display Mode Options

The user can view the events of previous days by right clicking on the view menu and selecting "*Display Mode…/File."* The full list of event files associated with the current configuration are shown and are available for selection.



Event Log View – Select File

Whilst the event log is in 'File' mode it is possible to browse through the event files using the '*Next'* and '*Prev'* commands or to select the file for a specific date via the '*Select'* sub-menu.



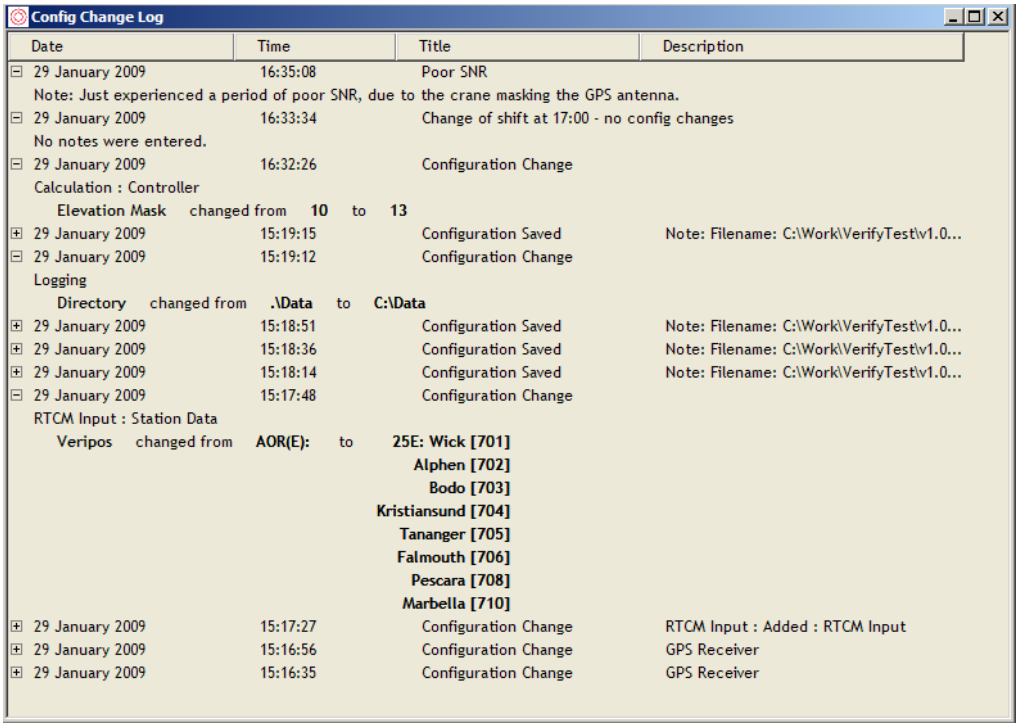
Event Log View – File Mode

The view options outlined above are available also by right clicking on the header bar of the view.

8.6.2 Config Change Log

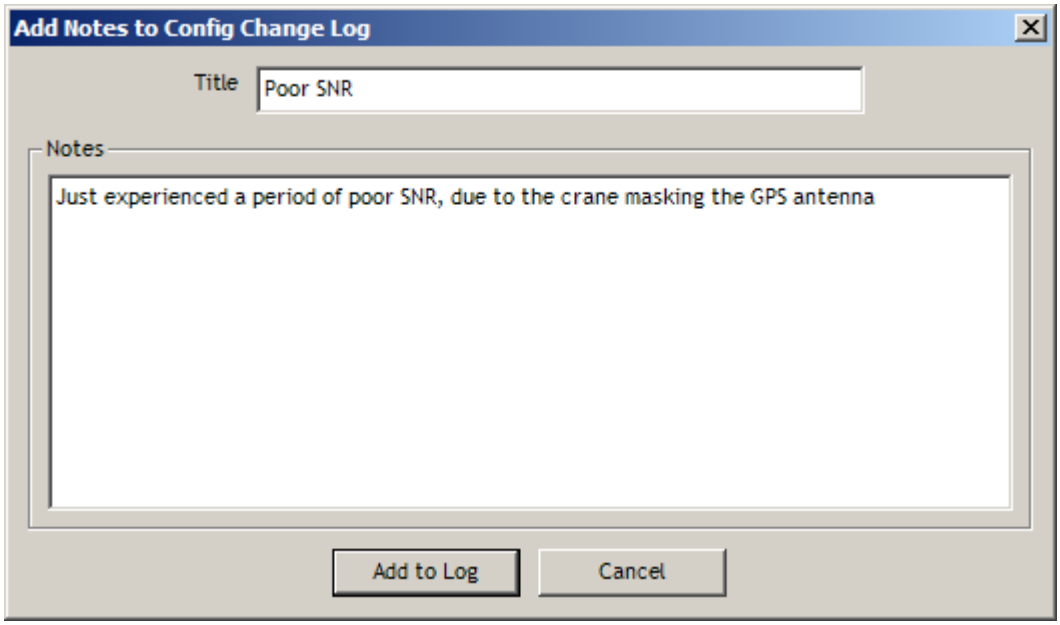
All configuration changes are stored in an XML file with the same name and kept in the same location as the configuration file. This log of configuration changes is displayed also in Verify QC in the Config Change log View.

The view contains a record of the date and time of the change, a title and a description of the change. Further details of the change can be displayed by clicking on the '**+**' symbol at the start of the specific change entry. Similarly, the details can be collapsed.



Config Change Log View

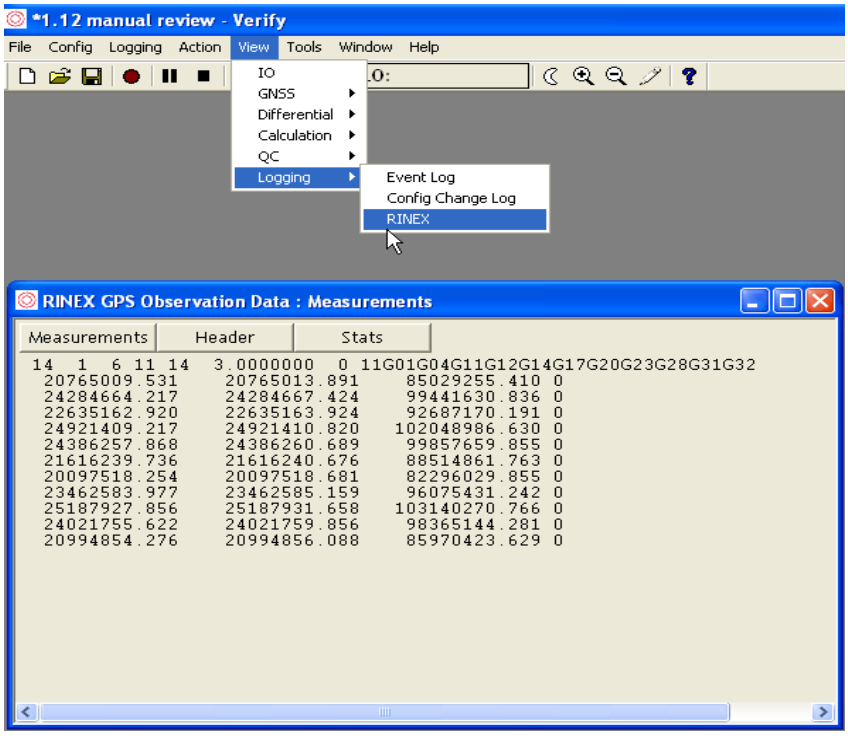
In addition to the software storing all configuration changes automatically, the user can add notes to the log (XML file). The 'Add Notes to Config Change Log' dialogue will open following a right mouse click on the view and selecting '**Add to Log**'.



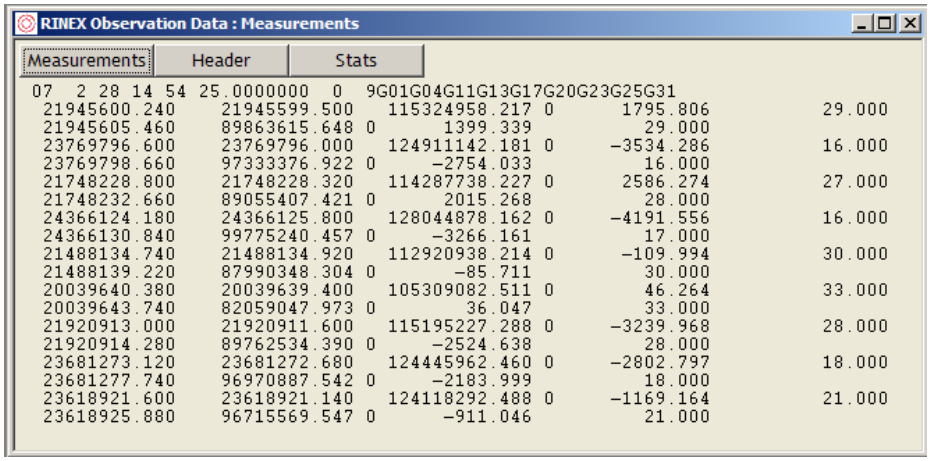
Config Change Log Add Notes Dialogue

8.6.3 RINEX

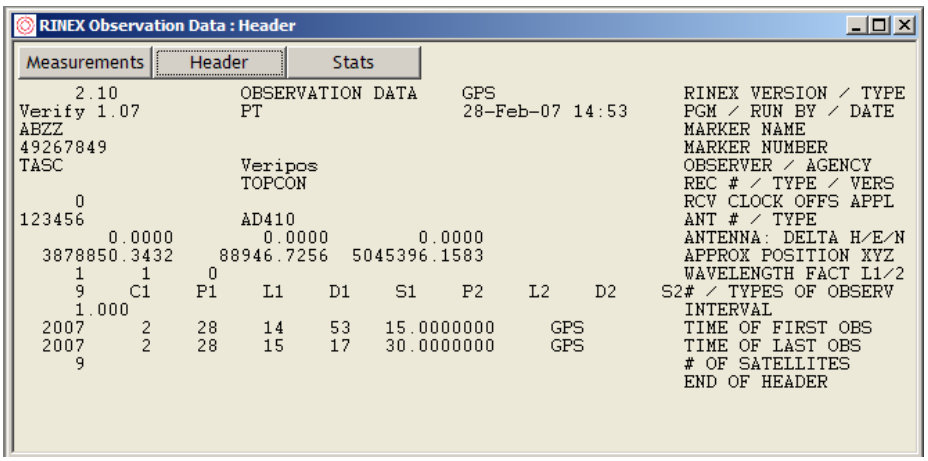
"View/Logging/RINEX" opens the RINEX logging status view and displays the Measurements, Header and Stats chosen from the option menu at the top of the view.



See RINEX standards for further details about the displayed RINEX data records.



RINEX View - Measurements

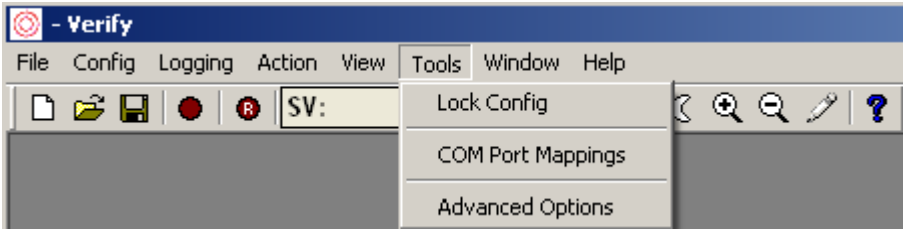


RINEX View - Header

The RINEX '**Stats**' view shows the current logging path and the size of the current data file.

9. TOOLS

The Tools menu offers a small selection of amenities to enhance Verify QC operations.

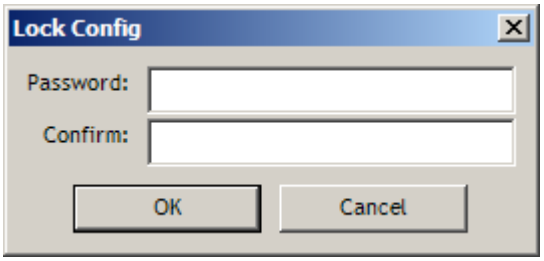


Tools Menu Structure

9.1 LOCK CONFIG

The configuration file in use can be secured by means of a password. Using "*Lock Config*" allows file protection by the entry of a password (at least 6 characters long). It is recommended that all Users are advised of this password for access to the configuration once it has been locked.

Locking the configuration file will disable access to configuration menus. However, users can still change the window display, and make any other cosmetic changes.

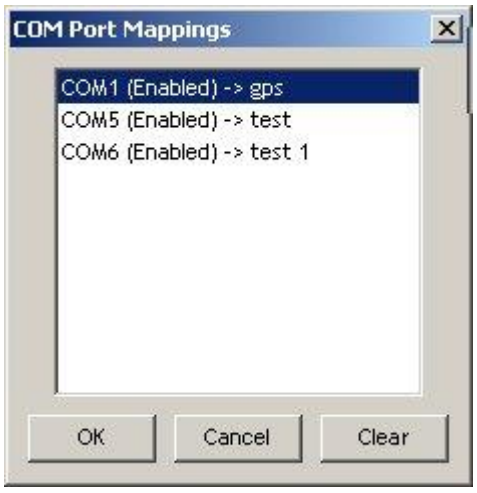


Lock Config

9.2 COM PORT MAPPING

All COM ports can be allocated descriptive names in this dialogue box. The COM ports can be named according to their function after the various external devices have been interfaced, for example COM1 = GPS input. This will aid the user in selecting the correct COM ports for input and outputs when configuring Verify QC.

Note: when using this feature, please ensure that the physical connections between the PC and the Receivers are not changed, as this will create confusions in future configuration setups.



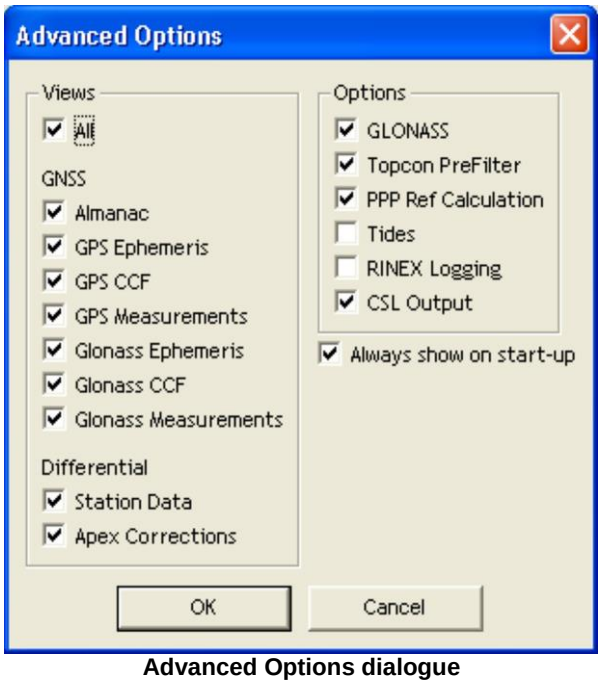
COM Port Mapping

To edit the COM Port name double click on its name in the dialogue box. If required COM ports can be disabled so that they cannot be selected for inputs or outputs in Verify QC. This is particularly useful if some ports have already been reserved for other applications.

COM Port Editing

9.3 ADVANCED OPTIONS

The user can disable certain advanced views or software options using "*Tools/Advanced Options*".



Advanced Options dialogue

The Advanced Options dialogue also appears on start-up of the software.

Enabling / disabling views or options affects the functionality and views accessible through the Verify QC menu structure.

The Advanced Views appear deselected by default. If views are enabled their enable status is stored in the configuration file such that the same view will be available when the user re-opens the configuration file.

The Options currently supported by the dongle are all selected by default in a new configuration. Several additional options can be selected. Options not supported by the dongle are greyed out. For options selected or deselected the selection status is stored in the configuration file such that the option is set correctly when the configuration file is re-opened.

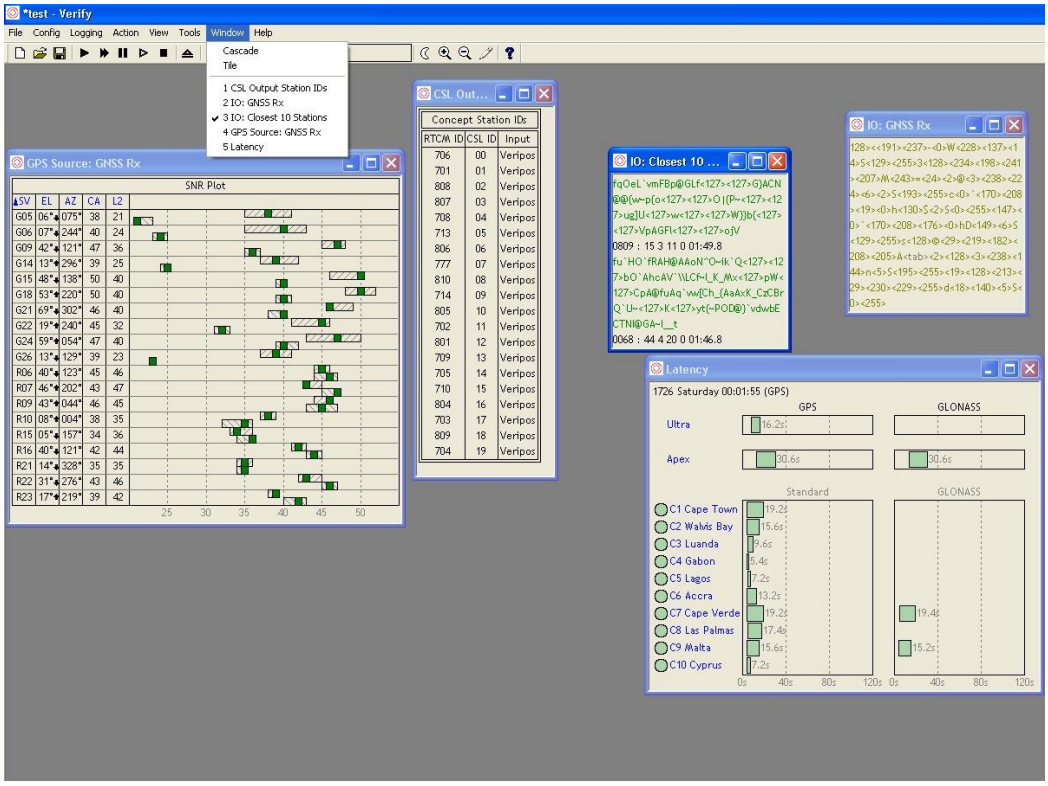
The manual covers all option dependent functionality and views by describing the full menu structure.

If certain functionality or views are absent the user is advised to check the dongle enable status under "*Help/Dongle/View…"* and the selections under "*Tools/Advanced Options*."

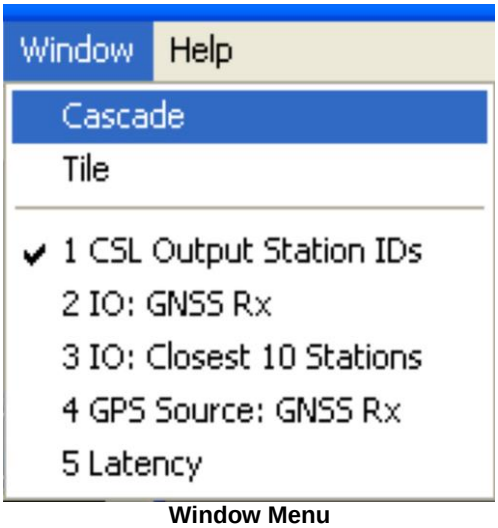
If using a Topcon or Javad receiver please refer to the Topcon Prefilter section (Section 3.4) of this manual.

10. WINDOWS

In the “Windows” menu all open Verify QC views can displayed in Tile or Cascade format.



The “Windows” menu also shows all current windows open. Selecting these options makes the window active. The active window has a tick displayed next to the label in the menu.



Window Menu

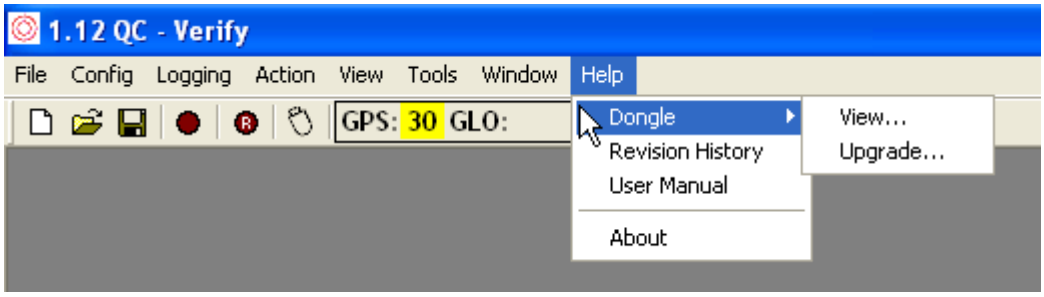
11. HELP

The Help menu contains utilities for reprogramming dongles and gives access to the revision history, the User Manual and the software About details.

11.1 DONGLE, UPGRADES AND HELPDESK

11.1.1 View

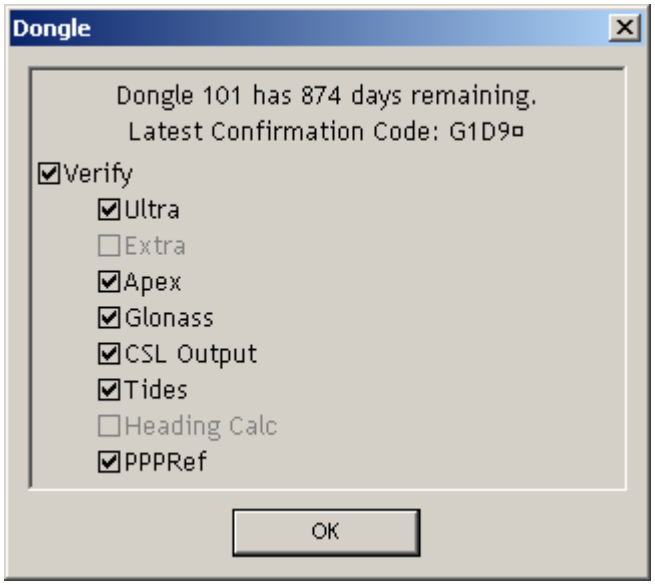
"*Help/Dongle/View*" allows the user to see the current status of the Verify QC Dongle.



Help Dongle Menu

The Dongle view displays the amount of time left on the dongle activation and the software features enabled for the dongle. It also shows the most recent dongle upgrade Confirmation Code, which has to be supplied to the VERIPOS Helpdesk after the dongle has been upgraded with new features.

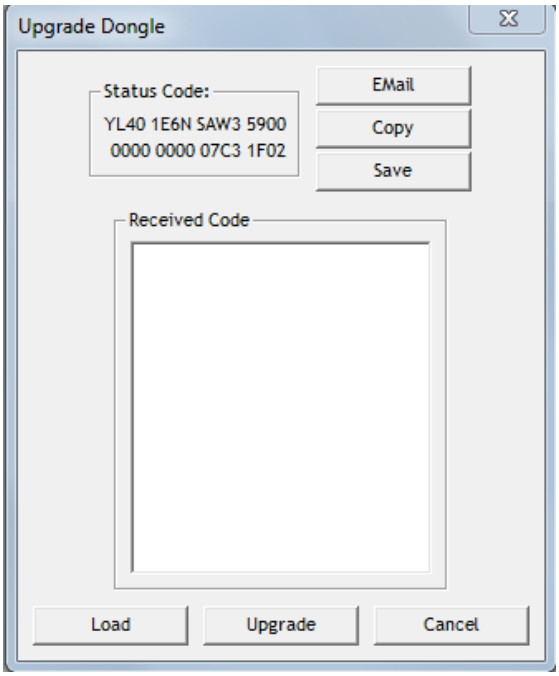
Verify QC will remind the user by means of a pop-up warning box when the dongle has less than 7 days remaining and is about to expire. The number of dongle days remaining is also displayed on the 'Information Bar' at the bottom left of the Verify QC screen.



Dongle View

11.1.2 Dongle Upgrades and Helpdesk

"*Help/Dongle/Upgrade*" allows the user to save the current dongle code to a USB memory stick. This code is needed to request a dongle upgrade or extend the dongle duration with the VERIPOS Helpdesk.



Verify QC Dongle Status Code

Pressing the **'Email'** button will start the user's default email software, (e.g. MS Outlook), and open a new email message to be sent with the dongle status code in the e-mail message body. The VERIPOS Help Desk email address is automatically populated in the 'send to' address of the email.

The '**Save**' button will create an ASCII file on the USB memory stick with the name status.dsf. This file can be sent by the user to the VERIPOS Helpdesk as an email attachment.

The '**Copy**' button will copy the dongle status code to the clip board so that it can be pasted into an e-mail or fax.

VERIPOS help desk details: helpdesk@veripos.com Tel. +44 (0) 1224 965900

Once the VERIPOS Helpdesk returns an upgrade code the code will be required to be saved in a file named "upgrade.dsf".

Save the file to a USB memory stick and insert into the Verify QC PC.
Go to "*Help/Dongle/Upgrade…",* press Load then browse to the location on the USB memory stick where the "upgrade.dsf" file is saved.
The upgrade code will appear in the text box in the middle of the window.

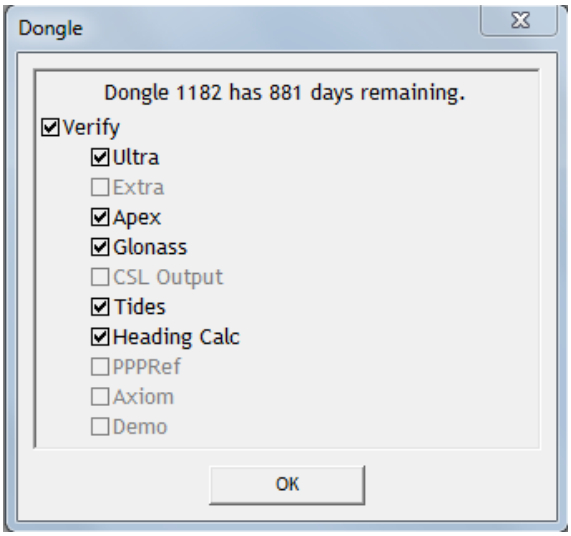
Press *Upgrade* and the code will be applied to the dongle and confirmation code will be returned by the software.

Please send this confirmation code to the VERIPOS Helpdesk to record a successful upgrade. Failure to do so may result in dongles not accepting future updates.

When the codes have been entered, the user can check if the upgrade has been applied as requested, by selecting "*Dongle/View*".

The view will now contain the latest confirmation code.

Once the code has been entered the user can check if the upgrade has been applied by selecting "*Dongle/View*" to bring up the view (example below) to show dongle status.



Dongle View after upgrade

11.2 REVISION HISTORY

Provides a summary of the revisions of Verify QC software versions.

11.3 USER MANUAL

Opens the Verify QC manual in PDF format, provided Adobe Reader is installed on the PC.

11.4 ABOUT

This opens the following dialogue box containing the necessary support contact information together with the Verify QC Software Version and the version of the Algorithms. The software version may be requested if the user requires support to assist in resolving any technical issues.

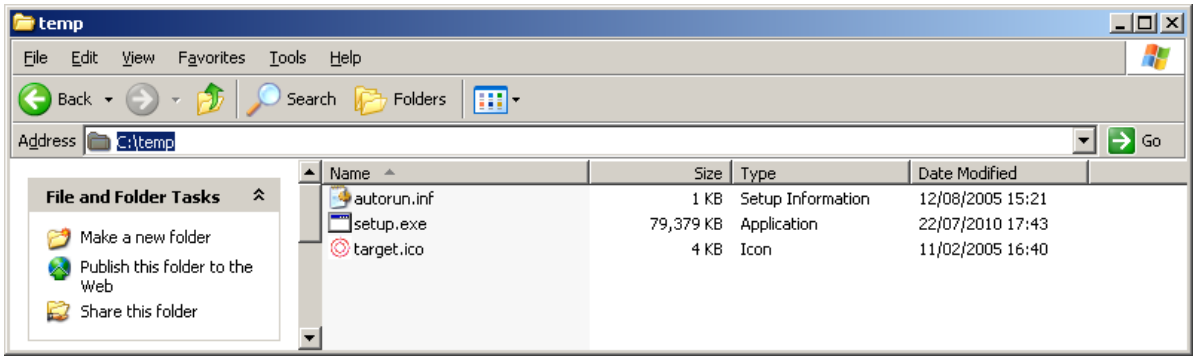
Verify QC *About* View (Example)

12. INDEX OF APPENDICES

APPENDICES

A INSTALLING VERIFY QC

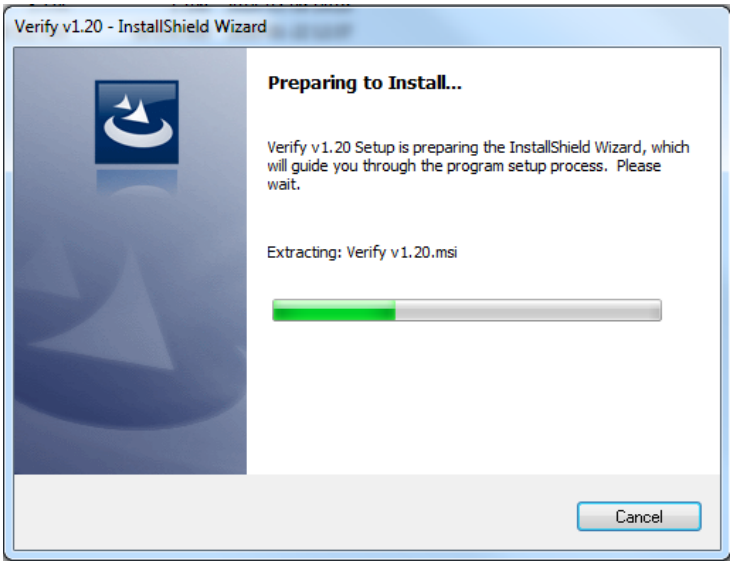
The Verify QC software is installed from a CD inserted into a PC CDROM drive. It contains an auto-start feature that will start the installation process automatically. If installing from a different location or auto-start is not available, double click the *setup.exe* file to begin the installation.



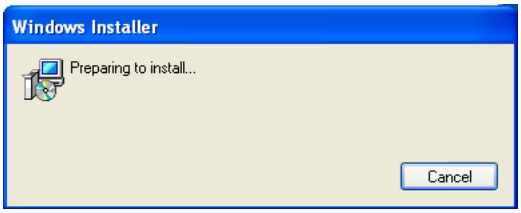
Verify QC Program Setup

A.1 SOFTWARE INSTALLATION

When the installation starts, the following screen will appear:

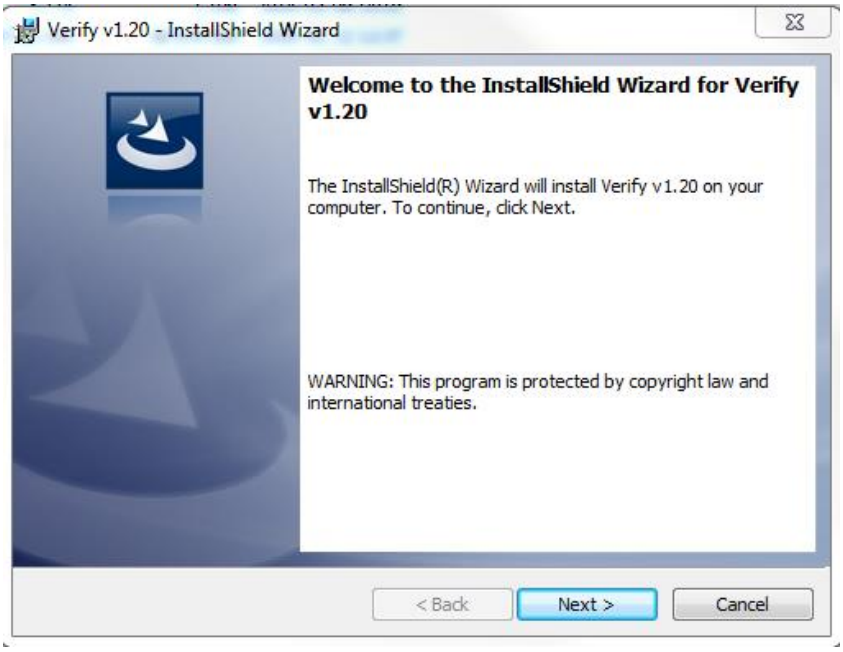


Screen Display of Preparing to Install



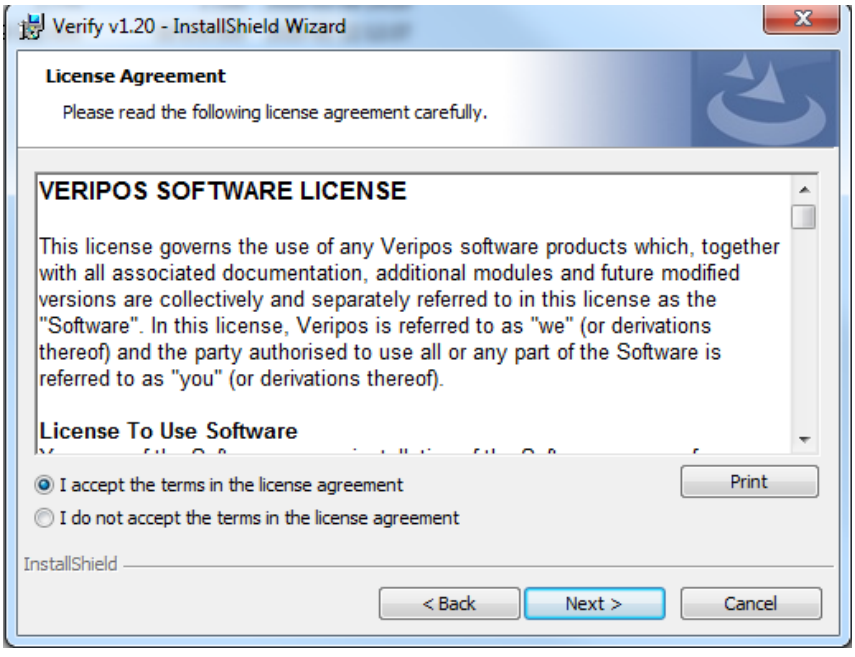
Windows Installer

Check that the version of Verify QC you are installing is correct, and then click ***Next.***



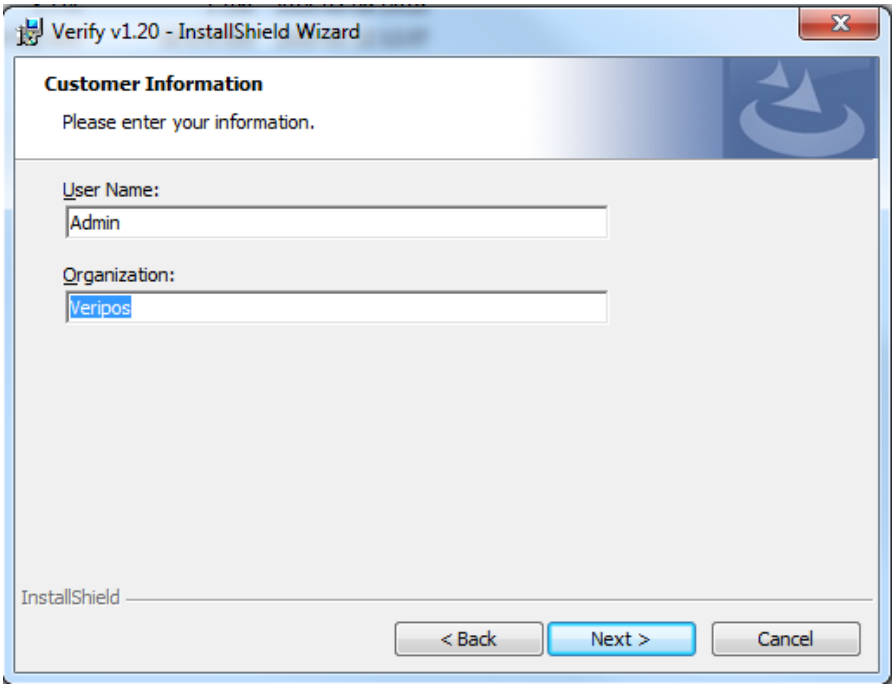
Verify QC Software Version

Read the VERIPOS Software License, accept the terms in the license agreement to continue and then click ***Next.***



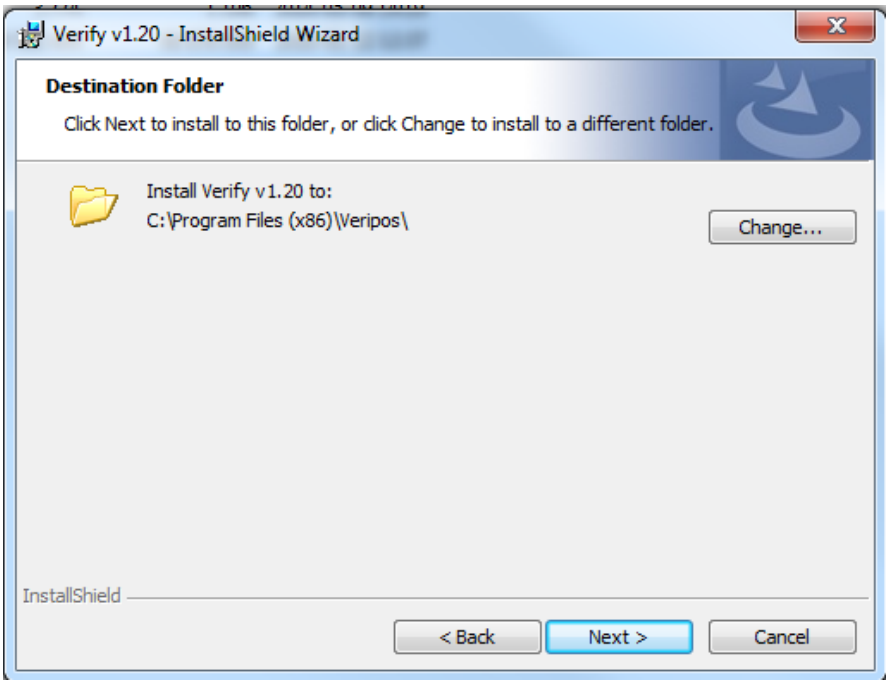
VERIPOS Software License

Enter the required customer information on this page and click ***Next.***



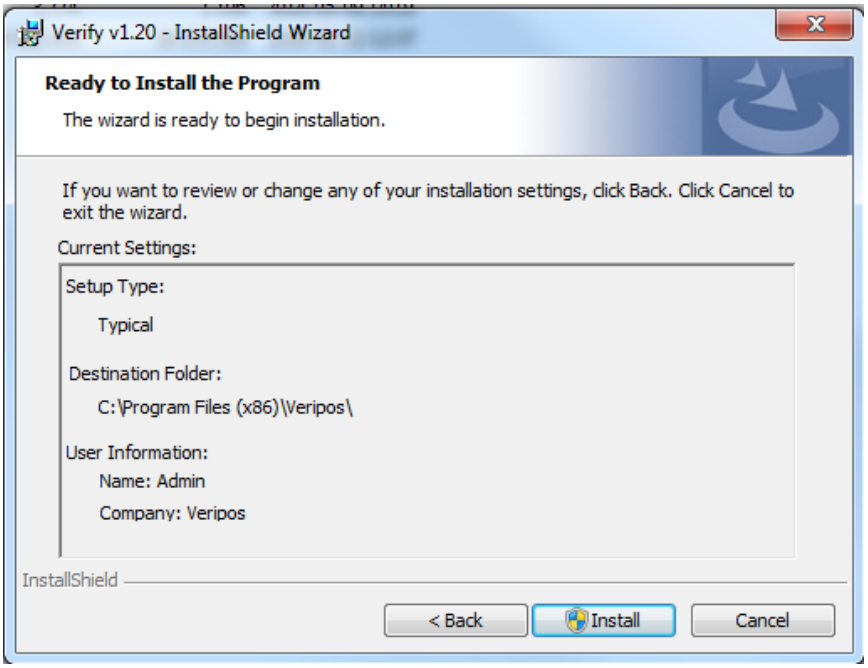
Customer Information

The default installation directory is *C:\Program Files\VERIPOS*. Click ***Change*** if a different location is to be used. Select the directory to be used then click ***Next.***



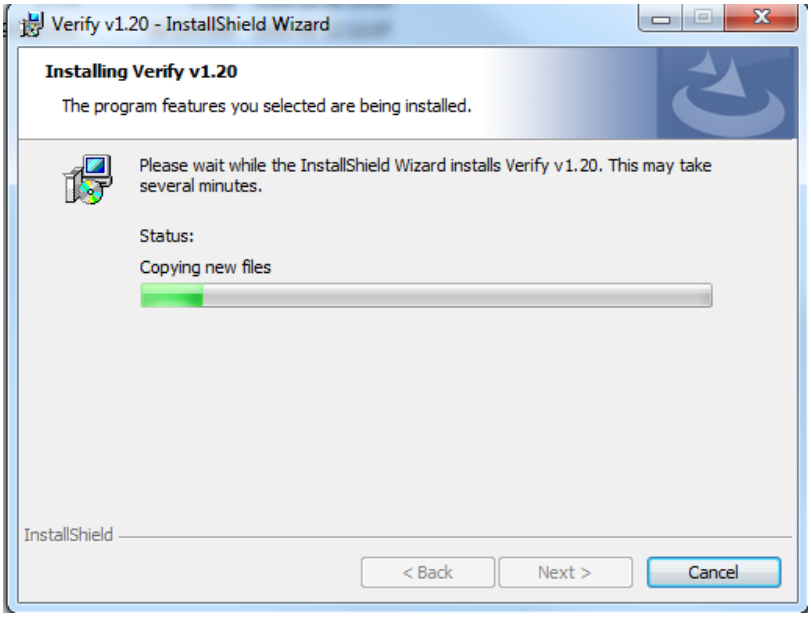
Verify QC Installation Directory

Check to make sure that all current installation settings are correct. Click ***Install*** to start the software installation.



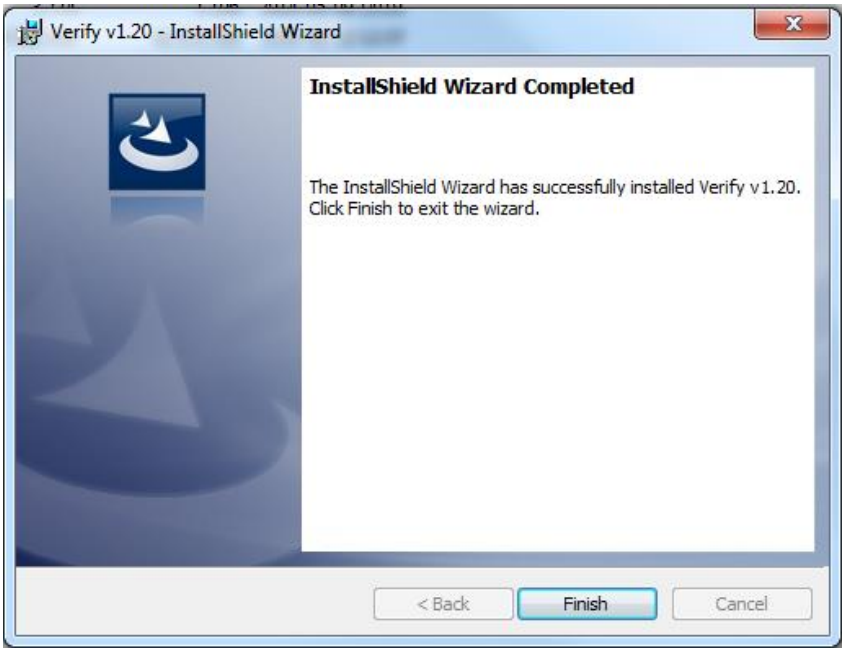
Verify QC Ready to Install

Installation of Verify QC will now commence.



Verify QC Installation Status

Installation is now complete. Click ***Finish.***



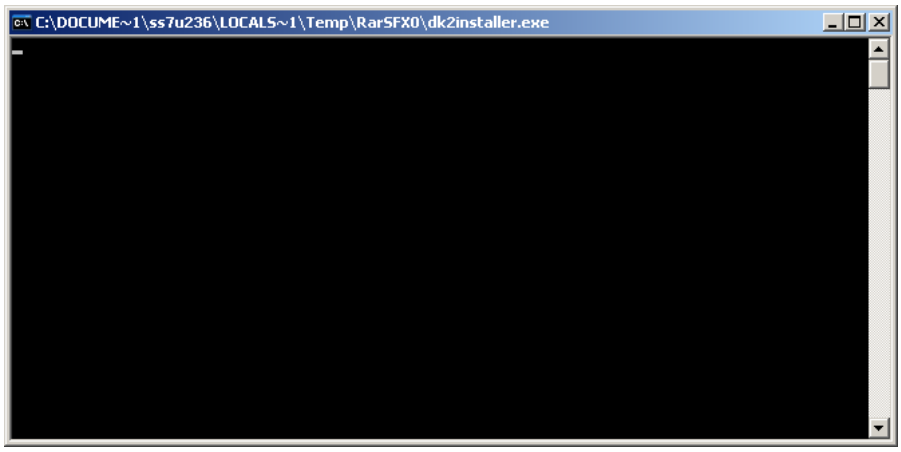
Verify QC Installation Complete

B DONGLE DRIVER INSTALLATION

The Verify QC software is dongle protected. An enabled dongle will be supplied with the software. If dongle is missing or not enabled contact VERIPOS.

The installation of the dongle driver will automatically follow the Verify QC software installation.

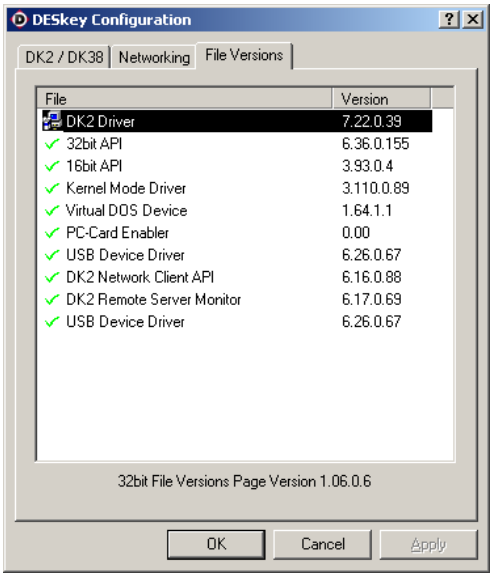
The drivers may be upgraded or (re)installed manually by going to “Start\All Programs\VERIPOS\Dongle Drivers\Reinstall Drivers”.



Dongle Driver Installer

It is possible to check in Control panel whether dongle drivers and which version have been installed.

Go to “Start/Control Panel” and double click on the DESkey icon. This will open the ‘DESkey Configuration’ dialogue. The details of the installed driver can be read in the ‘File Versions’ tab:

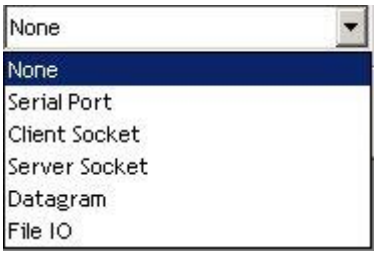


DESkey Configuration – File Versions

C DEVICE IO DESCRIPTIONS

This appendix outlines the functionality of the *IO Device* options in the configuration dialogues.

The Verify QC software supports a number of communication types for data input and output as described below: -



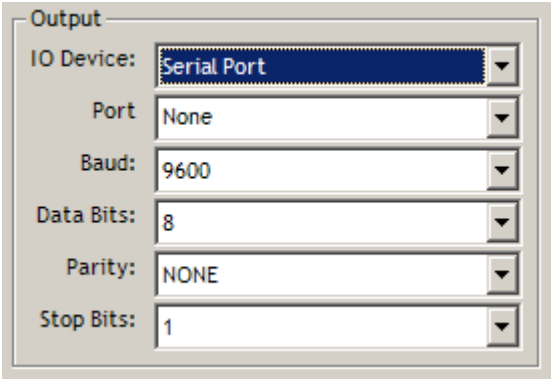
IO Device Communication Types

All communication types available within the software are displayed in the drop down "**IO Device**" menu. The list has been customised such that only input communication types are available in input dialogues and vice versa.

Each communication method is described in the following sections.

C.1 SERIAL PORTS

Serial ports are the physical connections to the hardware. The settings depend on the device being used or the data being output. Select Serial Port connection type from the IO Device menu to access the serial port configurations options.



Serial Port Options

The *Port* number is a sequential number corresponding to the communication port on the computer. When using a multi-port board (Digi/Decision SI-8) board the *Port* numbers will increment from the permanent ports as shown in the example below:

Com1 = Computer Com1
Com2 = Computer Com2
Com3 = Digi 1
Com4 = Digi 2
Etc.

Detailed information for the PC's available ports can be found under Device Manager, which is a sub-section of the System Manager in the Windows Control Panel.

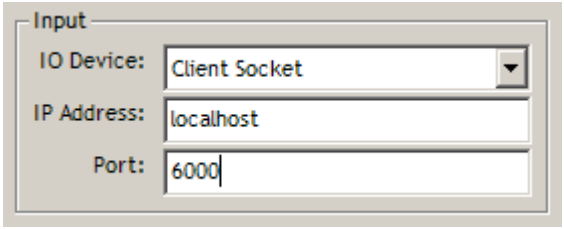
A Com port already in use by Verify QC or another application on the PC will be labelled as 'in use' in the *Port* pull down menu. It can still be selected but Verify QC cannot open this port as it is locked by the Operating System.

Select the correct *Baud* rate. This must match the settings of the device connected to Verify, or the setting required for the output string. *Data Bits*, *Parity* and *Stop Bits* can be changed if the interfaced device does not use the 8 NONE 1 protocol.

C.2 CLIENT SOCKET

GPS, RTCM and Demodulator Status data can be received from other applications on the network using Client Sockets with the TCP/IP protocol.

Typically, a GPS receiver or a VERIPOS Demodulator can be connected to a networked computer using one of the physical ports or DIGI ports. The data is then input into the VERIPOS VIO software, part of the Verify QC suite of programs. The VIO software can be configured with Server Sockets such that data is broadcast over the network (including the local host computer) making the data available to more than one user.

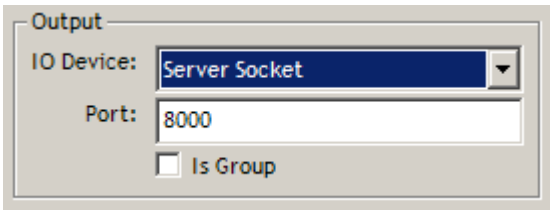


Client Socket Options

The Client Socket dialogue allows users to enter the *IP Address* of the computer serving out the data and the *Port* on which the TCP/IP data is present. If the data is coming from the same computer as Verify QC the IP address should be left as "localhost". Ports range is between 0 – 65535.

C.3 SERVER SOCKET

Position output data can be sent to other applications on the network using Server Sockets with the TCP/IP protocol.

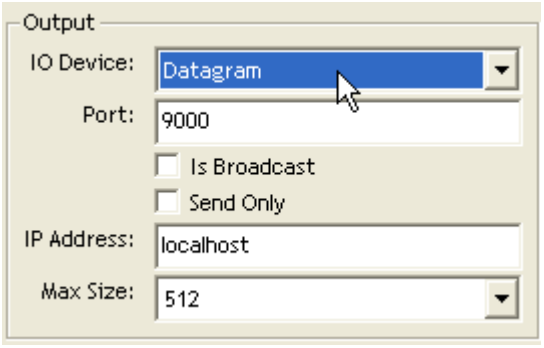


Server Socket Options

The Server Socket dialogue allows users to enter the *Port* on which the TCP/IP data will be present.

C.4 DATAGRAM

The Datagram connection type in Verify QC uses the User Datagram Protocol (UDP). UDP is an alternative to TCP. It does not manage a connection for purposes of flow control. Instead packets of data are issued to the intranet/internet in either broadcast mode, where any networked computer on the LAN can receive them, or in the address mode where the data packets have headers specifying the addressees of the intended recipient. There is no guarantee with this protocol that the messages will arrive in the order they were sent.



Datagram Options

As with Server and Clients Sockets the user is required to enter a *Port* number. The Datagram communication type can be used to send or receive data. To broadcast data, tick the 'Is Broadcast' box. To receive data, leave this box unchecked.

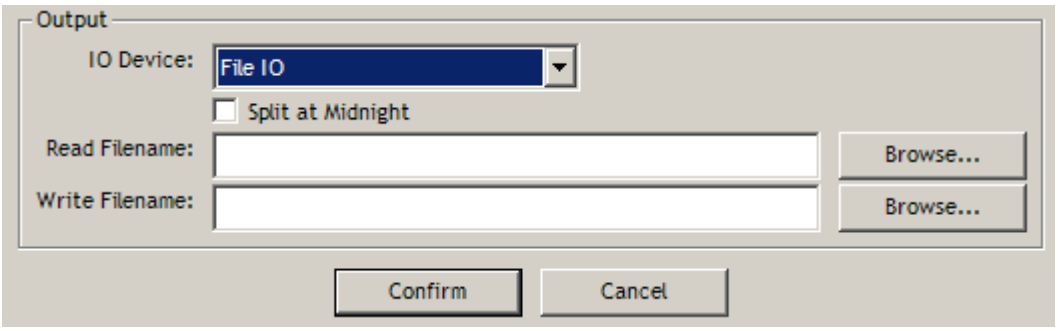
The *IP Address* configuration defaults to 'local host' with a Max Size of 512, limiting the packet size to 512kb. These two parameters are user selectable.

The *Send Only* tick box when selected allows the Datagram IO component to send data to an existing Datagram listener on the same PC without binding itself to a port to listen to incoming messages. This will allow other software on the same computer to connect to the port.

C.5 FILE IO

The File IO device type allows the logging of output data to file. Users can browse to the destination directory and enter the name and extension of the logging file under 'Write Filename'. It is advisable to use the '.txt' file extension, as this will allow the files to be read using most ASCII file viewers.

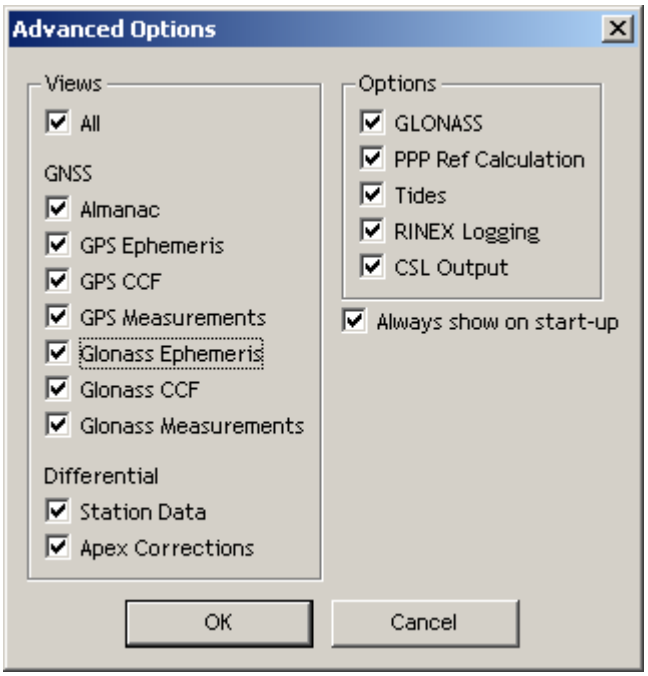
A new logging file is created at midnight if the box *'Split at Midnight'* is ticked. The date is then included automatically in the file name, using the convention 'Write Filename_YYMMDD.txt'.



File IO Options

D ADVANCED VIEWS

This appendix outlines the Advanced Views that can be enabled under *Tools/Advanced Options*.



Advanced Options dialogue

D.1 ALMANAC

In Verify QC 1.20 the Satellite constellation convention is adopted as below;

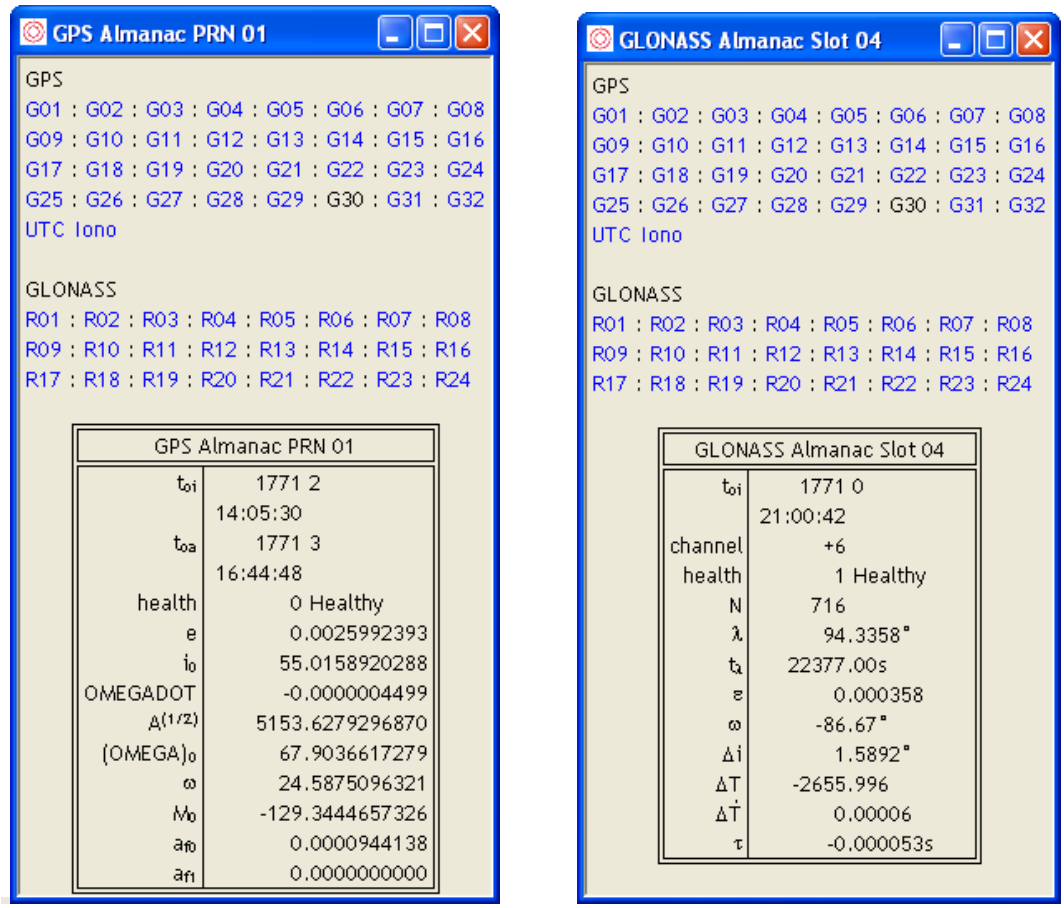
GPS = G## (where ## represents the SV PRN)

GLONASS = R## (where ## represents the SV slot number)

In future when available on the GNSS receiver, Galileo SV's will show *E##* and Compass SV's will show *C##*.

View/GNSS/Almanac displays the current Almanac data for each satellite in view.

The almanac contains orbit information of all the satellites, the satellite clock parameters, ionospheric and tropospheric delay parameters.



Almanac View

Clicking on the BLUE satellite numbers changes the displayed data to that particular satellite.

GPS Almanac Data

t_{oi}	Time of issue, given as GPS week and GPS time
t_{oa}	Time of almanac, given as GPS week and GPS time
health	based on the 5 Least Significant Bits (LSB) of the 8-bit health words in the navigation sub-frame data. The health flag ranges from 0-255. A non-zero value indicates that the satellite is unhealthy
e	Eccentricity
i_0	Inclination angle at reference time
$(O)_0$	Rate of change right ascension.
$A^{(1/2)}$	Square root of the semi major-axis in (root) meter
(Omega)O	longitude of ascending Node of Orbit Plane at Weekly Epoch
ω	Argument of perigee
M_0	Mean anomaly at reference time
a_{f0}	Satellite clock offset
a_{f1}	Satellite clock drift

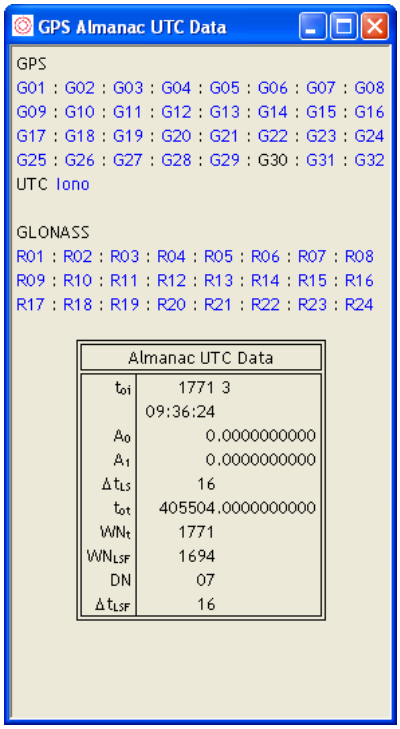
GLONASS Almanac Data

t_{oi}	Time of issue, given as GPS week and GPS time
channel	GLONASS satellite channel number
health	A satellites health is established by the GLONASS Control Centre, and from there a satellite is either flagged as healthy (1) or not
N	Current date. Calendar number of day within four-year interval starting from a leap year
λ	Longitude of the first ascending node in PZ-90 coordinate system
t_λ	Time of the first ascending node passage
ε	Eccentricity
ω	Argument of perigee
Δi	correction to the mean value of inclination
ΔT	Correction to the mean value of Draconian period
ΔTdot	Rate of change of orbital period
τ	Time correction to GLONASS time scale (vs. UTC(SU))

By clicking on the blue UTC in the GPS Almanac section the Almanac UTC data will be shown.

GPS Almanac UTC Data

t_{oi}	Time of issue, given as GPS week and GPS time
A_0	Constant and first order terms polynomial.
A_1	Constant and first order terms polynomial.
Δt_{LS}	Delta time due to leap seconds, the offset between GPS time and UTC time
t_{ot}	Reference time for UTC data.
WN_t	UTC reference week number.
WN_{LSF}	Week number.
DN	Day number.
Δt_{LSF}	Delay time due to leap seconds

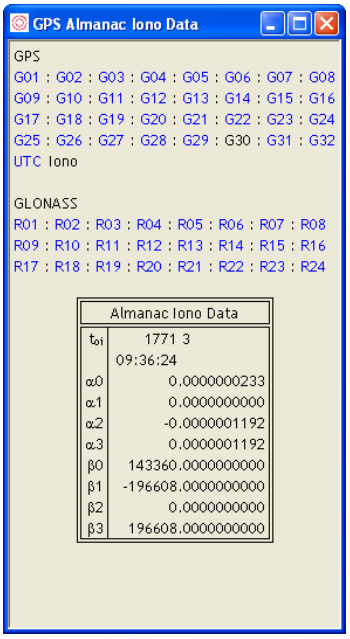


GPS Almanac UTC Data

By clicking on the blue Iono in the GPS Almanac section the Almanac Iono data will be shown.

GPS Almanac Iono Data

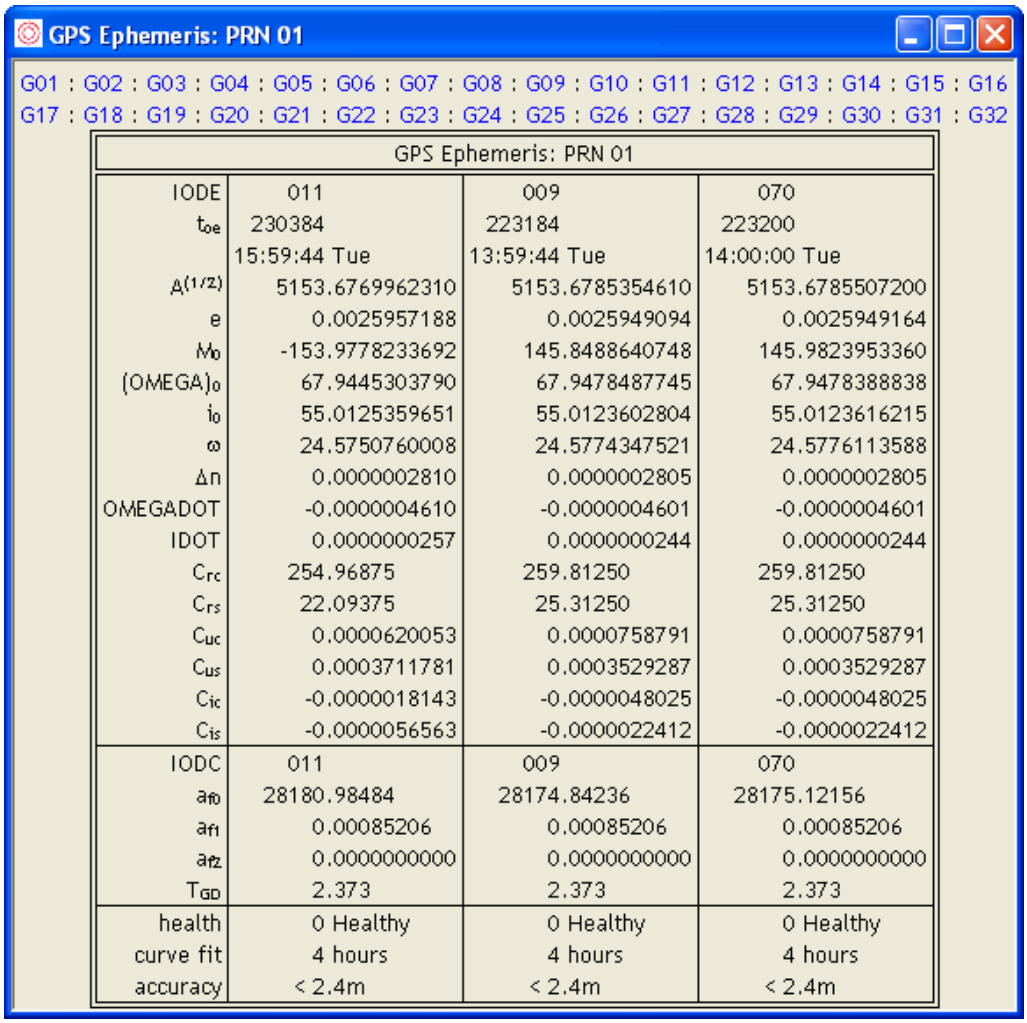
t_{oi}	Time of issue, given as GPS week and GPS time
α(n)	The coefficients of a cubic equation representing the amplitude of the vertical delay, 4 coefficients
β(n)	The coefficients of a cubic representing the period of the model, 4 coefficients



GPS Almanac Iono Data

D.2 GPS EPHEMERIS

View/GNSS/GPS Ephemeris displays the current ephemeris data for each satellite that is being tracked.



GPS Ephemeris: PRN 01

IODE	011	009	070
t_{oe}	230384	223184	223200
	15:59:44 Tue	13:59:44 Tue	14:00:00 Tue
$A^{(1/2)}$	5153.6769962310	5153.6785354610	5153.6785507200
e	0.0025957188	0.0025949094	0.0025949164
M_0	-153.9778233692	145.8488640748	145.9823953360
$(OMEGA)_0$	67.9445303790	67.9478487745	67.9478388838
i_0	55.0125359651	55.0123602804	55.0123616215
ω	24.5750760008	24.5774347521	24.5776113588
Δn	0.0000002810	0.0000002805	0.0000002805
OMEGADOT	-0.0000004610	-0.0000004601	-0.0000004601
IDOT	0.0000000257	0.0000000244	0.0000000244
C_{rc}	254.96875	259.81250	259.81250
C_{rs}	22.09375	25.31250	25.31250
C_{uc}	0.0000620053	0.0000758791	0.0000758791
C_{us}	0.0003711781	0.0003529287	0.0003529287
C_{ic}	-0.0000018143	-0.0000048025	-0.0000048025
C_{is}	-0.0000056563	-0.0000022412	-0.0000022412
IODC	011	009	070
a_{f0}	28180.98484	28174.84236	28175.12156
a_{f1}	0.00085206	0.00085206	0.00085206
a_{f2}	0.0000000000	0.0000000000	0.0000000000
T_{GD}	2.373	2.373	2.373
health	0 Healthy	0 Healthy	0 Healthy
curve fit	4 hours	4 hours	4 hours
accuracy	< 2.4m	< 2.4m	< 2.4m

GPS Ephemeris View

Clicking on the blue PRN numbers displays the data for that particular satellite.

IODE	Issue of Data Ephemeris provides a means of detecting any change in the ephemeris representational parameters. The displayed value is a serial number of the current issue.
t_{oe}	Reference time of ephemeris in seconds related to a GPS week. A GPS week has a length of 604800 seconds.
$A^{(1/2)}$	Square root of the semi major-axis (root) in meters
e	Eccentricity
M_0	Mean anomaly at reference time
$(OMEGA)_0$	Longitude of ascending node of orbit plane at a weekly epoch
i_0	Inclination angle at reference time
ω	Argument of perigee

Δn	Mean motion difference from computed value
OMEGADOT	Rate of change right ascension
IDOT	Rate of change of inclination angle
C_{rc}	Amplitude of the cosine harmonic correction term to the orbit (radians)
C_{rs}	Amplitude of the sine harmonic correction term to the orbit (radians)
C_{uc}	Amplitude of the cosine harmonic correction term to the argument of latitude
C_{us}	Amplitude of the sine harmonic correction term to the argument of latitude
C_{ic}	Amplitude of the cosine harmonic correction term to the angle of latitude
C_{is}	Amplitude of the sine harmonic correction term to the angle of inclination
IODC	Issue of Date Clock
a_{f0}	Satellite clock offset
a_{f1}	Satellite clock drift
a_{f2}	Satellite clock frequency drift.
T_{GD}	Tropospheric group delay. L1 – L2 correction
health	GPS satellite health
curve fit	Length of curve fit
accuracy	Accuracy of fit

D.3 GPS CCF

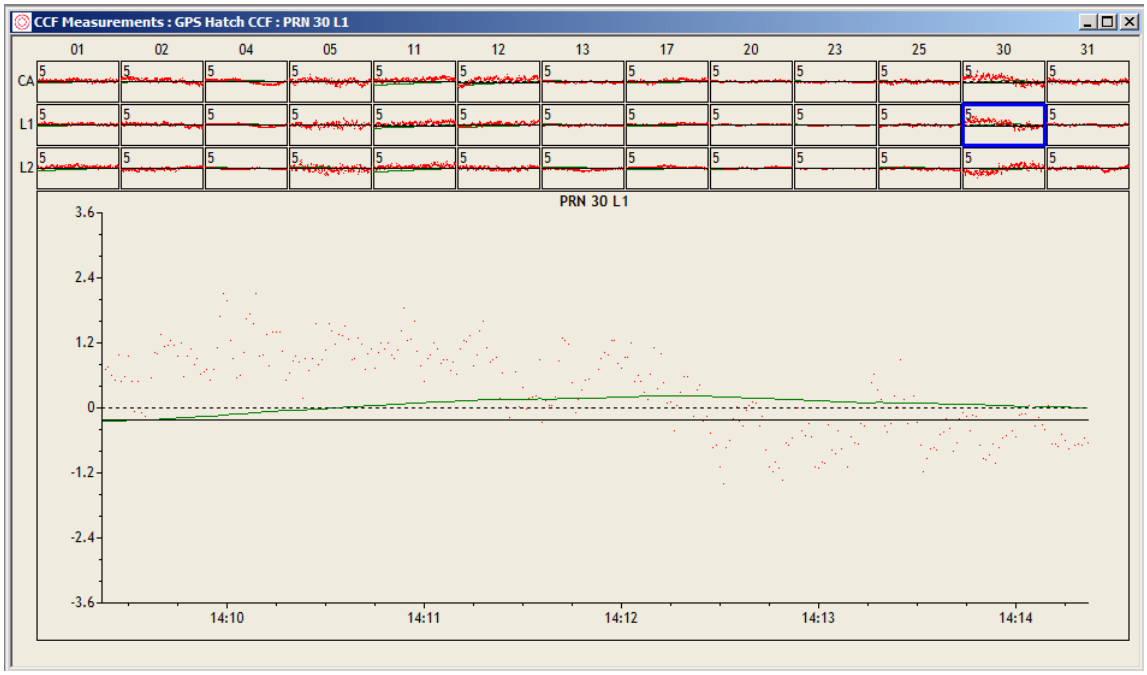
The Code Carrier Filter (CCF) displays the GPS observation filtering process as a time series plot. Two fundamental observables can be derived from the GPS signal, the code and the carrier. The Code or Pseudo-Range (PR) is derived from the time difference between the transmitted code and that of the receiver code. The carrier is the continuous wave frequency upon which the code is modulated. At the receiver the carrier, or the integrated Doppler measurements, are less affected by multipath compared to the code measurements. The CCF uses the more stable carrier measurements to filter and smooth the code measurements. These smoothed code measurements are then used in the position calculation process.

If the CCF reading is permanently high, or fluctuates, then the code measurements are suffering from increased noise. This is common for low elevation satellites or satellites that are tracked intermittently. If poor CCF readings are seen on all satellite and also at higher elevation then it is likely that interference is present, the receiver antenna is badly positioned or there is a problem with the antenna cable / connections.

Cycle slips are a loss of lock on the carrier wave, and this can also be seen in the CCF graph by means of a blue vertical line. If there are large numbers of cycle slips, then the positioning of the antenna should be looked at.

The CCF view is broken down into thumbnails and a main plot. Thumbnail views for the CA, L1* and L2* observations are displayed for each satellite in view. The user can select a thumbnail to get an enlarged CCF chart in the main display by clicking on it. The CCF chart is a time series representation of the code carrier filter for each measurement of the last 15 minutes.

* Which observations are available is receiver dependent. L2 will only be available if the GPS receiver is a dual frequency unit. For some single frequency receivers such as the DG14/16 only CA will be displayed.

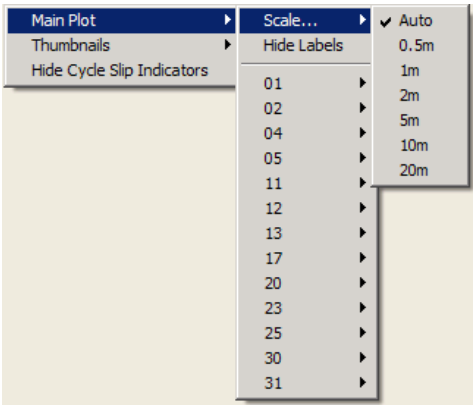


GPS CCF View

The Red dots are raw unfiltered measurements from the GPS receiver.
The Black line is the mean of the raw measurements.
The Green line shows the result of the Code Carrier Filter and should follow the red dots.
Cycle slips are indicated by a blue vertical line.

Clicking the right mouse button in the window allows the user to change the appearance of the display. CA, L1 and L2 thumbnails can be switched on or off. It also possible to hide the cycle slip indicators.

Scale allows the scale of the main plot to be selected. The scale can either be automatically managed by Verify QC or set to one of the offered scales from 0.5m to 20m. The thumbnails have a fixed 5m scale. If the data exceeds the 5m range, the 5 will be shown in bold red with an exclamation mark behind it.

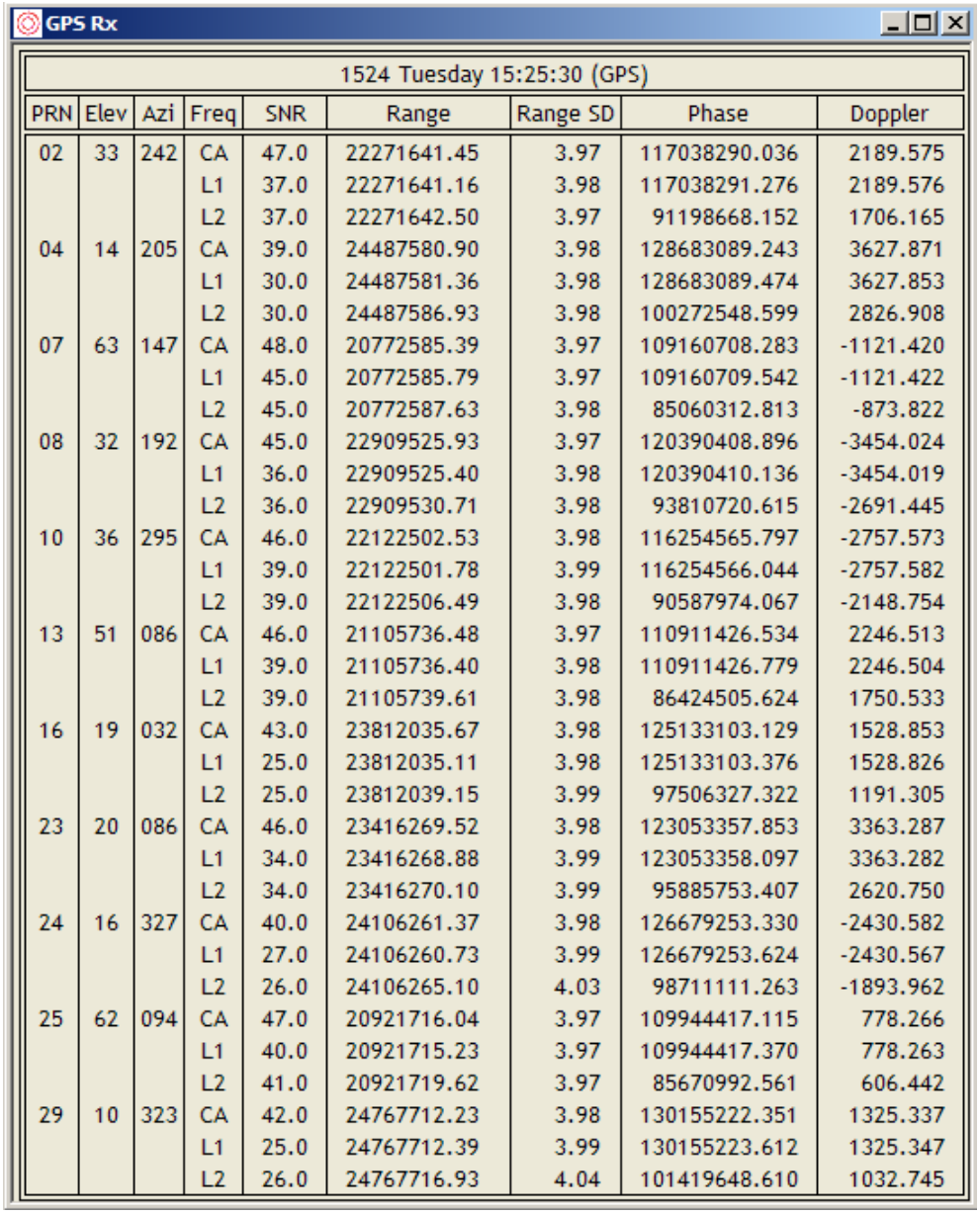


CCF View Options

NOTE: The CCF views will not be populated when GNSS decoder "*Veripos LD5/LD6 (Novatel OEM6)*" is used.

D.4 GPS MEASUREMENTS

This view displays information about the GPS measurements received and decoded by Verify QC. The top row is showing the GPS week number, the day and GPS time.



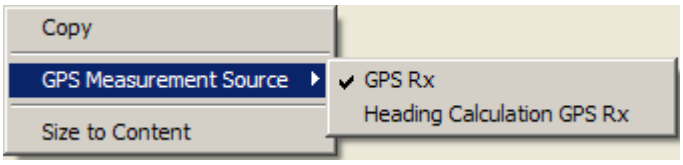
PRN	Elev	Azi	Freq	SNR	Range	Range SD	Phase	Doppler
02	33	242	CA	47.0	22271641.45	3.97	117038290.036	2189.575
			L1	37.0	22271641.16	3.98	117038291.276	2189.576
			L2	37.0	22271642.50	3.97	91198668.152	1706.165
04	14	205	CA	39.0	24487580.90	3.98	128683089.243	3627.871
			L1	30.0	24487581.36	3.98	128683089.474	3627.853
			L2	30.0	24487586.93	3.98	100272548.599	2826.908
07	63	147	CA	48.0	20772585.39	3.97	109160708.283	-1121.420
			L1	45.0	20772585.79	3.97	109160709.542	-1121.422
			L2	45.0	20772587.63	3.98	85060312.813	-873.822
08	32	192	CA	45.0	22909525.93	3.97	120390408.896	-3454.024
			L1	36.0	22909525.40	3.98	120390410.136	-3454.019
			L2	36.0	22909530.71	3.98	93810720.615	-2691.445
10	36	295	CA	46.0	22122502.53	3.98	116254565.797	-2757.573
			L1	39.0	22122501.78	3.99	116254566.044	-2757.582
			L2	39.0	22122506.49	3.98	90587974.067	-2148.754
13	51	086	CA	46.0	21105736.48	3.97	110911426.534	2246.513
			L1	39.0	21105736.40	3.98	110911426.779	2246.504
			L2	39.0	21105739.61	3.98	86424505.624	1750.533
16	19	032	CA	43.0	23812035.67	3.98	125133103.129	1528.853
			L1	25.0	23812035.11	3.98	125133103.376	1528.826
			L2	25.0	23812039.15	3.99	97506327.322	1191.305
23	20	086	CA	46.0	23416269.52	3.98	123053357.853	3363.287
			L1	34.0	23416268.88	3.99	123053358.097	3363.282
			L2	34.0	23416270.10	3.99	95885753.407	2620.750
24	16	327	CA	40.0	24106261.37	3.98	126679253.330	-2430.582
			L1	27.0	24106260.73	3.99	126679253.624	-2430.567
			L2	26.0	24106265.10	4.03	98711111.263	-1893.962
25	62	094	CA	47.0	20921716.04	3.97	109944417.115	778.266
			L1	40.0	20921715.23	3.97	109944417.370	778.263
			L2	41.0	20921719.62	3.97	85670992.561	606.442
29	10	323	CA	42.0	24767712.23	3.98	130155222.351	1325.337
			L1	25.0	24767712.39	3.99	130155223.612	1325.347
			L2	26.0	24767716.93	4.04	101419648.610	1032.745

GPS Measurements View

GPS Measurement Data

PRN	Pseudo Random Noise code is a unique identification number for each GPS satellite. For example, if a satellite is referred to as PRN 13, this refers to the satellite transmitting the 13th weekly portion of the P code.
Elev	The elevation angle measured in degrees of the satellite position above the horizon at the user's location.
Azi	Azimuth is the horizontal angle measured in degrees from north to the direction of the satellite relative to the user's location.
Freq	Frequency refers to the observation types: - • C/A - range measurement derived from the Coarse Acquisition Code on the L1 frequency • L1 - range measurement derived from the carrier at the L1 frequency • L2 - range measurement derived from the carrier at the L2 frequency
SNR	Signal to Noise Ratio is a measure of the power of a received satellites carrier signal at a GPS receiver. Signal strength is generally measured in dBHz but there are differences between the various GPS receiver types. A low SNR is less than 30 dBHz whilst good SNR exceeds 40 dBHz.
Range	Range is the distance measured from the satellite to the users GPS antenna, the unit of measurement being the metre.
Range SD	Range Standard Deviation is a statistical parameter of the range data. The lower the standard deviation the higher the accuracy of the ranges. SD is measured in meters.
Phase	This is the Range divided by the wavelength measured in metres. Wavelengths: L1 ≈ 19cm L2 ≈ 24cm
Doppler	Doppler effect is the change of signal frequency as the transmitting source moves closer or further away from the receiver. The reading in this table gives the difference between the transmitted carrier frequency at the satellite and the frequency received at the GPS receiver. The Doppler measurement is used for the calculation of the user velocity.

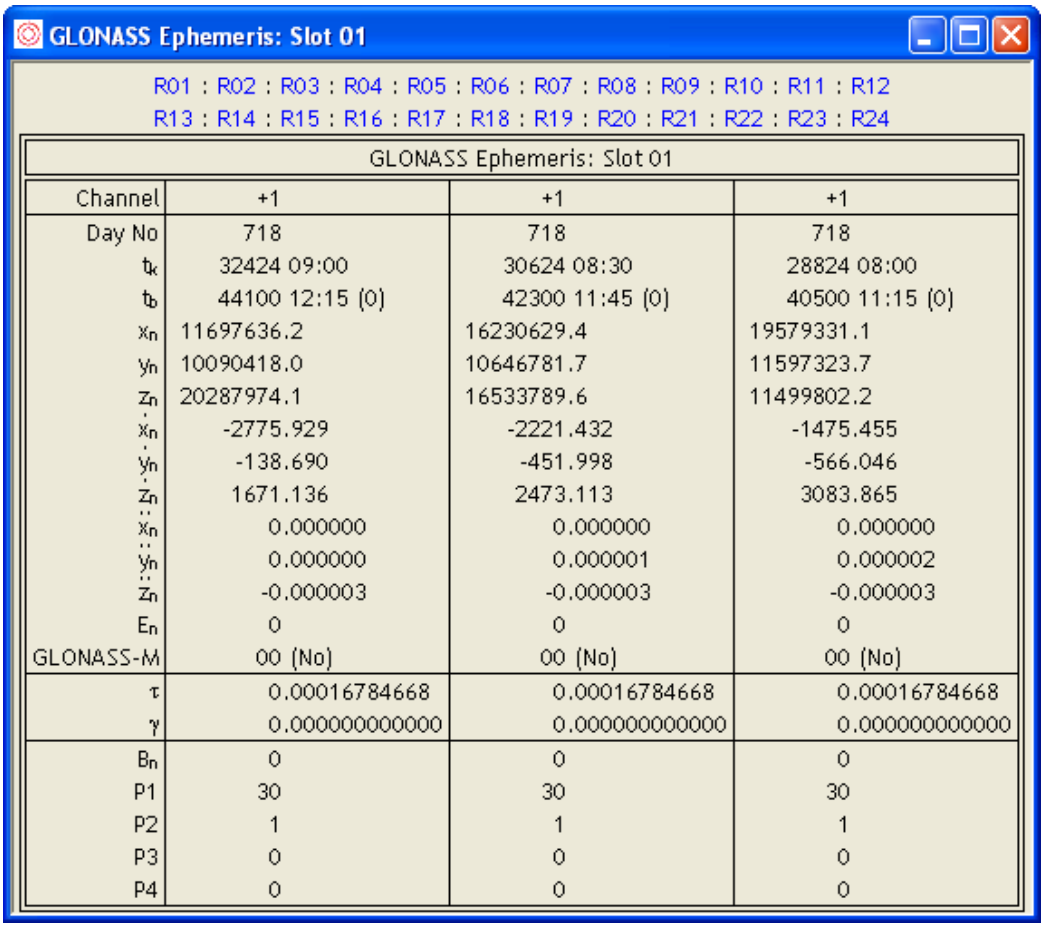
The GPS data for a second GNSS receiver can be displayed in the view when Verify QC is configured to receive GPS data from a second GNSS receiver, i.e. when the Heading Calculation is configured. This data can be selected via a right-click on the view and setting the GPS Measurement Source accordingly.



GPS Measurements View Options

D.5 GLONASS EPHEMERIS

View/GNSS/GLONASS Ephemeris displays the current ephemeris data for each satellite that is being tracked.



GLONASS Ephemeris: Slot 01

Channel	+1	+1	+1
Day No	718	718	718
t_k	32424 09:00	30624 08:30	28824 08:00
t_b	44100 12:15 (0)	42300 11:45 (0)	40500 11:15 (0)
x_n	11697636.2	16230629.4	19579331.1
y_n	10090418.0	10646781.7	11597323.7
z_n	20287974.1	16533789.6	11499802.2
$\dot{x}_n$	-2775.929	-2221.432	-1475.455
$\dot{y}_n$	-138.690	-451.998	-566.046
$\dot{z}_n$	1671.136	2473.113	3083.865
$\ddot{x}_n$	0.000000	0.000000	0.000000
$\ddot{y}_n$	0.000000	0.000001	0.000002
$\ddot{z}_n$	-0.000003	-0.000003	-0.000003
E_n	0	0	0
GLONASS-M	00 (No)	00 (No)	00 (No)
τ	0.00016784668	0.00016784668	0.00016784668
γ	0.000000000000	0.000000000000	0.000000000000
B_n	0	0	0
P1	30	30	30
P2	1	1	1
P3	0	0	0
P4	0	0	0

GLONASS Ephemeris View

Clicking on the blue slot numbers displays the data for that particular satellite.

GLONASS Ephemeris Data

Channel	Shows the GLONASS satellite channel number
Day No	Shows the current date. Calendar number of day within four-year interval starting from a leap year.
t_k	the time referenced to the beginning of the frame within the current day
t_b	index of a time interval within current day according to UTC (SU) +03 hours 00 min. The number between brackets indicates the number of ephemeris messages received with the same t_b value.
X_n, Y_n, Z_n	coordinates of the n^{th} satellite in PZ-90 coordinate system at the instant t_b
$'X_n$, $'Y_n$, $'Z_n$	velocity vector components of the n^{th} satellite in PZ-90 coordinate system at instant t_b
$''X_n$, $''Y_n$, $''Z_n$	acceleration components of the n^{th} satellite in PZ-90 coordinate system at instant t_b

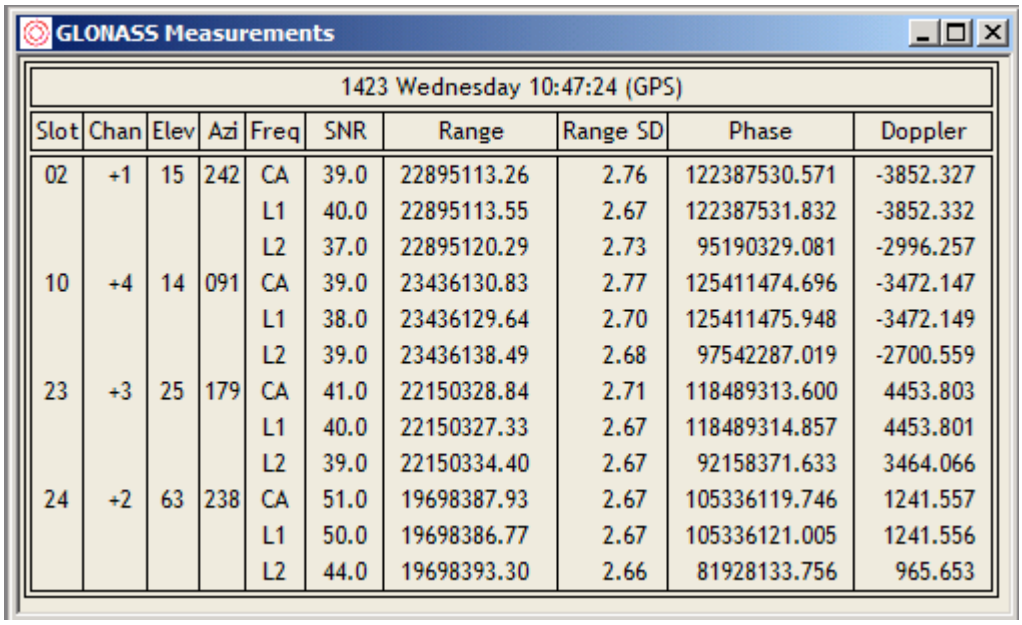
E_n	"age" of the immediate information. The time interval elapsed since the instant of its calculation (uploading) until the instant t_b for n^{th} satellite. This word is generated on board the satellite
τ_c	GLONASS time scale correction to UTC(SU) time
τ	correction of satellite clock vs. GLONASS time
γ	relative deviation of predicted carrier frequency value of n^{th} satellite from nominal value at the instant t_b
B_n	health flag. The equipment analyzes only one MSB of this word. 1 indicates malfunction of given satellite. The equipment does not consider the second or third bits of this word
P1	flag indicates time interval between two adjacent values of t_b (minutes) in both current and previous frames
P2	flag indicates oddness ("1") or evenness ("0") of the value of t_b (for intervals of 30 or 60 minutes)
P3	flag indicates number of satellites with almanac transmission within given frame. 1 indicates five satellites, 0 corresponds to four.
P4	flag indicating ephemeris parameters are present. "1" indicates updated ephemeris or frequency/time parameters have been uploaded by the control segment

D.6 GLONASS CCF

The GLONASS CCF view and its options are similar to that of GPS. See section B.3. The GLONASS slot numbers are used to identify the individual GLONASS satellites.

D.7 GLONASS MEASUREMENTS

This view displays information about the GLONASS measurements received and decoded by Verify QC. The top row shows the GPS/GLONASS receiver date and time expressed by the GPS week number, the day and GPS Time.



GLONASS Measurements View

GLONASS Measurement Data

Slot	Shows the dedicated satellite number as assigned to the satellites orbital path.
Chan	Indicates the increment or decrement of the satellite transmitting frequency from the F1 frequency.
Elev	Elevation angle measured in degrees of the satellite above the horizon at the user's location.
Azi	Azimuth is the horizontal angle measured in degrees from the north direction to the direction of the satellite relative to the user's location.
Freq	Frequency refers to: - • C/A - range measurement derived from the Coarse Acquisition Code on the L1 frequency • L1 - range measurement derived from the carrier at the L1 frequency • L2 - range measurement derived from the carrier at the L2 frequency
SNR	Signal to Noise Ratio is a measure of the power of a received satellites carrier signal at the receiver. Signal strength is generally measured in dBHz but there are differences between the various receiver types. A low SNR is less than 30 dBHz whilst good SNR exceeds 40 dBHz.
Range	is the distance measured from the satellite to the user's antenna in metres?
Range SD	Range Standard Deviation is a statistical parameter of the range data measured in meters. The lower the standard deviation the higher the accuracy of the ranges.
Phase	is the range divided by the wavelength in metres?
Doppler	Doppler effect is the change of signal frequency as the transmitting source moves closer or further away from the receiver. The reading gives the difference between the transmitted carrier frequency at the satellite and the frequency received at the receiver. The Doppler measurement is used to calculate the user velocity.

D.8 STATION DATA

A single view per station is used to show the reference station information as contained in the correction messages. The view has a GPS section for the GPS range correction data in the Standard messages and a GLONASS section for the GLONASS range correction data in the GLONASS messages. Two separate sections show the received WGS84 and PZ-90 reference station coordinates.

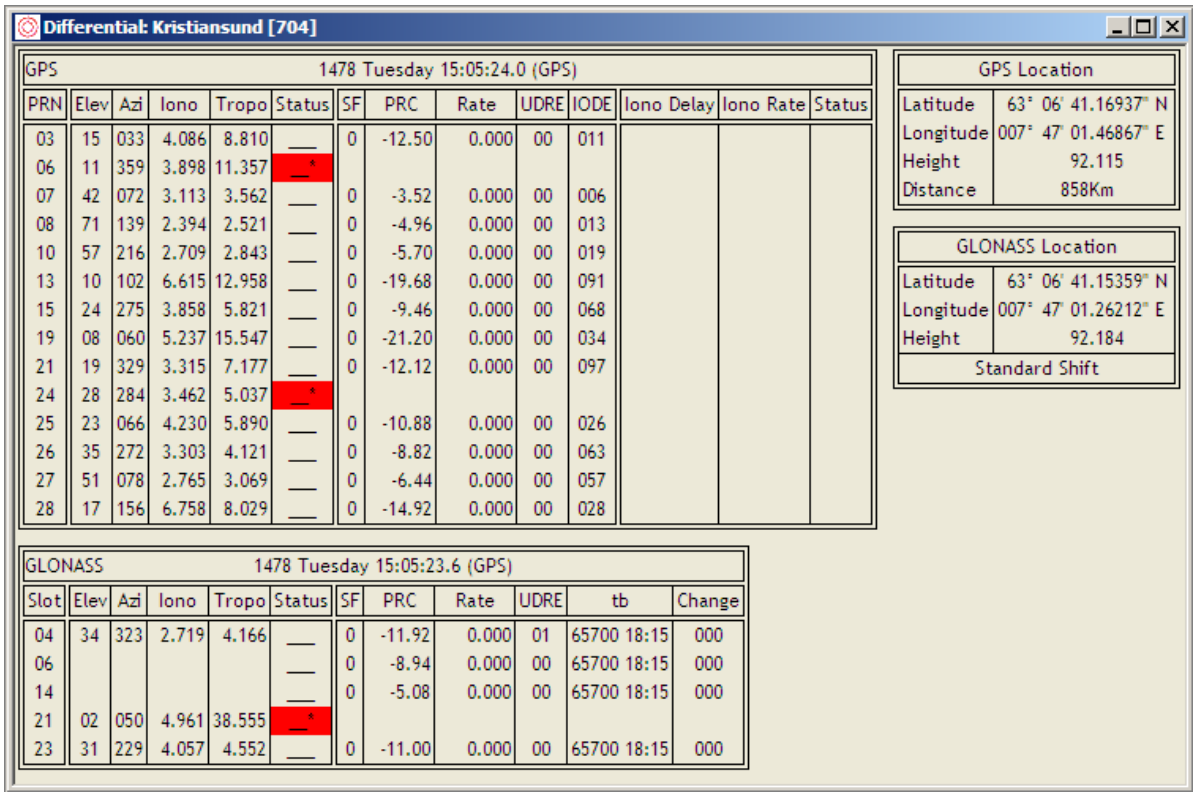


Figure 1 – Differential Data View

The reference station location is required to calculate the elevation and azimuth of the satellites at the reference station as well as their ionospheric and tropospheric model information. This information is obtained from the RTCM Type 3 message. The Type 3 is displayed in the *Location* box. If no Type 3 is received for a non-VERIPOS station it is assumed to be 'local', i.e. at the user's location.

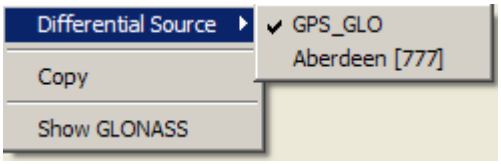
The *GLONASS Location* box displays the contents of the RTCM Type 32 message. It also includes information about the relationship between the Type 3 and the Type 32, i.e. the PZ-90 to WGS84 datum shift. The following shifts may be detected:

- Standard Shift (used by Topcon/Javad)
- RTCM Shift (published in RTCM v2.3)
- NovAtel Shift (used by NovAtel)
- No Shift
- Unknown Shift

If an unknown shift is detected the 3D residual after applying the Standard Shift is displayed in brackets.

Note: GLONASS users should carefully consider whether a non-VERIPOS reference station with an unknown datum shift should be incorporated in any of the position calculations in Verify QC.

Right clicking in the display allows the user to select a different reference station to be displayed. It is also possible to hide the GLONASS correction data.



Differential Data View Options

GPS Specific Differential Data

PRN	Pseudo Random Noise code is a unique identification number for each GPS satellite. For example, if a satellite is referred to as PRN 13, it is identified as the satellite that transmits the 13th weekly portion of the P code
IODE	The Issue of Data Ephemeris identifies the set of ephemeris parameters giving the user a means of detecting changes in these parameters
Iono Delay	The ionospheric delay (meters) is measured at the reference station
Iono Rate	is the rate of change of the Iono Delay measured at the reference station

GLONASS Specific Differential Data

Slot	The dedicated satellite number assigned to the satellites orbital path.
t_b	index of a time interval within current day according to UTC(SU) +03 hours 00 min
Change	Indicates whether the GLONASS ephemeris data has changed without a change in the t_b value

Common Differential Data

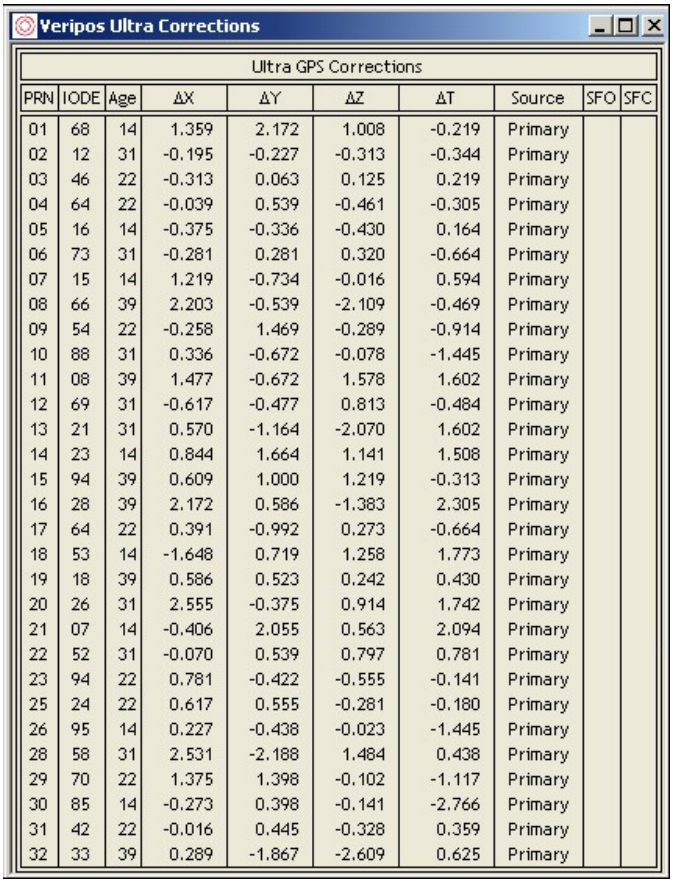
Elev	elevation angle measured in degrees of the satellite above the horizon at the reference station location
Azi	The horizontal angle measured in degrees from the north direction to the direction of the satellite relative to the reference station location
Iono	The delay in meters caused by the Ionosphere to the GPS/GLONASS signal from a particular satellite. This ionospheric delay value is derived from the Klobuchar model in the Almanac
Tropo	The delay in meters caused by the troposphere to the GPS/GLONASS signal from the satellite, at the reference station. This tropospheric delay value is derived using the Hopfield model defined within the software
SF	scale factor as a code equal to 0 or 1: - 0 = scale factor for pseudo range correction better than 0.02 meter and for range rate correction 0.002 meter/second 1 = scale factor for pseudo range correction better than 0.32 meter and for range rate correction 0.032 meter/second

PRC	Pseudo Range Correction as observed on the L1 pseudo-range at the reference station
Rate	Rate of Change, in meters, of the pseudo-range corrections
UDRE	User Differential Range Error is an estimate of the performance of the satellite pseudo-range as measured at the reference station in meters. This number is provided as part of the RTCM Type 1 and Type 31 messages in the form of a binary code 0 to 3: ▪ 0: ≤ 1 meter at 1 sigma ▪ 1: > 1 meter and ≤ 4 meter at 1 sigma ▪ 2: > 4 meter and ≤ 8 meter at 1 sigma ▪ 3: > 8 meter at 1 sigma

D.9 ULTRA CORRECTIONS

Ultra corrections are shown in the menus when an Ultra capable, dual frequency GNSS receiver card is selected.

The *View/Differential/Ultra Corrections* view displays the Ultra corrections received and decoded by Verify QC.



PRN	IODE	Age	ΔX	ΔY	ΔZ	ΔT	Source	SFO	SFC
01	68	14	1.359	2.172	1.008	-0.219	Primary		
02	12	31	-0.195	-0.227	-0.313	-0.344	Primary		
03	46	22	-0.313	0.063	0.125	0.219	Primary		
04	64	22	-0.039	0.539	-0.461	-0.305	Primary		
05	16	14	-0.375	-0.336	-0.430	0.164	Primary		
06	73	31	-0.281	0.281	0.320	-0.664	Primary		
07	15	14	1.219	-0.734	-0.016	0.594	Primary		
08	66	39	2.203	-0.539	-2.109	-0.469	Primary		
09	54	22	-0.258	1.469	-0.289	-0.914	Primary		
10	88	31	0.336	-0.672	-0.078	-1.445	Primary		
11	08	39	1.477	-0.672	1.578	1.602	Primary		
12	69	31	-0.617	-0.477	0.813	-0.484	Primary		
13	21	31	0.570	-1.164	-2.070	1.602	Primary		
14	23	14	0.844	1.664	1.141	1.508	Primary		
15	94	39	0.609	1.000	1.219	-0.313	Primary		
16	28	39	2.172	0.586	-1.383	2.305	Primary		
17	64	22	0.391	-0.992	0.273	-0.664	Primary		
18	53	14	-1.648	0.719	1.258	1.773	Primary		
19	18	39	0.586	0.523	0.242	0.430	Primary		
20	26	31	2.555	-0.375	0.914	1.742	Primary		
21	07	14	-0.406	2.055	0.563	2.094	Primary		
22	52	31	-0.070	0.539	0.797	0.781	Primary		
23	94	22	0.781	-0.422	-0.555	-0.141	Primary		
25	24	22	0.617	0.555	-0.281	-0.180	Primary		
26	95	14	0.227	-0.438	-0.023	-1.445	Primary		
28	58	31	2.531	-2.188	1.484	0.438	Primary		
29	70	22	1.375	1.398	-0.102	-1.117	Primary		
30	85	14	-0.273	0.398	-0.141	-2.766	Primary		
31	42	22	-0.016	0.445	-0.328	0.359	Primary		
32	33	39	0.289	-1.867	-2.609	0.625	Primary		

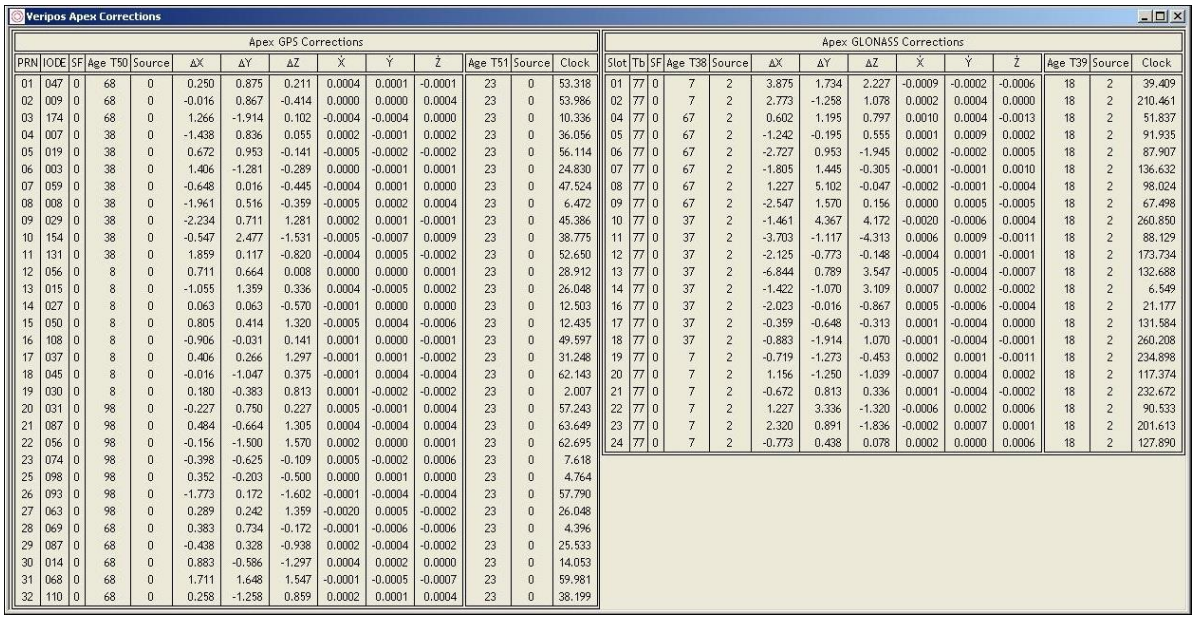
Ultra Corrections View

The Ultra correction information is listed by GPS PRN number. The headings in the table refer to: -

PRN	Pseudo Random Noise code. This is a unique identification number for each GPS satellite. For example, if a satellite is referred to as PRN 13, this refers to the satellite that transmits the 13th weekly portion of the P code
IODE	The Issue of Data Ephemeris identifies the set of ephemeris parameters and gives the user a means of detecting any change in these parameters
Age	The difference between the current time and time that the correction values were generated, in seconds
Delta X	GPS orbit correction to the ECEF X coordinate of the broadcast ephemeris, in metres
Delta Y	GPS orbit correction to the ECEF Y coordinate of the broadcast ephemeris, in metres
Delta Z	GPS orbit correction to the ECEF Z coordinate of the broadcast ephemeris, in metres
Delta T	GPS clock correction relative to the GPS broadcast clock, in metres
Source	Reference to the source of the Ultra corrections within the Veripos data network, i.e. Primary or Secondary. A transition between sources is managed within the Ultra algorithms
SFO	Scale Factor - Orbits
SFC	Scale Factor - Clocks

D.10 APEX CORRECTIONS

The *View/Differential/Apex Corrections* view displays the Apex corrections received and decoded by Verify QC.



PRN	IODE	SF	Age T50	Source	ΔX	ΔY	ΔZ	Ẋ	Ẏ	Ż	Age T51	Source	Clock
01	047	0	68	0	0.250	0.875	0.211	0.0004	0.0001	-0.0001	23	0	53.318
02	009	0	68	0	-0.016	0.867	-0.414	0.0000	0.0000	0.0004	23	0	53.986
03	174	0	68	0	1.266	-1.914	0.102	-0.0004	-0.0004	0.0000	23	0	10.336
04	007	0	38	0	-1.438	0.836	0.055	0.0002	-0.0001	0.0002	23	0	36.056
05	019	0	38	0	0.672	0.953	-0.141	-0.0005	-0.0002	-0.0002	23	0	56.114
06	003	0	38	0	1.406	-1.281	-0.289	0.0000	-0.0001	0.0001	23	0	24.830
07	059	0	38	0	-0.648	0.016	-0.445	-0.0004	0.0001	0.0000	23	0	47.524
08	008	0	38	0	-1.961	0.516	-0.359	-0.0005	0.0002	0.0004	23	0	6.472
09	029	0	38	0	-2.234	0.711	1.281	0.0002	0.0001	-0.0001	23	0	45.386
10	154	0	38	0	-0.547	2.477	-1.531	-0.0005	-0.0007	0.0009	23	0	38.775
11	131	0	38	0	1.859	0.117	-0.820	-0.0004	0.0005	-0.0002	23	0	52.650
12	056	0	8	0	0.711	0.664	0.008	0.0000	0.0000	0.0001	23	0	28.912
13	015	0	8	0	-1.055	1.359	0.336	0.0004	-0.0005	0.0002	23	0	26.048
14	027	0	8	0	0.063	0.063	-0.570	-0.0001	0.0000	0.0000	23	0	12.503
15	050	0	8	0	0.805	0.414	1.320	-0.0005	0.0004	-0.0006	23	0	12.435
16	108	0	8	0	-0.906	-0.031	0.141	0.0001	0.0000	-0.0001	23	0	49.597
17	037	0	8	0	0.406	0.266	1.297	-0.0001	0.0001	-0.0002	23	0	31.248
18	045	0	8	0	-0.016	-1.047	0.375	-0.0001	0.0004	-0.0004	23	0	62.143
19	030	0	8	0	0.180	-0.383	0.813	0.0001	-0.0002	-0.0002	23	0	2.007
20	031	0	98	0	-0.227	0.750	0.227	0.0005	-0.0001	0.0004	23	0	57.243
21	087	0	98	0	0.484	-0.664	1.305	0.0004	-0.0004	0.0004	23	0	63.649
22	056	0	98	0	-0.156	-1.500	1.570	0.0002	0.0000	0.0001	23	0	62.695
23	074	0	98	0	-0.398	-0.625	-0.109	0.0005	-0.0002	0.0006	23	0	7.618
25	098	0	98	0	0.352	-0.203	-0.500	0.0000	0.0001	0.0000	23	0	4.764
26	093	0	98	0	-1.773	0.172	-1.602	-0.0001	-0.0004	-0.0004	23	0	57.790
27	063	0	98	0	0.289	0.242	1.359	-0.0020	0.0005	-0.0002	23	0	26.048
28	069	0	68	0	0.383	0.734	-0.172	-0.0001	-0.0006	-0.0006	23	0	4.396
29	087	0	68	0	-0.438	0.328	-0.938	0.0002	-0.0004	-0.0002	23	0	25.533
30	014	0	68	0	0.883	-0.586	-1.297	0.0004	0.0002	0.0000	23	0	14.053
31	068	0	68	0	1.711	1.648	1.547	-0.0001	-0.0005	-0.0007	23	0	59.981
32	110	0	68	0	0.258	-1.258	0.859	0.0002	0.0001	0.0004	23	0	38.199

Slot	Tb	SF	Age T38	Source	ΔX	ΔY	ΔZ	Ẋ	Ẏ	Ż	Age T39	Source	Clock
01	77	0	7	2	3.875	1.734	2.227	-0.0009	-0.0002	-0.0006	18	2	39.409
02	77	0	7	2	2.773	-1.258	1.078	0.0002	0.0004	0.0000	18	2	210.461
04	77	0	67	2	0.602	1.195	0.797	0.0010	0.0004	-0.0013	18	2	51.837
05	77	0	67	2	-1.242	-0.195	0.555	0.0001	0.0009	0.0002	18	2	91.935
06	77	0	67	2	-2.727	0.953	-1.945	0.0002	-0.0002	0.0005	18	2	87.907
07	77	0	67	2	-1.805	1.445	-0.305	-0.0001	-0.0001	0.0010	18	2	136.632
08	77	0	67	2	1.227	5.102	-0.047	-0.0002	-0.0001	-0.0004	18	2	98.024
09	77	0	67	2	-2.547	1.570	0.156	0.0000	0.0005	-0.0005	18	2	67.498
10	77	0	37	2	-1.461	4.367	4.172	-0.0020	-0.0006	0.0004	18	2	260.850
11	77	0	37	2	-3.703	-1.117	-4.313	0.0006	0.0009	-0.0011	18	2	88.129
12	77	0	37	2	-2.125	-0.773	-0.148	-0.0004	0.0001	-0.0001	18	2	173.734
13	77	0	37	2	-6.844	0.789	3.547	-0.0005	-0.0004	-0.0007	18	2	132.688
14	77	0	37	2	-1.422	-1.070	3.109	0.0007	0.0002	-0.0002	18	2	6.549
16	77	0	37	2	-2.023	-0.016	-0.867	0.0005	-0.0006	-0.0004	18	2	21.177
17	77	0	37	2	-0.359	-0.648	-0.313	0.0001	-0.0004	0.0000	18	2	131.584
18	77	0	37	2	-0.883	-1.914	1.070	-0.0001	-0.0004	-0.0001	18	2	260.208
19	77	0	7	2	-0.719	-1.273	-0.453	0.0002	0.0001	-0.0011	18	2	234.898
20	77	0	7	2	1.156	-1.250	-1.039	-0.0007	0.0004	0.0002	18	2	117.374
21	77	0	7	2	-0.672	0.813	0.336	0.0001	-0.0004	-0.0002	18	2	232.672
22	77	0	7	2	1.227	3.336	-1.320	-0.0006	0.0002	0.0006	18	2	90.533
23	77	0	7	2	2.320	0.891	-1.836	-0.0002	0.0007	0.0001	18	2	201.613
24	77	0	7	2	-0.773	0.438	0.078	0.0002	0.0000	0.0006	18	2	127.890

Apex Corrections View

GPS

The Apex correction information is listed by GPS PRN number. The headings in the table refer to: -

PRN	Pseudo Random Noise code. This is a unique identification number for each GPS satellite. For example, if a satellite is referred to as PRN 13, this refers to the satellite that transmits the 13th weekly portion of the P code
IODE	The Issue of Data Ephemeris identifies the set of ephemeris parameters and gives the user a means of detecting any change in these parameters
SF	Scale Factor, 0 or 1. The orbit corrections have a lower numerical resolution when the scale factor is 1.
Age T50	The age of the GPS orbit correction, i.e. the difference between the current time and time that the correction values were generated, in seconds
Source	Reference to the source (processing centre) of the Apex corrections within the Veripos data network, i.e. 0-3. A transition between sources is managed within the Apex algorithms
ΔX	GPS orbit correction to the ECEF X coordinate of the broadcast ephemeris, in metres
ΔY	GPS orbit correction to the ECEF Y coordinate of the broadcast ephemeris, in metres
ΔZ	GPS orbit correction to the ECEF Z coordinate of the broadcast ephemeris, in metres
$\dot{X}$	Rate of Change of the GPS orbit ECEF X coordinate correction
$\dot{Y}$	Rate of Change of the GPS orbit ECEF Y coordinate correction
$\dot{Z}$	Rate of Change of the GPS orbit ECEF Z coordinate correction
Age T51	The age of the GPS clock correction, i.e. the difference between the current time and time that the correction values were generated, in seconds
Source	Reference to the source (processing centre) of the Apex corrections within the Veripos data network, i.e. 0-3. A transition between sources is managed within the Apex algorithms
Clock	The clock correction value relative to a proprietary reference, in metres

GLONASS

The Apex correction information is listed by Glonass Slot number. The headings in the table refer to: -

Slot	Identifies the GLONASS satellite slot number
Tb	Tb value in seconds divided by 900. Tb value is the index of a time interval within current day according to UTC(SU) +03 hours 00 min
SF	Scale Factor, 0 or 1. The orbit corrections have a lower numerical resolution when the scale factor is 1.
Age T38	The age of the GLONASS orbit correction, i.e. the difference between the current time and time that the correction values were generated, in seconds
Source	Reference to the source (processing centre) of the Apex corrections within the Veripos data network, i.e. 0-3. A transition between sources is managed within the Apex algorithms
ΔX	GLONASS orbit correction to the ECEF X coordinate of the broadcast ephemeris, in metres
ΔY	GLONASS orbit correction to the ECEF Y coordinate of the broadcast ephemeris, in metres
ΔZ	GLONASS orbit correction to the ECEF Z coordinate of the broadcast ephemeris, in metres
$\dot{X}$	Rate of Change of the GLONASS orbit ECEF X coordinate correction
$\dot{Y}$	Rate of Change of the GLONASS orbit ECEF Y coordinate correction

$\dot{Z}$	Rate of Change of the GLONASS orbit ECEF Z coordinate correction
Age T39	The age of the GLONASS clock correction, i.e. the difference between the current time and time that the correction values were generated, in seconds
Source	Reference to the source (processing centre) of the Apex corrections within the Veripos data network, i.e. 0-3. A transition between sources is managed within the Apex algorithms
Clock	The clock correction value relative to a proprietary reference, in metres

E QUALITY STANDARDS

A number of standards offer marine satellite navigation system users DGNSS (DGPS/DGPS+DGLONASS) quality information. The most well known and frequently referred to standards are:

1. UKOOA
2. NMEA-0183

Each standard is explained in more detail in the following sections.

NMEA have recently introduced the NMEA-2000 interface standard. This standard falls outside the scope of this document. See www.nmea.org for further information.

References

[1] Guidelines for the use of Differential GPS in offshore surveying, UKOOA, 1994

[2] NMEA 0183 Standard for interfacing marine electronic devices, version 3.01, January 1, 2002

E.1 UKOOA STANDARD

The UK Offshore Operator Association (UKOOA) issued 'Guidelines for the use of Differential GPS in offshore surveying' in 1994. These guidelines set out what is generally regarded as good practise in the offshore industry. They are not mandatory and operators are free to adopt different guidelines or standards.

These guidelines are now dated in certain areas due to advancements in positioning technology and algorithms. However, they contain useful suggestions for quality monitoring as indicated below [see 1]: -

> *"To assist DGPS operators and client representatives to monitor the quality of the DGPS system in real-time the following information should be continuously available:*
> - *Pseudo-range residuals of all SV's and observation weight values used*
> - *Unit variance*
> - *Number of satellites in view and number used in solution*
> - *Redundancy of least squares solution*
> - *DOP values (HDOP, PDOP and VDOP)*
> - *Latency of differential correction data*
> - *Position comparisons derived from different reference stations*
> - *Derived antenna height with respect to "known" height*
> - *Monitor station information, especially position error measured at the monitor station. All data should be time tagged*
> - *Maximum external reliability figure and observation carrying it"*

The UKOOA guidelines present a set of test statistics and quality measures recommended for use with DGPS. In its final recommendations [see 1] it states: -

"It is essential to assess the precision and reliability of each position in order to ensure the quality of the DGPS measurements. Thus is recommends that the following processing steps be implemented: -

- *w-test for outliers carried out for each position fix*
- *F-test for unit variance carried out for each position fix*
- *When no more outliers are identified in any fix, precision and reliability measures will be calculated:*
  - *Precision: a-posteriori error ellipse*
  - *Reliability: external reliability (positional MDE using a power of test of 80%)"*

Where accuracy and precision statistical parameters are generated these all represent a 95% (2σ) confidence region.

Appendix A of the UKOOA guidelines emphasises this by listing 'Suggested parameters to be specified by a system user for typical marine survey operations' and states that 'In order to carry out rigorous QC, the covariance matrix generated by the least squares computation should be used to generate test statistics and quality measures'.

It recommends the following Test Statistics:

1. w-test — used to detect outliers
2. F-test — used to verify the model which is being used to account for 'errors' in the DGPS observations

It recommends also the following Quality Measures:

1. Error Ellipse — an approximate graphical representation of the positional standard deviation in two dimensions
2. External Reliability — the effect of the maximum MDE (Marginally Detectable Error) on the computed position

These recommendations are particularly aimed at survey applications but could be applied equally to DP applications.

E.2 NMEA-0183 STANDARD

The National Marine Electronics Association (NMEA) has developed a specification defining the interface between various pieces of marine electronic equipment. The standard permits marine electronics to send information to computers and to other marine equipment via a serial interface. A full copy of this standard is available for purchase at their web site (www.nmea.org). The current version of the standard is 3.01.

GPS receiver communication is defined within this specification. The idea of NMEA is to send a line of data called a sentence that is totally self contained and independent from other sentences. There are standard sentences for each device category and in addition NMEA permits hardware manufactures to define their own proprietary sentences for whatever purpose they see fit. All standard sentences have a two letter prefix defining the device using that sentence type. For GPS receivers the prefix is GP followed by a three letter sequence defining the sentence contents. All proprietary sentences begin with the letter P and are followed with 3 letters identifying the manufacturer controlling that sentence.

NMEA consists of sentences, the first word of which, called a data type, defines the interpretation of the rest of the sentence. Each data type has its own unique interpretation and is defined in the NMEA standard. Each sentence begins with a '$' and ends with a carriage return/line feed sequence no longer than 80 characters of visible text (plus the line terminators). The data is contained within this single line with data items separated by commas. The data itself is ASCII text and may extend over multiple sentences in certain specialized instances but is normally fully contained in one variable length sentence. The data may vary in the amount of precision contained in the sentence. For example time might be indicated to decimal parts of a second or location may be shown with 3 or even 5 digits after the decimal point. Programs reading the data should only use the commas to determine the field boundaries and not depend on column positions. There is a provision for a checksum at the end of each sentence which may or may not be checked by the unit reading the data. The checksum field consists of a '*' and two hex digits representing the exclusive OR of all characters between, but not including, the '$' and '*'. A checksum is required on some sentences.

There have been several changes to the standard but for GPS use the only ones that are likely to be encountered are 1.5 and 2.0 through 2.3. Version 2.3 added a mode indicator to several sentences used to indicate the kind of fix the receiver currently has. The value can be A=autonomous, D=differential, E=Estimated, N=not valid, S=Simulator. Sometimes there can be a null value as well. Only the A and D values correspond to an active and reliable sentence. This mode character has been added to the RMC, RMB, VTG, and GLL, sentences and optionally some others including the BWC and XTE sentences.

The hardware interface for GPS receivers is designed to meet the NMEA requirements. They are compatible also with most computer serial ports using RS232 protocols, however strictly speaking the NMEA standard is not RS232. They recommend conformance to EIA-422. The interface speed generally can be adjusted but the NMEA standard is 4800 baud with 8 bits of data, no parity, and one stop bit. All GPS receivers supporting NMEA should support this speed. Note that, at a baud rate of 4800, you can easily send enough data to more than fill a full second of time.

At 4800 baud 480 characters per second can be sent. As an NMEA sentence can be as long as 82 characters this can be limited to less than six different sentences. The actual

limit is determined by the specific sentences used and it is easy to overrun the capabilities for rapid sentence response.

A cable is required to connect to the GPS receiver output. Data can be output also via Ethernet or wireless connection. For general NMEA use with a GPS receiver only two wires are required in the cable, data out from the GPS receiver and ground.

F VERIFY QC OUTPUTS

Verify QC can output the following NMEA sentences (see [2]):

- GGA (Default)
- GGA (PPP)
- GGA (DP)
- GGA (Alstom)
- GLL
- GST
- ZDA
- GNS
- VTG (Default)
- VTG (Old)
- GSA
- GSV

In addition Verify QC can output the following advanced positioning and QC output sentences:

- WesternGeco TRINAV (see [4])
- WesternGeco TRINAV V3 (see [5])
- VERIPOS UKOOA Output (see [6])
- VERIPOS UKOOA 2 Output (see [7])
- GPLCT
- Veripos Applications – Axiom **(For output to VERIPOS Axiom software only)**

References

[2] NMEA 0183 Standard for interfacing marine electronic devices, version 3.01, January 1, 2002

[4] GPS and RTCM Formats, Schlumberger, 2002

[5] Third Party Equipment GPS Interface Format, WesternGeco, 23 February 2009

[6] Document AB-R-MD-01673. Data Format Definition, UKOOA Format, 03 October 2005

[7] Document AB-V-MD-00511. Data Format Definition, UKOOA 2 Format, 30 June 2006

F.1 NMEA SENTENCES

This section describes the message structure of the following advanced positioning and QC output messages: -

- GGA
- GLL
- GST
- ZDA
- GNS
- VTG
- GSA
- GSV – GSV

NMEA GGA Sentence

The NMEA GGA sentence contains time and position fix related data for a GPS system. It includes basic quality information, which is limited to 'Fix Quality', 'Number of Satellites in Use', 'HDOP' and 'Age of Differential GPS Data'.

Structure and Example: -

$GPGGA,hhmmss.ss,ddmm.mmmmmmm,a,dddmm.mmmmmmm,b,Q,s,p.p,h.h,M,g.g,M,x.x,nnnn*c<CR><LF>
$GPGGA,150207.00,5708.7100972,N,00217.1170486,W,2,10,0.9,137.44,M,50.72,M,6.4,0704*57

GGA sentence defined: -

GGA	Global Positioning System Fix Data
hhmmss.ss	UTC of position
ddmm.mmmmmmm	latitude of position
a	N or S, latitude hemisphere
dddmm.mmmmmmm	longitude of position
b	E or W, longitude hemisphere
Q	GPS Quality indicator (0 = invalid, 1 = GPS SPS, 2 = DGPS fix, 3 = GPS PPS, 4 = Fixed RTK, 5 = Float RTK, 6 = Estimated (dead reckoning), 7 = Manual Input Mode, 8 = Simulation Mode)
s	number of satellites in use
p.p	horizontal dilution of precision
h.h	antenna altitude above mean-sea-level
M	units of antenna altitude, meters
g.g	Geoidal height
M	units of geoidal height, meters
x.x	age of differential GPS data
nnnn	Differential reference station ID, 0000 to 1023
*c<CR><LF>	checksum, carriage return and line feed

Verify QC supports 4 variations of the NMEA GGA. These variations are: -

- GGA (Default) number of SV's can exceed 12 and sentence length can exceed 82 characters. Increased precision (7 decimals for Lat & Lon)
- GGA-DP fully NMEA-0183 compatible string. Number of SV's is limited to 12 and the sentence length is restricted to 82 characters

- GGA-Alstom — number of SV's is limited to 12 and the sentence length can exceed 82 characters. The latency value equals the actual latency divided by 12 for DGNSS solutions and divided by 36 for the Ultra or Apex solution
- GGA-PPP — number of SV's can exceed 12 and sentence length can exceed 82 characters. The DGPS QI parameter offers the full range from 0-9. It will show 5 for an Apex or Ultra solution and 2 for a DGPS solution. Increased precision (7 decimals for Lat & Lon)

NMEA GLL Sentence

The NMEA GGL sentence provides 2D position data.

Structure and Example:

$GPGLL,ddmm.mmmmmmm ,a, dddmm.mmmmmmm ,b,hhmmss.ss,S,I*cc<CR><LF>
$GPGLL,5708.7104685,N,00217.1169613,W,062859.00,A,D*72

GLL sentence defined:

GLL = Geographic position - Latitude and Longitude

ddmm.mmmmmmm	latitude of position
a	N or S
dddmm.mmmmmmm	longitude of position
b	E or W
hhmmss.ss	UTC of position
S	status (A = data valid ; V = data not valid)
I	mode indicator (A = Autonomous, D = Differential, E = Estimated, M = Manual, S = Simulator, N = data Not valid)
*cc<CR><LF>	checksum, carriage return and line feed

NMEA GST Sentence

The NMEA GST sentence provides error statistics of the position fix. These statistics follow from the position calculation process.

Structure and Example:

$GPGST,hhmmss.ss,a.aa,b.bb,c.cc,ddd.dd,e.ee,f.ff,g.gg*hh<CR><LF>
$GPGST,024603.00,3.2,6.6,4.7,47.3,5.8,5.6,22.0*58

GST sentence defined:

GST = GNSS Pseudo-range Error Statistics

hhmmss.ss	UTC time in hours, minutes, seconds of the GPS position
a.aa	RMS value of the standard deviation of the range inputs to the navigation process. Range inputs include pseudo-ranges and differential DGNSS corrections
b.bb	Standard deviation of semi-major axis of error ellipse (meters)
c.cc	Standard deviation of semi-minor axis of error ellipse (meters)
ddd.dd	Orientation of semi-major axis of error ellipse (degrees)
e.ee	Standard deviation of latitude error (meters)
f.ff	Standard deviation of longitude error (meters)
g.gg	Standard deviation of altitude error (meters)
*hh<CR><LF>	checksum, carriage return and line feed

NMEA ZDA Sentence

The NMEA ZDA sentence provides time and time zone information.

Structure and Example:

```
$GPZDA,hhmmss.ss,dd,mm,yyyy,xx,yy*hh<CR><LF>
$GPZDA,201530.00,04,07,2002,00,00*6E
```

ZDA sentence defined:

ZDA = Time & Date	
hhmmss.ss	UTC time in hours, minutes, seconds of the GPS position
dd,mm,yyyy	Day,Month,Year (UTC)
xx	local zone hours (00 to +/-13 hrs)
yy	local zone minutes (00 to 59)
*hh<CR><LF>	checksum, carriage return and line feed

NMEA GNS Sentence

The NMEA GNS sentence contains time and position fix related data for a single or combined satellite navigation system. Separate $GPGNS and $GLGNS sentences are used to report data calculated from individual systems if a combined GPS+GLONASS position is output. A single string will be output if no GLONASS data is in use.

Structure and Example:

```
$GPGNS,hhmmss.ss,ddmm.mmmmmmmm,a,dddmm.mmmmmmmm,b,Q,ss,p.p,h.h,g.g,l.l,nnnn*cc<CR><LF>
$GNGNS,104601.00,5707.7332018,N,00204.7778500,W,DD,12,0.71,24.743,50.284,,*45
$GPGNS,104601.00,,,,,,09,,,,3.0,0001*44
$GLGNS,104601.00,,,,,,03,,,,3.4,0001*56
```

GNS sentence defined:

GNS = GNSS Fix Data	
hhmmss.ss	UTC of position
ddmm.mmmmmmm	latitude of position
a	N or S, latitude hemisphere
dddmm.mmmmmmm	longitude of position
b	E or W, longitude hemisphere
Q	Mode Indicator. First character is for the GPS system, the second character for the GLONASS system. (N = No Fix, A = Autonomous, D = Differential, P = Precise, R = Real Time Kinematic, F = Float RTK, E = Estimated, M = Manual Input Mode, S = Simulation Mode)
ss	number of satellites in use
p.p	horizontal dilution of precision
h.h	antenna altitude above mean-sea-level
g.g	Geoidal height
l.l	age of differential GPS data
nnnn	Differential reference station ID, 0000 to 1023
*cc<CR><LF>	checksum, carriage return and line feed

NMEA VTG Sentence

The NMEA VTG sentence provides the actual course and speed relative to the ground.

Structure and Example:

$GPVTG,p.p,T,q.q,M,r.r,N,s.s,K,u*hh<CR><LF>
$GPVTG,054.7,T,034.4,M,005.5,N,010.2,K*33

VTG sentence defined:

VTG = Course over ground and ground speed

p.p	course over ground
T	degrees True
q.q	course over ground
M	degrees Magnetic
r.r	speed over ground
N	knots
s.s	speed over ground
K	km/hr
U	mode indicator (A = Autonomous, D = Differential, E = Estimated)
*hh<CR><LF>	checksum, carriage return and line feed

Verify QC supports 2 variations of the NMEA VTG sentence. These variations are:

- VTG (Default) conforms to NMEA v3.0 standard and includes the mode indicator
- VTG (Old) conforms to previous NMEA standards and does not include the mode indicator

NMEA GSA Sentence

The NMEA GSA sentence contains the GNSS DOP and satellites used in the solution. If only GPS SVs are used in the calculation the talker ID will be GP. If only Glonass SVs are used in the calculation the Talker ID will be GL. If the GPS and Glonass SVs are used in a combined solution the talker ID will be GN and multiple GSA sentences are produced.

Structure and Example:

$--GSA,a,n,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,pp.p,hh.h,vv.v*c<CR><LF>
$GNGSA,A,3,02,04,05,07,08,10,13,16,23,29,,,1.1,0.6,0.9*21
$GNGSA,A,3,68,69,70,78,79,80,85,86,,,,,1.1,0.6,0.9*2F
GSA sentence defined: -

GSA = GNSS DOP and Active Satellites

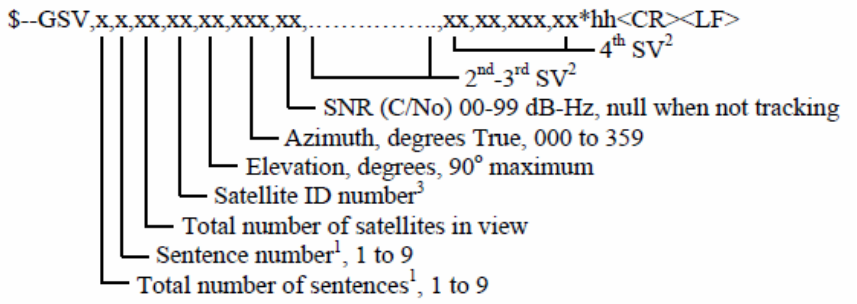
a	Mode M = Manual, forced to operate in 2D or 3D mode A = Automatic, allowed to automatically switch 2D/3D
n	Mode: 1 = Fix not available, 2 = 2D, 3 = 3D
xx (x12)	ID numbers of satellites used in solution, up to the first 12 ID's
pp.p	PDOP
hh.h	HDOP
v.vv	VDOP
*c<CR><LF>	checksum, carriage return and line feed

NMEA GSV Sentence

GNSS Satellites In View

Number of satellites (SV) in view, satellite ID numbers, elevation, azimuth, and SNR value. Four
satellites maximum per transmission. Total number of sentences being transmitted and the number of the sentence being transmitted are indicated in the first two fields.

If multiple GPS, GLONASS, etc. satellites are in view, use separate GSV sentences with talker ID GP to show the GPS satellites in view and talker GL to show the GLONASS satellites in view, etc. The GN identifier shall not be used with this sentence.



Notes:

1) Satellite information may require the transmission of multiple sentences all containing identical field formats when sending a complete message. The first field specifies the total number of sentences, minimum value 1.

The second field identifies the order of this sentence (sentence number), minimum value 1. For efficiency it is recommended that null fields be used in the additional sentences when the data is unchanged from the first sentence.

2) A variable number of "Satellite ID-Elevation-Azimuth-SNR" sets are allowed up to a maximum of four sets per sentence. Null fields are not required for unused sets when less than four sets are transmitted.

3) Satellite ID numbers. To avoid possible confusion caused by repetition of satellite ID numbers when using multiple satellite systems, the following convention has been adopted:

a) GPS satellites are identified by their PRN numbers, which range from 1 to 32.
b) The numbers 33-64 are reserved for WAAS satellites. The WAAS system PRN numbers are 120-138. The offset from NMEA WAAS SV ID to WAAS PRN number is 87. A WAAS PRN number of 120 minus 87 yields the SV ID of 33. The addition of 87 to the SV ID yields the WAAS PRN number.
c) The numbers 65-96 are reserved for GLONASS satellites. GLONASS satellites are identified by 64+satellite slot number. The slot numbers are 1 through 24 for the full GLONASS constellation of 24 satellites, this gives a range of 65 through 88. The numbers 89 through 96 are available if slot numbers above 24 are allocated to on-orbit spares.

ADVANCED POSITIONING AND QC SENTENCES

This section describes the message structure of the following advanced positioning and QC output messages: -

- WesternGeco TRINAV
- WesternGeco TRINAV v3
- VERIPOS UKOOA Output
- VERIPOS UKOOA 2 Output
- GPLCT
- Veripos Applications – Axiom

In order to provide the necessary outputs, VERIPOS have designed two proprietary formats containing information relative to position information and statistical measure as recommended by UKOOA. The VERIPOS UKOOA and VERIPOS UKOOA 2 outputs are in line with the recommendations used within the UKOOA standard.

The primary objective of the formats is to provide an output containing all the main proprietary advanced positioning and QC information used by the majority of navigation systems and DP systems within industry.

The formats allow the transfer of enough information to produce statistical testing when required and contain the positioning and QC information required by navigational systems. The VERIPOS formats contain also extra information unique to the VERIPOS system.

The format is variable in length as it includes the number of satellites and the PRN numbers of the satellites used in the calculation. Additionally, the number of reference stations used and their ID's are included. As these fields change, length of the message changes also. To assist with integration to the other systems, the variable fields are included at the end of the message and the length of the message is included at the start.

WesternGeco TRINAV Sentence

Example:

[0102 1 Verify108 501 486140.0 2.0 23 56.73661N 096 17.34229W -4.2 0.8 1.6 1.28 0.06 0.00 0.06 0.48 0.3 3 10 3 2 10 12 15 18 21 24 26 29 30501502503]

WesternGeco TRINAV sentence defined:

Content	Format	Field	Unit	Comments
Start Character	A1	1……1	-	= [(Open string)
Record Identifier	I2	2…….3	-	= 01
Format Version	I2	4……5	-	= 02 for this version
Nav. Point No.	I2	6……7	-	See comment 1
System Name/Version	A10	8……17	-	See comment 2
GPS Week Number	I4	18…..21	-	GPS Week no. since 21/08/99
GPS Time of Fix	F9.1	18.....30	sec	Seconds into GPS week (GPS Time).
Age of Fix	F4.1	31.....34	sec	See comment 3
Latitude	A13	35.....47	dm	^dd^mm.mmmmmN (^=space)
Longitude	A14	48…..61	dm	^dd^mm.mmmmmE (^=space)
Height	F5.1	62…..66	m	Antenna height above WGS84 ellipsoid. See comment 4
HDOP	F5.1	67.....71	-	
VDOP	F5.1	72.....76	-	
Unit Variance	F6.3	77.....82	-	
Variance Latitude	F6.3	83.....88	m²	See comment 5
Covariance Lat/Long	F6.3	89.....94	m²	See comment 5
Variance Long.	F6.3	95.....100	m²	See comment 5
Variance Height	F6.3	101…106	m²	See comment 5
External Reliability	F6.1	107…112	m	See comment 6
Fix Status	I2	113…114	-	See comment 7
No. of Satellites (n)	I3	115…117	-	No. of satellites used for this fix
No. of Ref. Stations (r)	I3	118…120	-	No. of ref. stations used for this fix. See Comment 8
PRN's of sats. used	I3*n	Variable	-	Satellites used for this fix
Idents of ref. stations	I3*r	Variable	-	Reference stations used for this fix
End Character	A1		-	Close string
CRLF	A2			

Comments:

1. The "Nav point no." is a unique integer identifying the position. It should be input manually to the software according to requests from Navigations System operators. Alternatively it should start from 1 and be incremented if several positions are output from the same system.
2. The system name should identify the system (or contractor) and software
3. The "Age of fix" is the time of the first character of the data string being output to WesternGeco's positioning system minus the time of position
4. WGS84 ellipsoid and datum must be used. The height must be antenna height above the WGS84 ellipsoid
5. The Variance and Covariance terms are elements from the variance-covariance matrix of the position fix computation (un-scaled)
6. The External Reliability is the maximum positional effect of an undetectable error in an observation. This quantity is related to the Power of the test (probability that the MDE would be detected) and the Significance level used.
    a. The values recommended by UKOOA should be used (see UKOOA Guidelines for The use of Differential GPS in offshore surveying, Issue no. 1, Sept. 1994) i.e. a Significance level of test 1% and the Power of the test 80%
    b. If values other than those given above are used, this must be explicitly stated by the contractor
    c. If no statistical testing takes place in the software, or the value is not computed, the external reliability must be set to -1
7. Fix status codes:

Single Frequency	
Status Code	**Meaning**
0	No or Bad Fixes
1	Altitude Aiding (Weighted Height used in Fix)
2	Altitude hold (2D Fix)
3	3D Fix
Dual Frequency (4 is added to the above values when positioning is set-up for dual frequency calculations)	
Status Code	**Meaning**
4	No or Bad Fix
5	Altitude Aiding (Weighted Height used in Fix)
6	Altitude hold (2D Fix)
7	3D Fix

8. "No. of ref. stations" gives the number of reference stations in use for this fix, not the number of stations available. This field must be set to 0 if the fix is not differential. If numerical data is missing or can not be computed, the value must be set to -1.

Field Formats:

Ax	Alphanumeric text
Ix	Integer Field
Fx.y	Floating point field

Where:

x	gives the total length including the decimal point and decimals
y	the number of decimals

If a sign (+ or -) is included in the field, the sign must be immediately adjacent to the number it relates to with no spaces in between i.e. -3.12

Alphanumeric text fields must be left justified, and numeric fields must be right justified.

The field sizes are selected with a space between each field. This aids manual readability and protects against overflow.

WesternGeco TRINAV V3 Sentence

The WesternGeco Third Party Equipment GPS Interface Format V3 was introduced on 23 February 2009. It describe a standard GPS interface format applying to all installations of Third Party GPS equipment interfaced to WesternGeco Marine Positioning Systems.

Example:

$WGPOS,3,1,Verify1.08,501,486140.00,2.0,23 56.73661N,96 17.34229W,-4.197,0.8,1.6,1.279,0.055265,0.002591,0.062898,0.482222,0.35,3,0,1,10,3,2,10,12,15,18,21,24,26,29,30,501,502,503,]

WesternGeco TRINAV V3 sentence defined:

Content	Format	Unit	Comments
Start Character	A6	[-]	$WGPOS
Format Version	I	[-]	= 3 for this version
Nav. Point No.	I	[-]	See comment 1
System Name/Version	A	[-]	Name + version of DGPS system. See comment 2
GPS Week Number	I	[-]	GPS Week no. since August 21 1999
GPS Time of Fix	F10.2	[s]	Seconds into GPS week (GPS Time).
Age of Fix	F4.1	[s]	See comment 3
Latitude	A13	[dm]	dd mm.mmmmmN, space between D and M
Longitude	A14	[dm]	dd mm.mmmmmE, space between D and M
Height	F7.3	[m]	Antenna height above ellipsoid. See comment 4
HDOP	F5.1	[-]	
VDOP	F5.1	[-]	
Unit Variance	F9.3	[m2]	See comment 5
Variance Latitude	F10.6	[m2]	See comment 5
Covariance Lat/Long	F10.6	[m2]	See comment 5
Variance Longitude	F10.6	[m2]	See comment 5
Variance Height	F10.6	[m2]	See comment 5
External Reliability	F7.2	[m]	See comment 6
Fix Status	I	[-]	See comment 7
Computation Type	I	[-]	See comment 8
Correction Type	I	[-]	See comment 9
No. of Satellites (n)	I	[-]	No. of satellites used for this fix
No. of Ref. Stations (r)	I	[-]	No. of ref. stations used for fix. See Comment 10
PRN's of Sats. Used	I*n	[-]	Satellites used for this fix. Separated by commas
Ref. Station Idents	I*n	[-]	Ref. stations used for this fix. Separated by commas
End Character	A1	[-]	Close string
CRLF	A2		

Comments:

1. The "Nav point no." is a unique integer identifying the position. It should be manually input to the software according to requests from Positioning Engineers. Alternatively, this should start from 1 and be incremented if several positions are output from the same system.
2. The system name should identify the system (or contractor) and software version (e.g. "SEADIFF 2.1" or "MFIX 1.2.3")
3. The "Age of fix" is the time of the first character of the data string being output to WesternGeco's Positioning system minus the time of position
4. WGS84 ellipsoid and datum must be used. The Height must be antenna height above the WGS84 ellipsoid
5. The Variance and Covariance terms are elements from the Variance-Covariance matrix of the position fix computation (un-scaled)
6. The External Reliability is the maximum positional effect of an undetectable error in an observation. This quantity is related to the Power of the test (probability that the MDE would be detected) and the Significance level used.
    a. The values recommended by UKOOA should be used (see UKOOA Guidelines for The use of Differential GPS in offshore surveying, Issue no. 1, Sept. 1994) i.e. a Significance level of test 1% and the Power of the test 80%
    b. If values other than those given above are used, this must be explicitly stated by the contractor
7. Fix Status Codes

Status Code	Meaning
0	No or Bad Fix
1	Altitude Aiding (Weighted Height used in Fix)
2	Altitude Hold (2D Fix)
3	3D Fix

8. Computation Type Codes

Type Code	Meaning
0	Single Frequency
1	Dual Frequency
2	GLONASS Augmented
3	Other

9. Correction Type Codes

Type Code	Meaning
0	No Corrections
1	Single Frequency pseudo range diff corrections
2	Dual Frequency pseudo range diff corrections
3	Satellite Orbit Corrections
4	Other

10. "No. of ref. stations" gives the number of reference stations in use for this fix, not the number of stations available. This field must be set to 0 if the fix is not differential

VERIPOS UKOOA Sentence

Example:

[239 1.06Verify 1 1392 491778.0 +0.4 +5.4 57 07.719007N 002 04.750811W 25.781 +50.28 1.389 0.775 1.152 3 19.258 0.781 0.13 1.398 +0.125 0.656 1.635 1.75 0.81 004.3 P 10{01 02 05 06 07 16 21 23 25 30} 4{0777 0701 0702 0705}]

VERIPOS UKOOA sentence defined:

Content	Format	Field	Unit	Comments
Start Character	A1	1	-	Open string
Length of Message	I4	2….5	-	Number of characters
Software Version	A5	6….10	-	
System Name	A6	11….16	-	
Record Identifier	I2	17…18	-	See comment 1
GPS Week Number	I5	19…23	-	Since Jan 6th 1980
GPS Time of Fix	F9.1	24…32	sec	Seconds into current GPS Week
Age of Record	F5.1	33…37	sec	See comment 2
Latency	F6.1	38…43	sec	
Latitude	F13.6	44…56	dm	^dd^mm.mmmmm (^=space)
Latitude Hemisphere Indicator (N or S)	A1	57	-	N or S
Longitude	F13.6	58…71	dm	^dd^mm.mmmmm (^=space)
Longitude Hemisphere Indicator (E or W)	A1	72	-	E or W
Altitude above MSL	F7.3	73…79	m	Antenna height above mean sea level. See comment 3
Geoid Separation	F8.2	80…87	m	See comment 4
PDOP	F7.3	88…94	-	
HDOP	F7.3	95…101	-	
VDOP	F7.3	102…108	-	
Fix Status	I2	109…110	-	See comment 5
Internal Reliability	F7.3	111…117	m	See comment 6
External Reliability (m)	F8.3	118…125	m	See comment 7
Unit Variance	F5.2	126…130	m²	See comment 8
Variance Latitude	F7.3	131…137	m²	See comment 8
Covariance Lat/Long	F8.3	138…145	m²	See comment 8
Variance Longitude	F7.3	146…152	m²	See comment 8
Variance Height	F7.3	153…159	m²	See comment 8
95% Error Ellipse Semi Major Axis	F6.2	160…165	m	See comment 9
95% Error Ellipse Semi Minor Axis	F6.2	166…171	m	See comment 9
Orientation Of Semi Major Axis of Error	F6.1	172…177	º	See comment 10
F Test (P=Pass, F=Fail)	A2	178…179	-	See comment 11

No of Satellites used in the Fix (n)	I3	180…182	-	
Satellite PRN Numbers of Satellites used in Fix	{I3*(n-1)+I2}	Variable	-	PRN numbers have format I2 and are space separated
Number of Reference Stations used for this Fix (00 – 99)	I2	Variable	-	
Ids of the Reference Stations used in the Fix	{I5*(n-1)+I4}	Variable	-	Station ID numbers have format I4 and are space separated
End of Character	A1		-	Close string
Carriage Return	¬		-	
Line Feed	^		-	

Field Formats:

Ax Alphanumeric text
Ix Integer Field
Fx.y Floating point field

Where:

x gives the total length including the decimal point and decimals
y the number of decimals

If a sign (+ or -) is included in the field, the sign must be immediately adjacent to the number it relates to with no spaces in between i.e. -3.12

Alphanumeric text fields must be left justified, and numeric fields must be right justified.

The field sizes are selected with a space between each field. This aids manual readability and protects against overflow.

Comments:

1. Record Identifier — shows the calculation used, as different calculations can be labelled: 1, 2, 3 etc
2. Age of Record — time of the first character of the data string being output, minus the time of position
3. Altitude Above MSL — the datum for height calculations
4. Geoid Separation — separation between mean sea level and the WGS84 reference ellipsoid, based on a Geoid model as for example EGM96
5. Fix Status Codes:

Single Frequency	
Status Code	**Meaning**
0	No or Bad Fixes
1	Altitude Aiding (Weighted Height used in Fix)
2	Altitude hold (2D Fix)
3	3D Fix
Dual Frequency (4 is added to the above values when positioning is set-up for dual frequency calculations)	
Status Code	**Meaning**
4	No or Bad Fix
5	Altitude Aiding (Weighted Height used in Fix)
6	Altitude hold (2D Fix)
7	3D Fix

6. Internal Reliability — smallest outlier that is likely to be detected by the current solution
7. External Reliability — maximum positional effect of an undetectable error in an observation. This quantity is related to the Power of the test (probability that the MDE would be detected) and the Significance level used.
8. (Co)-variance — The Variance and Covariance terms are elements from the variance-covariance matrix of the position fix computation (un-scaled)
9. 95% Error Ellipse — Shows 95% confidence level of the semi-major and semi-minor axis of the error ellipse
10. Orientation — Orientation of the semi major axis (degrees from true North)
11. F Test — A test applied to the Unit Variance. A “Fail” may result from large outliers in the measurements.

VERIPOS UKOOA 2 Sentence

Example:

[P0 1741590150906006W570743144N0020445062E0256M
3010007175008005021001P0100220060609060710131621232530003647777017027050000000000000000A6

VERIPOS UKOOA 2 sentence defined:

Content	Format	Field	Unit	Comments
Start Character	A1	1	-	Open String
Length of Message	binary	2	-	Dependent - SVs
Message Type Identifier	A1	3	-	P
Message Version Identifier	I1	4	-	0
Message Dependent Byte	A1	5	-	
Message Dependent Byte	A1	6	-	
UTC Time of Fix	I7	7…13	HHMMSSs	
Date of Fix	I6	14…19	DDMMYY	
Age of Data	I3	20…22	SSs	See comment 1
Datum Indicator	A1	23	-	See comment 2
Latitude	I9	24…32	DDMMSSsss	
Latitude Hemisphere	A1	33	-	N or S
Longitude	I10	34…43	DDDMMSSsss	
Longitude Hemisphere	A1	44	-	E or W
Height	I4	45…48	HHHh	See comment 3
Height Reference Indicator	A1	49	-	See comment 4
Mode	A1	50	-	See comment 5
95% / 68% Error Ellipse Semi-major Axis	I3	51…53	MMm	See comment 6
95% / 68% Error Ellipse Semi-minor Axis	I3	54…56	MMm	See comment 6
95% / 68% Error Ellipse Max Direction	I3	57…59	DDD	See comment 7
95% / 68% Latitude s d / Precision Value	I3	60…62	MMm	See comment 8
95% / 68% Longitude s d / Precision Value	I3	63…65	MMm	See comment 8
95% / 68% Height s d / Precision Value	I3	66…68	MMm	See comment 8
Unit Variance	I2	69…71	MMm	
F Test (P=Pass, F=Fail)	A1	72	-	See comment 9
HDOP	I3	73…75	NNn	
PDOP	I3	76…78	NNn	
External Reliability	I3	79…81	m	See comment 10
LOP with External Reliability	I2	82…83	MMm	See comment 11
Number of SV's used at the Mobile (*N*)	I2	84…85	NN	
Satellite PRN Numbers	{I2*n}	Variable	NN*n	

W-Test Rejected LOP	I2		NN	See comment 12
Total Number of SV's used in Solution	I2		NN	Approximately = *N x V* for multi-reference solution
Number of Reference Stations Used (*V*)	I1		N	0-9, 9 = 9 or more
The Codes of the Reference Station used.	{I3*n}	Variable	NNN*n	See comment 13
Optional Additional Data Before Checksum	I0 or {I1*n}	Variable		
Checksum	CS			
Carriage Return	¬			
Line Feed	^			

Comments:

1. Age of Data — the time of the first character of the data string being output, minus the time of position
2. Datum Indicator — this indicates which Datum is being used by the calculation. (W=WGS 84, Z=Other Datum, ?=Datum Not Known)
3. Height — height ranges from -999.9 to 9999.9
4. Height Ref Indicator — this shows which vertical datum is being used to calculate height in the calculation. (S=Spheroidal Height, M=Height above MSL i.e. Orthometric)
5. Mode — positioning mode used to derive height value. (H=Height Aided, 3=3D Solution, ?=Unknown)
6. Error Ellipse — shows 95% confidence level (or 68% confidence level, if the 'Output SD's at 1 sigma' box is ticked) of the semi-major axis and semi-minor axis
7. Direction — orientation of the semi major axis from centre to largest error detection (degrees from true North)
8. 95% / 68% SD — shows 95% precision value (or 68% precision value, if the 'Output SD's at 1 sigma' box is ticked) of the latitude, longitude and height coordinates
9. F Test — a test applied to the Unit Variance. A "Fail" may result from large outliers in the measurements.
10. External Reliability — the External Reliability is the maximum positional effect of an undetectable error in an observation. This quantity is related to the Power of the test (probability that the MDE would be detected) and the Significance level used. It is considered to be a more useful concept than internal reliability, hence its recommended use by UKOOA as the most suitable measure of Reliability. External reliability is measured in metres
11. LOP — LOP (Line of Position) indicates the PRN of the last satellite in the list with the External Reliability value. (SV PRN '01' – '99', 'HT' if Altitude, '00' = OK)
12. w-test Rejected LOP — w-test Rejected LOP gives the PRN of the last satellite in the list that fails the W-Test (SV PRN '01' – '99', 'HT' if Altitude, '00' = OK)
13. Reference Station ID — this lists the station ID's of stations being used in the calculation. If a multi ref is being calculated, this field can be padded with zeros to a fixed length if required by checking the box in the UKOOA 2 output setup window.

GPLCT Sentence

The GPLCT Sentence is particularly intended for use with the Ultra and Apex services as it includes a Float RTK GPS Quality Indicator.

String name			
GPLCT			
General Description			
This string is comma delimited but with fixed length fields. A checksum is included for extra robustness. The string is 87 characters, including the "*" character and the checksum.			
Sample			
$GPLCT,2006365,170002.00,2859.836227,N,09304.171413,W,5, -025.13, 090.00,05.55,02.01*64			
Pos	**Field Name**	**Format or Units**	**Comment**
0	Identifier	N/A	$GPLCT – fixed string that identifies the string
1	Date	yyyyjjj	Identifies year and Julian day.
2	Time	hhmmss.ss	Time
3	Latitude	ddmm.mmmmmm	Degrees and decimal minutes, 6 digits on the decimal minutes
4	Latitude Hemisphere	c	N or S
5	Longitude	dddmm.mmmmmm	Degrees and decimal minutes, 6 digits on the decimal minutes
6	Longitude Hemisphere	c	E or W
7	GPS Quality indicator	n	0 = fix not valid 1 = Uncorrected GPS fix 2 = DGPS fix 5 = Ultra or Apex fix
8	Antenna Height	±mmm.mm	Relative to ellipsoid, meters; Range: -999.99 to +999.99
9	Course	ddd.dd	Vessel course over ground, degrees from North
10	Velocity	ss.ss	Vessel speed over ground, knots; Range: 0.00 to +999.99
11	PDOP	pp.pp	PDOP
	*		Fixed end delimiter
			Checksum
			<CR><LF>

Veripos Applications - Axiom

The Axiom (INS) message is a proprietary message containing the variables required for the VERIPOS INS *Axiom* software. **This Axiom message is intended to be output to the VERIPOS Axiom software only and should not be used to output to vessel DP or Survey systems.**

String name			
Axiom (INS)			
General Description			
This string is comma delimited but with fixed length fields. A checksum is included for extra robustness. The string is 87 characters, including the "*" character and the checksum.			
Sample			
$--INS,hhmmss.ss,ddmm.mmmmmmm,a,dddmm.mmmmmmm,b,D,P,hh.h,pp.p,vv.v,h.hh, g.gg,l.ll,cc.c,ss.s,r.rr,t.tt,u.uu,w.ww,x.xx,y.yy,z.zz,nnnn,gp,xx (x gp),gl,xx (x gl) *c<CR><LF> $GPINS,120102.00,5708.7102489,N,00217.1179453,W,1,1,0.6,1.1,0.9,137.57,50.72,27.20,190.8 53,0.007,0.04,0.04,0.03,124.22,0.04,0.04,0.04,0081,10,02,04,05,07,10,16,20,23,29,30,9,04,05,06 ,13,14,15,20,21,22*5A			
Pos	**Field Name**	**Format or Units**	**Comment**
	Identifier	$--INS	$--INS – fixed field that identifies the string
0	Time	hhmmss.ss	UTC of position
1	Latitude	ddmm.mmmmmm	Latitude of position
2	Latitude Hemisphere	a	N or S, latitude hemisphere
3	Longitude	dddmm.mmmmmm	Longitude of position
4	Longitude Hemisphere	b	E or W, longitude hemisphere
5	Differential indicator	D	Differential indicator (0 = false, 1 = true)
6	Precise indicator	P	Precise indicator (0 = false, 1 = true)
7	HDOP	hh.h	HDOP (max 99.9)
8	PDOP	pp.p	PDOP (max 99.9)
9	VDOP	vv.v	VDOP (max 99.9)
10	Height	h.hh	Antenna altitude above mean-sea-level
11	Geoid Height	g.gg	Geoidal height
12	Age of correction	l.ll	Age of differential GPS data
13	Course over ground	cc.c	
14	Speed over ground	ss.s	
15	RMS	r.rr	RMS value of the standard deviation of the range inputs to the navigation process. Range inputs include pseudo-ranges and differential DGNSS

			corrections
16	Semi-major SD	t.tt	Standard deviation of semi-major axis (meters)
17	Semi-minor SD	u.uu	Standard deviation of semi-minor axis (meters)
18	Semi-major Axis orientation	w.ww	Orientation of semi-major axis of error ellipse (degrees)
19	Lat SD	x.xx	Standard deviation of latitude error (meters)
20	Lon SD	y.yy	Standard deviation of longitude error (meters)
21	Altitude SD	z.zz	Standard deviation of altitude error (meters)
22	Reference Station ID	nnnn	Differential reference station composite ID, 0000 to 1023
23	No. of GPS Svs	gp	Number of GPS satellites in use
24	GPS IDs	xx (x gp)	ID numbers of GPS satellites used in solution
25	No. of Glonass Svs	gl	Number of GLONASS satellites in use
26	Glonass IDs	xx (x gl)	ID numbers of GLONASS satellites used in solution
27		*c	Checksum
28		<CR><LF>	

G TIDES LOGGING FILE FORMATS

The Tides functionality will create three files in ASCII format:

- *Tideinfo.txt*
- *Doodson.txt*
- *SPRINT_Tides.txt*

The structure of each of these files is outlined in the tables below.

Filename
Tideinfo.txt
General Description
The TideInfo.txt file contains current system height and tide information at the Averaging Period as configured by the Verify QC user. This file contains comma delimited strings with variable length fields. Null fields indicate that no information is currently available; they should not be interpreted as 'zero'. A checksum is included for extra robustness. Negative tide is low tide and positive tide is high tide respectively.
Sample
$UltraTide,20070228,21:40:00,28,600,600,5236.2830,N,00143.5184,E,5.74,0.08,0.07,5.66,5.82,5.45,0.29,0.02,5.72,44.84,0.00,0.27,EGM96*2B

Field Number	Field Name	Format or Units	Description & Comments
0	TalkerID	-	$UltraTide or $VQC112Tide (Dependant on user configuration)
1	Date	yyyymmdd	Identifies year, month and day for which all information in the string is valid.
2	Time (UTC or GPS)	hh:mm:ss (UTC) or sssssssss (GPS)	Identifies time in UTC or GPS for which all information in the string is valid.
3	Sequence Number	numerical	Sequential number incrementing by 1 for every extra string. Maximum is 99999999 after which an automatic reset back to 1 takes place.
4	Averaging Period	numerical	User selected period over which VERIPOS Apex or Ultra heights are averaged in seconds. Minimum is 60, maximum is 3600.
5	Sample Count	numerical	Number of VERIPOS Apex or Ultra height samples that were included to derive the antenna height average. Minimum is 50% of 'Averaging Period', maximum is 'Averaging Period'
6	Latitude	ddmm.mmmm (degrees, minutes and decimal minutes)	Location where height and tide information is valid.
7	Latitude Hemisphere	c	N or S

8	Longitude	dddmm.mmmm (degrees, minutes and decimal minutes)	Location where height and tide information is valid.
9	Longitude Hemisphere	c	E or W
10	Mean Height	hh.hh (metres)	Mean of the VERIPOS Apex or Ultra heights during the 'Averaging Period'
11	Mean of Height SD	hh.hh (metres)	Mean of the Height SD's associated with the VERIPOS Apex or Ultra heights during the 'Averaging Period'. This is an indication of the quality of the VERIPOS Apex or Ultra heights
12	SD of Heights	hh.hh (metres)	Standard deviation of the VERIPOS Apex or Ultra heights during the 'Averaging Period'. This is an indication if the variation of the height due to vessel motion and position quality.
13	Minimum of Heights	hh.hh (metres)	Minimum of the VERIPOS Apex or Ultra heights during the 'Averaging Period'
14	Maximum of Heights	hh.hh (metres)	Maximum of the VERIPOS Apex or Ultra heights during the 'Averaging Period'
15	Doodson	hh.hh (metres)	Estimated tide-less antenna height above Mean Sea Surface from the Doodson filter. First available after 39 hours.
16	MSS Tide	hh.hh (metres)	Local tide based on the Mean Sea Surface derived from the Doodson filter. First available after 39 hours.
17	Geoid Tide	hh.hh (metres)	Local tide relative to user selected Geoid (see field 22). Available instantaneously after user configured 'hold-off' time
18	Antenna Height	hh.hh (metres)	User entered height of the antenna above the waterline.
19	Geoid Separation	hh.hh (metres)	Local offset between the user selected Geoid and the WGS84 reference ellipsoid.
20	Draft	hh.hh (metres)	The draft. Calculated as the current Doodson value minus the Doodson value for the first record.
21	Vertical Bias	hh.hh (metres)	The vertical bias detected between MSS Tide and Geoid Tide. Calculated as Antenna Height minus Doodson plus Draft.
22	Geoid Model	-	EGM96, EGM08 or USER, depending on user selection
	*	c	Fixed end delimiter

		cc	Checksum

Filename
Doodson.txt
General Description
The Doodson.txt file contains current system height and tide information at hourly intervals. The information in this file is consistent with the information contained in the file TideInfo.txt but information has been condensed to a fixed averaging period of one hour. This file contains comma delimited strings with variable length fields. Null fields indicate that no information is currently available; they should not be interpreted as 'zero'. A checksum is included for extra robustness. Negative tide is low tide and positive tide is high tide respectively.
Sample
$UltraTide,20070301,23:00:00,31,3600,3599,5236.2829,N,00143.5183,E,5.90,0.09,0.11,5.74,6.06,5.45,0.45,0.18,5.72,44.84,0.00,0.27,EGM96*22

Field Number	Field Name	Format or Units	Description & Comments
0	TalkerID	-	$UltraTide or $VQC112Tide (Dependant on user configuration)
1	Date	yyyymmdd	Identifies year, month and day for which all information in the string is valid.
2	Time	hh:mm:ss (UTC) or sssssssss (GPS)	Identifies time in UTC for which all information in the string is valid.
3	Sequence Number	numerical	Sequential number incrementing by 1 for every extra string. Maximum is 99999999 after which an automatic reset back to 1 takes place.
4	Averaging Period	numerical	Fixed period (3600 seconds) over which the VERIPOS Apex or Ultra heights are averaged in seconds.
5	Sample Count	numerical	Number of VERIPOS Apex or Ultra height samples that were included to derive the antenna height average. Minimum is 50% of 'Averaging Period', maximum is 'Averaging Period'
6	Latitude	ddmm.mmmm (degrees, minutes and decimal minutes)	Location where height and tide information is valid.
7	Latitude Hemisphere	c	N or S
8	Longitude	dddmm.mmmm (degrees, minutes and decimal minutes)	Location where height and tide information is valid.
9	Longitude Hemisphere	c	E or W

10	Mean Height	hh.hh (metres)	Mean of the VERIPOS Apex or Ultra heights during the 'Averaging Period'
11	Mean of Height SD	hh.hh (metres)	Mean of the Height SD's associated with the VERIPOS Apex or Ultra heights during the 'Averaging Period'. This is an indication of the quality of the VERIPOS Apex or Ultra heights
12	SD of Heights	hh.hh (metres)	Standard deviation of the VERIPOS Apex or Ultra heights during the 'Averaging Period'. This is an indication if the variation of the height due to vessel motion and position quality.
13	Minimum of Heights	hh.hh (metres)	Minimum of the VERIPOS Apex or Ultra heights during the 'Averaging Period'
14	Maximum of Heights	hh.hh (metres)	Maximum of the VERIPOS Apex or Ultra heights during the 'Averaging Period'
15	Doodson	hh.hh (metres)	Estimated tide-less antenna height above Mean Sea Surface from the Doodson filter. First available after 39 hours.
16	MSS Tide	hh.hh (metres)	Local tide based on the Mean Sea Surface derived from the Doodson filter. First available after 39 hours.
17	Geoid Tide	hh.hh (metres)	Local tide relative to user selected Geoid (see field 22). Available instantaneously after user configured 'hold-off' time
18	Antenna Height	hh.hh (metres)	User entered height of the antenna above the waterline.
19	Geoid Separation	hh.hh (metres)	Local offset between the user selected Geoid and the WGS84 reference ellipsoid.
20	Draft	hh.hh (metres)	The draft. Calculated as the current Doodson value minus the Doodson value for the first record.
21	Vertical Bias	hh.hh (metres)	The vertical bias detected between MSS Tide and Geoid Tide. Calculated as Antenna Height minus Doodson plus Draft.
22	Geoid Model	-	EGM96, EGM08 or USER, depending on user selection
	*	c	Fixed end delimiter
		cc	Checksum

Filename			
SPRINT_Tides.txt			
General Description			
The SPRINT_Tides.txt file contains the current UltraTide with the opposite sign compared to the MSS Tide contained in the TideInfo.txt and Doodson.txt files. This file contains comma delimited strings with variable length fields. Null fields indicate that no information is currently available; they should not be interpreted as 'zero'. A checksum is included for extra robustness. Negative tide is high tide and positive tide is low tide respectively.			
Sample			
12,20,22,09,2006,-0.88			
Field Number	**Field Name**	**Format or Units**	**Description & Comments**
0	Hours	HH	Hours in the day (UTC). Time for which all information in the string is valid.
1	Minutes	MM	Minutes in the day (UTC). Time for which all information in the string is valid.
2	Day	DD	Day in the month.
3	Month	MM	Month in the year.
4	Year	YYYY	Year.
5	UltraTide	hh.hh (metres)	Local UltraTide based on the Mean Sea Surface derived from the Doodson filter. First available after 39 hours. Set as 99999.99 when no UltraTide value is available.
	*	c	Fixed end delimiter (real time output only)
		cc	Checksum (real time output only)

H GNSS RECEIVER LIST

The table below lists the default baud rates used by the GNSS manufacturers of receivers supported by Verify QC. VERIPOS recommends a baud rate of no less than 38400 for raw GNSS measurements.

GNSS Receiver List	Default baud rate
Septentrio AsteRx[1/2]	115200
Septentrio AsteRx2eH[1/2]	115200
Topcon/Javad[1]	38400
Magellan ZX Sensor[1/2]	57600
Magellan DG14/16[1/2]	38400
Veripos LD5/LD6 (Novatel OEM6)	115200
Veripos LD4	115200
Veripos LD5	115200
Veripos LD6	115200
Veripos LD7	115200

[1] – Internal Card inside LDx Receiver or External/Standalone Receiver
[2] – External/Standalone Receiver

I VERIPOS - CONTACT DETAILS AND OFFICE LOCATIONS

VERIPOS UK

Veripos House
1B Farburn Terrace
Dyce
Aberdeen, AB21 7DT Scotland, United Kingdom

Veripos Helpdesk: help@veripos.com
Tel: +44 (0)1224 965900

For regional office locations please visit www.veripos.com